IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent of:	Juhyung Son, et al.	Attorney Docket No. 39843-0195IP1
U.S. Patent No.:	11,159,210	
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Appl. Serial No.:	16/731,031	
Filing Date:	December 31, 2019	
Title:	WIRELESS COMMUNICATION METHOD AND WIRELESS COMMUNICATION TERMINAL FOR SIGNALING MULTI-USER PACKET	

PUBLIC ACCESSIBILITY DECLARATION OF

CHRISTOPHER HANSEN, PH.D.

I declare that all statements made herein on my own knowledge are true and that all statements made on information and belief are believed to be true, and further, that these statements were made with the knowledge that willful false statements and the like so made are punishable under Section 1001 of Title 18 of the United States Code.

Date: April 30, 2025

By: _____
Christopher Hansen

SAMSUNG 1026

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I, Christopher Hansen, do hereby declare the following:

1. I submit this Declaration at the request of Samsung Electronics Co., Ltd. and Samsung Electronics America, Inc. (collectively, "Samsung" or "Petitioners") for consideration by the Patent Trial and Appeal Board in certain *inter partes* review ("IPR") proceedings.

2. I reside in Los Altos, California.

3. I am over eighteen years of age, and I am otherwise competent to testify as to the matters set forth herein if I am called upon to do so.

4. I am being compensated for my time at my standard consulting rate. I am also being reimbursed for expenses that I incur during the course of this work. My compensation is not contingent upon the results of my study and analysis, the substance of my testimony, or the outcome of any proceeding involving the challenged patent or patents. I have no financial interest in the outcome of this matter or in any litigation involving the challenged patent or patents.

I. PROFESSIONAL BACKGROUND

5. I have attached a copy of my curriculum vitae (CV) as Appendix A.

6. I received a Bachelor of Science (B.S.) degree in Electrical Engineering from Rensselaer Polytechnic Institute in 1987. I received a Ph.D. in Electrical Engineering from the University of California, Los Angeles ("UCLA") in 1997.

7. I was employed by Broadcom Corporation ("Broadcom") in Sunnyvale, California from January 2000 to May 2012. From January 2000 to February 2011, I held several titles, including Sr. Staff Scientist, Engineering Manager, and Sr. Principal Scientist. My duties in these roles included, among other things, Institute of Electrical and Electronics Engineers ("IEEE") 802.11 (*i.e.*, Wi-Fi) physical layer ("PHY") application-specific integrated circuit ("ASIC") development. I also participated in Bluetooth standard development during this timeframe. From March 2011 to May 2012, I served as an Associate Technical Director and my duties included, among other things, performing wireless communications technology research and development ("R&D") as well as standards and intellectual property development. Throughout my time at Broadcom, I regularly attended meetings for the IEEE 802.11 Working Group. I submitted technical contributions to Task Group E ("TGe"), Task Group H ("TGh"), and Task Group N ("TGn"). I also regularly accessed and reviewed documents submitted by members of the IEEE 802.11 Working Group, including through the IEEE's 802wirelessworld server and, later, the IEEE Mentor website.

8. I served on the Board of Directors of the Wireless Gigabit Alliance ("WiGig Alliance") from March 2010 to March 2012. Specifically, I served as the Board's Secretary. The WiGig Alliance was a trade association focused on the development and promotion of high-speed wireless communications technology.

The WiGig Alliance collaborated for multiple years with the Wi-Fi Alliance (an industry organization that owns the "Wi-Fi" brand and certifies devices for interoperability and security), and the two organizations eventually merged in 2013.

9. I served as the Vice Chair of the IEEE 802.11ad Task Group ("TGad") from May 2011 to March 2012. TGad developed an amendment to the IEEE 802.11 wireless networking standard focused on directional multi-gigabit (*i.e.*, DMG) technology. In this role, I assisted the task group Chair, Eldad Perahia, and Technical Editor, Carlos Cordeiro, with the operation of the task group meetings and developing the 802.11ad draft standards amendment documents.

10. I was employed as a Senior Wireless System Architect by Apple Inc. ("Apple") in Cupertino, California from June 2012 to July 2013. During my tenure at Apple, I was responsible for, among other things, performing systems engineering for iPhone Operating System ("iOS") Wi-Fi functionality. During this time, I participated in multiple IEEE 802.11 groups, including Task Group AF ("TGaf") and the HEW Study Group, on behalf of Apple. I also regularly accessed and reviewed documents submitted by members of the IEEE 802.11 Working Group, including through the IEEE Mentor server.

11. Since August 2013, I have been employed as President of Covariant Corporation in Los Altos, California. As part of this role, I provide technical

consulting services related to wireless communications, IEEE 802.11/Wi-Fi, signal processing technology, integrated circuits technology, and intellectual property. During the time I have been employed by Covariant, I have continued to regularly attend meetings for multiple IEEE 802.11 task groups. I submitted several technical contributions to Task Group AY ("TGay") (responsible for 802.11ay) which led to new mmWave features, Task Group M ("TGm") (responsible for the 802.11-2020 standard), and the Integrated mmWave Study Group ("IMW SG") (the precursor for TGbq). I received awards from the IEEE for my contributions to TGay and TGm. Appendix B. I have also continued to regularly access and review documents submitted by members of the IEEE 802.11 Working Group, including through the IEEE Mentor server.

12. I served as a member of the Board of Directors for the Professional and Technical Consultants Association ("PATCA") in Silicon Valley, California from March 2017 to March 2024. I was President of the Board of Directors from June 2019 to March 2024. PATCA is a non-profit corporation that supports technical consultants in Silicon Valley and elsewhere.

13. Since June 2020, I have been employed as a Guest Instructor for the UCLA Department of Electrical and Computer Engineering. I teach classes on wireless communications for upper-level undergraduate students and graduate

students in electrical engineering. In these classes, I use examples from the IEEE 802.11 standards.

14. I am a named inventor on over 100 issued United States patents related to wireless communications, signal processing, and integrated circuits.

15. I have been a member of the Institute of Electrical and Electronics Engineers ("IEEE") since 1981 (41 years) and am currently a Senior member. I have participated in the activities of the IEEE Standards Association ("IEEE-SA") continuously since 2000. I have participated in the IEEE 802.11 Wireless Local Area Networks ("WLAN") Working Group as a voting member since 2000.

16. Through my membership at the IEEE and participation in IEEE standards development, I have personal knowledge of the IEEE's policies and procedures, including with respect to documents management practices, the standard development process, as well as organization and operation of IEEE's working groups and task groups.

II. THE IEEE 802.11 WORKING GROUP AND TASK GROUP AX

17. IEEE-SA is an operating unit within the IEEE that develops global standards across a wide range of industries and technologies. The IEEE 802.11 Working Group is part of the IEEE-SA and includes several task groups.

18. A task group is created to develop a draft amendment to the baseline IEEE 802.11 standard. The process for creating an amendment to the baseline

IEEE 802.11 standard is as follows. First, a study group is created by the working group to investigate a new feature or technology. Study group members make contributions and discuss and refine the features that will be a part of the new task group. Then, the study group produces a Project Authorization Request ("PAR"). The PAR must be approved by the study group, the 802.11 Working Group, and IEEE-SA for a task group to be created. Once these steps have been completed, the new task group can begin meeting and taking contributions.

19. The new task group receives technical contributions and votes on technical details as it develops a new draft standard amendment. Next, the task group forwards the draft standard amendment to the 802.11 Working Group for approval. If the draft standard amendment is approved by the 802.11 Working Group, it is presented to the IEEE 802 Sponsor Executive Committee ("SEC") for approval. Finally, if the draft standard amendment is approved by the IEEE 802 SEC, it is presented to the IEEE-SA for final approval. Upon the IEEE-SA's approval, the draft standard amendment transitions into the final form, and becomes an official standard amendment.

20. Task Group AX ("TGax") was formed in May 2014 to develop the IEEE 802.11ax standard amendment. Appendix C. The task group continued to meet until November of 2020. Appendix C. During this time, I followed the

activities of TGax, including reviewing and voting on the 802.11ax standard amendment drafts.

21. During the May 2014 to November 2020 timeframe, the time when TGax was active, the 802.11 Working Group held meetings every two months. Specifically, the 802.11 Working Group held meetings in January, March, May, July, September, and November of each year. Three of the six meetings in any given year were "plenary" meetings, *i.e.*, larger meetings across all IEEE 802 Working Groups. The remaining three 802.11 Working Group meetings in a given year were "interim" meetings, *i.e.*, the members of the 802.11 Working Group and other wireless Working Groups (such as 802.15) met separately from other IEEE 802 Working Groups. In July 2014, around the time when TGax was started, there were 533 members of the 802.11 Working Group, with 321 being voting members. Appendix D at 13. Approximately 300 people would attend each 802.11 Working Group meeting.

22. TGax meetings took place as part of these broader 802.11 Working Group meetings—in other words, TGax met six times per year from May 2014 to November 2020. Appendix C. TGax meeting attendees were generally engineers and researchers interested in wireless local area network ("WLAN") technology. The 802.11ax standard amendment was a major 802.11 Working Group project and, consequently, a majority of the roughly 300 802.11 Working Group meeting

attendees would typically attend each TGax meeting sessions. Attendance at TGax meetings was not restricted only to members of the 802.11 Working Group, however. Other registrants to a plenary or interim meeting could also attend the meeting of the TGax task group, members of other IEEE 802 working groups and any other interested member of the public who registered for the meeting.

23. During the May 2014 to November 2020 timeframe, TGax participants could submit and present technical submissions at TGax meetings. These submissions generally included technical proposals for the standard amendment draft. These submissions were made available to the public through the IEEE Mentor website. Appendix E. After the submission was presented, TGax members would generally vote on whether to incorporate the submission into the current standard amendment draft. Appendix F at 7. If a submission was presented or voted on at a TGax meeting, it was normally uploaded to the IEEE Mentor website before the meeting.

24. As a matter of course, during IEEE standard amendment development, several standard amendment drafts are created and submitted to the "letter ballot" process. The task group editor creates the first one of such drafts (which is considered the first full and complete iteration in the draft process)—draft "D1.0"—once there is an agreement between task group participants with respect to a significant portion of the amendment framework. Once the draft is

completed, it is distributed to IEEE 802.11 Working Group members and a "letter ballot" is initiated whereby working group members can vote to approve or disapprove the draft, as well as provide comments. The task group then iteratively improves the standard amendment by amending the draft to address comments. Note that while D1.0 is generally the first draft submitted for letter ballot voting, earlier drafts are often circulated among the task group for feedback and amendments.

25. During development of the IEEE 802.11ax standard amendment, TGax created and submitted draft "D1.0" (formal title "P802.11ax/D1.0") to letter balloting. Appendix G. Prior to the D1.0 draft, TGax circulated other standard amendment drafts, including drafts D0.1 (Appendix H) and D0.5 (Appendix I).

26. TGax meetings were open to the public.[1] Appendix J. However, only "voting members" could vote on technical submissions and letter ballots.

27. During the relevant time period, the IEEE 802.11 Working Group published information about upcoming meetings on its website, which in my experience, was commonly visited by interested members of the public. Indeed,

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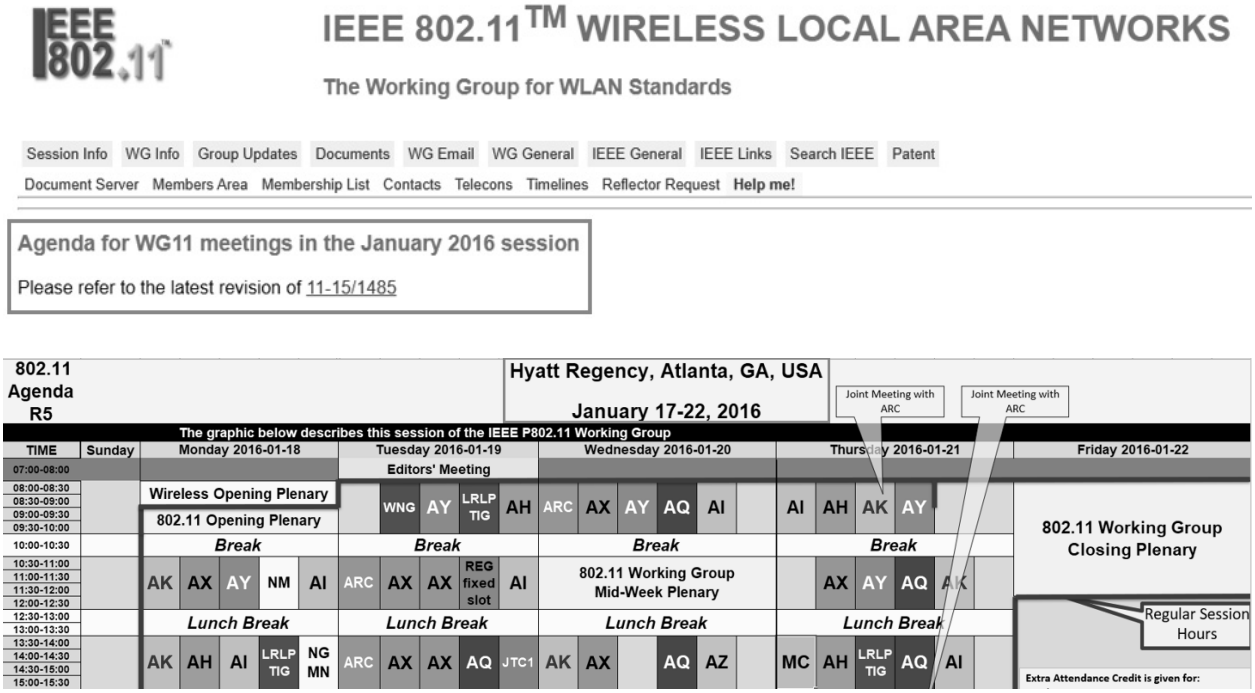
[1] Meeting attendees were required to pay a registration fee, but the fee could be waived for certain visitors, such as academics, professors, and students from educational institutes in the surrounding area.

IEEE is a prominent organization in the field and members of the public interested in wireless networking standards development (e.g., WLAN standards), including engineers in industry and academia, commonly followed events and developments announced on the IEEE 802.11 website. As an example, a January 1, 2016 archive of the 802.11 Working Group website includes a link to an "[a]genda for WG11 meetings in the January 2016 session. Appendix K. The link directs to a spreadsheet with information about the dates, location, and agenda for the January 2016 802.11 Working Group meeting, including the times for TGax working sessions, which are designated by a green "AX." Appendix L.



III. PUBLIC ACCESSIBILITY ANALYSIS

28. Below, I explain in detail how IEEE makes the following two categories of documents accessible to the interested public, namely (1) 802.11

Working Group documents and technical submissions housed on the IEEE Mentor website and (2) TGax standard amendment drafts, including the P802.11/D1.0 draft.

29. Based on my review of U.S. Patent No. 11,159,210 ("the '210 Patent"), the interested public with respect to the subject matter of the '210 Patent would include individuals interested in the development and/or implementation of wireless networking standards (e.g., Wireless Local Area Network ("WLAN") standards), and individuals interested in research related to the same, including the IEEE 802.11 standard, which is the world's leading WLAN standard. The interested public would include, for example, individuals interested in improving IEEE 802.11 network performance (e.g., reliability, speed) in dense networking environments. The interested public would include engineers and researchers working in the wireless communications industry as well as academics, professors, and students in disciplines related to wireless communications. Further, in my experience, many individuals and organizations in industry and academia were interested in continuously tracking development of the IEEE 802.11 standard to facilitate research and/or design of 802.11-based products on an ongoing basis.

30. The interested public would certainly have been aware of the IEEE and the 802.11 standard. At the time of the '210 Patent (*e.g.*, January 9, 2017)—and still today—the 802.11 standard was one of the most widely used wireless

communication standard in the world, including in the field of WLANs. Appendix M at 15.

31. Many members of the interested public would have already been members of IEEE. Other members of the interested public would have subscribed to IEEE publications and/or other publications related to the wireless communications industry including, for example, IEEE Spectrum magazine. Information about standards meetings and developments, including for the 802.11 working group were often highlighted in these publications.

32. The IEEE 802.11ax project was discussed in various publicly disseminated articles such that a member of the interested public would have been aware of the project no later than early 2016.

33. For example, in January 2015, The Beacon—the Wi-Fi Alliance's official blog—published an article by Craig Mathias entitled *Wi-Fi 2015: The Top-10 List*. Appendix N. Mr. Mathias noted "continued work on 802.11ax, which could reach . . . the magical 10 Gbps level of throughput . . . ." Appendix N at 3.

34. In September 2015, IEEE Spectrum magazine published an interview with 802.11 Working Group Vice Chair Dorothy Stanley. Appendix O. When asked "What can we expect next-generation Wi-Fi standards to deliver?", Ms. Stanley noted "the 802.11ax amendment for high- efficiency wireless local area networks. That looks for efficiency in dense deployments such as stadiums,

shopping malls, and subways where you have a lot of people accessing the Wi-Fi system." Appendix O at 4-5

35. The 802.11ax project was discussed extensively in a February 2016 article in the IEEE Wireless Communications magazine entitled *IEEE 802.11ax: High-efficiency WLANs* (Appendix P). As another example, a June 2016 article in the IEEE Vehicular Technology Magazine entitled *Exciting Projects for PHY and MAC Layers of IEEE 802.11* provided details on the 802.11ax project and described it as "the next major generation of Wi-Fi technology evolution after 802.11a" (Appendix Q at 2). From these articles, a member of the interested public would have understood the general scope of TGax's work—namely, "improving the spectrum efficiency and system throughput per area in high-density scenarios of access points and stations in both indoor and outdoor deployments, such as crowded public spaces, public transportation, and dense apartment buildings." (Appendix Q at 2).

36. Moreover, the IEEE maintains a public webpage entitled "Official IEEE 802.11 Working Group Project Timelines" where it publishes status information about past and present 802.11 task groups and projects. Appendix R. Information about the 802.11ax project, including a predicted timeline, is listed on archived versions of the webpage dating back to July 2, 2014 (Appendix S).

IEEE Project and Final Document	Final Doc Type	Project Authorization Request (PAR)	Task Group and Activity	Documentation		Current Status	PAR Approved, Modified, or Extended [Expires]	WG Letter Ballots	
				Session End Snapshot				Draft	Date / Result
				Format & Version	Incorporated Baselines			Predicted Initial	Predicted Recirc
IEEE Std P802.11ax	A	High Efficiency WLAN	TGax	None	802.11REVmc 802.11ai 802.11ah 802.11ak 802.11aq 802.11aj	Actual	2014-03-25		
						Predicted	C	Jul 2016	

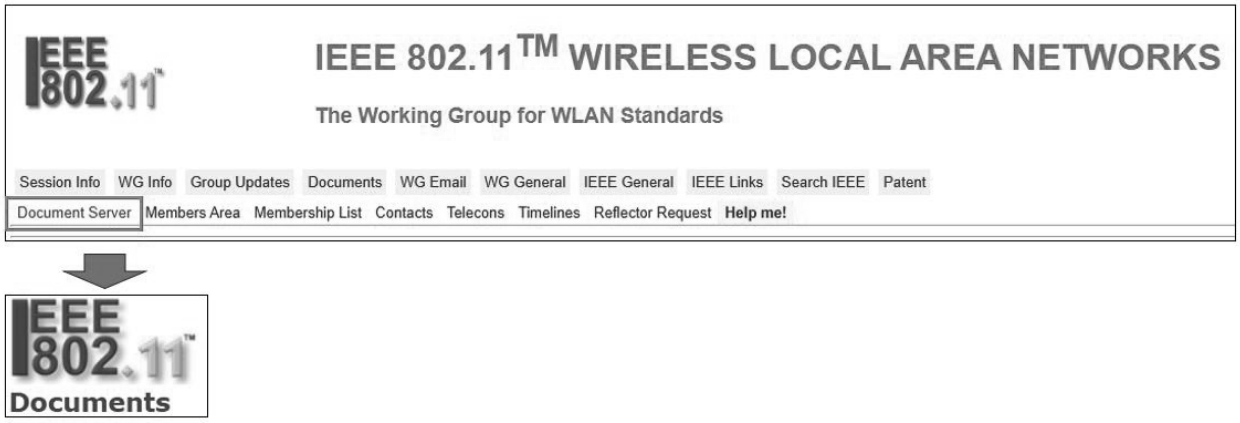
A. Public Accessibility of Documents Hosted on the IEEE Mentor Website

37. The IEEE maintains a public website called IEEE Mentor that houses working documents related to its various working groups and task groups. Appendix T. As discussed above, the IEEE Mentor website hosted TGax working documents and technical submissions while the task group was active. These TGax documents remain on the Mentor website today.

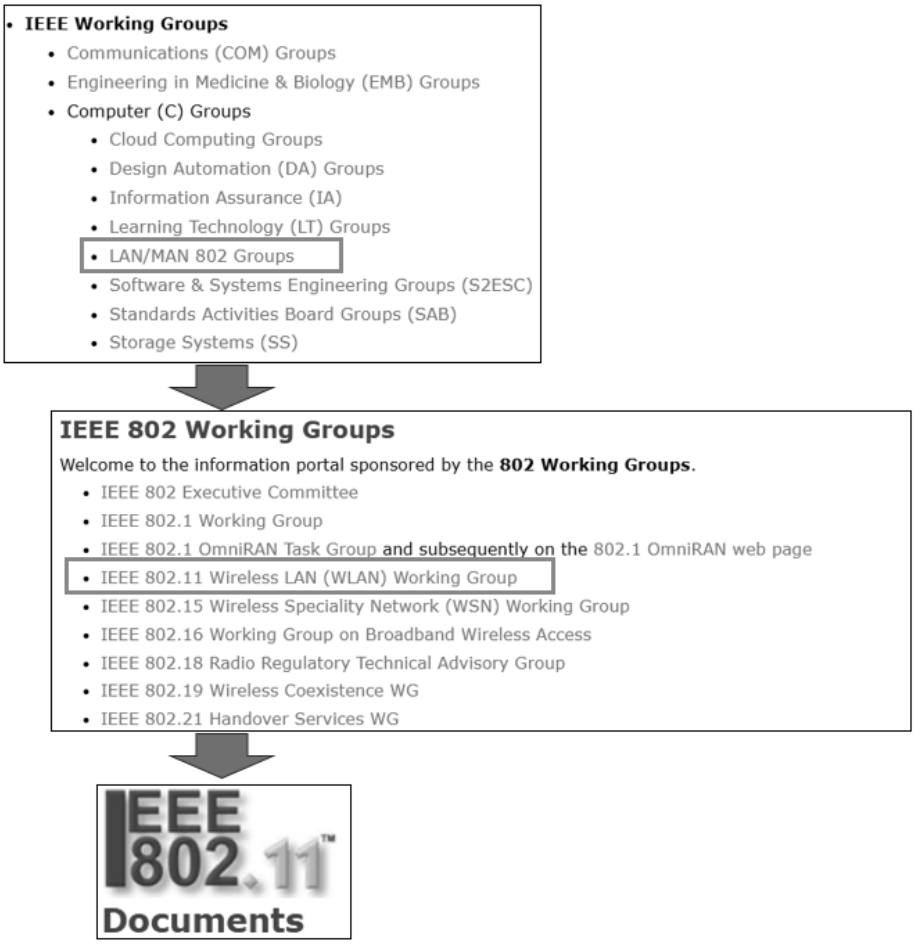
38. Many interested members of the public would have known how to access or navigate to the IEEE Mentor website through their experience tracking activities of the IEEE 802.11 Working Group and tracking ongoing development of the 802.11 standard. Other interested members of the public would have readily located the IEEE Mentor website based on information obtained from any number of public sources. For example, the IEEE Mentor webpage was directly linked to the 802.11 Working Group website through the "Document Server" link, as corroborated by an archived version of the webpage from January 1, 2016. Appendix K. As another example, the June 2016 article *Exciting Projects for PHY and MAC Layers of IEEE 802.11*, referenced above, cites the Mentor webpage in footnotes (Appendix Q at 3). IEEE websites, including Mentor, were also crawled

by commercial search engines, thereby allowing interested members of the public to navigate to the websites by clicking on a link in a list of keyword-based search results. For example, today, a Google.com search for "IEEE 802.11 technical submissions" returns multiple links to the Mentor website in the top flight of search results. Appendix U. Based on my experience, search engines such as Google would have similarly returned links to the Mentor website based on similar keyword searches by the earliest claimed priority date of the '210 Patent (*e.g.*, January 9, 2017). A member of the interested public seeking to stay up-to-date on TGax's development of the 802.11ax standard amendment would have been motivated to review the task group's working documents on the Mentor website.

39. The 802.11 Working Group documents on the IEEE Mentor website—including documents related to TGax—were readily accessible. As described above, clicking on the "Document Server" link on the 802.11 Working Group website would take a user to the "IEEE 802.11 Documents" page on the IEEE Mentor website. This is corroborated by a January 1, 2016 archived version of the 802.11 Working Group website. Appendix K.



40. Alternatively, assuming one accessed the IEEE Mentor website directly (for example, after learning of the webpage through the June 2016 article discussed above or elsewhere), the 802.11 Working Group documents could have been accessed by (1) opening the Mentor home page (Appendix T), (2) selecting "LAN/MAN 802 Groups," which directs the user to the "IEEE 802 Working Groups" page (Appendix V), and (3) selecting "IEEE 802.11 Wireless LAN (WLAN) Working Group," which directs the user to the "IEEE 802.11 Documents" page (Appendix W). The Mentor website operated in the same manner during the time period that TGax was actively developing the 802.11ax standard amendment. This is confirmed by archived copies of the Mentor home page (Appendix X), the "IEEE 802 Working Groups" page (Appendix Y), and the "IEEE 802.11 Documents" page (Appendix Z).



41. The "IEEE 802.11 Documents" page provides a list of documents that have been uploaded related to 802.11 standard projects. Appendix W. The webpage also includes identifying information for each document, including the created date, year, document control number (DCN), revision number, group (*e.g.*, TGax), document title, author and author affiliation (*e.g.*, employer), and the date and time the document was uploaded. Appendix W. The web page also includes a "Download" link for each document. Appendix W. The "IEEE 802.11 Documents" page operated in the same manner during the time when TGax was

active, including as of the earliest claimed priority date of the '210 Patent (*e.g.*, January 9, 2017). Appendix Z.

42. Documents uploaded to the IEEE Mentor website are publicly accessible immediately after they are uploaded. For instance, the screen capture below of the "IEEE 802.11 Documents" page was taken on April 28, 2025, and several documents that were uploaded to the website the same day are available for download. Appendix W. The webpage operated in the same manner during the time when TGax was active, including as of the earliest claimed priority date of the '210 Patent (*e.g.*, January 9, 2017). Appendix Z.

IEEE 802.11

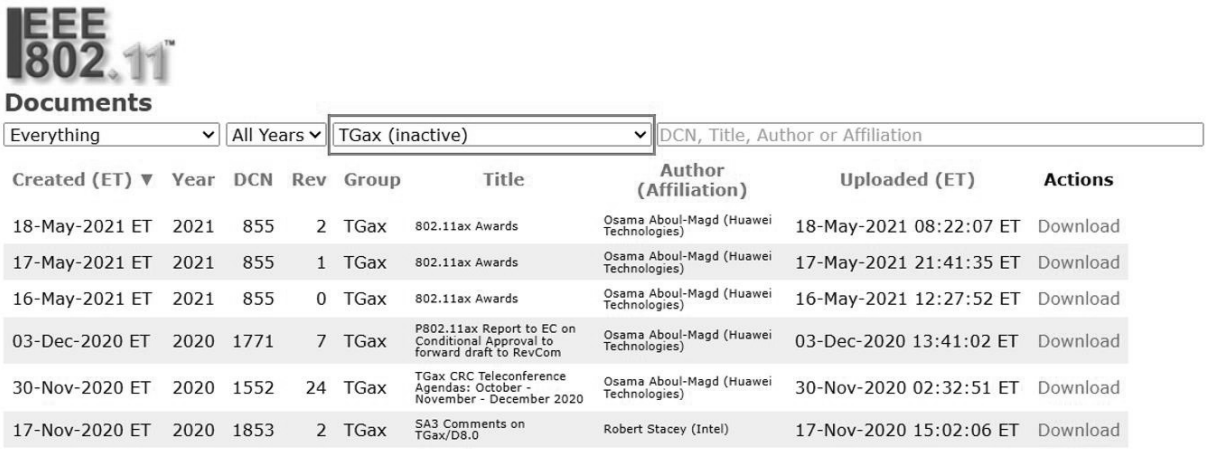
Documents

Everything | All Years | All Groups | DCN, Title, Author or Affiliation

Created (ET) ▼	Year	DCN	Rev	Group	Title	Author (Affiliation)	Uploaded (ET)	Actions
28-Apr-2025 ET	2025	255	3	TGm	P2P TWT Harmonization	Brian Hart (Cisco Systems)	28-Apr-2025 13:34:11 ET	Download
28-Apr-2025 ET	2024	1925	6	TGm	REVmf Motions	Michael Montemurro (Huawei)	28-Apr-2025 12:17:19 ET	Download
28-Apr-2025 ET	2025	662	3	TGm	April 28 Teleconference Agenda	Michael Montemurro (Huawei)	28-Apr-2025 12:14:48 ET	Download
28-Apr-2025 ET	2025	371	1	TGm	NR-IE_6GHz_Bits	Abhishek Patil (Qualcomm)	28-Apr-2025 11:33:33 ET	Download
28-Apr-2025 ET	2025	345	5	TGm	PASN ID for MLO	Yan Li(ZTE)	28-Apr-2025 09:42:37 ET	Download
28-Apr-2025 ET	2025	676	1	TGbn	CC50 CR for CID3866	Bo Cao (ZTE)	28-Apr-2025 09:37:41 ET	Download
28-Apr-2025 ET	2025	638	2	TGbn	CRs for CID related to definitions in MAPC scheme	Chun Huang (ZTE)	28-Apr-2025 08:18:13 ET	Download
28-Apr-2025 ET	2024	2080	1	TGbn	High-Capability Protection in DPS Follow Up	Maolin Zhang (Huawei)	28-Apr-2025 06:32:10 ET	Download
28-Apr-2025 ET	2025	3	2	TGbn	NPCA follow up	Yan Li(ZTE)	28-Apr-2025 04:45:27 ET	Download
28-Apr-2025 ET	2025	5	3	TGbn	MAP discovery follow up	Jay Yang(ZTE)	28-Apr-2025 03:46:33 ET	Download

43. The "Group" filter on the "IEEE 802.11 Documents" page can be used to filter the document list to only those documents related to TGax, as shown in the screenshot below. The webpage operated in the same manner during the

time TGax was active, as confirmed by an archived version of the "IEEE 802.11 Documents" page from January 20, 2016. Appendix W.



IEEE 802.11

Documents

Everything | All Years | TGax (inactive) | DCN, Title, Author or Affiliation

Created (ET) ▼	Year	DCN	Rev	Group	Title	Author (Affiliation)	Uploaded (ET)	Actions
18-May-2021 ET	2021	855	2	TGax	802.11ax Awards	Osama Aboul-Magd (Huawei Technologies)	18-May-2021 08:22:07 ET	Download
17-May-2021 ET	2021	855	1	TGax	802.11ax Awards	Osama Aboul-Magd (Huawei Technologies)	17-May-2021 21:41:35 ET	Download
16-May-2021 ET	2021	855	0	TGax	802.11ax Awards	Osama Aboul-Magd (Huawei Technologies)	16-May-2021 12:27:52 ET	Download
03-Dec-2020 ET	2020	1771	7	TGax	P802.11ax Report to EC on Conditional Approval to forward draft to RevCom	Osama Aboul-Magd (Huawei Technologies)	03-Dec-2020 13:41:02 ET	Download
30-Nov-2020 ET	2020	1552	24	TGax	TGax CRC Teleconference Agendas: October - November - December 2020	Osama Aboul-Magd (Huawei Technologies)	30-Nov-2020 02:32:51 ET	Download
17-Nov-2020 ET	2020	1853	2	TGax	SA3 Comments on TGax/D8.0	Robert Stacey (Intel)	17-Nov-2020 15:02:06 ET	Download

44. Upon accessing the IEEE Mentor website, a member of the interested public would have been capable of downloading and reviewing any document of interest. The individual would have been capable of locating a document of interest by using the search bar to search for particular documents by document control number ("DCN"), title, author, or affiliation (*i.e.*, company or organization the author(s) are affiliated with). In my experience, sometimes persons interested in the development of particular standards would download all of the files on the IEEE Mentor site and perform offline searches based on document content. For instance, I personally used a tool called "wget" to scrape the documents on the IEEE Mentor website so that I could search their contents. Appendix AA.

45. The Mentor website shows that Joonsuk Kim et al., *HE-SIG-B Structure*, DCN IEEE 802.11-15/0821r2 ("Kim 0821") was uploaded to the

Mentor website on July 15, 2015. Appendix AB. Appendix AC is a true and accurate copy of Kim 0821 obtained from the Mentor website. As explained above, a member of the interested public could have used the search functionality on the Mentor website to locate the Kim 0821 reference by DCN, title, author, or affiliation (i.e., company or organization the author(s) are affiliated with). For example, a member of the interested public desiring to learn more about the proposed structure for the HE-SIG-B field of the 802.11ax standard amendment could have located Kim 0821 by searching "HE SIG-B." Appendix AB. Further, the Kim 0821 reference was presented at the July 2015 TGax meeting as part of the PHY Ad Hoc session. Appendix AD. A member of the interested public who attended the July 2015 TGax meeting or otherwise reviewed the meeting materials afterward would therefore have been motivated to search for the Kim 0821 reference by DCN. Thus, based on the foregoing, it is my opinion that the Kim 0821 reference was publicly accessible to members of the interested public as of July 15, 2015.

46. The Mentor website shows that Kaushik Josiam et al., *HE-SIG-B Contents*, DCN IEEE 802.11-15/1066r0 ("Josiam 1066") was uploaded to the Mentor website on September 13, 2015. Appendix AE. Appendix AF is a true and accurate copy of Josiam 1066 obtained from the Mentor website. As explained

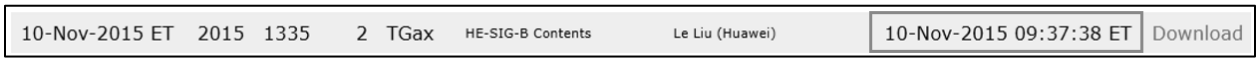
above, a member of the interested public could have used the search functionality on the Mentor website to locate the Josiam 1066 reference by DCN, title, author, or affiliation (i.e., company or organization the author(s) are affiliated with). For example, a member of the interested public desiring to learn more about the proposed contents for the HE-SIG-B field of the 802.11ax standard amendment could have located Josiam 1066 by searching "HE-SIG-B." Appendix AE. Further, the Josiam 1066 reference was presented at the September 2015 TGax meeting as part of the PHY Ad Hoc session. Appendix AG; Appendix AH. A member of the interested public who attended the September 2015 TGax meeting or otherwise reviewed the meeting materials afterward would therefore have been motivated to search for the Josiam 1066 reference by DCN. Thus, based on the foregoing, it is my opinion that the Josiam 1066 reference was publicly accessible to members of the interested public as of September 13, 2015.

47. The Mentor website shows that Kaushik Josiam et al., *HE-SIG-B Mapping and Compression*, DCN IEEE 802.11-15/1315r1 ("Josiam 1315") was uploaded to the Mentor website on November 10, 2015. Appendix AE. Appendix AI is a true and accurate copy of Josiam 1315 obtained from the Mentor website. As explained above, a member of the interested public could have used the search functionality on the Mentor website to locate the Josiam 1315 reference by DCN,

title, author, or affiliation (i.e., company or organization the author(s) are affiliated with). For example, a member of the interested public desiring to learn more about the proposed HE-SIG-B field of the 802.11ax standard amendment could have located Josiam 1315 by searching "HE-SIG-B." Appendix AE. Further, the Josiam 1315 reference was presented at the November 2015 TGax meeting as part of the PHY Ad Hoc session. Appendix AJ at 24; Appendix AK at 12. A member of the interested public who attended the November 2015 TGax meeting or otherwise reviewed the meeting materials afterward would therefore have been motivated to search for the Josiam 1315 reference by DCN. Thus, based on the foregoing, it is my opinion that the Josiam 1315 reference was publicly accessible to members of the interested public as of November 10, 2015.

48. The Mentor website shows that Le Liu et al., *HE-SIG-B Contents*, DCN IEEE 802.11-15/1335r2 ("Liu 1335") was uploaded to the Mentor website on November 10, 2015. Appendix AE. Appendix AL is a true and accurate copy of Liu 1335 obtained from the Mentor website. As explained above, a member of the interested public could have used the search functionality on the Mentor website to locate the Liu 1335 reference by DCN, title, author, or affiliation (i.e., company or organization the author(s) are affiliated with). For example, a member of the interested public desiring to learn more about the proposed contents for the HE-

SIG-B field of the 802.11ax standard amendment could have located Liu 1335 by searching "HE-SIG-B." Appendix AE. Further, the Liu 1335 reference was presented at the November 2015 TGax meeting as part of the PHY Ad Hoc session. Appendix AJ at 24; Appendix AK at 15. A member of the interested public who attended the November 2015 TGax meeting or otherwise reviewed the meeting materials afterward would therefore have been motivated to search for the Lui 1335 reference by DCN. Thus, based on the foregoing, it is my opinion that the Liu 1335 reference was publicly accessible to members of the interested public as of November 10, 2015.



49. The Mentor website shows that Yujin Noh et al., *Issues with Compressed SIG-B Mode*, DCN IEEE 802.11-16/0040r0 ("Noh 0040") was uploaded to the Mentor website on January 18, 2016. Appendix AM. Appendix AN is a true and accurate copy of Noh 0040 obtained from the Mentor website. As explained above, a member of the interested public could have used the search functionality on the Mentor website to locate the Noh 0040 reference by DCN, title, author, or affiliation (i.e., company or organization the author(s) are affiliated with). For example, a member of the interested public desiring to learn more about the proposed compressed SIG-B functionality of the 802.11ax standard amendment could have located Noh 0040 by searching "compressed SIG-B" (note that among

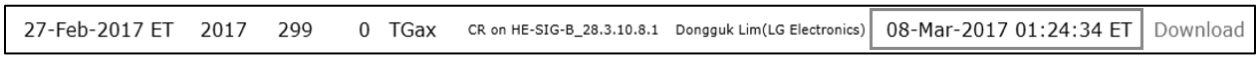
802.11 Working Group members, the terms "HE-SIG-B" and "SIG-B" are used interchangeably). Appendix AM. Further, the Noh 0040 reference was presented at the January 2016 TGax meeting as part of the PHY Ad Hoc session. Appendix AO at 13; Appendix AP at 7. A member of the interested public who attended the January 2016 TGax meeting or otherwise reviewed the meeting materials afterward would therefore have been motivated to search for the Noh 0040 reference by DCN. Thus, based on the foregoing, it is my opinion that the Noh 0040 reference was publicly accessible to members of the interested public as of January 18, 2016.

50. The Mentor website shows that Kaushik Josiam et al., *HE-SIG-B Compression Mode*, DCN IEEE 802.11-15/0349r1 ("Josiam 0349") was uploaded to the Mentor website on March 14, 2016. Appendix AE. Appendix AQ is a true and accurate copy of Josiam 0349 obtained from the Mentor website. As explained above, a member of the interested public could have used the search functionality on the Mentor website to locate the Josiam 0349 reference by DCN, title, author, or affiliation (i.e., company or organization the author(s) are affiliated with). For example, a member of the interested public desiring to learn more about the proposed HE-SIG B functionality of the 802.11ax standard amendment could have located Josiam 0349 by searching "HE-SIG-B." Appendix AE. Further, the

Josiam 0349 reference was presented at the March 2016 TGax meeting as part of the PHY Ad Hoc session. Appendix AR at 13. A member of the interested public who attended the March 2016 TGax meeting or otherwise reviewed the meeting materials afterward would therefore have been motivated to search for the Josiam 0349 reference by DCN. Thus, based on the foregoing, it is my opinion that the Josiam 0349 reference was publicly accessible to members of the interested public as of March 14, 2016.

51. The Mentor website shows that Dongguk Lim et al., *Comment Resolutions on Clause 28.3.10.8.1*, DCN IEEE 802.11-17/0299r0 ("Lim 0229") was uploaded to the Mentor website on March 8, 2017. Appendix AE. Appendix AS is a true and accurate copy of Lim 0299 obtained from the Mentor website. As explained above, a member of the interested public could have used the search functionality on the Mentor website to locate the Lim 0229 reference by DCN, title, author, or affiliation (i.e., company or organization the author(s) are affiliated with). For example, a member of the interested public desiring to learn more about the proposed HE-SIG-B functionality of the 802.11ax standard amendment could have located Lim 0299 by searching "HE-SIG-B" (note that the title as shown on Mentor includes "HE-SIG-B" even while the formal title on the document does not). Appendix AE. Thus, based on the foregoing, it is my opinion that the Lim

0299 reference was publicly accessible to members of the interested public as of March 8, 2017.



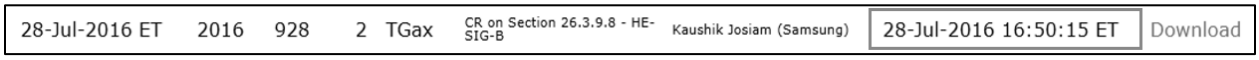
52. The Mentor website shows that Robert Stacey et al., *Comments on TGax/D1.0*, DCN IEEE 802.11-17/0010r0 ("Stacey 0010") was uploaded to the Mentor website on January 9, 2017. Appendix AT. Appendix AU is a true and accurate copy of Stacey 0010 obtained from the Mentor website. As explained above, a member of the interested public could have used the search functionality on the Mentor website to locate the Stacey 0010 reference by DCN, title, author, or affiliation (i.e., company or organization the author(s) are affiliated with). For example, a member of the interested public desiring to learn more about the D1.0 draft of the 802.11ax standard amendment, including comments and deliberations about the draft, could have located Stacey 0010 by searching "D1.0." Appendix AT. Thus, based on the foregoing, it is my opinion that the Stacey 0010 reference was publicly accessible to members of the interested public as of January 9, 2017.

53. The Mentor website shows that Lochan Verma et al., *Bit Field Finalization of HE-SIG-A in HE PPDU Formats*, DCN IEEE 802.11-16/0915r2 ("Verma 0915") was uploaded to the Mentor website on July 26, 2016. Appendix AV. Appendix AW is a true and accurate copy of Verma 0915 obtained from the

Mentor website. As explained above, a member of the interested public could have used the search functionality on the Mentor website to locate the Verma 0915 reference by DCN, title, author, or affiliation (i.e., company or organization the author(s) are affiliated with). For example, a member of the interested public desiring to learn more about the proposed HE-SIG-A functionality of the 802.11ax standard amendment could have located Verma 0915 by searching "HE-SIG-A." Appendix AV. Further, the Verma 0915 reference was presented at the July 2016 TGax meeting as part of the PHY Ad Hoc session. Appendix AX at 15, 34. A member of the interested public who attended the July 2016 TGax meeting or otherwise reviewed the meeting materials afterward would therefore have been motivated to search for the Verma 0915 reference by DCN. Thus, based on the foregoing, it is my opinion that the Verma 0915 reference was publicly accessible to members of the interested public as of July 26, 2016.

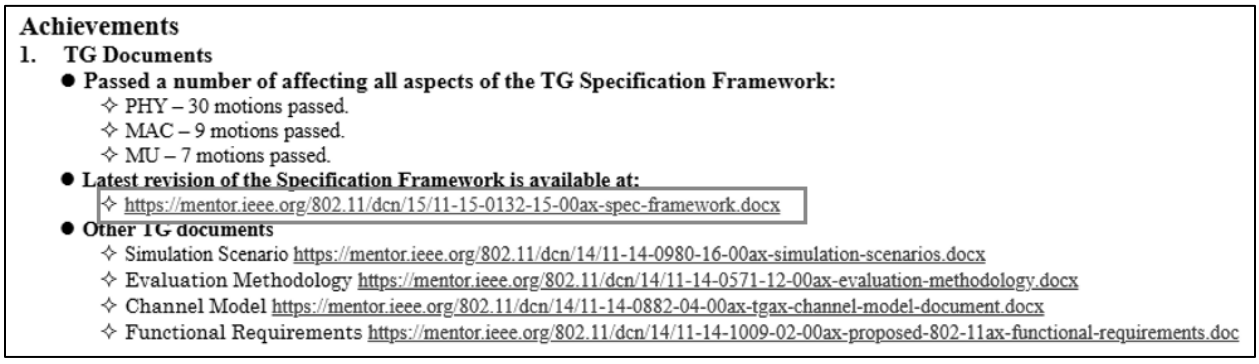
54. The Mentor website shows that Kaushik Josiam et al., *Proposed Resolutions to Comments on Clause 26.3.9.8*, DCN IEEE 802.11-16/0928r2 ("Josiam 0928") was uploaded to the Mentor website on July 28, 2016. Appendix AE. Appendix AY is a true and accurate copy of Josiam 0928 obtained from the Mentor website. As explained above, a member of the interested public could have used the search functionality on the Mentor website to locate the Josiam 0928

reference by DCN, title, author, or affiliation (i.e., company or organization the author(s) are affiliated with). For example, a member of the interested public desiring to learn more about the proposed HE-SIG B functionality of the 802.11ax standard amendment could have located Josiam 0928 by searching "HE-SIG-B" (note that the title as shown on Mentor includes "HE-SIG-B" even while the formal title on the document does not). Appendix AE. Further, an earlier version of the Josiam 0928 reference was presented at the July 2016 TGax meeting. Appendix AZ at 27. A member of the interested public who attended the July 2016 TGax meeting or otherwise reviewed the meeting materials afterward would therefore have been motivated to search for the Josiam 0928 reference by DCN. Thus, based on the foregoing, it is my opinion that the Josiam 0928 reference was publicly accessible to members of the interested public as of July 28, 2016.



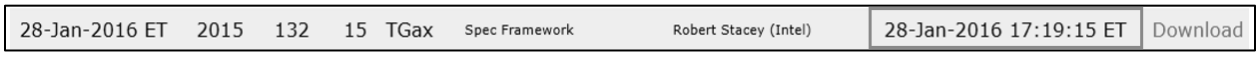
55. The Mentor website shows that Robert Stacey, *Specification Framework for TGax*, DCN IEEE 802.11-15/0132r15 ("Stacey 0132") was uploaded to the Mentor website on January 28, 2016. Appendix BA. Appendix BB is a true and accurate copy of Stacey 0132 obtained from the Mentor website. As explained above, a member of the interested public could have used the search functionality on the Mentor website to locate the Stacey 0132 reference by DCN, title, author, or affiliation (i.e., company or organization the author(s) are affiliated

with). Additionally, as of March 7, 2016, the TGax website included a link to Stacey 0132, stating it was the "[l]atest version of the Specification Framework . . . ." Appendix BC. Prior to a task group's creation of formal drafts, the Specification Framework document is the task group's primary work product. Therefore, a member of the interested public wishing to keep apprised of TGax's progress would have been motivated to review the Stacey 0132 reference. Thus, based on the foregoing, it is my opinion that the Stacey 0132 reference was publicly accessible to members of the interested public as of January 28, 2016.



Achievements

1. **TG Documents**
   - **Passed a number of affecting all aspects of the TG Specification Framework:**
     - PHY – 30 motions passed.
     - MAC – 9 motions passed.
     - MU – 7 motions passed.
   - **Latest revision of the Specification Framework is available at:**
     - https://mentor.ieee.org/802.11/dcn/15/11-15-0132-15-00ax-spec-framework.docx
   - **Other TG documents**
     - Simulation Scenario https://mentor.ieee.org/802.11/dcn/14/11-14-0980-16-00ax-simulation-scenarios.docx
     - Evaluation Methodology https://mentor.ieee.org/802.11/dcn/14/11-14-0571-12-00ax-evaluation-methodology.docx
     - Channel Model https://mentor.ieee.org/802.11/dcn/14/11-14-0882-04-00ax-tgax-channel-model-document.docx
     - Functional Requirements https://mentor.ieee.org/802.11/dcn/14/11-14-1009-02-00ax-proposed-802-11ax-functional-requirements.doc

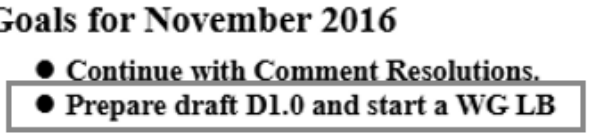


28-Jan-2016 ET	2015	132	15	TGax	Spec Framework	Robert Stacey (Intel)	28-Jan-2016 17:19:15 ET	Download

B. Public Accessibility of the P802.11ax/D1.0 Draft

56. A total of 6 drafts of the 802.11ax standard amendment were submitted to the 802.11 Working Group for letter ballot voting—D1.0, D2.0, D3.0, D4.0, D5.0, and D6.0. Appendix BD. Two additional 802.11ax standard amendment drafts—D7.0 and D8.0—were submitted to the broader IEEE SA for letter ballot voting.

57. An interested member of the public keeping abreast of TGax developments would have been aware of P802.11ax/D1.0 ("draft D1.0"), of which Appendix G is a true and accurate copy. For example, the IEEE maintained a public webpage with TGax status information and updates. Appendix BD. By October 13, 2016, the webpage stated that one of TGax's "Goals for November 2016" was to prepare draft D1.0 and begin the related letter ballot process (Appendix BE). Moreover, interested members of the public already would have been aware of earlier 802.11ax standard amendment drafts, including D0.1 and D0.5, and they would expect new drafts to be created as the standard development process progresses.

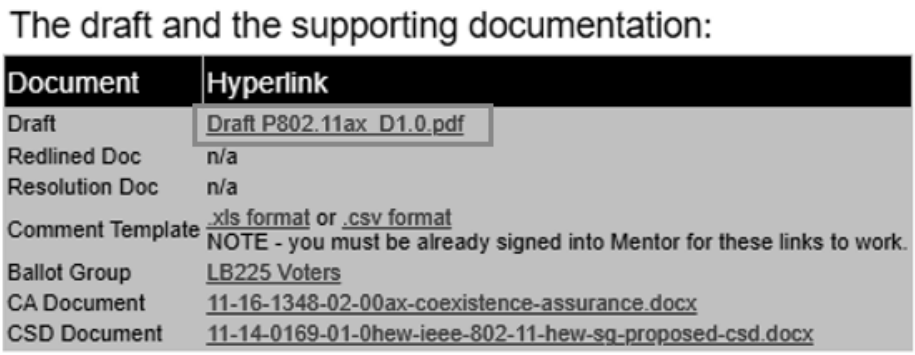


58. Draft D1.0 was also openly discussed at public TGax meetings such that those in attendance would have known about it. For instance, target dates for drafting the D1.0 draft were discussed during the July 2016 and September 2016 TGax meetings (Appendix BF at 27; Appendix BG at 30). At the November 2016 TGax meeting in San Antonio, Texas, TGax members voted for the editor to prepare draft D1.0 of the 802.11ax standard amendment. This vote is documented on page 28 of Appendix BH, which is the meeting minutes from the November 2016 TGax meeting. Later, at the March 2017 TGax meeting, members discussed

received comments related to draft D1.0 as well as proposed resolutions for such comments (Appendix BI at 6). These meetings were open to the public. Appendix J.

59. Draft D1.0 was initially made available to voting members of the IEEE 802.11 Working Group by December 1, 2016. On December 1, 2016, TGax Chair Osama Aboul-Magd sent an email to TGax members stating that "draft D1.0 is available in the member area" (Appendix BJ). This email is archived in the IEEE's public email archive.

60. Also on December 1, 2016, Adrian Stephens—the Chair of the 802.11 Working Group—sent an email to the broader IEEE 802.11 Working Group informing working group members that "the 802.11 Working Group is officially beginning WG Technical Letter Ballot 225 (LB225), which is a Letter Ballot on the question 'Should P802.11ax D1.0 be forwarded to Sponsor Ballot?'" (Appendix BK). The email included a link to instructions for completing letter ballot 225 (Appendix BL). The instructions page featured a link to the draft D1.0 PDF, which was password protected. A voting member of the IEEE 802.11 Working Group could enter their credentials (*i.e.*, username and password) to access the document. This email is archived in the IEEE's public email archive.



61. The IEEE 802.11 Working Group also maintains a webpage that shows the status and results of current and past letter ballots related to 802.11 standard amendment drafts (Appendix BD). Appendix BM—an archived version of the letter ballot webpage dated May 21, 2017—shows that letter ballot number 225 entitled "Technical TGax Draft 1.00" opened on December 1, 2016 and closed on January 8, 2017. The webpage shows the results for the draft D1.0 letter ballot, which received 145 "Approve" votes, 106 "Disapprove" votes, and 25 abstentions. The webpage shows that 371 people were able to vote on the letter ballot (the "Pool"). The webpage further includes a hyperlink to the "Draft P802.11ax_D1.0.pdf" document. Clicking the link would have prompted the user

to enter their voting member login credentials. After entry of the credentials, a voting member would have been able to access draft D1.0.

225	TGax	Technical TGax Draft 1.00	LB# 225	Draft	Draft P802.11ax_D1.0.pdf	2016-12-01	2017-01-08	38	Pool	371
									Approve	145
				Redlined Doc	N/A				Disapprove	106
				Resolution Doc	N/A				Abstain	25
									Return%	74
				Comment	Template				Approve%	58
				Pool	LB# 225 Voters					

62. Working Group voting member credentials for any IEEE 802 working group—not just 802.11—can be used to access the "member area" of the IEEE website. For example, a voting member of the 802.15 Working Group, which develops standards related to Bluetooth technology, would have been able to access the D1.0 draft in the member area of the IEEE website. Therefore, I estimate that at least 300 802.11 Working Group members and at least 300 additional members of other IEEE 802 Working Groups had direct access to the D1.0 document through the IEEE website as of December 1, 2016.

63. Although draft D1.0 was initially posted to a password-protected members area of the IEEE website, this posting in fact would have served to make draft D1.0 accessible to a broad swath of the interested public. As I explained above, many hundreds of individuals among the interested public were voting members in the IEEE 802 Working Group and would have had direct access to draft D1.0 from the member area website immediately upon its posting on December 1, 2016. As I describe in further detail below, any interested member of the public could become a voting member in the IEEE 802 Working Group by

following a straightforward process prescribed by IEEE. Furthermore, draft standard amendments posted to the member area were not closely held only by voting members. On the contrary, voting members commonly shared draft standard amendments like draft D1.0 with non-voting members in industry and academia, or other interested members of the public, upon their release on the members area of the IEEE website. There was, in practice, little expectation of confidentiality for draft standard amendments or other documents posted to the member area, and in my experience, voting members knew and expected that such documents would be shared with non-voting members for a variety of reasons. Below, I provide a description of how an interested member of the public—who was not already a voting member of the 802.11 Working Group—could have accessed draft D1.0, for example, by (1) following the straightforward process for becoming a voting member of the Working Group or (2) obtaining the document as a non-voting member.

1. Option 1: Become a Working Group Voting Member

64. First, any interested member of the public could have obtained access to draft D1.0 by being a voting member in the 802.11 Working Group. The process for becoming a voting member was well-defined and not onerous.

65. In the relevant timeframe leading up to the earliest claimed priority date of the '210 Patent (*e.g.*, January 9, 2017), becoming a "voting member"

simply required attending three meetings of the 802.11 Working Group, with at least two of these meetings being plenary sessions (Appendix J). As explained above, these meetings were generally held every two months and were open to the general public—no prior IEEE membership, special qualifications, or nomination were required to attend the meetings. An interested member of the public could have registered to attend the 802.11 Working Group meetings through the 802.11 Working Group website. Specifically, one could have registered for a working group meeting by (1) going to the IEEE 802.11 Working Group home page, (2) selecting "Session Info," which would open a drop-down menu, (3) select "Future Sessions," which would open the "IEEE 802.11 Future Session Plans" webpage, and (4) selecting "Registration" for a meeting for which registration was open. This is confirmed by archived versions of the 802.11 Working Group website from January 2016. Appendix K; Appendix BN.

66. Prospective 802.11 Working Group meeting attendees were required to pay a registration fee—for instance, between $375 and $975 for the January 2016 meeting in Atlanta, Georgia, depending on when the prospective attendee registered. Appendix BN. However, as explained above, the fee could be waived for certain visitors, such as academics, professors, and students from educational institutes in the surrounding area.

67. Task group leadership tracked attendance at each TGax meeting via electronic sign-in, and upon meeting the requirements for becoming a voting member (i.e., attending the requisite three meetings), participants were provided the login credentials for the "member area" of the IEEE-SA website where they could directly access draft standard amendments such as draft D1.0. Voting member credentials would only be provided at plenary sessions.

68. Login credentials for the "member area" are not unique to each voting member, and they are rarely changed (*e.g.*, the Chair can request a password change at his/her discretion, but rarely does so). When login credentials are updated, voting members receive an automated email from the Chair containing the new credentials. Through the member area, voting members can access standard amendment drafts.

69. Even if an interested member of the public did not become aware of TGax until the beginning of 2016—some one and a half years after the group began working on the 802.11ax standard amendment—they still could have attended any two plenary meetings and one interim meeting to gain "voting member" status before the earliest alleged priority date of the '210 Patent (*e.g.*, January 9, 2017). For example, one could have attended meetings in March 2016 in Macau (plenary session); May 2016 in Waikoloa, Hawaii (interim session); July 2016 in San Diego, California (plenary session); September 2016 in Warsaw, Poland (interim session); November 2016 in San Antonio, Texas (plenary session). Appendix BO. After attending just two previous meetings, one of which was a plenary session, one would have been granted voting privileges and login credentials for the member area of the 802.11 Working Group website at the start of the third meeting (which must be a plenary meeting).

70. A voting member would have been able to directly access draft D1.0 via the members area of the 802.11 Working Group website after the draft was uploaded to the site on December 1, 2016.

2. Option 2: Obtain the D1.0 Draft as a Non-Voting Member

71. Even apart from obtaining direct access to draft D1.0 as a voting member, interested members of the public also would have been capable of accessing draft D1.0 exercising reasonable diligence by obtaining a copy of the draft indirectly from a voting member.

72. In practice, IEEE imposed little if any restriction on the distribution of draft standard amendments like draft D1.0, despite nominally releasing them on the protected members area site. For example, the cover of draft D1.0 states that "[p]ermission is hereby granted for IEEE Standards Committee participants to reproduce this document for purposes of international standardization consideration." (Appendix G at Cover). Further, the "Copyrights" section on page iii of Draft D1.0 states that the document "is made available for a wide variety of both public and private uses," including "the promotion of engineering practices and methods." Appendix G at iii. Voting members of the IEEE 802.11 Working Group understood the document sharing policy to allow free distribution of standard amendment drafts to persons involved and/or interested in standards development. Moreover, the "Updating of IEEE documents" section on page iii

explains that IEEE standards are updated over time, providing interested members of the public with motivation to continually monitor the IEEE members area for new standards drafts. Appendix G at iii.

73. Voting members of the IEEE 802.11 Working Group commonly shared standard amendment drafts with non-voting members, as well as individuals who did not attend 802.11 Working Group or task group meetings at all. For example, in my experience, it was common for voting members to share draft standards with academic colleagues or industry engineers from their respective companies who were not voting members and, in some instances, were not even IEEE members. Based on the roughly 600 IEEE 802 Working Group members with direct access to the document (*see* ¶ 62), I estimate that draft D1.0 would have been disseminated to thousands of additional interested members of the public apart from just voting members by the earliest claimed priority date of the '210 Patent (*e.g.*, January 9, 2017). In other words, there was not an expectation of confidentiality with respect to draft D1.0. The motivation for sharing standard drafts is simple—Wi-Fi standardization impacts a broad range of stakeholders (manufacturers, researchers, inventors, etc.) that may not be able to actively participate in the standardization process. The standardization process is meant to be open and collaborative, and the goals of Wi-Fi standardization are (1) to create a high-quality technical specification and (2) garner support for the standard from

key stakeholders. These goals can be most effectively achieved by soliciting input from stakeholders that are unable to actively participate in the standardization process. This understanding is reflected in the IEEE-SA's policy toward sharing drafts with non-voting members. Many companies and other stakeholders also relied on just a single individual or a small number of individuals to represent their interests in 802.11 Working Group as a voting member, and those individuals would then share draft standard amendments and other developments to a much broader audience within their organizations.

74. Publicly available TGax documents corroborate that draft D1.0 was shared with and/or was made accessible to non-voting members of the 802.11 Working Group. Specifically, a number of submissions from the relevant timeframe (*i.e.*, 2016 to 2017) list non-voting members as authors and include additions or other edits to working drafts of the 802.11ax standard amendment, including the D1.0 draft. For example, a March 2017 submission entitled "Explanations for CT on 27.5.2.7 NDP Feedback Report" refers to a pre-D1.0 draft of the 802.11ax standard amendment and lists Genadiy Tsodik and Leonid Epstein as authors (Appendix BP). This indicates that both Mr. Tsodik and Mr. Epstein had access to the referenced 802.11ax standard amendment draft when they prepared the submission. However, archived 802.11 Working Group membership lists indicate that Genadiy Tsodik was not a voting member at the time of this

submission—he was a "potential member" as of November 2016 and downgraded to an "aspirant" as of May 2017 (Appendix BQ; Appendix BR). The archived membership lists similarly indicate that Leonid Epstein was not a voting member at the time of the submission either—he was an "aspirant" as of both November 2016 and May 2017 (Appendix BQ; Appendix BR).

75. A March 2017 submission entitled "BSS Load Information Element for 11ax" discusses comments to the D1.0 draft and lists Frank Hsu as a co-author, indicating that Mr. Hsu had access to the D1.0 draft (Appendix BS). However, Frank Hsu (Chien-Fang Hsu) was not a voting member—the archived 802.11 Working Group membership logs indicate he was an "aspirant" as of November 2016 and a "potential voter" as of May 2017 (Appendix BQ, Appendix BR).

76. A March 2017 submission entitled "Resolution to CID 7547" includes discussion of the D1.0 draft and lists Ilan Sutskover and Michael Simon as co-authors (Appendix BT). However, neither Mr. Sutskover nor Mr. Simon were voting members—neither is listed in the archived 802.11 Working Group membership logs for November 2016 or May 2017 (Appendix BQ, Appendix BR).

77. Based on the foregoing, it is my opinion that P802.11ax/D1.0, otherwise known as draft D1.0, was publicly accessible to members of the interested public as of December 1, 2016.

IV. CONCLUSION

78. I currently hold the opinions expressed in this declaration. But my analysis may continue, and I may acquire additional information and/or attain supplemental insights that may result in added observations.

Appendix A

CHRISTOPHER J. HANSEN

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(408) 899-8298 (office)
chris@covariantcorp.com

I. SUMMARY

- Senior electrical engineer - more than 25 years in industry plus Ph.D. (UCLA 1997).
- Named inventor on more than 125 issued patents, including many related to IEE802.11/Wi-Fi and Bluetooth wireless standards.
- Technical skills encompass wireless network physical layer (PHY) design, systems engineering, communication theory, integrated circuit (IC) design, signal processing, RF/microwave systems, intellectual property, and standardization.
- Experience with multiple successful product developments (802.11 WLAN chipsets and cellular base-station systems), research in new technologies (802.11n MIMO and 60 GHz), and leading standards bodies (IEEE 802.11, Bluetooth SIG, Wireless Gigabit Alliance).

II. EXPERIENCE

Covariant Corporation, Los Altos, California
President — August 2013 – present

- Consulting in wireless communication systems, signal processing, standards, and intellectual property.
- Recent clients include Octoscope, Google, and Peraso Technologies.
- Example projects:
  - Developed and executed IEEE 802.11 standards strategy for a technology startup company. Led standards participation in industry special interest group and IEEE 802.11ay and 802.11md task groups. Developed simulations in Matlab to support standards contributions.

- Developed Matlab tools to predict mmwave system performance including impact of cascade non-linearities and temperature variations.
- Analyzed patent portfolio for potential standards related patents related to IEEE 802.11 standards and Wi-Fi Alliance specifications. Developed claim charts for appropriate patents.
- Developed Matlab simulation tools as part of technical support for patent litigation. Analyzed performance benefits of physical layer features in IEEE 802.11 standards.
- Reviewed C, assembler, Verilog, and VHDL code for technical support in patent litigation.
- Developed and prototyped novel radar detection algorithms in Matlab and C for specialized radio receiver,

Apple, Cupertino, California
Senior Wireless System Architect June 2012 – July 2013

- Analysis of 802.11 wireless networks for iOS products.

Broadcom Corporation, Sunnyvale, California

Associate Technical Director, Office of the CTO	March 2011 – May 2012
Senior Principal Scientist, Office of the CTO	March 2007 - March 2011
Principal Scientist, Office of the CTO	March 2006 - March 2007
Engineering Manager, Wireless LAN Business Unit	June 2004 - March 2006
Senior Staff Scientist, Wireless LAN Business Unit	January 2000 - June 2004

- Analysis and development of new wireless networking technologies for application to WiGig (60 GHz wireless), WirelessHD, Bluetooth, Wimedia Ultrawideband, IEEE 802.11, and 802.15 systems. Investigation of inter-networking, antenna systems, beamforming techniques, signal processing and advanced devices employing multiple wireless technologies.
- Secretary, board member, and vice chair of the Technical Working Group of the Wireless Gigabit Alliance.
- Vice chair of the IEEE 802.11ad (60 GHz MAC/PHY) task group.
- Developed BT/802.11 technology and co-chaired the Bluetooth SIG 802.11 AMP (Alternate MAC/PHY) Study Group. The resulting specification was the hallmark feature of the Bluetooth 3.0 release.
- Developed significant intellectual property related to wireless networks and contributed to the management of company patent portfolio through patent review committee.

- Project manager and lead physical layer (PHY) systems engineer for 802.11n proposal to the IEEE. Key elements of this proposal and further contributions became the basis of the IEEE 802.11n standard including MIMO-OFDM physical layer and enhanced MAC layer for higher throughput wireless networks. Made contributions in the areas of preamble design, advanced channel coding, MIMO-OFDM, channel estimation, and multiple antenna beamforming. (See: https://en.wikipedia.org/wiki/IEEE_802.11n-2009)
- Led Broadcom effort to standardize power control and dynamic frequency selection for wireless networks in IEEE 802.11 Task Group H. Proposal is now part of 802.11h standard. (See: https://en.wikipedia.org/wiki/IEEE_802.11h-2003)
- System engineering for 802.11a/b/g wireless local area network chipsets, including analysis of radio and base-band dsp architectures for the physical layer design. Developed signal processing algorithms, channel models, radio system models, and laboratory radios.
- Designed and developed MATLAB and bit accurate C models for the physical layers of 802.11 WLAN chipsets. These included models for equalizers, convolutional coders/decoders, beamforming, nonlinear distortion in radio transceivers, and radio channels.
- Analyzed and debugged first silicon versions of commercially successful 802.11a/b/g integrated circuit products.
- Developed radar detection and dynamic frequency selection hardware and software for 802.11a chipsets to meet ETSI (European) and FCC (U.S.) regulations.

Excess Bandwidth Corporation (now **Conexant**), Santa Clara, California
Principal Systems Engineer 1998–1999

- System engineering and architecture for HDSL2/G.shdsl digital subscriber line modems, including MATLAB and C code to simulate equalizers, error correcting codes, timing recovery, digital phase locked loops, waiting time jitter, and performance in crosstalk.
- Developed DSP software in C and assembler (TI C6x) for prototype HDSL2/G.shdsl modem. Implemented modules for adaptive equalization, timing recovery, and activation frame handshake.

Amati Communications Corporation (now **Texas Instruments**)
San Jose, California
Senior Research Engineer 1997-1998

- Developed, analyzed, and implemented advanced equalizer training algorithms for discrete multi-tone (DMT) based asymmetric digital subscriber line (ADSL) models.

AT&T Bell Laboratories, Whippany, New Jersey
Member of Technical Staff 1990-1992

- Developed RF and analog circuit designs for AT&T Autoplex 1000 fiber optic micro-cell radio transceiver.
- Managed testing group and developed test program for high power 900 MHz feed-forward linear amplifier used in cellular telephone base stations.

MIT Lincoln Laboratory, Lexington, Massachusetts
Member of Technical Staff 1989-1990

- Developed signal processing software and RF hardware for experimental X-band and Ka-band radar.
- Conducted radar measurements at Lincoln Laboratory sites in Lexington, MA and Kwajalein Atoll, U.S. Marshall Islands.

III. LITIGATION EXPERIENCE

- NXP B.V. v. Broadcom Corp., No. 5:14-cv-826 (N.D. Cal.). Retained on behalf of Broadcom.
- Linex Techs., Inc. v. Hewlett-Packard Co. et al., No. 4:13-cv-00159 (N.D. Cal.). Retained on behalf of Broadcom.
- TomTom Int'l, B.V. v. Broadcom Corp., No. 8:14-cv-475 (C.D. Cal.). Retained on behalf of Broadcom.
- Certain Electronics Products, Including Products with Near-Field Communication ("NFC") System-Level Functionality and/or Battery Power-Up Functionality, Components Thereof, and Products Containing Same, No. 337-TA-950 (ITC). Retained on behalf of Dell.
- NXP B.V. et al. v. Dell Inc., No. 1:14-cv-00146 (D. Del.). Retained on behalf of Dell.
- California Institute of Tech. v. Broadcom Ltd. et al., No. 2:16-cv-3714 (C.D. Cal.). Retained on behalf of Broadcom. Deposed.
- Nokia Techs. Oy et al. v. Apple Inc., Nos. 2:16-cv-1440, 2:16-cv-1441 (E.D. Tex.). Retained on behalf of Apple Inc.

- Certain Electronic Devices, Including Mobile Phones, Tablet Computers, and Components Thereof, Nos. 337-TA-1038, 337-TA-1039 (ITC). Retained on behalf of Apple Inc.

- Ruckus Wireless, Inc., Belkin International, Inc., Amazon.com, Inc., Netgear, Inc., and Roku, Inc. v. Hera Wireless S.A., U.S. Patent and Trademark Office *Inter Partes Review*. Retained on behalf of Ruckus Wireless (Arris, Inc.).

- Certain Mobile Electronic Devices and Radio Frequency and Processing Components Thereof, Inv. No. 3337-TA-1065; Qualcomm Inc. v. Apple Inc, Civ. Action No. 3:17-cv-01375-JAH-MDD. Retained on behalf of Apple.

- VLSI Technology LLC v. Intel Corporation, No. 1:18-cv-00966 (Delaware). Retained on behalf of Intel Corporation.

- Nokia Techs. Oy v. Lenovo (Shanghai) Elects. Tech. Co. Ltd, et al., No. 5:19-cv-427 (E.D.N.C.) and In re Certain Electronic Devices, Including Computers, Tablet Computers, and Components and Modules Thereof, Inv. No. 337-TA-1208 (U.S.I.T.C). Retained on behalf of Lenovo.

- Koss Corporation v. Apple, Inc, No. 6:20-cv-00665 (W.D. Texas). Retained on behalf of Apple, Inc. Deposed.

- Aegis 11 S.A. v. Hisense Company, Ltd. and Hisense USA Corporation, No. 1:20-cv-03891 (N.D. Georgia). Retained on behalf of Hisense.

- Mediatek, Inc. v. NXP Semiconductors, No. 2:21-cv-04970 (C.D. California), In the Matter of Certain Integrated Circuits And Products Containing Same, Inv. No. 337-TA-1272. Retained on behalf of NXP. Deposed. Testified at evidentiary hearing.

- One-E-Way, Inc. v. Apple Inc., No. 2:20-cv-06339-JAK-PD (C.D. Cal.)

- NXP Semiconductors v. Mediatek, Inc. In the Matter of Certain Integrated Circuits And Products Containing Same, Inv. No. 337-TA-1287. Retained on behalf of NXP. Deposed.

- Intellectual Ventures v. General Motors, No. 6:21-cv-1088 (W.D. Texas). Retained on behalf of General Motors.

- XR Communications, LLC v. Hewlett Packard, 6:21-cv-00694 (W.D. Texas). Retained on behalf of Hewlett Packard.

- American Patents, LLC v. Marvell Semiconductors, 6:22-cv-771 (W.D. Texas). Retained on behalf of Marvell Semiconductors.

- TexasLDPC, Inc. v. Broadcom, C.A. No. 18-1966-SB (Delaware). Retained on behalf of Broadcom.

- Atlas Global Technologies v. OnePlus, 6:21-cv-01217-ADA. Retained on behalf of OnePlus.

- LG Electronics Inc. v. TCL Electronics Holding Ltd., 2:22-cv-122-JRG. Retained on behalf of LG Electronics Inc.

- Atlas Global Technologies v. TP-Link, 2:21-cv-430-JRG. Retained on behalf of TP-Link. Deposed. Testified at Trial.

- Panasonic Automotive Systems Co., Ltd. v. UNM Rainforest Innovations, U.S. Patent and Trademark Office *Inter Partes Review*. Retained on behalf of Panasonic.

- Intellectual Ventures I, LLC v. Ubiquiti, Inc., C.A. No. 23-cv-00865-GBW. Retained on behalf of Ubiquiti.

- Motorola Mobility LLC v. Ericsson AB, Certain Cellular Base Station Communications Equipment Components Thereof, And Products Containing Same. ITC 337-TA- . Retained on behalf of Ericsson.

- ASUS Technology. Licensing Inc., et al v. AT&T Corp., et al, Case No. 2:23-cv-00486 (EDTX); ASUS Technology. Licensing Inc., et al v. T-Mobile USA, Inc., Case No. 2:23-cv-00487 (EDTX); ASUS Technology. Licensing Inc., et al v. Cellco Partnership d/b/a Verizon Wireless, et al, Case No. 2:23-cv-00488 (EDTX); Innovative Sonic Ltd., et al v. AT&T Corp., et al Case No. 2:23-cv-00489 (EDTX); Innovative Sonic Ltd., et al v. T-Mobile USA, Inc. Case No. 2:23-cv-00490 (EDTX); Innovative Sonic Ltd., et al v. Cellco Partnership d/b/a Verizon Wireless, et al Case No. 2:23-cv-00491 (EDTX). Retained on behalf of Ericsson for defendants. Deposed.

- Secure Communications Technologies, LLC v. Samsung Electronics Co., Ltd. Case No. 2:24-cv-484 (E.D. Texas). Retained on behalf of Samsung.

IV. EDUCATION

Ph.D., Electrical Engineering 1997
University of California, Los Angeles
Dissertation: *Probing Techniques for Multiuser Channels with Power Control*
Research Area: Wireless and Digital Communications
Advisor: Gregory J. Pottie

M.S., Electrical Engineering 1989
University of Massachusetts, Amherst
Concentration: Signal Processing and Microwave Systems

B.S., Electrical Engineering 1987
Rensselaer Polytechnic Institute

V. HONORS AND AFFILIATIONS

- Institute of Electrical and Electronics Engineers (IEEE) Senior Member.
- Member, Society for Industrial and Applied Mathematics.
- Reviewer, IEEE Communications Magazine, 2014 - present.
- Board of Directors, PATCA - Professional and Technical Consultants Association, Silicon Valley, 2007 - present.
- Vice Chair, IEEE 802.11ad Task Group, 2011-2012.
- Secretary, Wireless Gigabit Alliance, 2010-2012.
- Rockwell graduate fellowship recipient, UCLA, 1992-1996.
- Eta Kappa Nu, Electrical Engineering Honor Society, Rensselaer Polytechnic Institute, 1987.

VI. SKILLS

- Architecture and analysis of wireless digital communication systems, including 802.11a/b/g/n/ac/ad/ax/ay, Bluetooth, Wimedia UWB, WirelessHD, and WiGig.

- DSP Programming (TI TMS320C62x and 320C5x) in C and assembler and general programming in C++, C, Matlab, and Python.
- RF/microwave/mmwave laboratory and over-the-air channel measurements.
- Extra class Amateur Radio license (W6COV) and Commercial General Radiotelephone license.

VII. PUBLICATIONS

C. J. Hansen, “Semi-blind Channel Estimation on 802.11 OFDM Data Symbols”, International Conference on Computing, Networking and Communications (ICNC 2024), February 2024.

A. Tompkins, et al, “A 16-Element Phased-Array Transceiver in 130-nm SiGe BiCMOS for Fixed Wireless Access Covering the Full 57-71 GHz Band”, IEEE Radio and Wireless Symposium (RWS), January 2020.

C. J. Hansen, “Internetworking with Bluetooth Low Energy”, ACM GetMobile, Vol 19, Issue #2, April 2015.

C. J. Hansen, “WiGig – Multigigabit Wireless Communication in the 60 GHz Band”, IEEE Communications Magazine, December 2011.

C. J. Hansen and G. J. Pottie, “A Distributed Access Algorithm for Cellular Personal Communication Systems with Channel Partitioning”, IEEE Transactions on Vehicular Technology, January 1999.

C. J. Hansen and G. J. Pottie, “Distributed Access Control in Wireless and Wireline Systems,” International Symposium on Information Theory, Whistler, B.C., 1995.

C. J. Hansen, C. C. Wang, and G. J. Pottie, “Distributed Dynamic Channel Resource Allocation in Wireless Communication Systems”, Asilomar Conference on Signals, Systems, and Computers, 1994.

VIII. PATENTS

Named inventor on the following United States patents:

US Patent Number	*Patent Title*
11,297,625	Method, system and apparatus for signaling station capabilities to establish wireless connections
11,121,818	Method and apparatus for unsolicited block acknowledgements
10,886,975	Single-carrier wideband beamforming method and system
10,820,328	Method and apparatus for de-centralized spatial reuse in wireless communications systems
10,784,990	Method and apparatus for encoding and modulating data for wireless transmission
10,735,133	Method and apparatus for configurable MIMO processing in wireless communications
10,716,117	Method, system and apparatus for signaling station capabilities to establish wireless connections
10,681,632	System and method for low power signaling in a wireless local area network
10,630,359	Method and apparatus for beamforming training using frames
10,498,419	Method and apparatus for determining direction for transmission to establish wireless connections
10,243,635	Method and apparatus for beamforming training using frames
10,236,964	Method and apparatus for beamforming training in basic service set discovery
10,110,273	Interference mitigation in wireless communication systems
10,015,741	System and method for low power signaling in a wireless local area network
9,960,865	Filtering of Wi-Fi physical layer measurements
9,949,227	Location determination
9,680,563	System and method for partial bandwidth communication
9,596,637	Dynamically adapting wireless communication
9,826,373	WLAN transmitter having high data throughput
9,622,216	Method and system for low rate MAC/PHY for 60 GHz transmission
9,516,483	Wireless communication between stations of differing protocols
9,356,673	Communication device incorporating beamforming handshaking
9,344,535	Multiple protocol wireless communications in a WLAN
9,307,350	Protocol adaptation layer for wireless communications
9,300,368	Method and system for 60 GHz antenna adaptation and user coordination based on base station beacons
9,247,439	High data throughput wireless local area network receiver

9,241,331	Method and system for optimal beamforming in wireless networks
9,198,035	Simple pairing to generate private keys for different protocol communications
9,130,705	Transmitting high rate data within a MIMO WLAN
9,104,569	Method and apparatus for signal detection and decoding
9,037,092	Method, apparatus and computer program for determining whether a received signal comprises a first signal component
9,025,491	High speed data transmission utilizing a high frequency physical layer for a wireless personal area network device
8,996,949	Encoding system and method for a transmitter in wireless communications
8,965,431	Multimode control device for allocating resources to communication devices that use differing protocols and methods for use therewith
8,964,895	WLAN transmitter having high data throughput
8,964,521	Method and system for compromise greenfield preambles for 802.11N
8,929,317	Transmission of wide bandwidth signals in a network having legacy devices
8,917,676	Device and method for transmitting long training sequence for wireless communications
8,909,272	Control device for allocating resources to communication devices that use differing protocols and methods for use therewith
8,897,320	High data throughput WLAN frame format
8,892,056	Protocol adaptation layer for wireless communications
8,891,642	Mixed mode preamble for MIMO wireless communications
8,805,277	Method and system for Bluetooth 802.11 alternate MAC/PHY (AMP) transmit power control (TPC)
8,804,685	Dual mode operation in a wireless network
8,774,327	Adjustable RF receiver
8,750,252	Long training sequence method and device for wireless communications
8,743,994	Feedback of channel information in a closed loop beamforming wireless communication system
8,737,189	Method and system for compromise greenfield preambles for 802.11n
8,725,101	Wireless device and method of operation
8,644,770	Protocol adaptation layer for wireless communications
8,644,284	Dual mode operation in a wireless network
8,638,263	Platform enhancements for planar array antennas
8,634,777	Pairing with directional code sequence
8,630,367	Signaling format for wireless communications

8,620,368	Method and system for 60 GHz antenna adaptation and user coordination based on base station beacons
8,611,821	Communication device that detects and adapts to the presence of other devices and methods for use therewith
8,588,283	Method and system for frame formats for MIMO channel measurement exchange
8,577,416	Transceiver with plural space hopping array antennas and methods for use therewith
8,576,695	Preamble formats for MIMO wireless communications
8,553,659	Method and system for optimal beamforming in wireless networks
8,548,087	Long training sequence for MIMO WLAN systems
8,520,669	High data throughput wireless local area network receiver
8,437,419	Method and system for frame formats for MIMO channel measurement exchange
8,437,362	Asymmetrical MIMO wireless communications
8,407,556	LDPC (low density parity check) coding and interleaving implemented in MIMO communication systems
8,406,204	Transmission of wide bandwidth signals in a network having legacy devices
8,385,844	Transceiver with plural space hopping phased array antennas and methods for use therewith
8,369,784	High speed data transmission utilizing a high frequency physical layer for a wireless personal area network device
8,363,642	High data throughput wireless local area network receiver
8,351,399	MIMO wireless communication greenfield preamble formats
8,345,732	Feedback of channel information in a closed loop beamforming wireless communication system
8,320,877	Method and system for 60 GHz location determination and coordination of WLAN/WPAN/GPS multimode devices
8,284,867	Mixed mode preamble for MIMO wireless communications
8,284,651	Preamble formats for MIMO wireless communications
8,265,185	Method and system for encoding a signal for wireless communications
8,254,407	Asymmetrical MIMO wireless communications
8,233,565	Method and system for high speed wireless data transmission between communication devices
8,213,395	Method and system for dual mode operation in wireless networks
8,195,092	Method and system for utilizing a high frequency PHY layer for high speed data transmission between wireless devices
8,190,162	Radar detection circuit for a WLAN transceiver
8,184,679	RF transceiver having adaptive modulation

8,176,380	Algebraic construction of LDPC (low density parity check) codes with corresponding parity check matrix having CSI (cyclic shifted identity) sub-matrices
8,175,542	Transceiver with plural space hopping phased array antennas and methods for use therewith
8,170,504	Modified preamble for programmable transmitter
8,170,496	Transceiver with space hopping phased array antenna and methods for use therewith
8,170,495	Collaborative pairing transceiver with space hopping phased array antenna and methods for use therewith
8,169,998	Method and system for an AD HOC wireless network with master control of network parameters
8,144,798	Long training sequence for MIMO WLAN systems
8,126,425	Method and system for 60 GHZ location determination based on varying antenna direction and coordination of WLAN/WPAN/GPS multimode devices
8,095,162	Control device for allocating resources to communication devices that use differing protocols and methods for use therewith
8,094,749	Signaling format for wireless communications
8,089,890	Transmitting high rate data within a MIMO WLAN
8,085,871	Adaptive modulation in a multiple input multiple output wireless communication system with optional beamforming
8,081,926	Method and system for multisession communication using multiple physical (PHY) layers
8,081,104	Radar detection circuit for a WLAN transceiver
8,077,810	Apparatus for high data throughput reception in a WLAN
8,059,740	WLAN transmitter having high data throughput
8,041,333	Method and system for 60 GHz antenna adaptation and user coordination based on base station beacons
8,032,167	Multimode control device for allocating resources to communication devices that use differing protocols and methods for use therewith
8,031,806	Mixed mode preamble for MIMO wireless communications
7,995,667	Reduced latency concatenated reed solomon-convolutional coding for MIMO wireless LAN
7,991,056	Method and system for encoding a signal for wireless communications
7,991,009	Preamble formats for MIMO wireless communications
7,978,729	High data throughput WLAN frame format
7,974,591	Modified preamble for programmable transmitter
7,957,450	Method and system for frame formats for MIMO channel measurement exchange
7,940,751	Personal area network data encapsulation in WLAN communications

7,924,943	Method and system for optional closed loop mechanism with adaptive modulations for multiple input multiple output (MIMO) wireless local area network (WLAN) system
7,920,526	Long training sequence method and device for wireless communications
7,912,449	Method and system for 60 GHz location determination and coordination of WLAN/WPAN/GPS multimode devices
7,894,852	Channel reciprocity matrix determination in a wireless MIMO communication system
7,873,022	Multiple input multiple output wireless local area network communications
7,865,142	Method and system for multisession bluetooth communication using multiple physical (PHY) layers
7,840,184	Method and system for utilizing a 60 GHZ PHY layer for high speed data transmission between bluetooth devices
7,826,547	Mixed mode preamble for MIMO wireless communications
7,801,098	Parallel MAC/PHY for enhanced transmission rate in a wireless network
7,796,696	Asymmetrical multiple stream wireless communication using STBC
7,773,565	MIMO wireless communication greenfield preamble formats
7,746,886	Asymmetrical MIMO wireless communications
7,702,291	Radar detection from pulse record with interference
7,701,382	Radar detection circuit for a WLAN transceiver
7,680,059	Multiple protocol wireless communications in a WLAN
7,617,439	Algebraic construction of LDPC (Low Density Parity Check) codes with corresponding parity check matrix having CSI (Cyclic Shifted Identity) sub-matrices
7,593,692	Radar detection circuit for a WLAN transceiver
7,590,429	RF transceiver configuring for a MIMO communication
7,590,189	Signaling format for wireless communications
7,586,881	MIMO wireless communication greenfield preamble formats
7,583,933	Dynamic frequency selection in a wireless communication network
7,570,619	Long training sequence method and device for wireless communications
7,564,914	Method and system for frame formats for MIMO channel measurement exchange
7,558,537	Modified preamble for programmable transmitter
7,555,053	Long training sequence for MIMO WLAN systems
7,539,501	High data throughput wireless local area network receiver
7,516,390	LDPC (Low Density Parity Check) coding and interleaving implemented in MIMO communication systems
7,502,408	RF transceiver having adaptive modulation

7,466,773	WLAN receiver having an iterative decoder
7,444,134	Device and method for transmitting long training sequence for wireless communications
7,423,989	Preamble formats for MIMO wireless communications
7,417,974	Transmitting high rate data within a MIMO WLAN
7,400,643	Transmission of wide bandwidth signals in a network having legacy devices
7,330,501	Orthogonal normalization for a radio frequency integrated circuit
7,324,785	Transmit power control of wireless communication devices
7,269,430	Frame format for high data throughput wireless local area network transmissions
7,242,961	Channel reciprocity matrix determination in a wireless MIMO communication system
7,233,773	Configuring a MIMO communication
7,162,204	Configurable spectral mask for use in a high data throughput wireless communication
7,158,759	Dynamic frequency selection in a wireless communication network
7,020,220	Digital estimation and correction of I/Q mismatch in direct conversion receivers

Appendix AA

wget - 1.25.0

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Appendix AB

Documents

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Everything | All Years | TGax (inactive)

HE SIG-B

Created (ET) ▼	Year	DCN	Rev	Group	Title	Author (Affiliation)	Uploaded (ET)	Actions
15-Jul-2015 ET	2015	821	2	TGax	HE SIG-B Structure	Joonsuk Kim (Apple)	15-Jul-2015 02:23:28 ET	Download
14-Jul-2015 ET	2015	821	1	TGax	HE SIG-B Structure	Joonsuk Kim (Apple)	14-Jul-2015 19:47:53 ET	Download
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Appendix AC

HE-SIG-B Structure

Date: 2015-07-11

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Discussion on HE-SIG B Structure

- The current SFD [1] defines HE-SIG-B as follows:
  - Downlink HE MU PPDU shall include HE-SIG-B field, and the number of OFDM symbols of HE-SIG-B field is variable.
    - NOTE—The HE-SIG-B field includes information required to interpret HE MU PPDU, and detail is TBD.
  - HE-SIG-B shall use a DFT period of 3.2 μs and subcarrier spacing of 312.5 kHz.
- Background
  - The structure of HE-SIG-B has to be defined with following details
    - How to sort the contents in sequence
      - Encoding sequence is discussed in another presentation [4]
    - For wider bandwidth than 20MHz, how to arrange over frequency bands
    - What information to be signaled
  - In this presentation, we propose a HE-SIG-B structure

Topic 1: Duplicate or Non-duplicate

- HE SIG-A is proposed to have 2 OFDM symbol [2]
  - HE SIG-A is duplicated over operating bandwidth, like 11n/ac
  - HE SIG-B exists only for DL-MU
- For MU, contents in HE SIG-A and HE SIG-B can be separated as follows:
  - HE SIG-A can deliver the information about the PPDU to all STAs
    - STAs do not know about the operating bandwidth yet; so better to be duplicated
  - HE SIG-B sends the information for designated receiving STAs for MU operation
- The remaining question is whether we have duplicated part in HE SIG-B if there is any
  - We may not need another duplicated portion in HE SIG-B, given that HE SIG-A has 48~52 information bits
  - Unless we are lack of number of bits in HE SIG-A to be fully duplicated, we do not need to duplicate any OFDM symbol of HE SIG-B over full bandwidth

Topic 2: Common & User-specific

- There are some information, which needs to be decoded by a group of STAs, as common information for DL-MU
  - For example, Resource Unit (RU) allocation needs to be decoded, not by only one specific STA, but by a group of STAs
  - A group includes TBD number of STAs. It can be all or a subset of designated receiving STAs.
  - Those information may not be necessary for the other group of STAs when it is signaled for a subset of STAs
- Common information for a group of receiving STAs can be signaled at once
  - These information may need to be located up front in HE SIG-B, before user-specific information (MCS, Nsts etc. for each user)
  - If the group is a subset of STAs, those information is better to be aligned with the designated group of receiving STAs, so that decoding error does not affect for other group of receiving STAs, in terms of sub-bands
    - We can minimize the impact of OBSS interference, which may occupy some of sub-bands

Common Field in SIG-B

- The information for non-designated STAs to avoid the further un-necessary decoding process can be included in L-SIG & HE SIG-A
- HE SIG-B includes control signaling for recipients of DL-MU PPDU
  - The common field in HE SIG-B has the information which is needed for recipients in common
    - E.g., RU allocation is common information to all or sub-set of recipients
  - The user-specific field in HE SIG-B has the information for a specific user, which is not needed for other users

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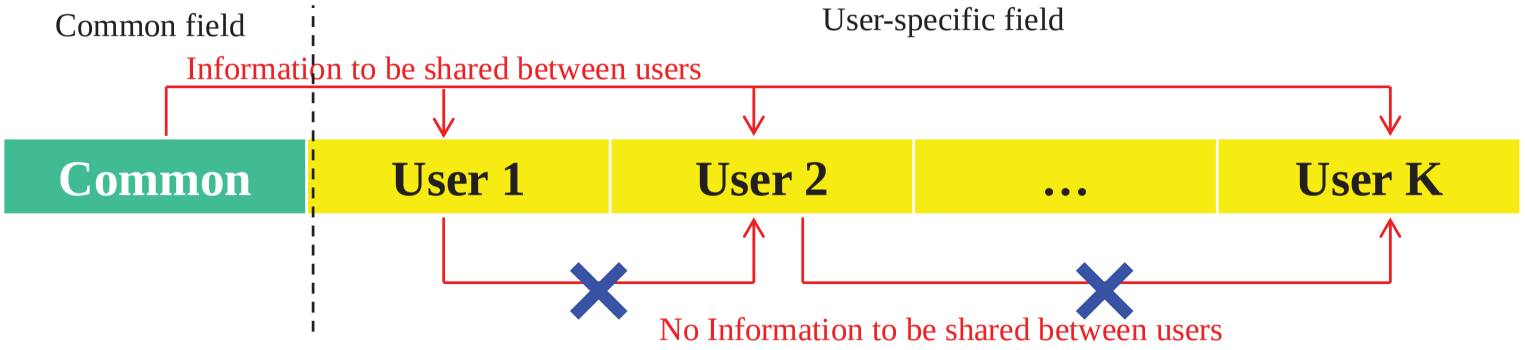
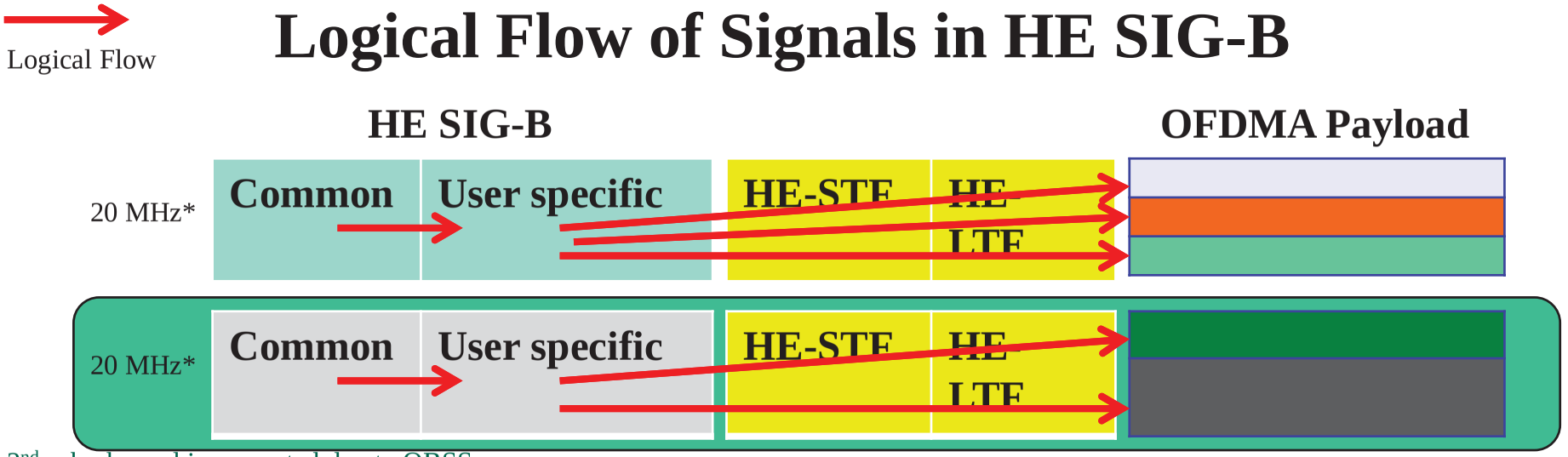
User-specific Field in HE SIG-B



- User-specific field consists of multiple sub-fields
- Per-STA information, one specific subfield may deliver some information for a specific STA, which may not be useful for some other STAs
  - i.e., Information is isolated between designated receiving STAs
- The boundary between common & user-specific field is in the bit-level, not OFDM symbol boundary

* 20MHz is an example

Logical Flow of Signals in HE SIG-B



- Information in SIG-B common field is shared between users within the same sub-band channel
  - E.g., Resource Unit Allocation
- Common/User specific signaling applies to the same sub-band channel
  - In this way, signaling in corrupted sub-band channel does not affect on decoding the PPDU in another sub-band channel
  - We can isolate the signaling to operate the OFDMA PPDU, so that partial interference does not corrupt the whole OFDMA PPDU reception

RU Allocation

- In MU (OFDMA or MIMO (SDMA)) operation, there are many combinations of RUs per bandwidth. Possible RUs [3], depending on the size of operating bandwidth, are
  - 26, 52,106, 242, 484, 996 and 996 x 2 data tones
- Receiving STAs need to know which RU needs to be decoded for themselves in HE SIG-B
- These RU allocation mapping is better to be up front, at common field, in HE SIG-B, because
  - Signaling for RU allocation for all receiving STAs can save the overhead, than individual signaling per STA, and
  - Receiver can prepare for decoding accordingly with early identified RU structure
- We propose to include RU allocation information in the common field of HE SIG-B
  - How to signal RU allocation is TBD

Summary

- We propose the HE signal field structure as follows
  - HE SIG-B does not have any OFDM symbol that is fully duplicated over the operating BW
    - Some part of an OFDM symbol may be duplicated if necessary
  - In HE SIG-B, which exists for DL-MU PPDU
    - We need to signal the control information for designated receiving STAs
    - For DL-MU, we need following information
      - Resource allocation (OFDMA or MU-MIMO)
      - Per-STA information, e.g.,
        - STA-ID
        - MCS
        - Nsts
    - We propose to have two fields in SIG-B
      - Common field, where RU allocation info is included
      - User-specific field, where per-STA info belongs to

Straw poll #1

- Do you agree to add to 11ax SFD that HE SIG-B does NOT have any OFDM symbol duplicated in each 20 MHz of the PPDU bandwidth?

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Straw poll #2

- Do you agree to add to 11ax SFD that HE SIG-B has the common field followed by the user-specific field, where
  - The common field includes the information for all of designated STAs to receive the PPDU in corresponding bandwidth
  - The user-specific field consists of multiple sub-fields that do not belong to the common field, where one or multiple of those sub-fields are for each designated receiving STA
  - The boundary between the common & the user-specific field is in the bit-level, not the OFDM symbol-level

Straw poll #3

- Do you agree to add to 11ax SFD that the common field in HE SIG-B contains Resource Unit (RU) allocation?

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Reference

[1] 11-15-0132-06-00ax-spec-framework

[2] 11-15-0822-00-00ax-HE-SIG-A-Structure

[3] 11-15-0330-04-00ax-OFDMA-numerology-and-structure

[4] 11-15-0873-00-00ax-HE-SIG-B-encoding-structure

Appendix AD

TGax PHY Ad Hoc Jul 2015 Meeting Agenda

Date: 2015-07-14

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IEEE 802.11 TGax
High Efficiency WLAN
PHY Ad Hoc

Co-Chairs:
Bo Sun (ZTE)
Yakun Sun (Marvell)
Jianhan Liu (Mediatek)

Agenda Items

- Call meeting to order
- Patent policy, etc. (Call for Potentially Essential Patents)
- Review ad hoc rules
- Set and approve agenda
- Technical Presentations approved by 802.11ax for presentation this week, and related straw polls
- Any other technical presentations

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Meeting Protocol, Attendance, Voting & Document Status

- **Please announce your affiliation when you first address the group during a meeting slot**
- **Cell Phones to be silent or Off**
- **Register your attendance via https://imat.ieee.org while on meeting SSID (e.g. Verilan-secure)**
- **Make sure your badges are correct**
- **If you plan to make a submission be sure it does not contain company logos or advertising**
- **Questions on Voting status, Ballot pool, Access to Reflector, Documentation, Member's Area**
  - Contact Jon Rosdahl – jrosdahl@ieee.org

Patent Policy and Other Guidelines

- Following 5 slides

Instructions for the WG Chair

The IEEE-SA strongly recommends that at each WG meeting the chair or a designee:

- **Show slides #1 through #4 of this presentation**
- **Advise the WG attendees that:**
  - The IEEE's patent policy is consistent with the ANSI patent policy and is described in Clause 6 of the *IEEE-SA Standards Board Bylaws*;
  - Early identification of patent claims which may be essential for the use of standards under development is strongly encouraged;
  - There may be Essential Patent Claims of which the IEEE is not aware. Additionally, neither the IEEE, the WG, nor the WG chair can ensure the accuracy or completeness of any assurance or whether any such assurance is, in fact, of a Patent Claim that is essential for the use of the standard under development.
- **Instruct the WG Secretary to record in the minutes of the relevant WG meeting:**
  - That the foregoing information was provided and that slides 1 through 4 (and this slide 0, if applicable) were shown;
  - That the chair or designee provided an opportunity for participants to identify patent claim(s)/patent application claim(s) and/or the holder of patent claim(s)/patent application claim(s) of which the participant is personally aware and that may be essential for the use of that standard
  - Any responses that were given, specifically the patent claim(s)/patent application claim(s) and/or the holder of the patent claim(s)/patent application claim(s) that were identified (if any) and by whom.
- The WG Chair shall ensure that a request is made to any identified holders of potential essential patent claim(s) to complete and submit a Letter of Assurance.
- It is recommended that the WG chair review the guidance in *IEEE-SA Standards Board Operations Manual* 6.3.5 and in FAQs 12 and 12a on inclusion of potential Essential Patent Claims by incorporation or by reference.

Note: **WG** includes Working Groups, Task Groups, and other standards-developing committees with a PAR approved by the IEEE-SA Standards Board.

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Participants, Patents, and Duty to Inform

All participants in this meeting have certain obligations under the IEEE-SA Patent Policy. Participants:

- **"Shall inform the IEEE (or cause the IEEE to be informed)" of the identity of each "holder of any potential Essential Patent Claims of which they are personally aware" if the claims are owned or controlled by the participant or the entity the participant is from, employed by, or otherwise represents**
  - **"Personal awareness" means that the participant "is personally aware that the holder may have a potential Essential Patent Claim," even if the participant is not personally aware of the specific patents or patent claims**
- **"Should inform the IEEE (or cause the IEEE to be informed)" of the identity of "any other holders of such potential Essential Patent Claims" (that is, third parties that are not affiliated with the participant, with the participant's employer, or with anyone else that the participant is from or otherwise represents)**
- **The above does not apply if the patent claim is already the subject of an Accepted Letter of Assurance that applies to the proposed standard(s) under consideration by this group**

Quoted text excerpted from IEEE-SA Standards Board Bylaws subclause 6.2

- Early identification of holders of potential Essential Patent Claims is strongly encouraged
- No duty to perform a patent search

Patent Related Links

All participants should be familiar with their obligations under the IEEE-SA Policies & Procedures for standards development.

Patent Policy is stated in these sources:

IEEE-SA Standards Boards Bylaws

http://standards.ieee.org/guides/bylaws/sect6-7.html#6

IEEE-SA Standards Board Operations Manual

http://standards.ieee.org/guides/opman/sect6.html#6.3

Material about the patent policy is available at

http://standards.ieee.org/board/pat/pat-material.html

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If you have questions, contact the IEEE-SA Standards Board Patent Committee Administrator at patcom@ieee.org or visit http://standards.ieee.org/board/pat/index.html

This slide set is available at http://standards.ieee.org/board/pat/pat-slideset.ppt

Call for Potentially Essential Patents

- **If anyone in this meeting is personally aware of the holder of any patent claims that are potentially essential to implementation of the proposed standard(s) under consideration by this group and that are not already the subject of an Accepted Letter of Assurance:**
  - Either speak up now or
  - Provide the chair of this group with the identity of the holder(s) of any and all such claims as soon as possible or
  - Cause an LOA to be submitted

Other Guidelines for IEEE WG Meetings

- All IEEE-SA standards meetings shall be conducted in compliance with all applicable laws, including antitrust and competition laws.
  - **Don't discuss the interpretation, validity, or essentiality of patents/patent claims.**
  - **Don't discuss specific license rates, terms, or conditions.**
    - Relative costs, including licensing costs of essential patent claims, of different technical approaches may be discussed in standards development meetings.
      - Technical considerations remain primary focus
  - **Don't discuss or engage in the fixing of product prices, allocation of customers, or division of sales markets.**
  - **Don't discuss the status or substance of ongoing or threatened litigation.**
  - **Don't be silent if inappropriate topics are discussed … do formally object.**

See *IEEE-SA Standards Board Operations Manual*, clause 5.3.10 and "Promoting Competition and Innovation: What You Need to Know about the IEEE Standards Association's Antitrust and Competition Policy" for more details.

Ad Hoc Groups Operation

- A straw poll needs to achieves at least 75% at the ad-hoc level to be converted to a motion at the TG level.
- In the case a consensus can not be reached within an Ad Hoc group (a stalemate that prohibits further progress), the subject is moved to the Task group, if an Ad Hoc straw poll vote to move the subject to the Taskgroup achieves > 50% approval.
- A straw poll affecting the Spec Framework has to start with,
  - Do you agree to add to the TG Specification Frame work document?
    - x.y.z. <feature description>
- For further details, please see 11-15-0075r0
- Minutes of the Ad Hoc group meetings will be available on mentor.

Submissions (PHY)

DCN	Title	Author	ad hoc
11-15/0805	SIG-B field for HEW PPDU	Young Hoon Kwon	PHY
11-15/0810	HE PHY Padding and Packet Extension	Hongyuan Zhang	PHY
11-15/0887	efficient padding for last OFDM symbol	Heejung Yu	PHY
11-15/0812	Pilot Design for Data Section	Sameer Vermani	PHY
11-15/0813	CP Indication for UL MU Transmission	Zhigang Rong	PHY
11-15/0817	P Matrix for HE-LTF	Yakun Sun	PHY
11-15/0819	11ax OFDMA Tone Plan Leftover Tones and Pilot Structure	Bin Tian	PHY
11-15/0824	Pilot Design for 11ax Downlink Transmissions	Yujin Noh	PHY
11-15/0822	SIG-A Structure in 11ax Preamble	Jianhan Liu	PHY
11-15/0821	HE SIG-B Structure	Joonsuk Kim	PHY
11-15/0823	Preamble Design and Auto-Detection for 11ax	Sungho Moon	PHY
11-15/0826	HE-SIG-A transmission for range extension	Jiayin Zhang	PHY
11-15/0827	Considerations on HE-SIG-A and B	Katsuo Yunoki	PHY
11-15/0832	Performance evaluation of SU/MU MIMO in OFDMA	Jiyong Pang	PHY
11-15/0845	LTF Design for Uplink MU-MIMO	Daewon Lee	PHY
11-15/0853	Extensible Preamble Format Design	Leonardo Lanante	PHY
11-15/0602	HE-LTF sequence for UL MU-MIMO	Qinghua Li	PHY
11-15/0865	Discussion of ACI performance and ACI requirements for IEEE 802.11ax	Leif Wilhelmsson	PHY
11-15/0868	impact of Frequency Selective Scheduling Feedback for OFDMA	Hakan Persson	PHY
11-15/0873	SIG-B Encoding Structure	Ron Porat	PHY
11-15/0579	preamble design and autodetection	Hongyuan Zhang	PHY
11-15/0580	11ax coding discussion	Hongyuan Zhang	PHY
11-15/0816	Interleaver and Tone Mapper for OFDMA	Yakun Sun	PHY

Note:

- Contribution presented and straw poll done if there is.
- Contribution presented but straw poll(s) deferred.
- Contribution NOT presented yet.

Tuesday AM2

- **Presented contributions:**
  - SIG-A
    - 11-15/0822r1
    - 11-15/0826r1
  - SIG-B
    - 11-15/0805r2
    - 11-15/0821r1

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SP1(SP1, 822r1)

Do you agree to add to 11ax SFD that HE-SIG-A is present in all 11ax packets and is two OFDM symbols long when it uses MCS0?

- Information bits in HE-SIGA are jointly encoded as in VHT-SIG-A (using 48 tones or 52 tones is TBD).
- SU packets and UL Trigger based packets do not contain HE-SIG-B symbols.

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- **Y: 99**
- **N: 4**
- **A: 2**

SP PASSED, READY FOR MOTION

SP2(SP2, 822r1)

Do you agree to add to 11ax SFD that the data field in UL Multi-user transmissions shall immediately follow the HE-LTF section?

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-Y 94

-N 1

-A 26

SP PASSED, READY FOR MOTION

SP3(826r1)

Do you support that HE-SIG-A have a repetition mode for range extension?

- In the repetition mode, HE-SIG-A symbols are repeated once in time. The bit interleaver is bypassed in the repeated HE-SIG-A symbols?
- The repetition mode should be indicated before HE-SIG-A.

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- **Y: 83**
- **N: 31**
- **A: 4**

SP FAILED

Wednesday PM1

- **Planned contributions:**
  - Pilot
    - 11-15/824r0, Pilot Design for 11ax Downlink Transmissions, Yujin Noh
  - Padding
    - 11-15/810r0, HE PHY Padding and Packet Extension, Hongyuan Zhang
    - 11-15/887r3, efficient padding for last OFDM symbol, Heejung Yu
  - LTF
    - 11-15/817r0, P Matrix for HE-LTF, Yakun Sun
    - 11-15/845r0, LTF Design for Uplink MU-MIMO, Daewon Lee
    - 11-15/602r4, HE-LTF sequence for UL MU-MIMO, Qinghua Li

SP4 (SP1, 11-15/810r0)

- **Do you agree to add the following text into Section 3.4 HE Data Field of the current SFD:**
  - An 11ax SU PPDU should apply the MAC/PHY pre-FEC padding scheme as in 11ac, to pad toward the nearest of the four possible boundaries ("*a*" factor) in the last Data OFDM symbol(s), and then use post-FEC padding bits to fill up the last OFDM symbol(s).
  - Packet Extension (PE) field is defined at the end of 11ax PPDUs.
    - PE should have the same average power as data field.
- **Y:56/N:28/A:6**
- **SP FAILED**

SP5 (SP, 11-15/887r3)

- **Do you support the concept**

  HE shall include mechanisms to enhance the MAC/PHY padding efficiency by adjusting OFDM symbol duration in the last OFDM symbol for SU transmissions.

- **Y: 23/N: 52/A:13**
- **SP ONLY FOR INFORMATION COLLECTION**

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SP6 (SP1, 11-15/817r0)

- **Do you agree to add the following text into Section x.x.x in current TGax SFD:**
  - in an OFDMA PPDU, using *N* HE-LTF symbols, an RU with $N_{sts,total}$ shall use the first $N_{sts,total}$ rows of the $N \times N$ P matrix?

- **Y: 64/N: 0/A: 14**

- **SP PASSED. READY FOR MOTION**

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SP7 (SP, 11-15/845r0)

- **Do you agree that more analysis of implementation complexity and performance on various scenarios is needed for uplink MU-MIMO LTF design?**

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Y: 37/N: 5/A: 32

SP ONLY FOR INFORMATION COLLECTION

Wednesday PM2

- **Planned contributions:**
  - LTF
    - 11-15/602r4, HE-LTF sequence for UL MU-MIMO, Qinghua Li
  - Coding
    - 11-15/580r1, 11ax coding discussion, Hongyuan Zhang
    - 11-15/816r0, Interleaver and Tone Mapper for OFDMA, Yakun Sun
  - MISC
    - 11-15/813r0, CP Indication for UL MU Transmission, Zhigang Rong
    - 11-15/832r0, Performance evaluation of SU/MU MIMO in OFDMA, Jiyong Pang
    - 11-15/853, Extensible Preamble Format Design, Leonardo Lanante
    - 11-15/865, Discussion of ACI performance and ACI requirements for IEEE 802.11ax, Leif Wilhelmsson
    - 11-15/868, mpact of Frequency Selective Scheduling Feedback for OFDMA, Hakan Persson

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SP8 (SP, 11-15/602r4)

- **Do you agree to add to TGax Specification Framework Document?**
  - The HE-LTF sequences for UL MU-MIMO shall be generated as follows. For each stream, a common sequence shall be masked repeatedly in a piece-wise manner by a distinct row of the 8x8 P matrix. When the length of the LTF sequence is not divisible by 8, the last M elements of the LTF sequence (M being the remainder after the division of LTF length by 8) shall be masked by the first M elements of the P matrix row.

Y: 39/N: 23/A: 10

SP FAILED

SP9 (SP1, 11-15/580r1)

- Do you agree to add the following text into 11ax SFD?
  - "LDPC is the only coding scheme in the 11ax Data field for allocation sizes 996 tones and 996*2 tones."

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Y: 68/N:0 /A: 8

SP PASSED. READY FOR MOTION

SP10 (SP2, 11-15/580r1)

- **Do you agree to add the following text into 11ax SFD?**
  - Support of BCC code is limited to less than or equal to four spatial streams (per user in case of MU-MIMO), and is mandatory (for both TX and RX) for RU sizes less than or equal to 242 tones (20MHz).
  - Support of LDPC code for both TX and RX is mandatory for HE STAs declaring support for at least one of HE 80/160/80+80 SU-PPDU bandwidths, or for HE STAs declaring support for more than 4 spatial streams. Otherwise, support of LDPC code for either TX or RX is optional.

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Y:60 /N:0 /A: 11

SP PASSED. READY FOR MOTION

SP11 (SP3, 11-15/580r1)

- **Do you agree to add the following text into 11ax SFD?**
  - 11ax MCS table shall not have any MCS exclusion, and when LDPC is applied, N_{DBPS} is computed as follows

    $N_{DBPS} = \lfloor N_{CBPS} * R \rfloor$, where R is the coding rate

Y: 52 /N: 0/A:16

SP PASSED. READY FOR MOTION

SP12 (SP1, 11-15/816r0)

- **Do you agree to add into 11ax SFD the following BCC interleaver and LDPC tone mapper parameters table?**

RU (tones)	BCC		LDPC
	N_{col}	N_{rot}	D_{TM}
26	8	2	1
52	16	11	3
106	17	29	6
242	26	58	9
484			12
996			20

Y: 59/N: 0/A:7

SP PASSED. READY FOR MOTION

SP13 (SP, 11-15/813r0)

- **Do you agree to add the following text into 11ax SFD?**
  - **3.y.z CP length of UL OFDMA/MU-MIMO transmission shall be explicitly indicated by AP in the Trigger frame that allocates resources for the UL OFDMA/MU-MIMO transmission. The value of CP length for all users addressed by the Trigger frame shall be the same.**

Y: 57 /N: 1/A:7

SP PASSED. READY FOR MOTION

SP14 (SP, 11-15/832r0)

- **Do you agree to add the following text into 11ax SFD?**
  - MU-MIMO shall only be supported on allocations sizes>=106 tones

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Y: 57 /N: 0/A: 16

SP PASSED. READY FOR MOTION

Appendix AE

Documents

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Everything | All Years | TGax (inactive)

HE-SIG-B

Created (ET) ▼	Year	DCN	Rev	Group	Title	Author (Affiliation)	Uploaded (ET)	Actions
03-May-2018 ET	2018	815	1	TGax	HE-SIG-B CIDs	Sigurd Schelstraete (Quantenna)	03-May-2018 21:07:17 ET	Download
02-May-2018 ET	2018	815	0	TGax	HE-SIG-B CIDs	Sigurd Schelstraete (Quantenna)	02-May-2018 12:19:21 ET	Download
06-Mar-2018 ET	2018	541	1	TGax	Fix the Issue on Number Of HE-SIG-B Symbols	Ming Gan (Huawei)	06-Mar-2018 16:31:15 ET	Download
06-Mar-2018 ET	2018	324	1	TGax	CR on HE-SIG-B part 3	Yujin Noh (Newracom)	06-Mar-2018 12:42:17 ET	Download
06-Mar-2018 ET	2018	541	0	TGax	Fix the Issue on Number Of HE-SIG-B Symbols	Ming Gan (Huawei)	06-Mar-2018 12:37:07 ET	Download
04-Mar-2018 ET	2018	352	1	TGax	LB230-PHY-CR on HE-SIG-B	Tianyu Wu (Samsung)	04-Mar-2018 02:14:22 ET	Download
21-Feb-2018 ET	2018	352	0	TGax	LB230-PHY-CR on HE-SIG-B	Tianyu Wu (Samsung)	02-Mar-2018 12:10:42 ET	Download
30-Jan-2018 ET	2018	324	0	TGax	CR on HE-SIG-B part 3	Yujin Noh (Newracom)	04-Mar-2018 22:33:34 ET	Download
16-Jan-2018 ET	2018	51	1	TGax	CR on HE-SIG-B part 2	Yujin Noh (Newracom)	16-Jan-2018 20:52:53 ET	Download
15-Jan-2018 ET	2018	50	1	TGax	CR on HE-SIG-B part 1	Yujin Noh (Newracom)	15-Jan-2018 23:59:28 ET	Download
05-Jan-2018 ET	2018	51	0	TGax	CR on HE-SIG-B part 2	Yujin Noh (Newracom)	11-Jan-2018 20:30:44 ET	Download
05-Jan-2018 ET	2018	50	0	TGax	CR on HE-SIG-B part 1	Yujin Noh (Newracom)	11-Jan-2018 20:31:44 ET	Download
12-Jul-2017 ET	2017	1006	2	TGax	Miscellaneous HE-SIG-B related CIDs	Sigurd Schelstraete (Quantenna)	12-Jul-2017 08:02:48 ET	Download
12-Jul-2017 ET	2017	1006	1	TGax	Miscellaneous HE-SIG-B related CIDs	Sigurd Schelstraete (Quantenna)	12-Jul-2017 07:35:15 ET	Download
10-Jul-2017 ET	2017	946	1	TGax	Text modification on HE-SIG-B 28.3.10.8.4-5	Yujin Noh (Newracom)	10-Jul-2017 15:41:08 ET	Download
10-Jul-2017 ET	2017	1109	0	TGax	Text modification on HE-SIG-B part 2	Yujin Noh (Newracom)	10-Jul-2017 15:40:18 ET	Download
06-Jul-2017 ET	2017	1006	0	TGax	Miscellaneous HE-SIG-B related CIDs	Sigurd Schelstraete (Quantenna)	06-Jul-2017 19:38:38 ET	Download
28-Jun-2017 ET	2017	946	0	TGax	Text modification on HE-SIG-B 28.3.10.8.4-5	Yujin Noh (Newracom)	10-Jul-2017 06:05:22 ET	Download
07-May-2017 ET	2017	289	2	TGax	CRs on HE-SIG-B terminologies on 28.3.10.8.1-3	Yujin Noh (Newracom)	07-May-2017 19:23:10 ET	Download
07-May-2017 ET	2017	288	2	TGax	CRs on HE-SIG-B 28.3.10.8.4-5 part 1	Yujin Noh (Newracom)	07-May-2017 19:22:36 ET	Download

03-May-2017 ET	2017	289	1	TGax	CRs on HE-SIG-B terminologies on 28.3.10.8.1-3	Yujin Noh (Newracom)	03-May-2017 01:11:24 ET	Download
29-Apr-2017 ET	2017	288	1	TGax	CRs on HE-SIG-B 28.3.10.8.4-5 part 1	Yujin Noh (Newracom)	29-Apr-2017 15:39:00 ET	Download
09-Mar-2017 ET	2017	299	2	TGax	CR on HE-SIG-B_28.3.10.8.1	Dongguk Lim(LG Electronics)	09-Mar-2017 19:31:02 ET	Download
08-Mar-2017 ET	2017	299	1	TGax	CR on HE-SIG-B_28.3.10.8.1	Dongguk Lim(LG Electronics)	08-Mar-2017 10:35:54 ET	Download
27-Feb-2017 ET	2017	299	0	TGax	CR on HE-SIG-B_28.3.10.8.1	Dongguk Lim(LG Electronics)	08-Mar-2017 01:24:34 ET	Download
23-Feb-2017 ET	2017	289	0	TGax	CRs on HE-SIG-B terminologies on 28.3.10.8.1-3	Yujin Noh (Newracom)	26-Apr-2017 14:23:01 ET	Download
23-Feb-2017 ET	2017	288	0	TGax	CRs on HE-SIG-B 28.3.10.8.4-5 part 1	Yujin Noh (Newracom)	26-Apr-2017 14:23:27 ET	Download
07-Nov-2016 ET	2016	1375	1	TGax	Commont Resolution for CID2867 and Text Change Proposal of 26.3.10.8 HE-SIG-B	Yujin Noh (Newracom)	07-Nov-2016 17:51:38 ET	Download
03-Nov-2016 ET	2016	1375	0	TGax	Commont Resolution for CID2867 and Text Change Proposal of 26.3.10.8 HE-SIG-B	Yujin Noh (Newracom)	06-Nov-2016 23:11:20 ET	Download
03-Nov-2016 ET	2016	1371	0	TGax	CR HE-SIG-B part III	Ross Jian Yu (Huawei)	07-Nov-2016 08:57:32 ET	Download
15-Sep-2016 ET	2016	1149	1	TGax	CR HE-SIG-B part II	Ross Jian Yu (Huawei)	15-Sep-2016 08:44:58 ET	Download
08-Sep-2016 ET	2016	1149	0	TGax	CR HE-SIG-B part II	Ross Jian Yu (Huawei)	12-Sep-2016 03:27:34 ET	Download
28-Jul-2016 ET	2016	928	2	TGax	CR on Section 26.3.9.8 - HE-SIG-B	Kaushik Josiam (Samsung)	28-Jul-2016 16:50:15 ET	Download
27-Jul-2016 ET	2016	928	1	TGax	CR on Section 26.3.9.8 - HE-SIG-B	Kaushik Josiam (Samsung)	27-Jul-2016 15:21:57 ET	Download
26-Jul-2016 ET	2016	873	1	TGax	CR HE-SIG-B Part I	Ross Jian Yu (Huawei)	26-Jul-2016 14:49:56 ET	Download
24-Jul-2016 ET	2016	928	0	TGax	CR on Section 26.3.9.8 - HE-SIG-B	Kaushik Josiam (Samsung)	25-Jul-2016 10:51:38 ET	Download
23-Jul-2016 ET	2016	873	0	TGax	CR HE-SIG-B Part I	Ross Jian Yu (Huawei)	25-Jul-2016 02:11:45 ET	Download
15-May-2016 ET	2016	639	0	TGax	Follow-up on HE-SIG-B user-specific field	Jinsoo Choi (LG Electronics)	16-May-2016 04:43:30 ET	Download
16-Mar-2016 ET	2016	397	2	TGax	HE-SIG-B Signaling Discussions	John Son (WILUS)	16-Mar-2016 02:02:31 ET	Download
16-Mar-2016 ET	2016	397	1	TGax	HE-SIG-B Signaling Discussions	John Son (WILUS)	16-Mar-2016 01:27:16 ET	Download
14-Mar-2016 ET	2016	349	1	TGax	HE-SIG-B Compression Mode	Kaushik Josiam (Samsung)	14-Mar-2016 23:50:30 ET	Download
13-Mar-2016 ET	2016	397	0	TGax	HE-SIG-B Signaling Discussions	John Son (WILUS)	14-Mar-2016 01:04:24 ET	Download
12-Mar-2016 ET	2016	349	0	TGax	HE-SIG-B Compression Mode	Kaushik Josiam (Samsung)	13-Mar-2016 23:54:54 ET	Download
18-Jan-2016 ET	2016	104	0	TGax	Rate Matching for HE-SIG-B	Daewon Lee (Newracom)	18-Jan-2016 10:28:49 ET	Download

10-Nov-2015 ET	2015	1315	1	TGax	HE-SIG-B Mapping and Compression	Kaushik Josiam (Samsung)	10-Nov-2015 12:29:26 ET	Download
10-Nov-2015 ET	2015	1335	2	TGax	HE-SIG-B Contents	Le Liu (Huawei)	10-Nov-2015 09:37:38 ET	Download
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07-Nov-2015 ET	2015	1324	0	TGax	MCS for HE-SIG-B	Dongguk Lim (LG)	08-Nov-2015 22:06:18 ET	Download
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12-Sep-2015 ET	2015	1068	0	TGax	Reliable Transmission Schemes for HE-SIG-B and Data	Jianhan Liu (Mediatek)	13-Sep-2015 19:14:23 ET	Download
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HE-SIG-B Structure

- The group agreed the following about HE-SIG-B structure [1]
  - HE-SIG-B is encoded on a per 20 MHz basis using BCC with common and user blocks separated in the bit domain.
  - For bandwidths ≥ 40 MHz, the number of 20 MHz subbands carrying different content is two and with structure as shown in Figure 1. Each square in the figure represents 20 MHz subband and 1/2 represents different signalling information.

Figure 1 - 20 MHz subchannel content for HE-SIG-B for bandwidths ≥ 40 MHz

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  - HE-SIG-B has a common field followed by a user specific field, where
    - The common field includes the information for all of designated STAs to receive the PPDU in corresponding bandwidth
    - The user specific field consists of multiple sub-fields that do not belong to the common field, where one or multiple of those sub-fields are for each designated receiving STA
    - The boundary between the common and the user specific field is at the bit level and not the OFDM symbol level
  - The common field in HE-SIG-B contains Resource Unit (RU) allocation

In this presentation

- We build on the progress from the last meeting by adding details on
  - The resource allocation information in the common part of HE-SIG-B
    - The size of the resource allocation information
  - Signaling information for each user in the sub-fields of the user –specific part
  - Improving HE-SIG-B efficiency by load balancing for MU-MIMO allocations
    - Arrangement of the common and the user-specific portions for MU-MIMO RUs > 20MHz.

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Resource Allocation Signaling

- The Resource Allocation signaling in the common portion of HE-SIG-B channel indicates
  - Arrangement of RUs in frequency
    - Indicates the distribution of RU allocations for single (SU-MIMO) and multiple (MU-MIMO) users
  - Number of users multiplexed when those RUs are used for MU-MIMO
- OFDMA tone plan is previous defined [2]
  - Allocation sizes are: 1x26, 1x52, 1x106, 1x242 1x484, 1x996, 2x996
- MU-MIMO multiplexing with OFDMA was also previous discussed [3]:
    - We agreed to support MU-MIMO on only RUs of size ≥ 106 tones
    - Assuming a maximum of 8 users can be multiplexed in MU
- Considering all combinations of RUs and number of users in MU-MIMO allocations, for a 20MHz PPDU BW
  - Number of possible combinations of RUs and #users ~ 175
  - 8 bits of resource allocation signaling are needed

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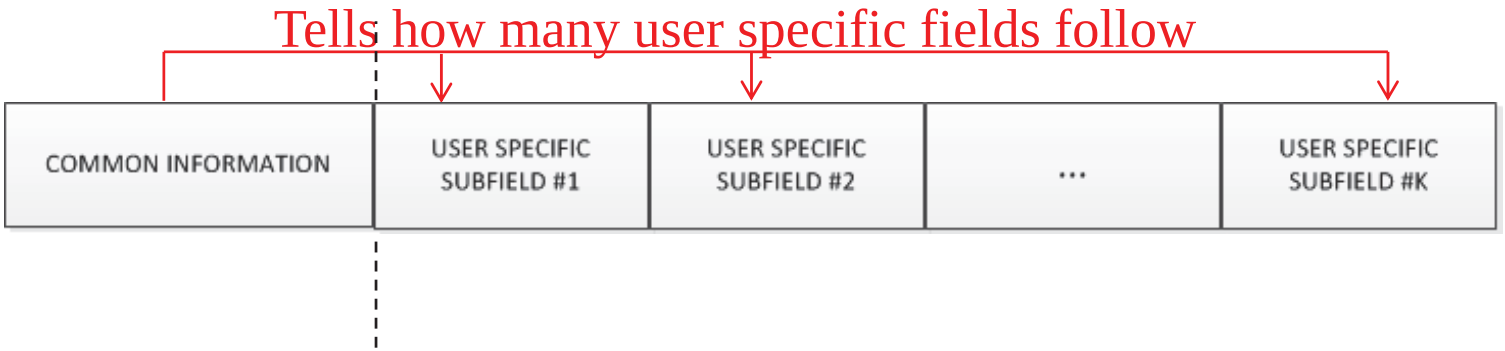
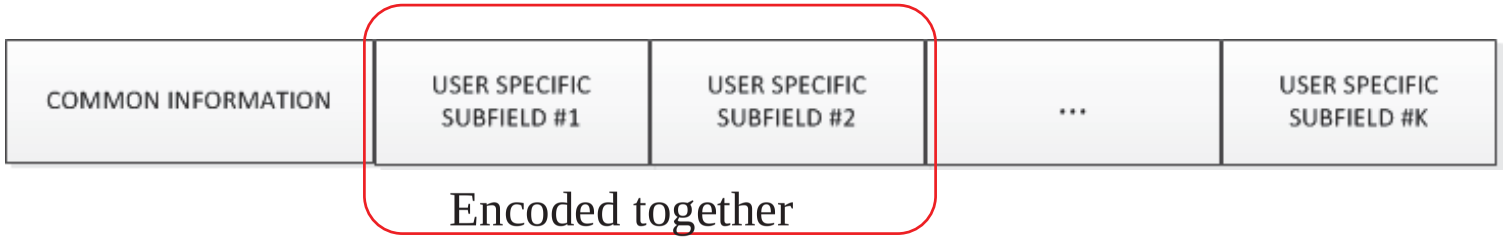
User Specific Fields in HE-SIG-B



- Common information communicates RU arrangement and the number of users for MU-MIMO allocations
- Each user specific field contains information for STA scheduled in the MU- PPDU
  - User specific sub-fields should contain
    - STA-ID for addressing
    - the information necessary to decode the PPDU
      - For single-user allocations in a RU: NSTS (Number of Spatial Streams), TxBF (transmit beamforming), MCS (Modulation and Coding Scheme) and Coding (Use of LDPC)
      - For each user in a multi-user allocation in a RU: Spatial Configuration Fields, MCS and Coding.
    - Other fields are TBD

User Specific Fields in HE-SIG-B

- In an accompanying contribution [5], we propose encoding groups of user specific information field together with one BCC.

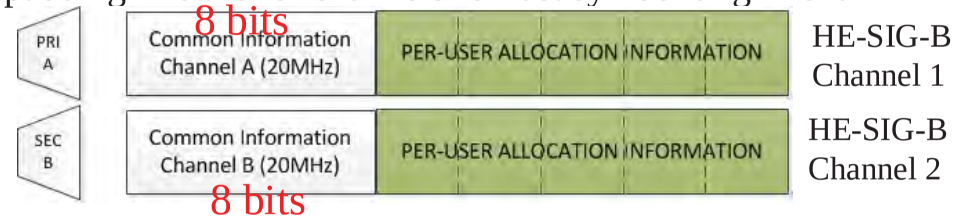


- Each user specific sub-field can carry information for either MU or SU.
  - Each user in a MU–MIMO allocation is separately addressed.
  - Data parsing of the content of user specific sub-fields differs based on SU or MU.
- To enable efficient grouping for joint encoding of user specific sub-fields
  - We prefer that the size of the user specific sub-fields be the same for both SU and MU allocations

HE-SIG-B Multiplexing

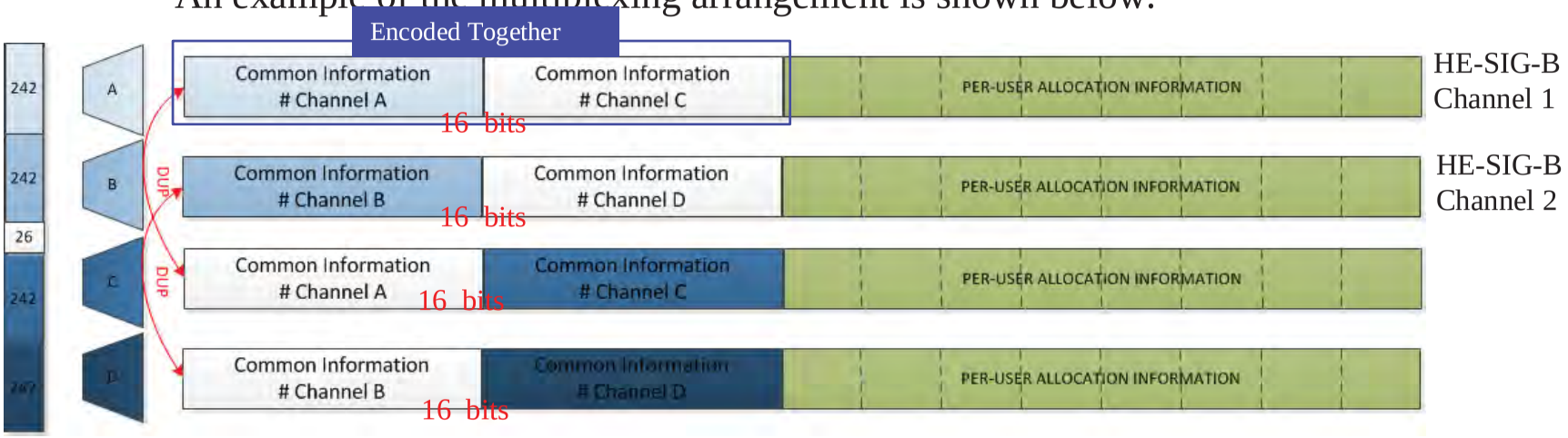
- For 20MHz, the HE-SIG-B construction is straight forward
  - Signal the RU Arrangement + MU information using 8 bits in the common information followed by per-user allocation information
    - STA uses the common information and the position of its allocation to unambiguously identify the RU containing its data

- For 40MHz, the HE-SIG-B has two channels each with different information
  - Each channel carries RU allocation information for users scheduled in the 20MHz segment
    - May require padding in either of channels for last symbol alignment



HE-SIG-B Multiplexing (80MHz)

- Four 20MHz segments have to be mapped to 2 HE-SIG-B channels duplicated per 40MHz [3]
  - 80MHz tone plan not aligned with 20MHz segments.
    - Channel A, B, C, D below refer to 242 tones RUs – and can signal RU arrangements for smaller RUs with-in the 242 tone RUs
      - 8 bits per 242 tone RU – 16 bits total per HE-SIG-B Channel
    - Central 26 tone RU may be signaled separately
  - An example of the multiplexing arrangement is shown below.

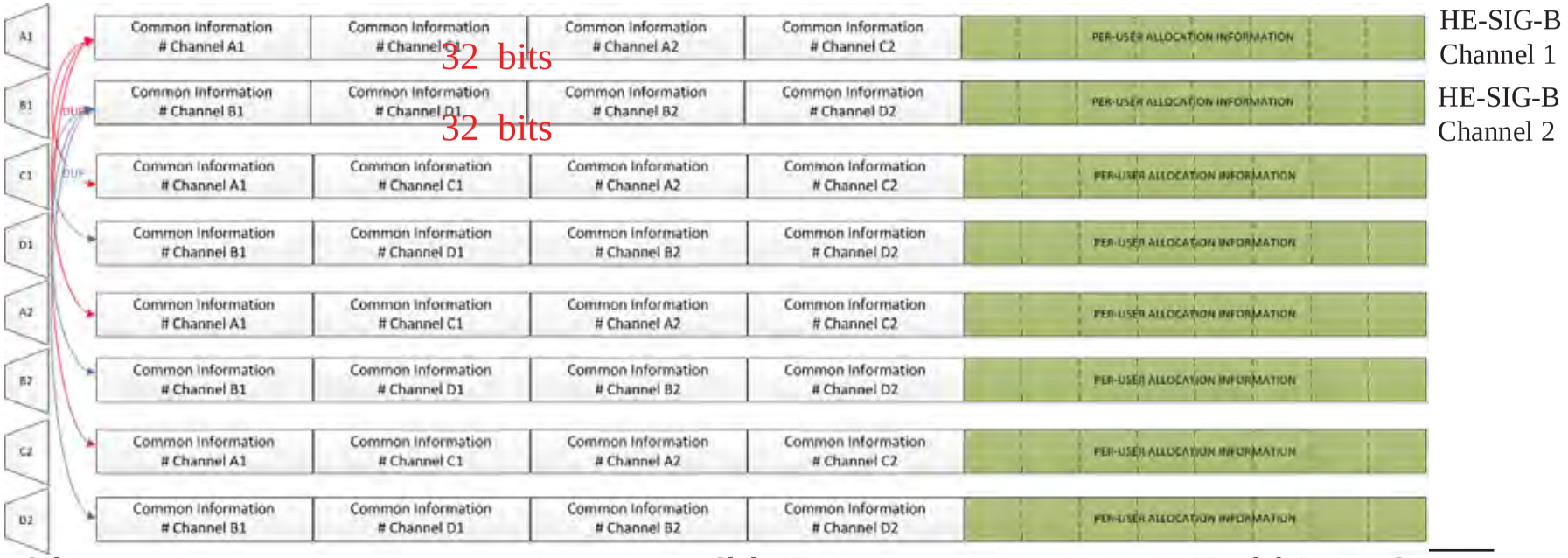


- Duplication of HE-SIG-B channels keeps control information in the 20MHz sub-carriers closest to the data sub-carriers.

Extending Multiplexing Support to 160MHz

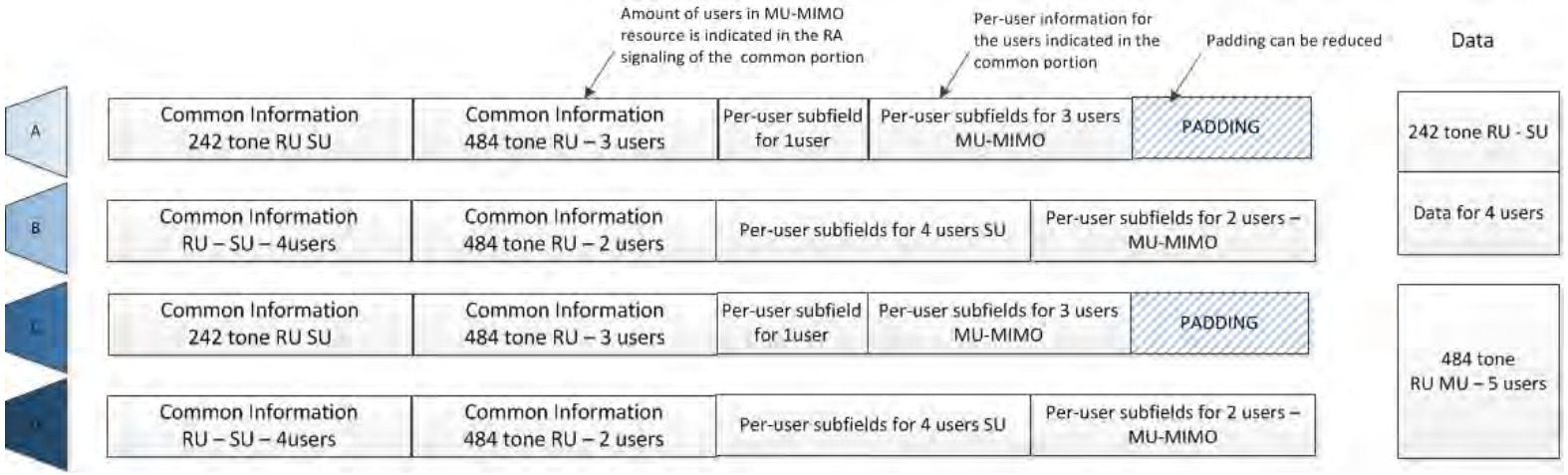
- Eight 20MHz segments have to be mapped to 2 HE-SIG-B channels duplicated per 40MHz
  - 160MHz tone plan built as two concatenated 80MHz tone plans
    - Channel A, B, C, D below refer to 242 tones RUs – and can signal RU arrangements for smaller RUs with-in the 242 tone RUs
      - 32 bits totally for the four channels
    - Two central 26 tone RUs in each 80MHz may be signaled separately.

Example Arrangement:



Load Balancing for large MU-MIMO allocations

- When RU sizes > 20MHz are used, AP divides the per-user content blocks between allocated channels dynamically based on load in each allocated channel
  - Since information spans 2 channels, control is carried over a 20MHz segment of the data - reliability in HE-SIG-B is ensured.
- Common Control Portion:
  - Repeat MU-MIMO allocation *size* in each allocated channel
  - Indicate number of per-user content blocks carried in the corresponding channel
- User specific fields:
  - Transmit per-user content blocks for the subset of users indicated in the common portion



Summary

- Resource Allocation Signaling in the common portion of HE-SIG-B needs 8 bits per 20MHz PPDU and indicates
  - RU Arrangement in the frequency domain
  - If MU-MIMO Capable RUs carry MU-MIMO
    - Number of users multiplexed when those RUs are used for MU-MIMO
- Resource Allocation Signaling indicates the number of user allocation sub-fields that follow the common portion of HE-SIG-B
  - Each user allocation sub-field addresses and STA and gives necessary information to decode data in the PPDU
  - Data parsing of the content of user allocation sub-fields differs based on SU or MU. The size of the sub-field should be the same for both SU and MU.

Summary

- For BW > 20MHz, the mapping of control information to two HE-SIG-B channels is done such that
  - the control information is carried in the same 20MHz segment as the data – ensures reliability.
  - For 80MHz, duplication of HE-SIG-B requires that
    - Control information for 2 segments be carried in each HE-SIG-B channel.
      - 8 bits per 20MHz segment – 16 bits of common control
  - For 160 MHz, control information for 4 segments be carried in each HE-SIG-B channel
    - 32 bits of common control information.
- For MU-MIMO allocations spanning larger than 20MHz BW, the AP can dynamically allocate users to each HE-SIG-B channel to improve load balancing among the two 2 HE-SIG-B channels.

References

[1] 11-15-0132-07-00ax-spec-framework

[2] 11-15-0330-04-00ax-OFDMA-numerology-and-structure

[3]11-15-0832-00-00ax-performance-evaluation-of-su-mu-mimo-in-ofdma

[4] 11-15-0873-00-00ax-HE-SIG-B-encoding-structure

[5] 11-15-0821-02-00ax-HE-SIG-B-structure

[6] 11-15-1059-00-00ax-sig-b-encoding-structure-part-II

Straw Poll #1

Do you agree to add the following text to the 11ax SFD:

The RU allocation signaling in the common field of HE-SIG-B signals an 8 bit per 20MHz PPDU BW for signaling

- The RU arrangement in frequency domain
- Number of MU-MIMO allocations: The RUs allocated for MU-MIMO and the number of users in the MU-MIMO allocations.

The exact mapping of the 8 bit to the RU arrangement and the number of MU-MIMO allocations is TBD.

Signaling for the center 26 unit in 80MHz is TBD

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Straw Poll #2

Do you agree to add the following text to the 11ax SFD:

The user specific subfields of HE-SIG-B containing the per user dedicated information include the following fields

- STA-ID
- For single-user allocations in a RU: NSTS (Number of Spatial Streams), TxBF (transmit beamforming), MCS (Modulation and Coding Scheme) and Coding (Use of LDPC)
- For each user in a multi-user allocation in a RU: Spatial Configuraiton Fields, MCS and Coding.

Other fields are TBD.

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Straw Poll #3

Do you agree to add the following text to the 11ax SFD:

The length of the user specific subfield in HE-SIG-B for a single-user allocation is equal to the length of the user specific subfield of each user in a multi-user allocation.

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Straw Poll #4

Do you agree to add the following text to the 11ax SFD:

For MU-MIMO allocation of RU size > 20MHz, the user-specific subfields is dynamically split between two HE-SIG-B content channels(1/2) and the split is decided by the AP (on a per case basis)

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APPENDIX

Number of bits for RA signaling

#1	#2	#3	#4	#5	#6	#7	#8	#9
26	26	26	26	26	26	26	26	26
52		52		26	52		52	
52		26	26	26	26	26	26	26
26	26	52		26	26	26	26	26
26	26	26	26	26	52		26	26
26	26	26	26	26	26	26	52	
52		52		26	26	26	26	26
52		26	26	26	52		26	26
52		26	26	26	26	26	52	
26	26	52		26	52		26	26
26	26	52		26	26	26	52	
26	26	26	26	26	52		52	
52		52		26	52		26	26
52		52		26	26	26	52	
52		26	26	26	52		52	
26	26	52		26	52		52	
106				26	106			
106				26	26	26	26	26
106				26	26	26	52	
106				26	52		26	26
106				26	52		52	
26	26	26	26	26	106			
26	26	52		26	106			
52		26	26	26	106			
52		52		26	106			
242								

484
996
2*996

8 bits are sufficient for resource allocation signaling in 20MHz PPDU BW

Appendix AG

TGax September 2015 Meeting Agenda

Date: 2015-08-04

Authors:

Name	Company	Address	Phone	email
Osama Aboul-Magd	Huawei Technologies	303 Terry Fox Drive Kanata, ONT, Canada K2K-3J1	613-287-1405	Osama.aboulmagd@Huawei.com

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IEEE 802.11 TGax: High Efficiency WLAN Task Group

Bangkok, Thailand

September 13-19, 2015

Chair: Osama Aboul-Magd (Huawei Technologies)
Vice Chair: Simone Merlin (Qualcomm)
Vice Chair: Ron Porat (Broadcom)
Secretary: Yasuhiko Inoue (NTT)
Technical Editor: Robert Stacey (Intel)

Meeting Protocol

- **Please announce your affiliation when you first address the group during a meeting slot**

Attendance

- http://newton.meeting.verilan.com

1. Register

2. Indicate attendance

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See document 11-15-0xxxr0 for more details

Attendance, Voting & Document Status

- **Make sure your badges are correct**
- **If you plan to make a submission be sure it does not contain company logos or advertising**
- **Questions on Voting status, Ballot pool, Access to Reflector, Documentation, member's area**
  - see Jon Rosdahl – jrosdahl@ieee.org
- **Cell Phones Silent or Off**

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Patent Policy

- **Following 5 slides**

Instructions for the WG Chair

The IEEE-SA strongly recommends that at each WG meeting the chair or a designee:

- **Show slides #1 through #4 of this presentation**
- **Advise the WG attendees that:**
  - The IEEE's patent policy is described in Clause 6 of the *IEEE-SA Standards Board Bylaws*;
  - Early identification of patent claims which may be essential for the use of standards under development is strongly encouraged;
  - There may be Essential Patent Claims of which the IEEE is not aware. Additionally, neither the IEEE, the WG, nor the WG chair can ensure the accuracy or completeness of any assurance or whether any such assurance is, in fact, of a Patent Claim that is essential for the use of the standard under development.
- **Instruct the WG Secretary to record in the minutes of the relevant WG meeting:**
  - That the foregoing information was provided and that slides 1 through 4 (and this slide 0, if applicable) were shown;
  - That the chair or designee provided an opportunity for participants to identify patent claim(s)/patent application claim(s) and/or the holder of patent claim(s)/patent application claim(s) of which the participant is personally aware and that may be essential for the use of that standard
  - Any responses that were given, specifically the patent claim(s)/patent application claim(s) and/or the holder of the patent claim(s)/patent application claim(s) that were identified (if any) and by whom.
- The WG Chair shall ensure that a request is made to any identified holders of potential essential patent claim(s) to complete and submit a Letter of Assurance.
- It is recommended that the WG chair review the guidance in *IEEE-SA Standards Board Operations Manual* 6.3.5 and in FAQs 14 and 15 on inclusion of potential Essential Patent Claims by incorporation or by reference.

Note: **WG** includes Working Groups, Task Groups, and other standards-developing committees with a PAR approved by the IEEE-SA Standards Board.

Participants, Patents, and Duty to Inform

All participants in this meeting have certain obligations under the IEEE-SA Patent Policy.

- **Participants [Note: Quoted text excerpted from IEEE-SA Standards Board Bylaws subclause 6.2]:**
  - **"Shall inform the IEEE (or cause the IEEE to be informed)" of the identity of each "holder of any potential Essential Patent Claims of which they are personally aware" if the claims are owned or controlled by the participant or the entity the participant is from, employed by, or otherwise represents**
  - **"Should inform the IEEE (or cause the IEEE to be informed)" of the identity of "any other holders of potential Essential Patent Claims" (that is, third parties that are not affiliated with the participant, with the participant's employer, or with anyone else that the participant is from or otherwise represents)**
- **The above does not apply if the patent claim is already the subject of an Accepted Letter of Assurance that applies to the proposed standard(s) under consideration by this group**
- **Early identification of holders of potential Essential Patent Claims is strongly encouraged**
- **No duty to perform a patent search**

Slide #1

Patent Related Links

All participants should be familiar with their obligations under the IEEE-SA Policies & Procedures for standards development.

Patent Policy is stated in these sources:

IEEE-SA Standards Boards Bylaws

http://standards.ieee.org/develop/policies/bylaws/sect6-7.html#6

IEEE-SA Standards Board Operations Manual

http://standards.ieee.org/develop/policies/opman/sect6.html#6.3

Material about the patent policy is available at

http://standards.ieee.org/about/sasb/patcom/materials.html

If you have questions, contact the IEEE-SA Standards Board Patent Committee Administrator at patcom@ieee.org or visit http://standards.ieee.org/about/sasb/patcom/index.html

This slide set is available at https://development.standards.ieee.org/myproject/Public/mytools/mob/slideset.ppt

Call for Potentially Essential Patents

- **If anyone in this meeting is personally aware of the holder of any patent claims that are potentially essential to implementation of the proposed standard(s) under consideration by this group and that are not already the subject of an Accepted Letter of Assurance:**
  - Either speak up now or
  - Provide the chair of this group with the identity of the holder(s) of any and all such claims as soon as possible or
  - Cause an LOA to be submitted

Slide #3

Other Guidelines for IEEE WG Meetings

- **All IEEE-SA standards meetings shall be conducted in compliance with all applicable laws, including antitrust and competition laws.**
  - **Don't discuss the interpretation, validity, or essentiality of patents/patent claims.**
  - **Don't discuss specific license rates, terms, or conditions.**
    - Relative costs, including licensing costs of essential patent claims, of different technical approaches may be discussed in standards development meetings.
      - Technical considerations remain primary focus
  - **Don't discuss or engage in the fixing of product prices, allocation of customers, or division of sales markets.**
  - **Don't discuss the status or substance of ongoing or threatened litigation.**
  - **Don't be silent if inappropriate topics are discussed … do formally object.**

See *IEEE-SA Standards Board Operations Manual*, clause 5.3.10 and "Promoting Competition and Innovation: What You Need to Know about the IEEE Standards Association's Antitrust and Competition Policy" for more details.

Slide #4

Agenda Items for the Week

- **Approve TG and Telecons minutes since January meeting.**
- **Continue to advance task group documents.**
  - Simulation Scenarios
  - Evaluation Methodology
  - Channel Model
  - Function Requirements
  - Specification Framework
- **Ad Hoc group meetings**
- **Technical Presentations and related straw polls and/or motions**
- **Schedule Telecon times.**

General Flow of the Meeting

- **Monday Sep 14, 10:30 – 12:30**
  - Call Meeting to order
  - IEEE 802 and 802.11 IPR Policy and procedure.
  - Review from November 2014 meeting
  - Call for submissions
  - Agenda setting and approval
  - TG Motions
  - Presentations
  - Recess
- **Monday Sept 14 , 13:30 – 15:30**
  - Ad Hoc Group Meetings
- **Tuesday Sept 15, 10:30 – 12:30**
  - Ad Hoc Group Meetings
- **Tuesday Sept 15, 13:30 – 15:30**
  - Ad Hoc Group Meetings
- **Tuesday Sept 15. 16:00 – 18:00**
  - Call Meeting to order
  - IEEE 802 and 802.11 IPR Policy and procedure.
  - Presentations
  - Recess
- **Wednesday Sept 16 , 08:00 – 10:00**
  - Call Meeting to order
  - IEEE 802 and 802.11 IPR Policy and procedure.
  - Presentations
  - Recess
- **Wednesday Sept 16 , 13:30 – 15:30**
  - Ad Hoc Group Meetings
- **Wednesday Sept 16 , 14:00 – 16:00**
  - Ad Hoc Group Meetings
- **Thursday Sept 17, 08:00 – 10:00**
  - Call Meeting to order
  - IEEE 802 and 802.11 IPR Policy and procedure.
  - Presentations
  - Recess
- **Thursday Sept 17, 13:30 – 15:30**
  - Call Meeting to order
  - IEEE 802 and 802.11 IPR Policy and procedure.
  - Presentations
  - TG Motions
  - Goals for May 2015
  - Telecons Schedule
  - Adjourn

TGax Schedule in a Glance

	Monday		Tuesday		Wednesday		Thursday
AM1					TGax		TGax
AM2	TGax		PHY	MAC			
PM1	PHY	MAC	SR	MU	PHY	SR	TGax
PM2			TGax		TGax		
EVE	PHY	MAC	SR	MU			

Submissions (PHY)

11-15/0579	preamble design and autodetection	Hongyuan Zhang	PHY
11-15/0580	11ax Coding Discussion	Hongyuan Zhang	PHY
11-15/810	HE PHY Padding and Packet Extension	Hongyuan Zhang	PHY
11-15/1031	DL MU Signalling	Katsuo Yunoki	PHY
11-15/1051	HE NDP frame for sounding	Young Hoon Kwon	PHY
11-15/1059	SIG-B Encoding Structure Part II	Ron Porat	PHY
11-15/1066	HE-SIG-B Contents	Kaushik Josiam	PHY
11-15/1068	Reliable Transmission Schemes for HE-SIG-B and Data	Jianhan Liu	PHY
11-15/1070	1024 QAM Proposal	??	PHY
11-15/1075	Number of BSS Color bits	Yasuhiko Inoue	PHY
11-15/0826	HE-SIG-A transmission for range extension	Jiayin Zhang	PHY
11-15/1077	HE-SIG-A Content	Jiayin Zhang	PHY
11-15/0853	Extensible Preamble Format Design	Leonardo Lanante	PHY
11-15/1088	LTF Design for Uplink MU-MIMO	Daewon Lee	PHY
11-15/1089	Considerations on PHY Padding and Packet Extension in 11ax	Yujin Noh	PHY
11-15/1091	Considerations on Range Extension with SIG-A Repetition	Yujin Noh	PHY
11-15/1092	Support of 1x/2x/4x OFDM Symbol in HE SU PPDU	Heejung Yu	PHY
11-15/1106	SIG-B Structure	Reza Hedayat	PHY
11-15/1111	SIG-B Resource unit allocation coding	Amin Jafarian	PHY
11-15/1119	Discussions on HE SIG-A Structure	John Son	PHY
11-15/1122	Identifiers in HE PPDUs for power saving	Alfred Asterjadhi	PHY
11-15/0602	HE-LTF squence for UL MU-MIMO	Xiaogang Chen	PHY
11-15/0823	Preamble Design and Auto-Detection for 11ax	Sungho Moon	PHY
11-15/1071	Tone Grouping Factors and NDP format for 802.11ax	Sameer Vermani	PHY

Submissions (MAC)

DCN	Title	Author	Ad Hoc
11-15/1013	802.11ae & 802.11ax	Guido R. Hiertz	MAC
11-15/1014	Multiple BSSID Element	Guido R. Hiertz	MAC
11-15/1015	Proxy ARB in 802.11ax	Guido R. Hiertz	MAC
11-15/1033	Data field in HE PPDU	Yongho Seok	MAC
11-15/1034	Notification of Operating Mode Changes	Yongho Seok	MAC
11-15/1044	Further Study of 11ax Multicast	Kazuyuki Sakoda	MAC
11-15/1052	Bandwidth for UL MU transmission	Young Hoon Kwon	MAC
11-15/1060	Receive Operating Mode Indication for Power Save	Eric Wong	MAC
11-15/1063	11ax Channel access procedure	Chao-Chun Wang	MAC
11-15/1067	MU TXOP truncation	Jeongki Kim	MAC
11-15/1096	Recovery Procedures in Cascading Sequences	John Son	MAC
11-15/1098	ACK/BA frame for UL MU under cascading structure	Narendar Madhavan	MAC
11-15/1114	Airtime Analysis of EDCA	Sean Coffey	MAC
11-15/1115	High Efficiency in Accessing the Medium	Sean Coffey	MAC
11-15/1116	Trigger Frame Channel Access	Jinsoo Ahn	MAC
11-15/1120	Buffer Status Report	Alfred Asterjadhi	MAC
11-15/1121	HE A-Control field	Alfred Asterjadhi	MAC
11-15/1137	Triggered OFDMA Random Access Observations	Russell Huang	MAC

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Submissions (MU)

DCN	Title	Author	Ad Hoc
11-15/1043	Overall Protocol of UL MU BA for Multicast Transmission	Kazuyuki Sakoda	MU
11-15/1047	RU selection process upon TF-R reception	Stephane Baron	MU
11-15/1053	Multiuser Block ACK Request (MU-BAR)	Guoqing Li	MU
11-15/1057	Multiple Resource Unit Allocation for TGax OFDMA	Kome Oteri	MU
11-15/1062	NAV Consideration for UL MU Response to Trigger frame	Po-Kai Huang	MU
11-15/1065	11ax uplink Multi-TID aggregation	Chao-Chun Wang	MU
11-15/1086	Consideration on multi-STA BA frame indication	Jing Ma	MU
11-15/1097	Reducing Channel Sounding Protocol Overhead for 11ax	Narendar Madhavan	MU
11-15/1102	Fragmentation with MU Operation	Chittabrata Ghosh	MU
11-15/1103	DL Sounding Sequence with UL MU Feedback	Chittabrata Ghosh	MU
11-15/1105	UL OFDMA-based Random Access Procedure	Chittabrata Ghosh	MU
11-15/1107	Power Save with Random Access	Chittabrata Ghosh	MU
11-15/1117	Regarding UL MU protection	Woojin Ahn	MU
11-15/1123	Acknowledgement to DL MU	Liwen Chu	MU
11-15/1129	Feedback overhead in DL-MU-MIMO	Filippo Tosato	MU
11-15/1058	CCA consideration for UL MU transmission	Kiseon Ryu	MU

Submissions (SR)

DCN	Title	Author	Ad Hoc
11-15/1045	Dynamic CCA control and TPC Simulation Result with SS1-SS3	Takeshi Itagaki	SR
11-15/1069	Adaptive CCA and TPC	James Wang	SR
11-15/1081	Further consideration on receive behaviour based on the cascading structure and the BSS color scheme	Jing Ma	SR
11-15/1082	Analysis of BSS and ESS Structure During Concurrent SR Transmissions	Chuck Lukaszewski	SR
11-15/1083	Cost/Benefit Analysis of SR Techniques	Chuck Lukaszewski	SR
11-15/1101	DSC/DCCA Calibration with TGax Agreed Scenarios	Masahito Mori	SR
11-15/1104	TXOP Considerations for Spatial Reuse	Reza Hedayat	SR
11-15/1109	OBSS NAV and PD Threshold Rule for Spatial Reuse	Rossi Jun Luo	SR
11-15/1110	BSS TXOP	Amin Jafarian	SR
11-15/1118	Discussions on Spatial Reuse Enhancement	Geonjung Ko	SR
11-13/1138	To DSC or not to DSC	Filip Mestanov	SR
11-13/1136	Discussion on AP Coordinated Concurrent STA-to-STA Transmissions in 11ax	Der-Jiunn Deng	SR

Submissions (TG)

DCN	Title	Author	Ad Hoc
11-15/1039	Spatial Reuse Measurements	Chuck Lukaszewski	TG
11-15/801	DCCA/DSC Reference Simulation Result	Masahito Mori	TG
11-15/1046	MAC calibration results	Stephane Baron	TG
11-15/1048	On TGax Scenario 4 channel model	Marcin Filo	TG
11-15/1049	Implications of wrap-around for TGax Scenario 3 and Scenario 4	Marcin Filo	TG
11-15/1056	Clarifying Link Level Simulator Assumptions	Kome Oteri	TG
11-15/1087	MU BFee Interference channel feedback	Sigurd Schelstraete	TG
11-15/1095	OFDMA performance in 11ax	Suhwook Kim	TG
11-15/1099	Power Save Simulation Result	Hyeyoung Choi	TG
11-15/1100	Discussion on Deep and Shallow Sleep States	Chittabrata Ghosh	TG
11-15/1113	Box5 Calibration results	Vida Ferdowsi	TG
11-15/1134	11ax Support for IoT	Shimi Shilo	TG
11-15/1135	Result for SS6 calibration case for single BSS and OBSS	Esa Tuomaala	TG

Requested by WG Leadership

- **Attendance count at the midpoint of each timeslot**
  - Required to be done during TG and ad hoc slots

Agenda for Monday September 14 , 10:30 – 13:30

- **Call meeting to order**
- **Patent policy, etc.**
- **Call for submissions**
- **Set Ad Hoc Groups schedule and approve agenda**
- **Summary from May 2015 meeting**
- **Timeline**
- **SFD review – Editor**
- **TG motions**
  - Approve TG meeting and Telecon minutes since July meeting.
  - Approve the latest SFD revision
- **Ad Hoc group Rules**
- **Presentations**
- **Recess**

Summary from July 2015 Meeting

- **Passed a number of motions affecting the TG Specification Framework. Motions passed related to PHY, MAC, and MU.**
- **Latest revision (not yet approved) of the Specification Framework is available at;**
  - https://mentor.ieee.org/802.11/dcn/15/11-15-0132-07-00ax-spec-framework.docx
- **Approved new revisions of the Evaluation Methodology TG documents.**
  - https://mentor.ieee.org/802.11/dcn/14/11-14-0571-10-00ax-evaluation-methodology.docx
  - https://mentor.ieee.org/802.11/dcn/14/11-14-0980-14-00ax-simulation-scenarios.docx
- **Other TG documents**
  - https://mentor.ieee.org/802.11/dcn/14/11-14-0882-04-00ax-tgax-channel-model-document.docx
  - https://mentor.ieee.org/802.11/dcn/14/11-14-1009-02-00ax-proposed-802-11ax-functional-requirements.doc

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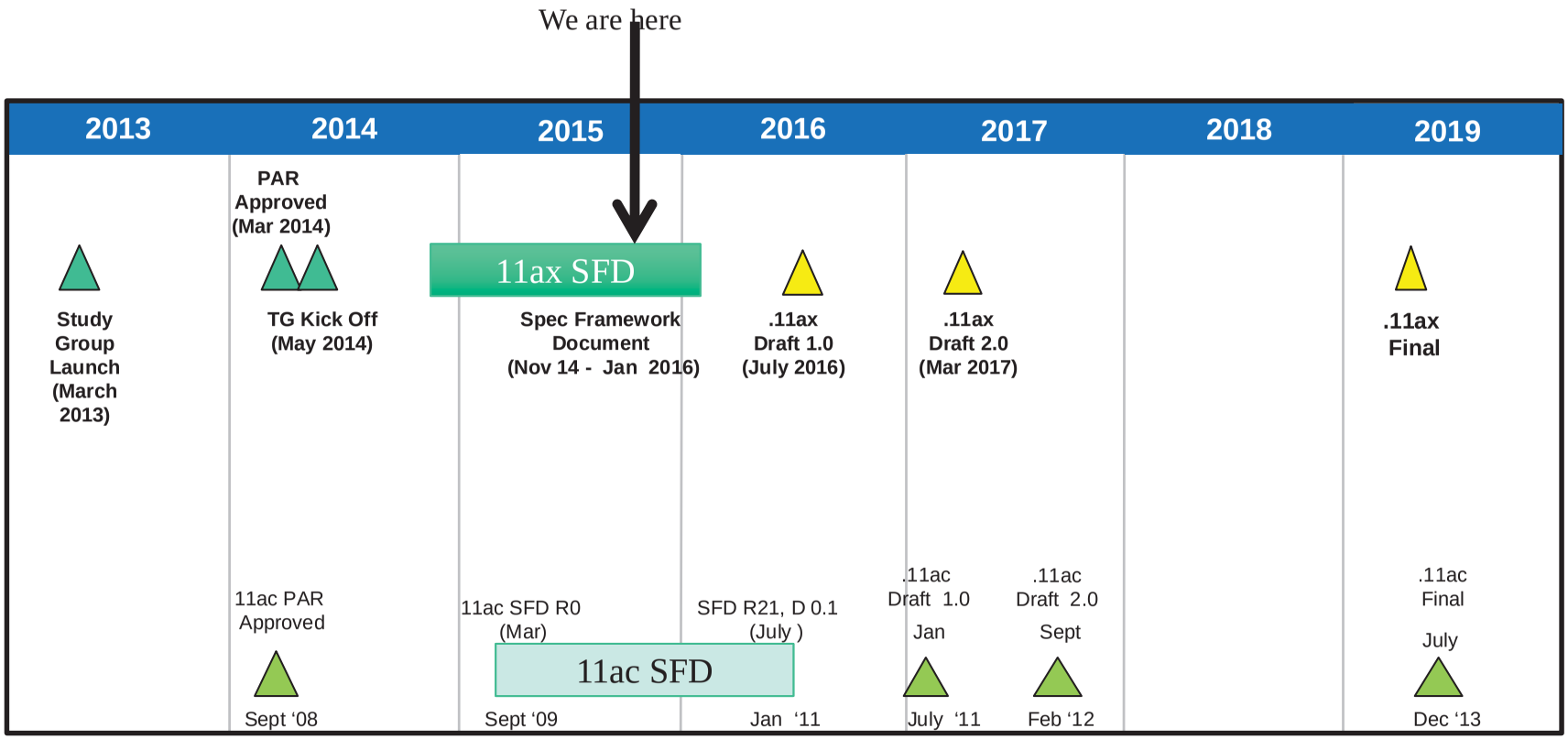
Timeline


We are here
2013
2014
2015
2016
2017
2018
2019
PAR Approved (Mar 2014)
11ax SFD
Study Group Launch (March 2013)
TG Kick Off (May 2014)
Spec Framework Document (Nov 14 - Jan 2016)
.11ax Draft 1.0 (July 2016)
.11ax Draft 2.0 (Mar 2017)
.11ax Final
11ac PAR Approved
11ac SFD R0 (Mar)
SFD R21, D 0.1 (July)
.11ac Draft 1.0 Jan
.11ac Draft 2.0 Sept
.11ac Final July
11ac SFD
Sept '08
Sept '09
Jan '11
July '11
Feb '12
Dec '13

SFD Review

- **Editor**
  - https://mentor.ieee.org/802.11/dcn/15/11-15-0132-07-00ax-spec-framework.docx

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Approval of TG Minutes (July 2015 Meeting and Telecon Minutes)

- **Approve TGax minutes of meetings and teleconferences from July 2015 Plenary meeting to today:**
  - https://mentor.ieee.org/802.11/dcn/15/11-15-0884-01-00ax-tgax-july-2015-waikoloa-meeting-minutes.docx
  - https://mentor.ieee.org/802.11/dcn/15/11-15-0971-01-00ax-july-meeting-minutes-of-the-spatial-reuse-ad-hoc-group.docx
  - https://mentor.ieee.org/802.11/dcn/15/11-15-0949-01-00ax-july-2015-hawaii-tgax-mu-ad-hoc-meeting-minutes.docx
  - https://mentor.ieee.org/802.11/dcn/15/11-15-0922-01-00ax-july-2015-hawaii-tgax-mac-ad-hoc-meeting-minutes.docx
  - https://mentor.ieee.org/802.11/dcn/15/11-15-0913-00-00ax-ieee-802-11-tgax-july-2015-hawaii-phy-ad-hoc-meeting-minutes.docx

- **Move: Lei Wang Second: Guido**
- **Approved with no objection**

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SFD Motion

- **Move to accept document 11-15/0132r7 as the current revision of the TG Specification Framework document.**

- **Move Second:**

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Ad Hoc Group Rules

- A straw poll needs to achieves at least 75% at the ad-hoc level to be converted to a motion at the TG level.
- In the case a consensus can not be reached within an Ad Hoc group (a stalemate that prohibits further progress), the subject is moved to the Task group, if an Ad Hoc straw poll vote to move the subject to the Taskgroup achieves > 50% approval.
- A straw poll affecting the Spec Framework has to start with,
  - Do you agree to add to the TG Specification Frame work document?
    - x.y.z. <feature description>
- For further details, please see 11-15-0075r0
- Minutes of the Ad Hoc group meetings will be available on mentor.

Agenda for Monday September 14 , 13:30 – 15:30

- **Ad Hoc Group Meetings**
  - PHY – World Ballroon B
  - MAC – World Ballroom C

Agenda for Monday September 14 , 19:30 – 21:30

- **Ad Hoc Meetings**
  - PHY: World Ballroom B
  - MAC: World Ballroom C

Agenda for Tuesday September 15, 10:30 – 12:30

- **Ad Hoc Group Meetings**
  - PHY: World Ballroom B
  - MAC: World Ballroom C

Agenda for Tuesday September 15, 13:30 – 15:30

- **Ad Hoc Group Meetings**
  - MU: World Ballroom B
  - SR: World Ballroom C

Agenda for Tuesday September 15, 16:00 – 18:00

- TG Meeting
- Call Meeting to order
- IEEE 802 and 802.11 IPR Policy and procedure.
- Progress Review
- Presentations (TG Presentations)
- Recess

Agenda for Tuesday September 15, 19:30 – 21:30

- **Ad Hoc Meetings**
  - TBD
  - TBD

Agenda for Wednesday September 16, 08:00 – 10:00

- **TG Meeting**
- **Call Meeting to order**
- **IEEE 802 and 802.11 IPR Policy and procedure.**
- **Update on TG Progress**
  - 2 MAC
  - 1 MU
  - 7 PHY
  - 4 SR
- **Presentations**
- **Recess**

Remaining TG Submissions

DCN	Title	Author	Ad Hoc
11-15/1039	Spatial Reuse Measurements	Chuck Lukaszewski	TG
11-15/801	DCCA/DSC Reference Simulation Result	Masahito Mori	TG
11-15/1046	MAC calibration results	Stephane Baron	TG
11-15/1048	On TGax Scenario 4 channel model	Marcin Filo	TG
11-15/1049	Implications of wrap-around for TGax Scenario 3 and Scenario 4	Marcin Filo	TG
11-15/1056	Clarifying Link Level Simulator Assumptions	Kome Oteri	TG
11-15/1087	MU BFee Interference channel feedback	Sigurd Schelstraete	TG
11-15/1095	OFDMA performance in 11ax	Suhwook Kim	TG
11-15/1099	Power Save Simulation Result	Hyeyoung Choi	TG
11-15/1100	Discussion on Deep and Shallow Sleep States	Chittabrata Ghosh	TG
11-15/1113	Box5 Calibration results	Vida Ferdowsi	TG
11-15/1134	11ax Support for IoT	Shimi Shilo	TG
11-15/1135	Result for SS6 calibration case for single BSS and OBSS	Esa Tuomaala	TG
11-15/1052	Bandwidth for UL MU transmission	Young Hoon Kwon	MAC
11-15/1137	Triggered OFDMA Random Access Observations	Russell Huang	MAC
11-15/1086	Consideration on multi-STA BA frame indication	Jing Ma	MU

Agenda for Wednesday September 16, 13:30 – 15:30

- **Ad Hoc Group Meetings**
  - PHY: World Ballroom B
  - SR: World Ballroom C

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Agenda for Wednesday September 16, 16:00 – 18:00

- **TG Meeting**
- **Call Meeting to order**
- **IEEE 802 and 802.11 IPR Policy and procedure.**
- **Update on TG Progress**
- **Presentations**
  - 11-15/1086
  - 11-15/1134
- **Recess**

Agenda for Thursday September 17, 08:00 – 10:00 and 13:30-15:30

- TG Meeting
- Call Meeting to order
- IEEE 802 and 802.11 IPR Policy and procedure.
- TG Motions – starting at 8:30 am
- SSD and EVM Motions
- Goals for November 2015
- Telecon Schedule
- Presentations
- Adjourn

PHY Motion #36

- **Move to make the following text changes in 11ax SFD (3.3.3 Coding)**
  - *LDPC is the only coding scheme in the HE PPDU Data field for allocation sizes of 484 tones, 996 tones and 996*2 tones.*
  - ….
  - *Support of LDPC code for both TX and RX is mandatory for HE STAs declaring support for at least one of HE 40/80/160/80+80 SU-PPDU bandwidths, ……..*

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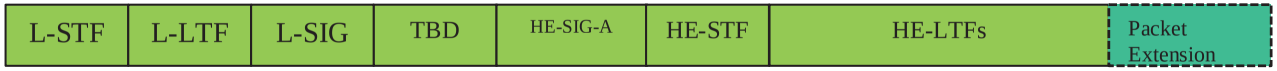
- **Move: Hongyuan Zhang Second: Ron Porat**
- **Accepted with no objection**

- **DCN: 11-15/0580r2 SP Result: 40/0/18**

PHY Motion #37

- **Move to add to the TG Specification Framework:**
  - 4.y.z The spec shall define an HE-NDP for DL Sounding. The frame format of HE-NDP is based on the 11ax SU PPDU format and is shown in the diagram below. The presence and duration of packet extension at the end of HE-NDP is TBD.

Format of HE-NDP



- **Move: Young Hoon Kwon Second: Ron Porat**
- **Accepted with no objectoion**
- **DCN: 11-15/1051r1 SP Result:38/0/4**

PHY Motion #38

- **Move to add the following text to the TGax spec framework document:**

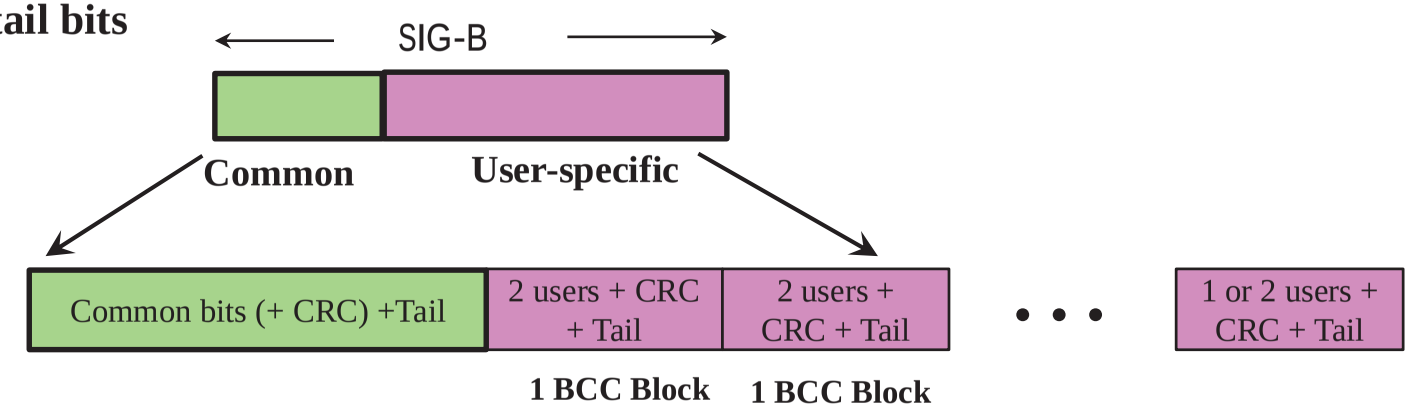
  "802.11ax spec shall not support Ng=1 for sounding feedback. Note that the tone grouping factor, Ng is defined with respect to data tones of the 11ax PPDU. "

- **Move: Sameer Vermani Second: Ron Porat**
- **Accepted with no objection**
- **DCN:11-15/1071r2 SP Result:Unanimous**

PHY Motion #39

Move to add the following text to the SFD: The encoding structure of each BCC in SIG-B is as shown in the figure and as described below:

- **2 users are grouped together and jointly encoded in each BCC block in the user specific section of HE SIG-B**
- **The CRC in the common block is TBD**
- **The last user information is immediately followed by tail bits (regardless of whether the number of users is odd or even) and padding bits are only added after those tail bits**



- **Move: Ron Porat** **Second: Yasu Inoue**
- **Accepted with no objection**
- **DCN: 11-15/1059r1** **SP Result: 43/0/21**

PHY Motion #40

- **Move to add the following text to the 11ax SFD:**
  - The user specific subfields of HE-SIG-B containing the per user dedicated information include the following fields
  - STA-ID
  - For single-user allocations in a RU: NSTS (Number of Spatial Streams), TxBF (transmit beamforming), MCS (Modulation and Coding Scheme) and Coding (Use of LDPC)
  - For each user in a multi-user allocation in a RU: Spatial Configuraiton Fields, MCS and Coding.
  - Other fields are TBD.
- **Move: Yasu Inoue Second: Ron Porat**
- **Accepted with no objection**
- **DCN:11-15/1066r0 SP Result: 43/0/16**

PHY Motion #41

- **Move to add the following text to the 11ax SFD:**

  –For MU-MIMO allocation of RU size > 20MHz, the user-specific subfields is dynamically split between two HE-SIG-B content channels(1/2) and the split is decided by the AP (on a per case basis)

  - **Move: Yasu Inoue Second: Ron Porat**
  - **Accepted with no objection**
  - **DCN: 11-15/1066r0 SP Result: 39/0/15**

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PHY Motion #42

- **Move to add the following text to the 11ax SFD:**
  - 1024 QAM is used as an optional feature for SU and MU using resource units equal to or larger than 242 tones in 11ax

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- **Move: Eunsung Park** **Second: Ron Porat**
- **Accepted with no objection**
- **DCN:11-15/1070r3** **SP Result: 35/0/18**

PHY Motion #43

- **Move to add to SFD**
  - HE-SIG-A shall include the following fields in SU PPDU.
    - The size of each field is TBD
    - The other fields are TBD

Format indication
TXOP duration
BW
Payload GI
PE
MCS
coding
LTF compression
Nsts
STBC
BF
CRC
tail

- **Move: Jiayin Zhang**
- **Second: Ron Porat**
- **Accepted with no objection**
- **DCN:11-15/1077r0**
- **SP Result: 53/14/6**

PHY Motion #44

- **Move to add to SFD**
  - HE-SIG-A shall include the following fields in MU DL PPDU.
    - The size of each field is TBD
    - The other fields are TBD

Format indication
TXOP duration
Number of HE-SIG-B symbols
MCS of SIGB
CRC
tail

- Move: Jiayin Zhang
- Second: Ron Porat
- Accepted with no objection
- DCN:11-15/1077r0
- SP Result: 56/14/4

PHY Motion #45

- **Move to add to SFD**
  - HE-SIG-A shall include the following fields in MU UL PPDU.
    - The size of each field is TBD
    - The other fields are TBD

Format indication
TXOP duration
CRC
tail

- Move: Jiayin Zhang
- Second: Ron Porat
- Accepted with no objection
- DCN: 11-15/1077r0
- SP Result: 52/0/16

PHY Motion #46

- **Move to add to the SFD:**
  - The spec shall support adding a BSS COLOR field in the SIG-A field
    - The BSS COLOR field is an identifier of the BSS (size TBD)
- **Move:** Alfred Asterjadhi **Second: Ron Porat**
- **Accepted with no objection**
- **DCN:11-15/1122r0** **SP Result:60/0/13**

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PHY Motion #47

- **Move to add the following rules to the SFD:**
  - An HE non-AP STA may enter the Doze state until the end of an HE DL MU PPDU if:
    - the value of the PPDU's BSS COLOR field is equal to the BSS COLOR of its BSS, and
    - the value derived from any of the STA Identifiers in the SIG-B field does not match its own identifier or that of a broadcast/multicast identifier
  - An HE non-AP STA may enter the Doze state until the end of an HE UL MU PPDU if:
    - the value of the PPDU's BSS COLOR field is equal to the BSS COLOR of its BSS
- **Move:** Alfred Asterjadhi **Second: Ron Porat**
- **Accepted with no objection**
- **DCN:11-15/1122r0** **SP Result:52/0/9**

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PHY Motion #48

- **Move to add to the SFD**
- **An UL/DL Flag field is present in the SIG-A of an HE SU PPDU**
  - The UL/DL Flag indicates whether the frame is Uplink or Downlink
    - The value of this field for TDLS is TBD
- **Move:** Alfred Asterjadhi **Second: Ron Porat**
- **Accepted with no objection**
- **DCN:11-15/1122r0** **SP Result:55/0/13**

PHY Motion #49

- **Move to add the following rules to the SFD:**
  - An HE STA may enter the Doze state until the end of an HE SU PPDU if:
    - the value of the PPDU's BSS COLOR field is equal to the BSS COLOR of its BSS, and
    - the value of the UL/DL Flag field indicates that the frame is uplink
- **Move:** Alfred Asterjadhi **Second: Ron Porat**
- **Accepted with no objection**
- **DCN:11-15/1122r0** **SP Result:50/0/10**

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PHY Motion # 50

- **Move to assign at least 6 bits for BSS Color field**

- **Move:** Yasuhiko Inoue **Second: Ron Porat**
- **Y/N/A: 52/18/24**
- **Motion fails**
- **DCN:11-15/1075r1** **SP Result: 43/0/6**

Motion to Defer

- **Move to defer PHY Motion #50**
- **Move: Chuck Second Sean Coffey**
- **Y/N/A: 28/35/32**
- **Motion fails**

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Motion to Amend

- Amend PHY motion #50 to:
- Move to assign at least 6 bits for BSS Color field
- Move: Yasu Inoue
- Second: Chuck
- Y/N/A: 31/23/40
- Motion passes

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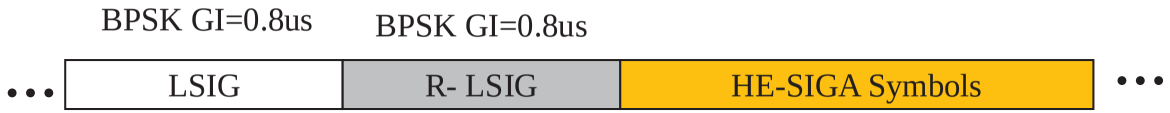
PHY Motion #51

Move to add to the SFD as below:

11ax preamble shall have a 4us symbol repeating the L-SIG content, right after the legacy section

– This symbol shall be modulated by BPSK and rate ½ BCC.



- **Move: Hongyuan Zhang** **Second: Ron Porat**
- **Accepted with no objection**
- **DCN: 11-15/0579r4** **SP Result: 74/16/5**

PHY Motion #52

- **Move to insert the following in SFD:**
  - In L-SIG, the L-LENGTH field is set to a value not divisible by 3.
  - The value of L_LENGTH mod 3 will be used for signaling of one bit of TBD information.

201

- **Move: Hongyuan Zhang** **Second: Ron Porat**
- **Accepted with no objection**
- **DCN: 11-15/0579r4** **SP Result: 71/12/4**

PHY Motion #53

- **Move to add dual sub-carrier modulations (DCM) as optional modulation schemes for HE-SIGB and Payload to 11ax SFD**
  - Dual sub-carrier modulation (DCM) are only applied to BPSK, QPSK and 16QAM modulations.

- **Move: Jianhan Liu Second: ron Porat**
- **Y/N/A:54/2/35**
- **Motion passes**
- **DCN: 11-15/1068r1 SP Result: 66/1/15**

PHY Motion #54

- **Move to add one bit DCM indication in HE-SIGA to 11ax SFD**

- **Move: Jianhan Liu Second: Ron Porat**
- **Accepted with no objection**
- **DCN: 11-15/1068r1 SP Result: 64/1/12**

PHY Motion #55

- **Move to add to 11ax SFD that HE-SIG-A shall have a repetition mode for range extension**
  - In the repetition mode, HE-SIG-A symbols are repeated once in time. The bit interleaver is bypassed in the repeated HE-SIG-A symbols
  - The repetition mode is indicated before HE-SIG-A.

- **Move: Jiayin Zhang Second: Ron Porat**
- **Accepted with no objection**
- **DCN: 11-15/0826r3 SP Result: 68/0/15**

PHY Motion #56

- **Move to add to TGax Specification Framework Document**
  - The HE-LTF sequences for UL MU-MIMO shall be generated as follows. For each stream, a common sequence shall be masked repeatedly in a piece-wise manner by a distinct row of an 8x8 orthogonal matrix. When the length of the LTF sequence is not divisible by 8, the last M elements of the LTF sequence (M being the remainder after the division of LTF length by 8) shall be masked by the first M elements of the orthogonal matrix row.
- **Move:** Xiaogang Chen **Second: Ron Porat**
- **Accepted with no objection**
- **DCN:11-15/0602r6** **SP Result: 59/1/12**

PHY Motion #57

- **Move to add to TGax Specification Framework Document**
  - The orthogonal matrix used to mask the HE-LTF sequence in SP1 is the 8x8 Pmatrix used in 11ac.

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- **Move:** Xiaogang Chen **Second: ron Porat**
- **Accepted with no objection**
- **DCN:11-15/0602r6** **SP Result: 52/12/2**

PHY Motion #58

- **Move to add the following text into Section 3.4 HE Data Field of the current SFD:**
  - An 11ax SU PPDU should apply the MAC/PHY pre-FEC padding scheme as in 11ac, to pad toward the nearest of the four possible boundaries ("*a*" factor) in the last Data OFDM symbol(s), and then use post-FEC padding bits to fill up the last OFDM symbol(s).
    - Packet Extension (PE) field is defined at the end of 11ax PPDUs.
    - PE should have the same average power as data field.
- **Move: Hongyuan Zhang Second: Ron Porat**
- **Accepted with no objection**
- **DCN:11-15/0810r1 SP Result: 73/0/17**

PHY Motion #59

- **Move to add the following text into SFD:**
  - 11ax shall define the max packet extension modes of 8μs and 16μs, correspond to the short symbol segment padding boundaries ("*a*-factor") according to the following PE duration (T_{PE}) values:
    - Max packet extension mode 8 μs: T_{PE} = [0 0 4 8] μs for $a = 1{\sim}4$ respectively;
    - Max packet extension mode 16 μs: T_{PE} = [4 8 12 16] μs for $a = 1{\sim}4$ respectively.
  - HE Capability field shall define two constellation level thresholds ($threshold_{16}$ and $threshold_{8}$) for a given {NSS, BW} combination, to determine if and when max packet extension modes 8 μs and 16 μs are applied, i.e.
    - 3 bits are used to specify each threshold as the table below.
    - If constellation ≥ $threshold_{16}$ apply max PE 16 μs mode, else if constellation ≥ $threshold_{8}$ apply max PE 8 μs mode, else no packet extension.
    - If no PE is required for all constellations both $threshold_{8}$ and $threshold_{16}$ are set to 111
    - If only max PE 8 μs mode is required, set $threshold_{16}$ to be 111, and $threshold_{8}$ to be the constellation at which max PE 8 μs mode starts
    - If only max PE 16μs mode is required, set $threshold_{16}$ to be the constellation at which max PE 16μs mode starts, and $threshold_{8}$ to be 111
    - When ≥80 MHz is supported, no thresholds are defined for RU size less than or equal to 242 tones (20 MHz); otherwise, thresholds are defined down to a TBD RU size.

Constellation	Threshold Encoding in HE Capability
BPSK	000
QPSK	001
16QAM	010
64QAM	011
256QAM	100
1024QAM (TBD)	101
None	111

  - Move: Hongyuan Zhang
  - Second: Ron Porat
  - Accepted with no objection
  - DCN 11-15/0810r1
  - SP Result: 68/13/5

PHY Motion #60

- **Move to add the following text into SFD:**
  - The number of uncoded bits for each of the first 3 short symbol segments (a=1~3) equals to the number of uncoded bits corresponding to $N_{SD.short}$ subcarriers as specified by the following table, and the number of uncoded bits for the last short symbol segment (a=4) equals to the number of bits of the whole OFDM symbol subtracting the total number of uncoded bits of the first three short symbol segments.

RU Size	$N_{SD.short}$
26	6
52	12
106	24
242	60
484	120
996	240
996x2	492

  - Move: Hongyuan Zhang
  - Second: Ron Porat
  - Accepted with no objection
  - DCN: 11-15/0810r1
  - SP Result: 71/0/15

PHY Motion #61

- **Move to add the following text (this page and next page) into SFD:**

  - HE-SIG-A field contains a "*a-factor*" field of 2 bits, and a "PE-Disambiguity" field of 1 bit, with setting methods as blow:
  - In L-SIG, the L-LENGTH field is set by:

$$L_LENGTH = \left\lceil \frac{TXTIME - 20}{4} \right\rceil \times 3 - 3 + m,\ m = 1 \text{ or } 2$$

where $TXTIME = T_{L_PREAMBLE} + T_{HE_PREAMBLE} + T_{HE_DATA} + T_{PE}$

$T_{HE_DATA} = T_{HE_SYM} \times N_{SYM} = (12.8 + T_{GI}) \times N_{SYM}$

T_{PE} is the PE duration

  - In HE-SIG-A:
  - ***a-factor* field:**

a-factor value	a-factor field encoding
1	01
2	10
3	11
4	00

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PHY Motion # 61 (Cntd)

– **PE Dis-ambiguity Field:**

- If $T_{PE} + 4 \times \left(\left\lceil \frac{TXTIME - 20}{4} \right\rceil - \left(\frac{TXTIME - 20}{4} \right) \right) \geq T_{SYM}$, where $T_{SYM} = 12.8 + T_{GI}$, set this field to 1; otherwise, set to 0.
- At receiver side, the following equations may be run to compute N_{SYM} and T_{PE} respectively:

$$N_{SYM} = \left\lfloor \left(\frac{L_LENGTH - m + 3}{3} \times 4 - T_{HE_PREAMBLE} \right) / T_{SYM} \right\rfloor - b_{PE_Disambiguity}$$

$$T_{PE} = \left\lfloor \frac{\left(\frac{L_LENGTH - m + 3}{3} \times 4 - T_{HE_PREAMBLE} \right) - N_{SYM} \times T_{SYM}}{4} \right\rfloor \times 4$$

- **Move: Hongyuan Zhang Second: Ron Porat**
- **Accepted with no objection**
- **DCN:11-15/0810r1 SP Result: 71/0/15**

PHY Motion #62

- **Move to add the following text into SFD:**
  - When the AP transmits DL-MU packets:
    - All users use the same N_{SYM} and *a-factor* values according to the user with the longest span.
    - Based on *a-factor* value and each user's PE capabilities, compute the PE duration for each user $T_{PE,u}$, and the PE duration of the whole DL-MU PPDU is $T_{PE} = \max_u(T_{PE,u})$.
    - In HE-SIG-A field, the "a-factor" field, the "PE Disambiguity" field, and the "LDPC extra symbol" field, are common for all users.
- **Move: Hongyuan Zhang Second: Ron Porat**
- **Accepted with no objection**
- **DCN:11-15/0810r1 SP result: 72/0/14**

PHY Motion #63

- **Move to add the following text into SFD:**
  - For UL-MU packet transmission:
    - AP indicates its desired *Nsym*, *a-factor*, LDPC Extra Symbol indication and *PE* duration values in trigger frame.
    - Possible PE values for UL-MU are TBD.
    - Each user when transmitting the UL-MU PPDU, shall encode and conduct PHY padding using the parameters:
    - N_{SYM} as indicated in the trigger frame;
    - *a-factor* as indicated in the trigger frame;
    - LDPC Extra Symbol as indicated in the trigger frame;
    - Append PE specified in the trigger frame.
- **Move: Hongyuan Zhang Second: Ron Porat**
- **Accepted with no objection**
- **DCN:11-15/0810r1 SP Result: unanimous**

PHY Motion #64

- **Move to add the following text to the 11ax SFD:**
-

  The RU allocation signaling in the common field of HE-SIG-B signals an 8 bit per 20MHz PPDU BW for signaling
  - The RU arrangement in frequency domain
  - Number of MU-MIMO allocations: The RUs allocated for MU-MIMO and the number of users in the MU-MIMO allocations.
  - The exact mapping of the 8 bit to the RU arrangement and the number of MU-MIMO allocations is TBD.
  - Signaling for the center 26 unit in 80MHz is TBD
- **Move: Yasu Inoue Second: Ron Porat**
- **Accepted with no objection**
- **DCN:11-15/1066r0 SP Result: 56/0/14**

PHY Motion #65

- **Move to add the following text to the 11ax SFD:**
  - The length of the user specific subfield in HE-SIG-B for a single-user allocation is equal to the length of the user specific subfield of each user in a multi-user allocation.
- **Move: Yasu Inoue Second: Ron Porat**
- **Accepted with no objection**
- **DCN:11-15/1066r0 SP Result: 54/0/15**

MAC Motion #27

- **Moved to add to the end of Clause 6 (MAC) of the IEEE 802.11 TGax Specification Framework:**
  - "The amendment shall define a HE AP to implement Proxy ARP capability."
- **Move: Guido Hiertz Second: Ron Porat**
- **Y/N/A:29/27/64**
- **Motion fails**
- **DCN:11-15/1015r1 SP Result: 32/8/many**

MAC Motion #28

- **Move to add the following to the IEEE 802.11 TGax Specification Framework**

  6.X.Y: “HE STAs shall support the Multiple BSSID Set.”

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Move: Guido R. Hiertz **Second: Ron Porat**

Accepted with no objection

DCN:11-15/1014r0 SP Result: 17/2/3

MAC Motion #29

- **Move to add the TGax SFD:**
  - 6.1 General
    In a downlink MU HE PPDU, at most one A-MPDU is allowed to contain one or more MPDUs that solicit an immediate response, except when an immediate response is carried in UL MU PPDU. In such case, one or more A-MPDUs are allowed to contain one or more MPDUs that solicit an immediate response carried in UL MU PPDU.
- **Move:** Yongho Seok **Second: Ron Porat**
- **Approved with no objection**
- **DCN: 11-15/1033r0** **SP Result:17/0/28**

MAC Motion #30

- **Move to add the TGax SFD:**
  - 6.2 Power Save
    HE STA may use a notification of its operating mode changes for 802.11ax power saving mechanism
- **Move:** Yongho Seok **Second: Ron Porat**
- **Approved with no objection**
- **DCN:11-15/1034r0 SP Result: 5/0/39**

MAC Motion #31

- **Move to add the TGax SFD:**
  - 6.2 Power Save
    The 802.11ax Operating Mode Notification behavior should specify a clarification for
    - A channel width that a STA can transmit
    - A number of spatial streams (Tx NSS) that a STA can transmit

- **Move:** Yongho Seok **Second: Ron Porat**
- **Y/N/A:22/9/50**
- **Motion fails**
- **DCN:11-15/1034r0** **SP Result: 5/0/43**

MAC Motion #32

- **Move to add to 11ax SFD:**
  - the spec shall define a mechanism for a transmitting STA to indicate its RX operating mode, i.e. RX NSS, RX channel width, in a transmitted DATA type MAC header, so that the responding STA shall not transmit a subsequent PPDU using an NSS or channel width value not indicated as supported in the RX operating mode of the transmitting STA.
  - The responding STA shall not adopt the new NSS and BW until a time TBD.
- **Move: Guoqing Li Second: Ron Porat**
- **Accepted with no objection**
- **DCN: 11-15/1060 SP Result: 24/0/12**

MAC Motion #33

- **Move to add the following text in SFD**
  - When a STA receives a CF-End from an OBSS STA, if the last NAV update was caused by an Intra-BSS frame, the STA should not reset its NAV
- **Move:** Jeongki Kim **Second: Ron Porat**
- **Accepted with no objection**
- **DCN: 11-15/1067r0 SP Result: 29/0/15**

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MAC Motion #34

- **Move to add the following text to the spec framework**
  - The STA determines whether the detected frame is an inter-BSS or an intra-BSS frame by using BSS color or MAC address in the MAC header. If the detected frame is an inter-BSS frame, under TBD condition, uses TBD OBSS PD level that is greater than the minimum receive sensitivity level
  - NOTE–Maybe extra rules need to be added to ensure that all 11ax STAs can make the decision in a consistent manner.
- **Move: Jianhan Liu Second: Ron Porat**
- **Accepted with no objection**
- **DCN: 11-15/1063r1 SP Result: 29/6/7**

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MAC Motion #35

- Move to add the following text into 11ax SFD

4.1 In cascading sequence, when AP does not receive acknowledgements from a STA after sending DL Data MPDUs, AP may recover using one of the following procedures:

  - Transmitting a BAR with SSN value set to the SN of the unacknowledged Data MPDUs
  - Retransmitting unacknowledged Data MPDUs
  - Transmitting additional Data MPDUs along with a BAR with SSN value set to the SN of the unacknowledged Data MPDUs

- **Move: John Son Second: Jinsoo Ahn**
- **Y/N/A: 10/17/49 Motion fails**
- **DCN:11-15/1096r0 SP Result: 11/0/31**

MAC Motion #36

- **Move to add to the TG Specification Frame work document**
  - 4.1. DL-OFDMA may reuse the same sharing mechanism of an EDCA TXOP as DL MU-MIMO.
- **Move:** Jinsoo Ahn **Second: John Son**
- **Accepted with no objection**
- **DCN:11-15/1116r1** **SP Result:11/0/34**

Move to Amend

- **Amend MAC motion #36 as:**
- **Do you agree to add to the TG Specification Frame work document?**
  - 4.1. DL-OFDMA shall reuse sharing an EDCA TXOP mechanism of DL MU-MIMO.
- **to**
- **Move to add to the TG Specification Frame work document**
  - 4.1. DL-OFDMA may reuse the same sharing mechanism of an EDCA TXOP as DL MU-MIMO.
- **Move: Alfred Second: Jinsoo Ahn**
- **Y/N/A:14/0/51 Motion passes**

MAC Motion #37

- **Move to add the following to 11ax SFD**

  Non-AP STAs support using the QoS Control field in QoS Data and QoS Null frames to report per-TID Buffer Status information

Move: Alfred Asterjadhi **Second: Ron Porat**

Accepted with no objection

DCN:11-15/1120r0 **SP Result: 37/0/11**

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MAC Motion #38

- **Move to add the following to 11ax SFD**

An AP can poll STAs for buffer status reports using the frame carrying the trigger info.

  - The poll can request for specific buffer status information with TBD granularity.

Move: Alfred Asterjadhi **Second: Ron Porat**

Accepted with no objection

DCN:11-15/1120r0 **SP Result: 35/0/12**

MAC Motion #39

- **Move to add the following to 11ax SFD**

The spec shall define an HE variant (of the VHT variant) of the HT Control field that carries one or more control fields for HE control information

- B0 and B1 of the HT Control field in this case are set to 1
- The control fields can be called HE Control field

Move: Alfred Asterjadhi **Second: Ron Porat**

Accepted with no objection

DCN:11-15/1121r0 **SP Result: 30/0/18**

MAC Motion #40

- **Move to modify sub-clause 4.1 of the TG Specification Framework as follows**
  - An AP shall not allocate UL subchannel in any 20 MHz channel that is not occupied by the ~~Trigger frame~~ immediately preceding DL PPDU that contains trigger information. In each 20 MHz channel occupied by the ~~Trigger frame~~ immediately preceding DL PPDU that contains trigger information, there is at least one allocated subchannel for UL transmission.
- **Move: Young Hoon Kwon Second: Reza Hedayat**
- **Accepted with no objection**
- **DCN: 11-15/1052r0 SP Result: 45/3/22**

MAC Motion #41

- **Move to add to the TG SFD:**
  - A HE AP is allowed to broadcast a TBD parameter in the trigger frame to the STAs so that STAs can initiate the random access process after the trigger frames

- **Move: Russell Huang Second: Ron Porat**
- **Accepted with no objection**
- **DCN: 11-15/1137r1 SP Result: 87/0/19**

MU Motion #12

- **Move to add to the TG Specification Frame work document**
  - 4.y.z. The amendment shall include a mechanism to multiplex acknowledgment frames in response to Multicast receptions under GCR BA operation.
- **Move:** Kazuyuki Sakoda **Second: Guido Hiertz**
- **Accepted with no objection**
- **DCN: 11-15/1043r1** **SP Result:11/0/many**

233

MU Motion #13

- **Move to add to the TG SFD:**
  - The spec shall define a MU-BAR frame to solicit BA/ACKs from multiple STAs in UL MU transmissions
- **Move:** Guoqing Li **Second: Ron Porat**
- **Accepted with no objection**
- **DCN: 11-15/1053r1** **SP Result: 57/0/4**

234

MU Motion #14

- **Move to add to the SFD**

  4 Multi-user (MU) features

  4.1 General

  STA shall consider CCA status to respond to a Trigger frame under a non-null TBD set of conditions.

Move: Kiseon Ryu Second: Jinsoo Choi

Accepted with no objection

DCN: 11-15/1058r0 SP Result: 47/0/13

MU Motion #15

- Move to add to the TG Specification Frame work document
  - x.y.z. A STA that is polled from a trigger frame for UL MU transmission considers the NAV in determining whether to respond unless one of the following conditions is met
    - the NAV was set by a frame originating from the AP sending the trigger frame
    - the response contains ACK/BA and the duration of the UL MU transmission is below a TBD threshold
    - Other condition TBD
- Move: Po-Kai Huang Second: Chitto
- Accepted with no objection
- DCN:11-15/1062r1SP Result: 46/3/13

MU Motion #16

- **Move to add to the SFD:**
  - The spec shall allow multiple TIDs in a single PSDU between AP and a STA for DL/UL OFDMA/MU-MIMO
  - Multiple TIDs aggregation rules are TBD if necessary
- **Move: Jianhan Liu Second: Hongyuan Zhang**
- **Accepted with no objection**
- **DCN: 11-15/1065r1 SP Result: 39/0/12**

MU Motion #17

- ***Move to add to the TG Specification Framework:***
- ***x.y.z. :***

– The amendment shall define a mechanism to enable multiplexing of the Compressed Beamforming Action frame (CSI feedback) from multiple stations using UL MU(MIMO or OFDMA) mode

– Move: Narendar Madhavan Second: Ron Porat

– Accepted with no objection

– DCN: 11-15/1097r1 SP Result: 24/0/8

MU Motion #18

- ***Move to add to the TG Specification Framework:***
- ***x.y.z. :***

– The amendment shall define a new channel sounding sequence that includes trigger information in order to facilitate UL MU mode of Compressed Beamforming Action frame from multiple STAs.

– Move: Narendar Madhavan Second: Masahito Mori

– Accepted with no objection

– DCN: 11-15/1097r1 SP Result: 21/0/14

MU Motion #19

- **Move to add to the TG SFD:**
  - The spec shall support fragmentation negotiation in A-MPDUs for HE STAs

- **Move:** Chittabrata Ghosh **Second: Po-Kai Huang**
- **Y/N/A: 49/4/31 Motion passes**
- **DCN: 11-15/1102r0 SP Result: 51/0/9**

MU Motion #20

- **Move to include the DL sounding sequence illustrated in Slide 15 (of 802.11-15/1103r0) to the spec framework**
- **Move:** Chittabrata Ghosh **Second: Po-Kai Huang**
- **Accepted with no objection**
- **DCN:11-15/1103r0 SP Result: 40/0/7**

241

MU Motion # 27

- **Move to include in the SFD the following random access procedure:**
  - When an STA has a frame to send, it initializes it's OBO (OFDMA Back-off) to a random value in the range 0 to CWO (OFDMA Contention window)
  - For an STA with non-zero OBO value, it decrements its OBO by 1 in every RU assigned to AID value TBD within the TF-R
  - For an STA, its OBO decrements by a value, unless OBO=0, equal to the number of RUs assigned to AID value TBD in a TF-R
    - OBO for any STA can only be 0 once every TF-R
  - An STA with OBO decremented to 0 randomly selects any one of the assigned RUs for random access and transmits its frame

  - Move: Chittabrata Ghosh Second: Po-Kai Huang
  - Accepted with no objection
- **DCN:11-15/1105r0 SP Result:31/5/8**

242

MU Motion #21

- **Move to add to the spec framework**

The spec shall indicate cascaded sequence of Trigger frames for random access by using a bit in the Trigger frame.

243

- **Move:** Chittabrata Ghosh **Second: Po-Kai Huang**
- **Accepted with no objection**
- **DCN: 11-15/1107r0 SP Result:41/0/11**

MU Motion #22

- **Move to add to the spec framework**

The spec shall include a mechanism that allows the Beacon frame to indicate the target transmission time(s) of one or more Trigger frame(s) that allocates resources for random access.

Move: Chittabrata Ghosh **Second: Po-Kai Huang**

Accepted with no objection

DCN: 11-15/1107 SP Result:40/0/11

MU Motion #23

Move to add the following to the SFD:

- The spec shall allow that the schedule information for OFDMA acknowledgement from STAs is contained in the MAC header of DL MPDU.

- **Move: Lei Wang Second: Kiseon Ryu**
- **Accepted with no objection**
- **DCN: 11-15/1123r1 SP Result:33/0/14**

MU Motion #24

Move to add the following to the SFD

- **The contents of the scheduling information for an UL OFDMA ACK/BA includes;**
  - **UL PPDU Length (9 bits) + RU Allocation (TBD).**

- **Move: Lei Wang Second: Kiseon Ryu**
- **Accepted with no objection**
- **DCN: 11-15/1123r1 SP Result: 33/0/10**

MU Motion #25

- **Move to add the following to the IEEE 802.11 TGax Specification Framework (sec 4.1)**
  - The amendment shall define a mechanism to reduce the MIMO compressed beamforming feedback overhead
- **Move:** Filippo Tosato **Second: Ron Porat**
- **Accepted with no objection**
- **DCN: 11-15/1129r1 SP Result:29/0/13**

247

MU Motion #26

Move to add to the TG Specification Frame work document

Use a reserved bit in BA control field to indicate that the frame is multi-STA BA frame.

248

Move: Yasu Inoue Second: Guido Hiertz

Y/N/A: 18/13/50 Motion fails

DCN:11-15/1086r1 SP Result: 10/0/many

SR Motion #1

- **Move to add to the TG Specification Frame work document**
  - 5.1 Features for operation in dense environments [802.11ax SFD]

A STA should regard an Inter-BSS PPDU with a valid PHY header and that has a receive power/RSSI below the OBSS PD level used by the receiving STA and that meets additional TBD conditions, as not having been received at all (e.g., should not update its NAV), except that the medium condition shall indicate BUSY during the period of time that is taken by the receiving STA to validate that the PPDU is from an Inter-BSS, but not longer than the time indicated as the length of the PPDU payload

- The OBSS PD level is greater than the minimum receive sensitivity level

- **Move: Luojun Second: Ron Porat**
- **Accepted with no objection**
- **DCN:11-15/1109r1 SP Result:39/0/12**

SR Motion #2

- **Move to add to Section 5.1 of the SFD:**
  - "The amendment shall include one or more mechanisms to improve spatial reuse by allowing adjustments to one or more of the CCA-ED, 802.11 Signal Detect CCA, OBSS_PD or TXPWR threshold values. The constraints on selecting threshold values are TBD."
- **Move: Filip Mestanov Second: Guido Hiertz**
- **Y/N/A: 35/5/36 Motion Passes**
- **DCN:11-15/1138r1 SP Result: 24/0/18**

250

SR Motion #3

- Move to add to 11ax SFD:

  The specification to consider a procedure that may revise the NAV depending on TBD conditions at the recipient of the ongoing OBSS frame.

Move: Reza Hedayat Second: Ron Porat

Accepted with no objection

DCN:11-15/1104r3 SP Result: 16/0/26

251

SR Motion #4

Move to add the following text into 11ax SFD

- **An 11ax STA regards a valid OBSS PPDU *as not having been received at all (e.g., should not update its NAV), except that the medium condition shall indicate BUSY during the period of time that is taken by the receiving STA to validate that the PPDU is from an Inter-BSS, but not longer than the time indicated as the length of the PPDU payload* if the RXPWR of the received PPDU is below the OBSS_PD threshold and TBD conditions are met, noting that the OBSS_PD threshold is accompanied by a TXPWR value and a reduction in the TXPWR may be accompanied by an TBD increase in the OBSS_PD threshold value.**

252

- **Move: Tianyu Wu** **Second: Ron Porat**
- **Accepted with no objection**
- **DCN:11-15/1069r3** **SP Result: 38/1/18**

Goals for November 2015

- **Continue to advance the TG documents based on submissions.**
  - With priority to the TG Specification Framework document.
- **Technical Presentations**

Conference call times

- **Thursday October 15 10:00 – 12:00 ET**

Appendix AH

IEEE P802.11
Wireless LANs

IEEE 802.11 TGax

September 2015 Bangkok PHY Ad Hoc Meeting Minutes

Date: 2015-09-13

Author(s):

Name	Affiliation	Address	Phone	email
Yakun Sun	Marvell Semiconductor			yakunsun@marvell.com

Abstract

TGax meeting minutes from the IEEE 802.11 Bangkok PHY Ad hoc session, September, 2015.

IEEE 802.11 Task Group ax PHY Ad Hoc
Sept 2015 Bangkok Meeting

Monday, Sept 13th, 2015, PM1 TGax Session (13:35-15:30)

1. **Meeting called to order by Jianhan Liu (Mediatek) at 13:35.**
   1.1. The agenda is contained in 11-15/1125r1 which is on the server.

2. **Administrative Items**
   2.1. Chair reminded the IEEE 802 and IEEE 802.11 Policy and Procedure.
   2.2. Chair also reminded to do attendance.

3. **Set and approve agenda**
   3.1. Proposed agenda for Monday PM1
      3.1.1. Call Meeting to order
      3.1.2. IEEE 802 and 802.11 IPR Policy and procedure.
      3.1.3.Presentations follow the order of DCN.
      3.1.4. Recess
   3.2. Chair asked for approval of the proposed agenda. – Agenda approved.

4. **Presentations**

4.1 11-15/0580r2 11ax Coding Discussions
Hongyuan Zhang (Marvell) presented.

Discussions:
No questions.

SP #1:

- **Do you agree to make the following text changes in 11ax SFD (3.3.3 Coding)?**
  - *LDPC is the only coding scheme in the HE PPDU Data field for allocation sizes of 484 tones, 996 tones and 996*2 tones.*
  - ….
  - *Support of LDPC code for both TX and RX is mandatory for HE STAs declaring support for at least one of HE 40/80/160/80+80 SU-PPDU bandwidths, ……..*

SP Result:
Y40 N0 A18
SP passed.

4.2 11-15/1031r0 DL MU Signaling
Katsuo Yunoki (KDDI R&D Laboratories) Presented

Discussions:

SP #1:

- **Do you agree to add the following text to SFD?**
  The amendment shall define Group ID expression to identify stations multiplexed in DL MU PPDU with MU-MIMO, OFDMA or combined usage of both.

SP Result:
Y1, N many
SP failed

4.3 11-15/1051r0 HE NDP Frame for Sounding
Young Hoon Kwon (Newracom) Presented

Discussions:

Sameer (Qualcomm): Terminology of "OFDM" format
Answer: lack of a good name now.
Hongyuan (Marvell): LTF compression of 2x/4x is open for discussion. Also have issue on the "SU" frame format.
Answer: also due to lack of a good name.

SP:

- **Do you agree to add to the TG Specification Framework:**
  - 4.y.z An HE NDP frame for DL sounding shall use Non-OFDMA (SU) frame format.

Sameer requested to delay the SP after his contribution is presented since they are close related.

Sameer: still wondering if there is a better name for "non-OFDMA". How about just say "SU" frame.
Bin Tian: have we defined "SU" frame? Is it related to data portion? Everyone agrees the intention. Suggest to defer and work offline for a better phrase.
Answer: will work offline to harmonize and bring back.

4.4 11-15/1071r2 Tone grouping Factors and NDP Format for 802.11ax
Sameer Vermani (Qualcomm) presented.

Discussions:

Young Hoon (Newracom): what if AP allows UL OFDMA-type of sounding from multiple STA at the same time?
Sameer: that is a good point. Need to think more. Generally AP has more antenna. BF in UL is less used. Defer the 2nd SP.
Daewon: single stream pilot may not be transmitted over 2x. Outdoor is more freq selective and the steering matrix. May need Ng be smaller.

Sameer: In a real channel Ng can be set back to 2 if such a freq selective has enough rank to support high order MIMO. Our simulation only shows Ng=1 is not required, so we still keep Ng=2 at this moment.

SP1:

- **Do you agree to add the following text to the TGax spec framework document:**

"802.11ax spec shall not support Ng=1 for sounding feedback. Note that the tone grouping factor, Ng is defined with respect to data tones of the 11ax PPDU. "

SP passes unanimously

SP2:

- **Do you agree to add the following text and diagram to the SFD**

The spec shall define an HE-NDP for collecting sounding feedback, whose frame format is shown in the diagram below. The presence and duration of packet extension at the end of HE-NDP is TBD.

SP is deferred.

4.5 11-15/1059r1 SIGB Encoding Structure Part II

Ron Porat (Broadcom) presents.

Discussions:

Daewon: size of CRC, and payload size?

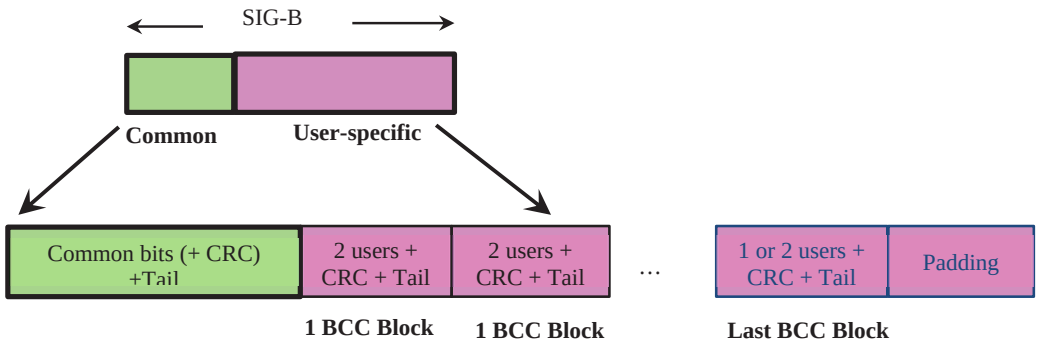
Ron: K is number of user coded together. CRC is 4 bits. Payload size is not important. We are simulating SIGB.

Daewon: overhead changes with K and impacts the performance. So that is why I asked the size of each specific fields.

SP:

Do you agree to add the following text to the SFD: The encoding structure of each BCC in SIG-B is as shown in the figure and as described below:

- 2 users are grouped together and jointly encoded in each BCC block in the user specific section of HE SIG-B
- The CRC in the common block is TBD
- The last user information is immediately followed by tail bits (regardless of whether the number of users is odd or even) and padding bits are only added after those tail bits



Results:
Y43 N0 A21
SP passes

4.6 11-15/1066r0 HE-SIGB contents
Kaushik Josiam (Samsung)

Interdigital: does the 106RU means the all the user has the same ID?
Kaushik: doesn't mean all users have the same user ID

Discussions

SP#1
Do you agree to add the following text to the 11ax SFD:
The RU allocation signaling in the common field of HE-SIG-B signals an 8 bit per 20MHz PPDU BW for signaling

- The RU arrangement in frequency domain
- Number of MU-MIMO allocations: The RUs allocated for MU-MIMO and the number of users in the MU-MIMO allocations.

The exact mapping of the 8 bit to the RU arrangement and the number of MU-MIMO allocations is TBD.
Signaling for the center 26 unit in 80MHz is TBD

SP#2
Do you agree to add the following text to the 11ax SFD:
The user specific subfields of HE-SIG-B containing the per user dedicated information include the following fields

- STA-ID
- For single-user allocations in a RU: NSTS (Number of Spatial Streams), TxBF (transmit beamforming), MCS (Modulation and Coding Scheme) and Coding (Use of LDPC)
- For each user in a multi-user allocation in a RU: Spatial Configuraiton Fields, MCS and Coding.

Other fields are TBD.

SP#3
Do you agree to add the following text to the 11ax SFD:

The length of the user specific subfield in HE-SIG-B for a single-user allocation is equal to the length of the user specific subfield of each user in a multi-user allocation.

SP#4
Do you agree to add the following text to the 11ax SFD:
For MU-MIMO allocation of RU size > 20MHz, the user-specific subfields is dynamically split between two HE-SIG-B content channels(1/2) and the split is decided by the AP (on a per case basis)

Monday, Sept 13th, 2015, PM1 TGax Session (19:40-21:30)

1. **Meeting called to order by Jianhan Liu (Mediatek) at 19:40.**
   1.1. The agenda is contained in 11-15/1125r2 which is on the server.

2. **Administrative Items**
   2.1. Chair reminded the IEEE 802 and IEEE 802.11 Policy and Procedure.
   2.2. Chair also reminded to do attendance.

3. **Set and approve agenda**
   3.1. Proposed agenda for Monday PM1
      3.1.1. Call Meeting to order
      3.1.2. IEEE 802 and 802.11 IPR Policy and procedure.
      3.1.3.Presentations follow the order of DCN.
      3.1.4. Recess
   3.2. Chair asked for approval of the proposed agenda. – Agenda approved.

4. **Presentations**

4.1 11-15/1066r0 HE-SIGB contents
Kaushik Josiam (Samsung) continued the Q&A from the last session

Discussions:
Amin (Newracom): request to defer SP. Has a very close contribution. Not sure 8bits are enough for the allocations.
KDDI: will a STA need to decode all user specific subfield?
Answer: it is up to the group.
Interdigital: Does this mean only one RU is allocated to one user?
Answer: Doesn't mandate.

SP #1:
Deferred

SP#2
Do you agree to add the following text to the 11ax SFD:
The user specific subfields of HE-SIG-B containing the per user dedicated information include the following fields
- STA-ID
- For single-user allocations in a RU: NSTS (Number of Spatial Streams), TxBF (transmit beamforming), MCS (Modulation and Coding Scheme) and Coding (Use of LDPC)

- For each user in a multi-user allocation in a RU: Spatial Configuraiton Fields, MCS and Coding.

Other fields are TBD.

43Y 0N 17A

SP#3
Deferred.

SP#4
Do you agree to add the following text to the 11ax SFD:
For MU-MIMO allocation of RU size > 20MHz, the user-specific subfields is dynamically split between two HE-SIG-B content channels(1/2) and the split is decided by the AP (on a per case basis)

39Y 0N 15A

4.2 11-15/1051r0 HE NDP Frame for Sounding
Young Hoon Kwon (Newracom) returned for SP

SP:

- **Do you agree to add to the TG Specification Framework:**
  - 4.y.z The spec shall define an HE-NDP for DL Sounding. The frame format of HE-NDP is based on the 11ax SU PPDU format is shown in the diagram below. The presence and duration of packet extension at the end of HE-NDP is TBD.

38Y 0N 4A

4.3 11-15/1111r0 SIG-B Resource unit allocation coding
Amin Jafarian (Newracom)

Shenaz: 4MHz = 52 tone? It is not exact to refer to 4MHz.
Answer: we can rephrase.
Shernaz: slide 4, the user needs to decode the tree to know the number of users
Answer: yes.
Jianhan: it is variable length. How to decode?
Answer: don't need the tail bits, just start to trace back from the minimum codeword length.
Kaushik: how to cover MU-MIMO in signaling?
Answer: don't need to.
Kaushik: how to know the number of users?
Answer: by the SIGB length
Kaushik: there will be ambiguity.
Kaushik: how does two methods compare when you have more than 9 users in 20MHz?
Answer: not practical.
Arjun: if all RU is allocated, 11 bits
Answer: Y
Arjun: again how to decode SIGB?
Answer: Y
Arjun: cannot resolve number of users from SIGB length.

Arjun: cannot signal 484tone.

SP:
Deferred.

4.4 11-15/1070r3 1024 QAM Proposal
Eunsung Park (LG) presents

Sigard: have you simulated CFO?
A: no
Daewon: EVM is TxEVM?
A: Y
Interdigital: no channel estimation loss?
A: No. will do.

SP:

- **Do you agree to add the following text to the 11ax SFD:**
  - 1024 QAM is used as an optional feature for SU and MU using resource units equal to or larger than 242 tones in 11ax?

35Y 0N 18A
SP passes

4.5 11-15/1077r0 HE-SIGA content
Jiayin Zhang (Huawei) presents

Daewon: why BW length is TBD?
Jiayin: there has been proposal on non-contigous channel bonding. So we left some flexibility here.
Daewon: why BW is fixed for SU?
Jiayin: to control implementation complexity, channel bonding is not suggested.
Daewon: PE has been agreed.
Jiayin: still want to keep the field.
Ron: Many proposal have talked about PE.
Daewon: need to think about if to support STBC
Jiayin: for each PPDU to exclude STBC? For some cases we want to keep it.
Interdigital: SR fields to add later on?
Jiayin: need further discussions

SP1

- **Do you agree to add to SFD**
  - HE-SIG-A shall include the following fields in SU PPDU.
    - The size of each field is TBD
    - The other fields are TBD

Format indication
TXOP duration
BW

Payload GI
PE
MCS
coding
LTF compression
Nsts
STBC
BF
CRC
tail

Y53 N14 A6

SP2

- **Do you agree to add to SFD**
  - HE-SIG-A shall include the following fields in MU DL PPDU.
  - The size of each field is TBD
  - The other fields are TBD

Format indication
TXOP duration
Number of HE-SIG-B symbols
MCS of SIGB
CRC
tail

Y53 N14 A6

SP3

- **Do you agree to add to SFD**
  - HE-SIG-A shall include the following fields in MU UL PPDU.
  - The size of each field is TBD
  - The other fields are TBD

Format indication
TXOP duration
CRC
tail

Y52 N0 A16

4.6 11-15/1122r0 **Identifiers in HE PPDUs for power saving**
Alfred Asterjadhi (Qualcomm) presents

SP1

- Do you support to add to the SFD:
  - The spec shall support adding a BSS COLOR field in the SIG-A field
    - The BSS COLOR field is an identifier of the BSS (size TBD)

Newracom: already in 15/0077?
A: no

60Y 0N 3A

SP2

- Do you support adding the following rules to the SFD:
  - An HE non-AP STA may enter the Doze state until the end of an HE DL MU PPDU if:
    - the value of the PPDU's BSS COLOR field is equal to the BSS COLOR of its BSS, and
    - the value derived from any of the STA Identifiers in the SIG-B field does not match its own identifier or that of a broadcast/multicast identifier
  - An HE non-AP STA may enter the Doze state until the end of an HE UL MU PPDU if:
    - the value of the PPDU's BSS COLOR field is equal to the BSS COLOR of its BSS

52Y 0N 9A

SP3

- Do you support adding an UL/DL Flag field in the SIG-A of an HE SU PPDU?
  - The UL/DL Flag indicates whether the frame is Uplink or Downlink
    - The value of this field for TDLS is TBD

??: how about RTS/CTS?
A: RTS/CTS in legacy format and not covered here. If it is in HE format, it depends on STA/AP.

55Y 0N 13A

SP4

- Do you support to add the following rules to the SFD:
  - An HE STA may enter the Doze state until the end of an HE SU PPDU if:
    - the value of the PPDU's BSS COLOR field is equal to the BSS COLOR of its BSS, and
    - the value of the UL/DL Flag field indicates that the frame is uplink

55Y 0N 10A

4.7 **d**

Tuesday, Sept 14th, 2015, AM2 TGax Session (10:30-12:30)

1. **Meeting called to order by Jianhan Liu (Mediatek) at 10:30.**
   1.1. The agenda is contained in 11-15/1125r3 which is on the server.

2. Administrative Items

2.1. Chair reminded the IEEE 802 and IEEE 802.11 Policy and Procedure.
2.2. Chair also reminded to do attendance.

3. Set and approve agenda

3.1. Proposed agenda for Monday PM1
3.1.1. Call Meeting to order
3.1.2. IEEE 802 and 802.11 IPR Policy and procedure.
3.1.3.Presentations follow the order of DCN.
3.1.4. Recess
3.2. Chair asked for approval of the proposed agenda. – Agenda approved.

4. Presentations

4.1 11-15/1075r1 **Number of BSS Color bits**

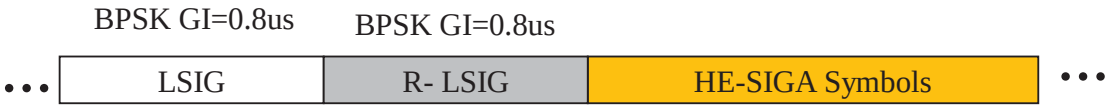
SP:
Do you support to assign 6 bits for BSS Color?

43Y 0N 6A

4.2 **11-15/0579r4 preamble design and autodetection**

SP#1

- **Do you support to add to the SFD as below:**
  11ax preamble shall have a 4us symbol repeating the L-SIG content, right after the legacy section?
  - This symbol shall be modulated by BPSK and rate ½ BCC.



74Y 16N 5A

SP#2

- **Do you agree to insert the following in SFD:**
  - In L-SIG, the L-LENGTH field is set to a value not divisible by 3.
  - The value of L_LENGTH mod 3 will be used for signaling of one bit of TBD information.

71Y 12N 4A

4.3 **11-15/0823r3 Preamble Design and Auto-Detection for 11ax**

SP#1

- **Do you support the following?**

HE PPDU is with a separately encoded signature symbol immediately after L-SIG. The bitwidth of the signature in the signature symbol is TBD.

Withdrawn

4.4 **11-15/1068r1 Reliable Dual Sub-Carrier Modulations (DCM) for HE-SIG-B and Data**

Quantenna: every bit is transmitted on two subcarriers?
A: yes
Quantenna: you can only carry half of data?
A: modulation is up, so data rate is the same
Quantenna: so you are comparing BPSK w/ QPSK?
A: yes, same data rate
Interdigital: how to separate the repetition?
A: k and k+N/2, simplest
Interdigital: compliant with OFDMA?
A: N is the RU size then
Interdigital: if you know where the interference will be, use it to separate bits
A: fixed separation is simulated.
Newracom: what is used on BPSK?
A: it is like MCS10 in 11ah, half data rate with 3dB gain
Newracom: interleaver?
A: no new interleaver design
Marvell: it is equivalent to interleave before or after interleaver.
A: it is TBD how to handle interleaver. Here we are proposing high level concept

SP#1

- **Do you agree to add dual sub-carrier modulations (DCM) as optional modulation schemes for HE-SIGB and Payload to 11ax SFD?**
  - Dual sub-carrier modulation (DCM) are only applied to BPSK, QPSK and 16QAM modulations.

66Y 1N 15A

SP#2

- **Do you agree to add one bit DCM indication in HE-SIGA to 11ax SFD?**

64Y 1N 12A

4.5 **11-15/0826r2 HE-SIG-A transmission for range extension**

Interdigital: why HESIGA RE performance is different with RLSIG?
A: different number of bits.

SP#1

- **Do you support that HE-SIG-A have a repetition mode for range extension?**
  - In the repetition mode, HE-SIG-A symbols are repeated once in time. The bit interleaver is bypassed in the repeated HE-SIG-A symbols?
  - The repetition mode is indicated before HE-SIG-A.

68Y 0N 15A

4.6 **11-15/1091r0 Considerations on Range Extension with SIG-A Repetition**

No discussions

4.7 **11-15/0602r5**

SP1

- **Do you agree to add to TGax Specification Framework Document?**
  - The HE-LTF sequences for UL MU-MIMO shall be generated as follows. For each stream, a common sequence shall be masked repeatedly in a piece-wise manner by a distinct row of an 8x8 orthogonal matrix. When the length of the LTF sequence is not divisible by 8, the last M elements of the LTF sequence (M being the remainder after the division of LTF length by 8) shall be masked by the first M elements of the orthogonal matrix row.

59Y 1N 12A

SP2

- **Do you agree to add to TGax Specification Framework Document?**
  - The orthogonal matrix used to mask the HE-LTF sequence in SP1 is the 8x8 Pmatrix used in 11ac.

Wednesday, Sept 16th, 2015, PM1 TGax Session (13:30-15:30)

1. **Meeting called to order by Jianhan Liu (Mediatek) at 13:35.**
   1.1. The agenda is contained in 11-15/1125r1 which is on the server.

2. **Administrative Items**
   2.1. Chair reminded the IEEE 802 and IEEE 802.11 Policy and Procedure.
   2.2. Chair also reminded to do attendance.

3. **Set and approve agenda**
   3.1. Proposed agenda for Monday PM1
      3.1.1. Call Meeting to order
      3.1.2. IEEE 802 and 802.11 IPR Policy and procedure.
      3.1.3.Presentations follow the order of DCN.
      3.1.4. Recess
   3.2. Chair asked for approval of the proposed agenda. – Agenda approved.

4. **Presentations**

   4.1. 11-15/1088r0 LTF Design for Uplink MU-MIMO

Discussions:

Qinghua: ZF filtering only replies on CSD values or also related to CSI?
A: Only knows CSD values for simple receiver
Bin: For your time domain processing, do you apply windowing?
A: No

SP

- **Do you agree add the following statement to SFD:**
  - CSD parameters, that result in per-stream orthogonality within a HE-LTF OFDM symbol, shall be used in HE-LTF of uplink MU-MIMO transmission.

16Y 5N many ABS

4.2. 11-15/1089r0 Considerations on PHY Padding and Packet Extension in 11ax

Hongyuan: STBC is used for Nss=1~2 and won't be the bottleneck. LDPC with Nss>2 will be.
A: different vendors have different design target.

4.3. 11-15/0810 HE PHY Padding and Packet Extension

Daewon: determine alpha value by tx parameters
A: yes
Daewon: then receiver iteratively compute alpha and PE by PPDU length
A: it is not a concern

- **Do you agree to add the following text into Section 3.4 HE Data Field of the current SFD:**
  - An 11ax SU PPDU should apply the MAC/PHY pre-FEC padding scheme as in 11ac, to pad toward the nearest of the four possible boundaries ("*a*" factor) in the last Data OFDM symbol(s), and then use post-FEC padding bits to fill up the last OFDM symbol(s).
    - Packet Extension (PE) field is defined at the end of 11ax PPDUs.
    - PE should have the same average power as data field.

73Y 0N 17A

- **Do you agree to add the following text into SFD:**
  - 11ax shall define the max packet extension modes of 8μs and 16μs, correspond to the short symbol segment padding boundaries ("*a*-factor") according to the following PE duration (*TPE*) values:
    - Max packet extension mode 8 μs: *TPE* = [0 0 4 8] μs for *a = 1~4* respectively;
    - Max packet extension mode 16 μs: *TPE* = [4 8 12 16] μs for *a = 1~4* respectively.
  - HE Capability field shall define two constellation level thresholds (*threshold16* and *threshold8*) for a given {NSS, BW} combination, to determine if and when max packet extension modes 8 μs and 16 μs are applied, i.e.
    - 3 bits are used to specify each threshold as the table below.

- If constellation ≥ *threshold*$_{16}$ apply max PE 16 µs mode, else if constellation ≥ *threshold*$_{8}$ apply max PE 8 µs mode, else no packet extension.
- If no PE is required for all constellations both *threshold*$_{8}$ and *threshold*$_{16}$ are set to 111
- If only max PE 8 µs mode is required, set *threshold*$_{16}$ to be 111, and *threshold*$_{8}$ to be the constellation at which max PE 8 µs mode starts
- If only max PE 16µs mode is required, set *threshold*$_{16}$ to be the constellation at which max PE 16µs mode starts, and *threshold*$_{8}$ to be 111
- When ≥80 MHz is supported, no thresholds are defined for RU size less than or equal to 242 tones (20 MHz); otherwise, thresholds are defined down to a TBD RU size.

Daewon: now we have mulitiple mode?
A: yes, different than 11ac with 1 mode.

68Y 13N 5A

- **Do you agree to add the following text into SFD:**
  - The number of uncoded bits for each of the first 3 short symbol segments (a=1~3) equals to the number of uncoded bits corresponding to $N_{SD.short}$ subcarriers as specified by the following table, and the number of uncoded bits for the last short symbol segment (a=4) equals to the number of bits of the whole OFDM symbol subtracting the total number of uncoded bits of the first three short symbol segments.

RU Size	$N_{SD.short}$
26	6
52	12
106	24
242	60
484	120
996	240
996x2	492

71Y 0N 15A

- **Do you agree to add the following text (this page and next page) into SFD:**
  - HE-SIG-A field contains a "*a-factor*" field of 2 bits, and a "PE-Disambiguity" field of 1 bit, with setting methods as blow:
  - In L-SIG, the L-LENGTH field is set by:

$$L_LENGTH = \left\lceil \frac{TXTIME - 20}{4} \right\rceil \times 3 - 3 + m,\ m = 1 \text{ or } 2$$

where $TXTIME = T_{L_PREAMBLE} + T_{HE_PREAMBLE} + T_{HE_DATA} + T_{PE}$

$T_{HE_DATA} = T_{HE_SYM} \times N_{SYM} = (12.8 + T_{GI}) \times N_{SYM}$

T_{PE} is the PE duration

- In HE-SIG-A:
- *a-factor* field:

a-factor value	a-factor field encoding
1	01
2	10
3	11
4	00

72Y 0N 15A

- **PE Dis-ambiguity Field:**
  - If $T_{PE}+4\times\left(\left\lceil\frac{TXTIME-20}{4}\right\rceil-\left(\frac{TXTIME-20}{4}\right)\right)\geq T_{SYM}$, where $T_{SYM}=12.8+T_{GI}$, set this field to 1; otherwise, set to 0.
  - At receiver side, the following equations may be run to compute *NSYM* and *TPE* respectively:

$$N_{SYM}=\left\lfloor\left(\frac{L_LENGTH-m+3}{3}\times 4-T_{HE_PREAMBLE}\right)/T_{SYM}\right\rfloor-b_{PE_Disambiguity}$$

$$T_{PE}=\left\lfloor\frac{\left(\frac{L_LENGTH-m+3}{3}\times 4-T_{HE_PREAMBLE}\right)-N_{SYM}\times T_{SYM}}{4}\right\rfloor\times 4$$

71Y 0N 15A

- **Do you agree to add the following text into SFD:**
  - When the AP transmits DL-MU packets:
    - All users use the same *NSYM* and *a-factor* values according to the user with the longest span.
    - Based on *a-factor* value and each user's PE capabilities, compute the PE duration for each user *TPE,u*, and the PE duration of the whole DL-MU PPDU is *TPE* = maxu(*TPE,u*).
    - In HE-SIG-A field, the "a-factor" field, the "PE Disambiguity" field, and the "LDPC extra symbol" field, are common for all users.

72Y 0N 15A

- **Do you agree to add the following text into SFD:**
  - For UL-MU packet transmission:
    - AP indicates its desired *Nsym*, *a-factor*, LDPC Extra Symbol indication and *PE* duration values in trigger frame.
    - Possible PE values for UL-MU are TBD.
    - Each user when transmitting the UL-MU PPDU, shall encode and conduct PHY padding using the parameters:
    - N_{SYM} as indicated in the trigger frame;
    - *a-factor* as indicated in the trigger frame;
    - LDPC Extra Symbol as indicated in the trigger frame;
    - Append PE specified in the trigger frame.

Pass Unanimously

4.4. 11-15/0853r3 Extensible Preamble Format Design

No discussions

4.5. 11-15/1092 Support of 1x/2x/4x OFDM Symbol in HE SU PPDU

No discussions

4.6. 11-15/1119 Discussions on HE SIG-A Structure

Jianhan: pilot tones are the same?
A: TBD

SP:

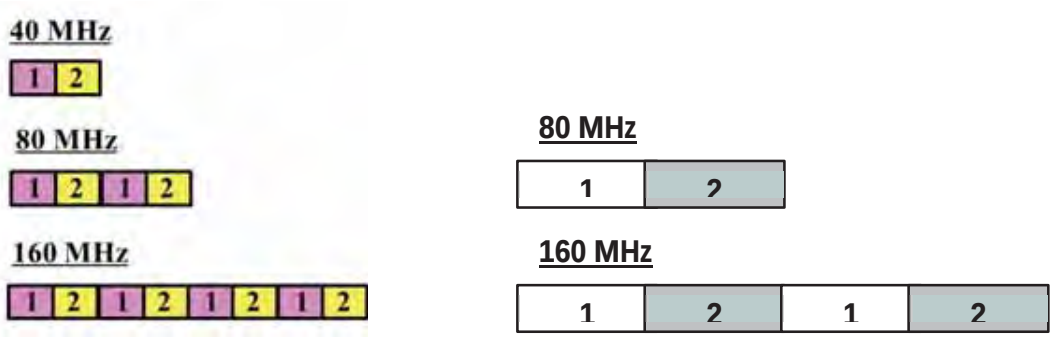
- **Do you agree the following?**
  - Information bits in HE-SIG-A are jointly encoded as in VHT-SIG-A (using 52 tones) with additional pilots on subcarriers of {±27, ±28} before HE-SIG-A symbols.

7Y 0N many ABS

4.7. 11-15/1106r1 SIGB structure

Jianhan: need to indicate the mode
A: yes, in SIGA if per PPDU change.
Ron: why no need for immunity to interference?
A: no much OBSS interference in many scenarios
HW: 1/2/1/2/ have diversity gain.

- **Do you agree to modify the following in 11ax SFD:**
  HE-SIG-B is encoded on a per 20 MHz or 40 MHz basis using BCC with common and user blocks separated in the bit domain
  For bandwidths ≥ 40 MHz, the number of 20 MHz or 40 MHz subbands carrying different content is two and with structure as shown below. Each square in the figure represents 20 MHz (left) or 40MHz (right) subband and 1/2 represents different signaling information. The method to indicate 20MHz or 40MHz basis is TBD.



15Y 27N 22ABS

4.8 11-15/1066r0 HE-SIGB contents

Continue the deferred SP.

SP#1
Do you agree to add the following text to the 11ax SFD:
The RU allocation signaling in the common field of HE-SIG-B signals an 8 bit per 20MHz PPDU BW for signaling

- The RU arrangement in frequency domain
- Number of MU-MIMO allocations: The RUs allocated for MU-MIMO and the number of users in the MU-MIMO allocations.

The exact mapping of the 8 bit to the RU arrangement and the number of MU-MIMO allocations is TBD.
Signaling for the center 26 unit in 80MHz is TBD

56Y 0N 14A

SP#3
Do you agree to add the following text to the 11ax SFD:
The length of the user specific subfield in HE-SIG-B for a single-user allocation is equal to the length of the user specific subfield of each user in a multi-user allocation.

54Y 0N 14A

Appendix AI

HE-SIG-B Mapping and Compression

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HE-SIG-B

- **Basic structure and contents of the HE-SIG-B for MU-PPDUs were agreed in the last meeting**
  - Two HE-SIG-B channels (per 40MHz) – duplicated for BWs > 40Mhz [2]
  - The contents of the common and user specific sub-fields [3]
  - Number of bits of RU allocation signaling for different bandwidths [3]
  - Load balancing for user redistribution among HE-SIG-B channels when MU-MIMO is used in RUs > 242 tones are used.[3]

- **This presentation discusses**
  - Mapping of allocation information to the two HE-SIG-B channels.
  - Optimization of HE-SIG-B transmission and the need for indication in HE-SIG-A
    - Compression of common information for MU-MIMO

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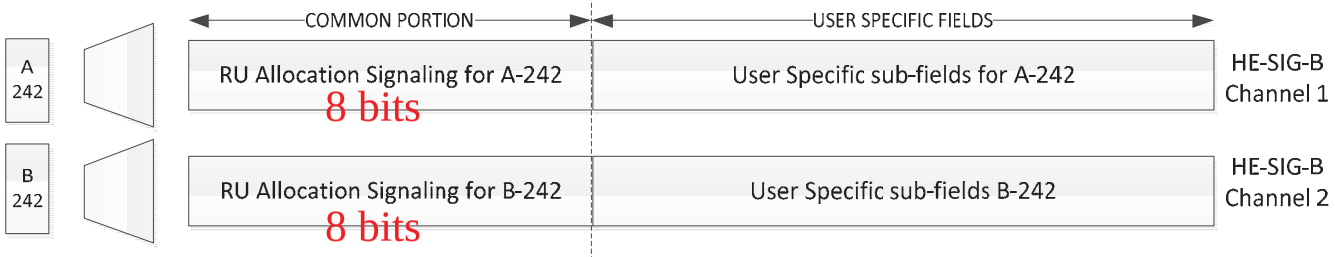
HE-SIG-B Information Mapping

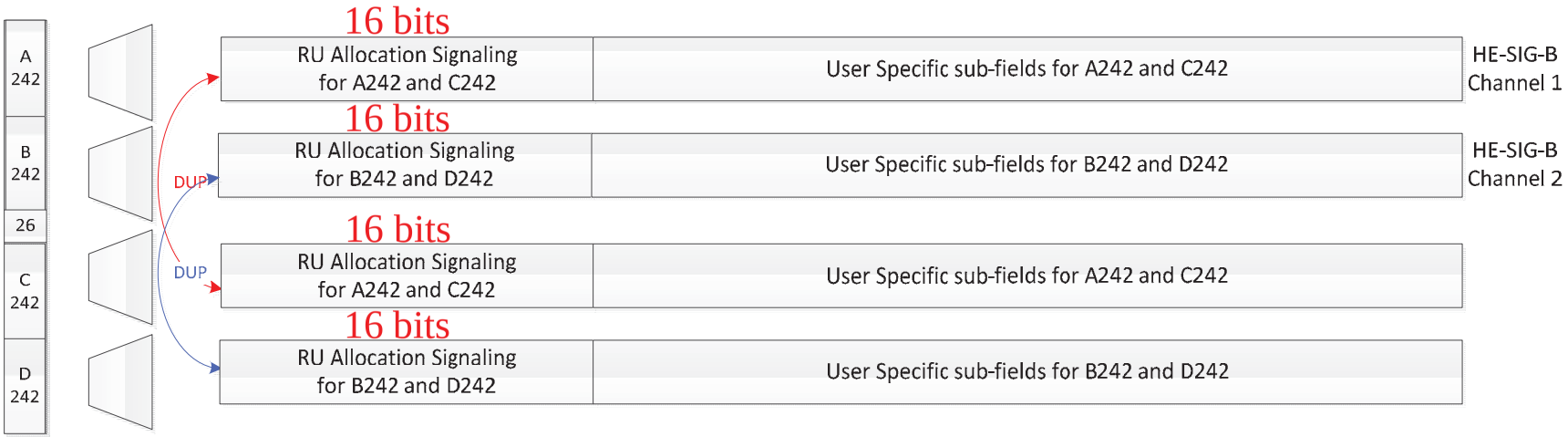
- For 20MHz, the HE-SIG-B information mapping is straight forward
  - Signal the RU Allocation Signaling using 8 bits in the common information fields followed by user specific sub-fields
    - STA uses the RU allocation signaling and the position of its allocation to unambiguously identify the RU containing its data

- For 40MHz, the HE-SIG-B has two channels each with different information
  - Each 20MHz channel carries control information for users scheduled in that 20MHz segment
    - May require padding in either of channels for last symbol alignment



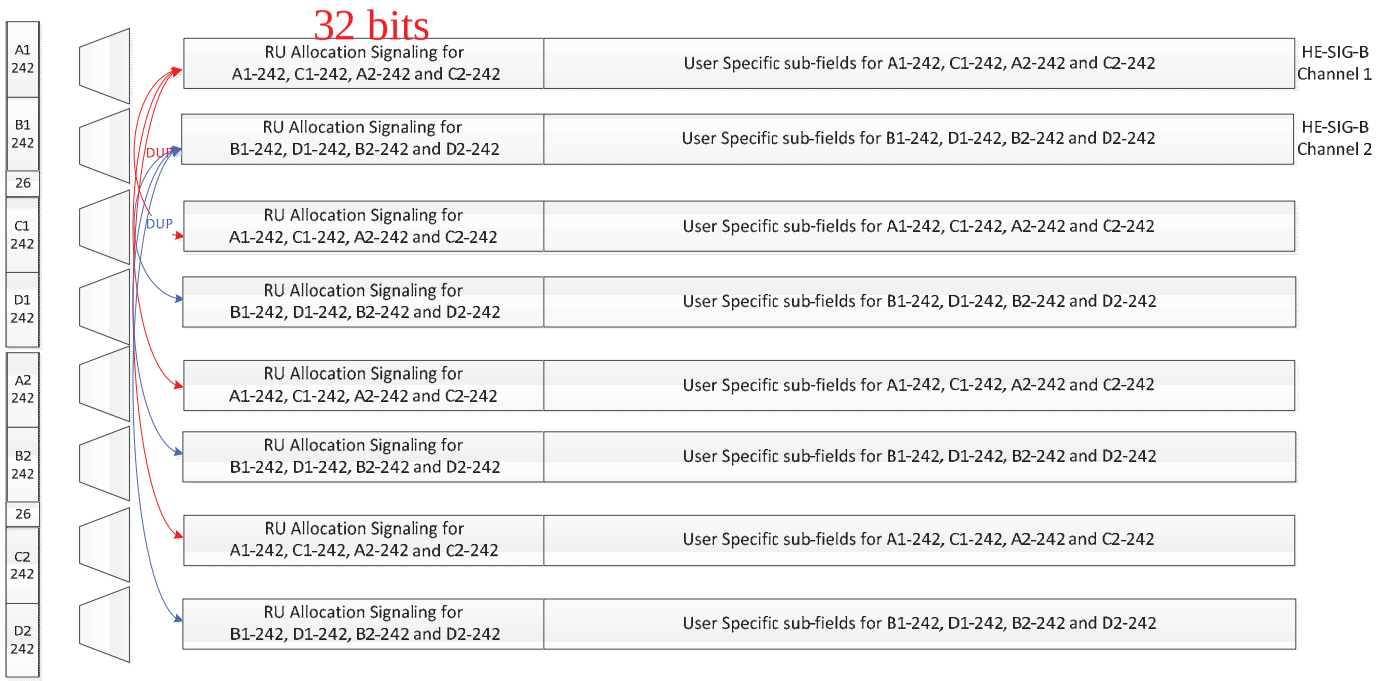
HE-SIG-B Information Mapping (80MHz)

- RU Allocation Signaling of four 20MHz segments have to be mapped to 2 HE-SIG-B channels duplicated per 40MHz [2]
  - 80MHz tone plan not aligned with 20MHz segments.
    - We refer to the 242 tones RUs that span the 20MHz segment– and can signal RU arrangements for smaller RUs with-in the 242 tone RUs - 8 bits per 242 tone RU – 16 bits of RU allocation signaling per HE-SIG-B Channel
    - The allocation signaling for the 26 tone RU around the DC is TBD as captured in the SFD.[1]
  - The default mapping of the RU allocation signaling and the associated user specific sub-fields for the four 242 tone RU segments to two HE-SIG-B channels is shown below



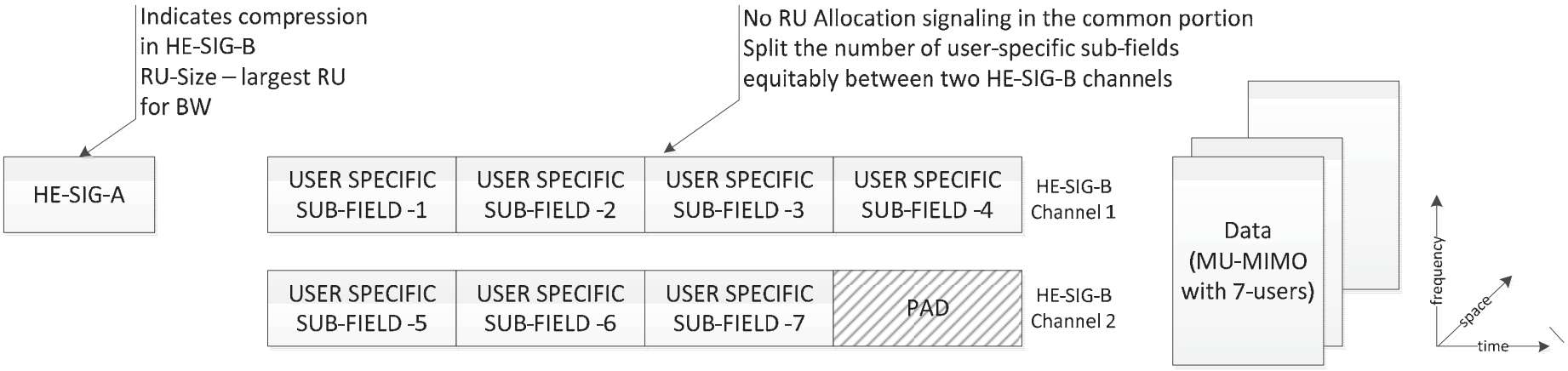
Extending Multiplexing Support to 160MHz

- 160MHz tone plan built as two concatenated 80MHz tone plans
  - RU Allocation Signaling information and the associated user specific sub-fields for four 242 tones RU segments have to be added to each HE-SIG-B channels - 32 bits totally for the four channels
  - The signaling of the two central 26 tone RUs in each 80MHz can be signaled separately and is currently TBD.
  - The default mapping of the RU allocation signaling and the associated user specific sub-fields for the eight 242 tone RU segments to two HE-SIG-B channels is shown below



HE-SIG-B Compression for MU-MIMO

- For MU-MIMO over the entire BW, 1 bit in HE-SIG-A indicates compression.
  - No RU signaling information transmitted in HE-SIG-B
    - RU Size is set to the largest RU for the BW (20MHz – 242 tone RU, 40 – 484, 80– 996, 160 – 2x996)
  - The user specific sub-fields are split equitably between the two HE-SIG-B Channels for efficient load-balancing
    - For k user MU-MIMO PPDU, $1, \ldots \left\lceil \frac{k}{2} \right\rceil$ user specific sub-fields in HE-SIG-B channel 1 and $\left\lceil \frac{k}{2} \right\rceil + 1, \ldots, k$ user specific sub-fields in HE-SIG-B channel 2
    - Pad to end contents in both channels at same OFDM symbol



Summary

- The resource allocation signaling in the common control field and user specific subfields for an STA carried in the HE-SIG-B are transmitted in the same 20MHz sub-channel as the data for 20MHz and 40MHz PPDU.
- The default mapping of the RU allocation signaling and user-specific fields of the component 242 tone RU segments of 80MHz and 160MHz PPDU to the two HE-SIG-B channels are also defined.

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- When 11ac- style MU-MIMO over the whole bandwidth is used, no RU allocation signaling is necessary in the common portion of the HE-SIG-B
  - One compression bit in the HE-SIG-A indicates full bandwidth MU-MIMO.
  - The user specific fields are split equitably between the two HE-SIG-B channels.
  - Improves efficiency by saving HE-SIG-B overhead.

References

[1] 11-15-0132-09-00ax-spec-framework

[2] 11-15-0821-02-00ax-HE-SIG-B-structure

[3] 11-15-1066-00-00ax-he-sig-b-contents

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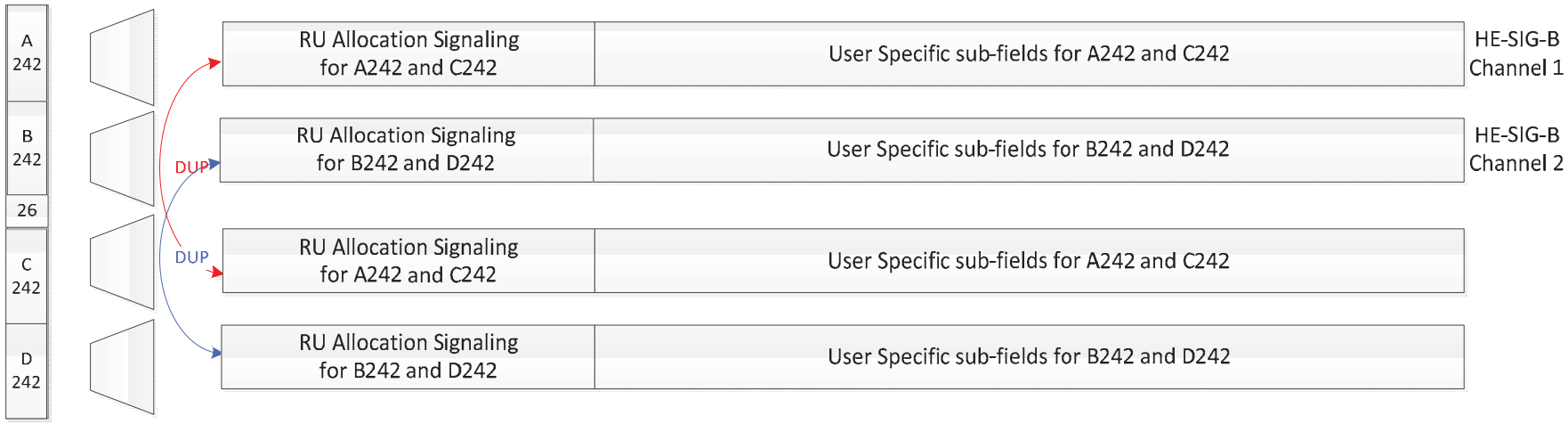
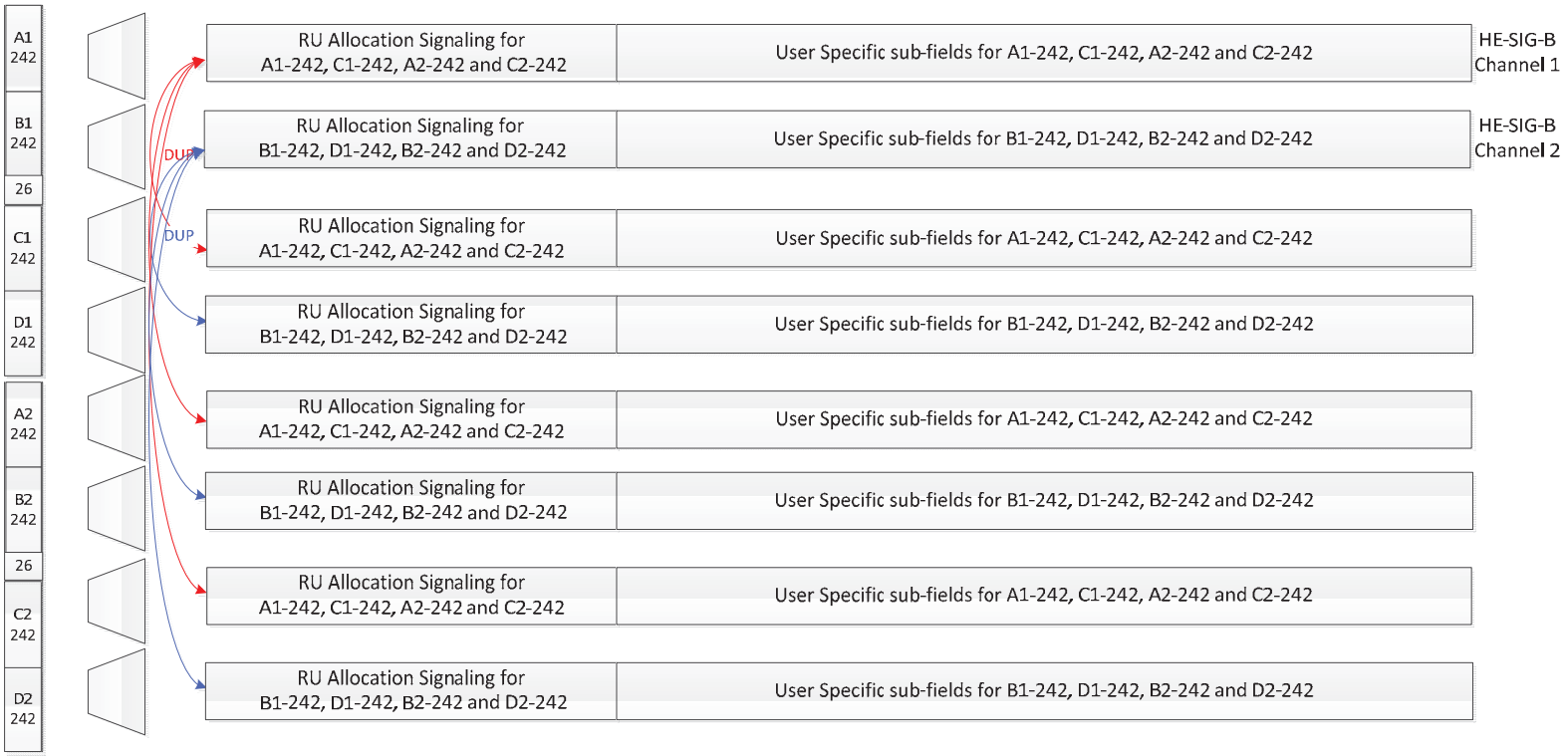
Straw Poll #1

Do you agree to add the following text to the 11ax SFD:

- The resource allocation signaling in the common control field and user specific subfields for an STA carried in the HE-SIG-B are transmitted in the same 20MHz sub-channel as the data for 20MHz and 40MHz PPDU.
- For an 80MHz PPDU, the default mapping per 20MHz as shown in the figure below.



- For a 160MHz PPDU , the default mapping per 20MHz is as shown in the figure below



Straw Poll #2

Do you agree to add the following text to the 11ax SFD:

- A compression bit is carried in the HE-SIG-A MU format to differentiate full BW MU-MIMO from OFDMA MU PPDU.
- In case of full BW MU-MIMO, the following conditions hold:
  - Only applicable for RU sizes 242,484,996,2*996
  - The RU information in HE-SIGB common is not signaled
  - For bandwidths > 20MHz, the user specific sub-fields are split equitably between the two HE-SIG-B Channels

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Appendix AJ

TGax PHY Ad Hoc Nov 2015 Meeting Agenda

Date: 2015-11-10

Authors:

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IEEE 802.11 TGax
High Efficiency WLAN
PHY Ad Hoc

Co-Chairs:
Yakun Sun (Marvell)
Jianhan Liu (Mediatek)
Bo Sun (ZTE)

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Agenda Items

- Call meeting to order
- Patent policy, etc. (Call for Potentially Essential Patents)
- Set and approve agenda

- Review ad hoc rules
- Technical Presentations approved by 802.11ax for presentation this week, and related straw polls
- Any other technical presentations

Meeting Protocol, Attendance, Voting & Document Status

- **Please announce your affiliation when you first address the group during a meeting slot**
- **Cell Phones to be silent or Off**
- **Register your attendance via https://imat.ieee.org while on meeting SSID (e.g. Verilan-secure)**
- **Make sure your badges are correct**
- **If you plan to make a submission be sure it does not contain company logos or advertising**
- **Questions on Voting status, Ballot pool, Access to Reflector, Documentation, Member's Area**
  - Contact Jon Rosdahl – jrosdahl@ieee.org

Patent Policy and Other Guidelines

- Following 5 slides

Instructions for the WG Chair

The IEEE-SA strongly recommends that at each WG meeting the chair or a designee:

- **Show slides #1 through #4 of this presentation**
- **Advise the WG attendees that:**
  - The IEEE's patent policy is consistent with the ANSI patent policy and is described in Clause 6 of the *IEEE-SA Standards Board Bylaws*;
  - Early identification of patent claims which may be essential for the use of standards under development is strongly encouraged;
  - There may be Essential Patent Claims of which the IEEE is not aware. Additionally, neither the IEEE, the WG, nor the WG chair can ensure the accuracy or completeness of any assurance or whether any such assurance is, in fact, of a Patent Claim that is essential for the use of the standard under development.
- **Instruct the WG Secretary to record in the minutes of the relevant WG meeting:**
  - That the foregoing information was provided and that slides 1 through 4 (and this slide 0, if applicable) were shown;
  - That the chair or designee provided an opportunity for participants to identify patent claim(s)/patent application claim(s) and/or the holder of patent claim(s)/patent application claim(s) of which the participant is personally aware and that may be essential for the use of that standard
  - Any responses that were given, specifically the patent claim(s)/patent application claim(s) and/or the holder of the patent claim(s)/patent application claim(s) that were identified (if any) and by whom.
- The WG Chair shall ensure that a request is made to any identified holders of potential essential patent claim(s) to complete and submit a Letter of Assurance.
- It is recommended that the WG chair review the guidance in *IEEE-SA Standards Board Operations Manual* 6.3.5 and in FAQs 12 and 12a on inclusion of potential Essential Patent Claims by incorporation or by reference.

Note: **WG** includes Working Groups, Task Groups, and other standards-developing committees with a PAR approved by the IEEE-SA Standards Board.

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Participants, Patents, and Duty to Inform

All participants in this meeting have certain obligations under the IEEE-SA Patent Policy. Participants:

- **"Shall inform the IEEE (or cause the IEEE to be informed)" of the identity of each "holder of any potential Essential Patent Claims of which they are personally aware" if the claims are owned or controlled by the participant or the entity the participant is from, employed by, or otherwise represents**
  - **"Personal awareness" means that the participant "is personally aware that the holder may have a potential Essential Patent Claim," even if the participant is not personally aware of the specific patents or patent claims**
- **"Should inform the IEEE (or cause the IEEE to be informed)" of the identity of "any other holders of such potential Essential Patent Claims" (that is, third parties that are not affiliated with the participant, with the participant's employer, or with anyone else that the participant is from or otherwise represents)**
- **The above does not apply if the patent claim is already the subject of an Accepted Letter of Assurance that applies to the proposed standard(s) under consideration by this group**

Quoted text excerpted from IEEE-SA Standards Board Bylaws subclause 6.2

- Early identification of holders of potential Essential Patent Claims is strongly encouraged
- No duty to perform a patent search

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Slide #1

Patent Related Links

All participants should be familiar with their obligations under the IEEE-SA Policies & Procedures for standards development.

Patent Policy is stated in these sources:

IEEE-SA Standards Boards Bylaws

http://standards.ieee.org/guides/bylaws/sect6-7.html#6

IEEE-SA Standards Board Operations Manual

http://standards.ieee.org/guides/opman/sect6.html#6.3

Material about the patent policy is available at

http://standards.ieee.org/board/pat/pat-material.html

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If you have questions, contact the IEEE-SA Standards Board Patent Committee Administrator at patcom@ieee.org or visit http://standards.ieee.org/board/pat/index.html

This slide set is available at http://standards.ieee.org/board/pat/pat-slideset.ppt

Slide #2

Call for Potentially Essential Patents

- **If anyone in this meeting is personally aware of the holder of any patent claims that are potentially essential to implementation of the proposed standard(s) under consideration by this group and that are not already the subject of an Accepted Letter of Assurance:**
  - Either speak up now or
  - Provide the chair of this group with the identity of the holder(s) of any and all such claims as soon as possible or
  - Cause an LOA to be submitted

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Slide #3

Other Guidelines for IEEE WG Meetings

- All IEEE-SA standards meetings shall be conducted in compliance with all applicable laws, including antitrust and competition laws.
  - **Don't discuss the interpretation, validity, or essentiality of patents/patent claims.**
  - **Don't discuss specific license rates, terms, or conditions.**
    - Relative costs, including licensing costs of essential patent claims, of different technical approaches may be discussed in standards development meetings.
      - Technical considerations remain primary focus
  - **Don't discuss or engage in the fixing of product prices, allocation of customers, or division of sales markets.**
  - **Don't discuss the status or substance of ongoing or threatened litigation.**
  - **Don't be silent if inappropriate topics are discussed … do formally object.**

See *IEEE-SA Standards Board Operations Manual*, clause 5.3.10 and "Promoting Competition and Innovation: What You Need to Know about the IEEE Standards Association's Antitrust and Competition Policy" for more details.

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Slide #4

Ad Hoc Groups Operation

- **Straw Polls are only allowed during Ad Hoc group meeting // no motions, anyone can vote**
- **A straw poll affecting the Spec Framework has to start with,**
  - Do you agree to add to the TG Specification Frame work document?
- **A straw poll needs to achieves at least 75% to be converted to a motion at the TG level.**
- **Each Presentation will be limited to 20 minutes.**

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Meeting Schedule

	Monday	Tuesday		Wednesday		Thursday
AM1	**TGax**			**TGax**		**TGax**
AM2		PHY	MAC			
PM1	**TGax**	MU	SR	PHY	SR	**TGax**
PM2				PHY	MU	
EVE		PHY	MAC			

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Submissions

Preamble (SIGA)

- **11-15/1309 Extended Range Support for 11ax**
- **11-15/1353 Preamble Formats**
- **11-15/1357 Extra tones in the preamble**
- **11-15/1372 L-LENGTH Equation Updates**

Data

- **11-15/1289 Non-Uniform Constellations for 1024-QAM**
- **11-15/1305 STBC and Padding Discussions**
- **11-15/1310 11ax LDPC Tone Mapper for 160MHz**
- **11-15/1311 11ax Spectral Mask**
- **11-15/1327 Diversity Mode in OFDMA**
- **11-15/1329 Link Adaptation for HE WLAN**
- **11-15/1331 PHY Padding Capability Signaling**

STF/LTF

- **11-15/1323 HE-STF Sequence**
- **11-15/1303 LTF Sequence Designs**
- **11-15/1334 HE-LTF Sequence Design**
- **11-15/1322 Channel Estimation Enhancement and Transmission Efficiency Improvement Using Beam-Change Indication and 1x HE-LTF**

SIGB

- **11-15/1304 Supported Resource Allocations in SIG-B**
- **11-15/1315 HE-SIG-B Mapping and Compression**
- **11-15/1324 MCS for HE-SIG-B**
- **11-15/1335 HE-SIG-B Contents**
- **11-15/1059 SIG-B Encoding Structure Part II**
- **11-15/1350 Spatial Configuration And Signaling for MU-MIMO**
- **11-15/1354 SIGA fields and Bitwidths**

Sounding and feedback

- 11-15/1320 Maximum Tone Grouping Size for 802.11ax Feedback
- 11-15/1321 Reducing Explicit MIMO Compressed Beamforming Feedback Overhead for 802.11a
- 11-15/1332 Implicit Sounding for HE WLAN
- 11-15/1347 Strategies to reduce MIMO feedback overhead
- 11-15/1349 Sounding for Uplink Transmission

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Tuesday AM2

- 11-15/1309 Extended Range Support for 11ax
- 11-15/1353 Preamble Formats
- 11-15/1357 Extra tones in the preamble
- 11-15/1372 L-LENGTH Equation Updates
- 11-15/1289 Non-Uniform Constellations for 1024-QAM
- 11-15/1310 11ax LDPC Tone Mapper for 160MHz

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1309r1 SP#1

- **Do you support adding the following to the spec framework**

“L-STF power is boosted by 3 dB in the extended range preamble”

309

- **Y: 50**
- **N: 4**
- **A: 18**

SP passes

1309r1 SP#2

- **Do you support adding the following to the spec framework**

“L-LTF power is boosted by 3 dB in the extended range preamble”

- **Y: 51**
- **N: 0**
- **A: 22**

SP passes

1353r0 SP #1

Do you support that there are only three pre-HE-STF preamble formats defined as:

- SU format (mandatory) / Trigger based UL
- MU format (mandatory)
- Extended range SU format

311

Yes: 51

No: 2

Abs: 21

SP passes

1353r0 SP #2

Do you support the signaling of the three preamble formats as shown on slide 15?

312

Yes: 55

No: 0

Abs: 21

SP passes

1353r0 SP #3

Do you support that the following are the only mandatory combinations of LTF size and CP size

- **2x LTF+ 0.8uS**
- **2x LTF+ 1.6uS**
- **4x LTF+ 3.2uS**

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with HE-LTF and payload using the same CP size.

and that LTF size and CP size are jointly signaled using 3 bits.

Yes: 57

No: 0

Abs: 15

SP passes

1353r0 SP #4

Do you support that SIGB only has one CP size equal to 0.8uS

314

Yes: 61

No: 0

Abs: 14

SP passes

1357r1 Straw poll

- **Do you support to:**
  - Allocate 4 extra subcarriers, two at each edge of each 20MHz sub-channel, for L-SIG, RL-SIG, HE-SIG-A and HE-SIG-B fields in 11ax PPDUs.
    - The 4 subcarriers added to the L-SIG and RL-SIG fields are transmitted with known TBD BPSK constellations (+-1).
    - The number of data subcarriers in HE-SIG-A and HE-SIG-B fields are increased by 4 in each 20MHz sub-channel.
    - L-SIG, RL-SIG, HE-SIG-A and HE-SIG-B fields are always transmitted with the same total power as L-LTF field (in cases when L-LTF is not being boosted).
  - Y: 46
  - N: 0
  - A: 13
  - **SP Passes**

315

1372r0 Straw Poll

- **Do you agree to make the following changes in red, on the equations in Section 3.3.5 of TGax SFD?**

$$L_LENGTH = \left\lceil \frac{TXTIME - 20}{4} \right\rceil \times 3 - 3 - \boldsymbol{m}, m = 1 \text{ or } 2$$

$$TXTIME = T_{L_PREAMBLE} + T_{HE_PREAMBLE} + T_{HE_DATA} + T_{PE}$$

$$N_{SYM} = \left\lfloor \frac{\left(\frac{L_LENGTH + m + 3}{3} \times 4 - T_{HE_PREAMBLE} \right)}{T_{SYM}} \right\rfloor - b_{PE_\boldsymbol{Disambiguity}}$$

$$T_{PE} = \left\lfloor \frac{\left(\frac{L_LENGTH + m + 3}{3} \times 4 - T_{HE_PREAMBLE} \right) - N_{SYM} \times T_{SYM}}{4} \right\rfloor \times 4$$

Y: 71
N: 0
A: 2
SP passes

316

1289r1 Straw Poll #1

Do you agree that is desirable to achieve the maximum possible gain for 1024-QAM (e.g. make also use of non-uniform constellations)?

317

- **Y/N/A**

Y: 10

N: 5

Abs: many

1289r1 Straw Poll #2

Do you agree that non-uniform constellations shall be used for 1024-QAM?

- **Y/N/A**

- **Y: 10**
- **N: 9**
- **Abs: Many**

1310r0 Straw-poll

- **Do you support to add the following text to 11ax SFD?**
  - 2x996RU employs a segment parser (as in 11ac) between two 996 tones (frequency segments) and the LDPC tone mapper in each 996 tone segment uses D_{TM}=20

- **Y: 57**
- **N: 0**
- **A: 3**

Tuesday Evening

- 11-15/1305 STBC and Padding Discussions
- 11-15/1311 11ax Spectral Mask
- 11-15/1327 Diversity Mode in OFDMA
- 11-15/1329 Link Adaptation for HE WLAN
- 11-15/1331 PHY Padding Capability Signaling

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1305r0 SP

- Do you agree to add the following text in 11ax SFD?
  - *STBC is an optional feature in 11ax and it is ONLY defined for single spatial stream (Nss=1 and Nsts=2)*
  - *In a MU PPDU all RUs are either STBC or not STBC.*

321

Y: 46

N: 0

A: 12

1311r0 Straw-poll

- **Do you support to add the following to 11ax SFD?**

The spectral masks for 11ax non-OFDMA 20/40/80/160/80+80 MHz PPDU are defined as in slides 13-15?

  - The bandwidth of the applied spectrum mask for a (non-OFDMA) PPDU shall be determined by the bandwidth occupied by the pre HE-STF portion of the preamble in this PPDU, regardless of the BSS bandwidth
  - The spectral mask requirements do not apply to LO leakage

322

  - Y: 49
  - N: 0
  - A: 8

1327r0 Straw Poll 1

Do you agree to add the following to the SFD?

- **Transmission diversity mode (i.e. non-continuous transmission) shall be supported in 11ax.**
  - Transmission diversity mode divides a single encoded packet in half and maps to 13 + 13 (26 RU) or 26 + 26 (52 RU) tones, that are spaced apart in frequency.
  - TBD whether only 26 RU, only 52 RU, or both 26 and 52 RU support transmit diversity mode.

323

- **Y: 12**
- **N: 23**
- **A: 21**

1329r1 Straw Poll #1

- Do you agree to include the following text to TGax SFD:
- **HE link adaptation shall define reference payload size for the reported MCS in MFB.**
  - Reference payload size may be dependent on the frames involved in link adaptation or fixed in specification. Details TBD.

- **Y: 12**
- **N: 1**
- **A: many**

1329r1 Straw Poll #2

- Do you agree to include the following text to TGax SFD:
- **HE link adaptation field, which is part of HE variant of HT control field, consists of MFB and TBD subfields. The MFB subfield includes NSS and MCS subfield.**

325

- **Y: 17**
- **N: 0**
- **A: 37**

1331r0 Strawpoll #1

- To you agree to added the following text in **SFD**:
- **HE padding and packet extension capability field shall be defined separately for STBC and non-STBC transmissions.**
- **HE padding and packet extension capability field content for STBC transmission is limited to Nss = 1.**

326

- **Y: 12**
- **N: 28**
- **A: 16**

1331r0 Strawpoll #2

- Do you agree to the following concept:
- **Maximum T_{PE} of 0us, 8us, or 16us is determined by number of codewords in the last two OFDM symbols (denoted as $N_{CW,left}$) containing information payload.**
- **Maximum T_{PE} capability can be signaled using two threshold values threshold8 and threshold16, which determine the $N_{CW,left}$ threshold for using max T_{PE} of 8us or 16us, respectively. The threshold value will be common for all BW and N_{SS}.**

- **Y:12**
- **N:26**
- **A:13**

Wednesday PM1

- 11-15/1323 HE-STF Sequence
- 11-15/1303 LTF Sequence Designs
- 11-15/1334 HE-LTF Sequence Design
- 11-15/1322 Channel Estimation Enhancement and Transmission Efficiency Improvement Using Beam-Change Indication and 1x HE-LTF
- 11-15/1315 HE-SIG-B Mapping and Compression
- 11-15/1324 MCS for HE-SIG-B

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1323r1 Straw poll

- **Do you agree to add the following HE-STF sequences for 0.8us and 1.6us periodicity to the 11ax SFD:**
  - ***M*** = {-1 -1 -1 +1 +1 +1 -1 +1 +1 +1 -1 +1 +1 -1 +1}
  - 1x HE-STF sequences
    - 20MHz
      - $HES_{-112,112}(-112:16:112)$ = ***M* *(1+*j*)*sqrt(1/2)**
      - $HES_{-112,112}(0) = 0$
    - 40MHz
      - $HES_{-240,240}(-240:16:240)$ = {***M***, 0, -***M***} ***(1+*j*)*sqrt(1/2)**
    - 80MHz
      - $HES_{-496,496}(-496:16:496)$ = {***M***, 1, -***M***, 0, -***M***, 1, -***M***} ***(1+*j*)*sqrt(1/2)**
  - 2x HE-STF sequences
    - 20MHz
      - $HES_{-120,120}(-120:8:120)$ = {***M***, 0 , -***M***} ***(1+*j*)*sqrt(1/2)**
    - 40MHz
      - $HES_{-248,248}(-248:8:248)$ = {***M***, -1, -***M***, 0, ***M***, -1, ***M***} ***(1+*j*)*sqrt(1/2)**
      - $HES_{-248,248}(\pm 248) = 0$
    - 80MHz
      - $HES_{-504,504}$ (-504:8:504) = {***M***, -1, ***M***, -1, -***M***, -1, ***M***, 0, -***M***, 1, ***M***, 1, -***M***, 1, -***M***} ***(1+*j*)*sqrt(1/2)**
      - $HES_{-504,504}(\pm 504) = 0$

329

Y: 48, N: 0, A: 12

1303r0 Straw Poll #1

- **Do you agree to add the following texts into the SFD?**
  - A HE LTF for 242SU shall reuse $VHT_{-122,122}$ with the same phase rotation [1, -1, -1, -1].
    - $HELTF_{242SU}$ = $VHTLTF_{-122,122}$ with the phase rotation of VHT80

330

Withdrawn

1303r0 Straw Poll #2

- **Do you agree to add the following texts into the SFD?**
  - HE LTFs for 26RU, 52RU, and 106RU shall use the following sequences:
    - $HELTF_{26RU}$ ={1,-1,1,1,-1,-1,-1,-1,1,1,1,1,-1,1,1,1,1,-1,1,1,1,1,-1,1,1,1,-1,1,1,1,-1,-1,-1,-1,-1}
    - $HELTF_{52RU}$ = {$HELTF_{26RU}$(1:13), -$HELTF_{26RU}$(14:26), -$HELTF_{26RU}$}
    - $HELTF_{106RU}$ = {$HELTF_{26RU}$, 1, -$HELTF_{26RU}$, -$HELTF_{26RU}$, 1, -$HELTF_{26RU}$}

331

Withdrawn

1303r0 Straw Poll #3

- **Do you agree to add the following texts into the SFD?**
  - A HE LTF for 242RU shall use $VHT_{-122,122}$ removing zeros with the phase rotation [1, -1, -1, -1].
    - $HELTF_{242RU}$ = {$VHTLTF_{-122,122left}$(1:60), -$VHTLTF_{-122,122left}$(61:121), -$VHTLTF_{-122,122right}$(1:121)},
      - where $VHTLTF_{-122,122left}$ and $VHTLTF_{-122,122right}$ are 121-length sequences in the left and right sides of 3 DCs in $VHTLTF_{-122,122}$, respectively

332

Withdrawn

1303r0 Straw Poll #4

- **Do you agree to add the following texts into the SFD?**
  - HE LTF sequences for 484RU, 484SU, and 996SU shall be made from concatenations of the HELTF sequence for 242RU in frequency domain, as shown in the followings:
    - $HELTF_{484RU} = \{HELTF_{242RU}, HELTF_{242RU}\}$
    - $HELTF_{484SU} = \{HELTF_{242RU}, 0, 0, 0, 0, 0, HELTF_{242RU}\}$
    - $HELTF_{996SU} = \{1, HELTF_{242RU}, -HELTF_{242RU}, -HELTF_{26RU}(1:13), 0,0,0,0,0, -HELTF_{26RU}(14:26), -HELTF_{242RU}, -HELTF_{242RU}, 1\}$

333

Withdrawn

1334r1 SP#1

- **Do you support to add to SFD**
  - 4x/2x HE-LTF sequences for 80MHz in slide 13-15
  - 4x/2x HE-LTF sequences for 40MHz in slide 20-21
  - 4x/2x HE-LTF sequences for 20MHz in slide 26

334

- Y: 63
- N: 2
- A: 16

1334r1 SP#2

- **Do you support to add to SFD**
  - In all transmission modes, HE-STF and HE-LTF only populate RUs that are populated in the data field.

335

- Y: 74
- N: 6
- A: 15

1334r1 SP#3

- **Do you support to add to SFD**
  - Gamma (tone rotation as defined in 22.3.7.5) is not applied on HE-STF and beyond.
    - TBD in case of a duplicated HE PPDU (if ever defined)

336

- Y: 60
- N: 0
- A: 13

1322r0 Straw Poll #1

- **Do you agree to add 1-bit beam-change indication into HE-SIGA?**
  - Value “1” indicates that spatial mapping is changed
  - Value “0” indicates that spatial mapping is unchanged

337

- **Y: 63**
- **N: 0**
- **A: 14**

Straw poll #2

- **Do you agree that when beam-change indication is “0”, the pre-HE-STF portion preamble shall be spatially mapped in the same way as HE-LTF1 on each tone?**

338

- **Y: 62**
- **N: 0**
- **A: 8**

Straw Poll #3

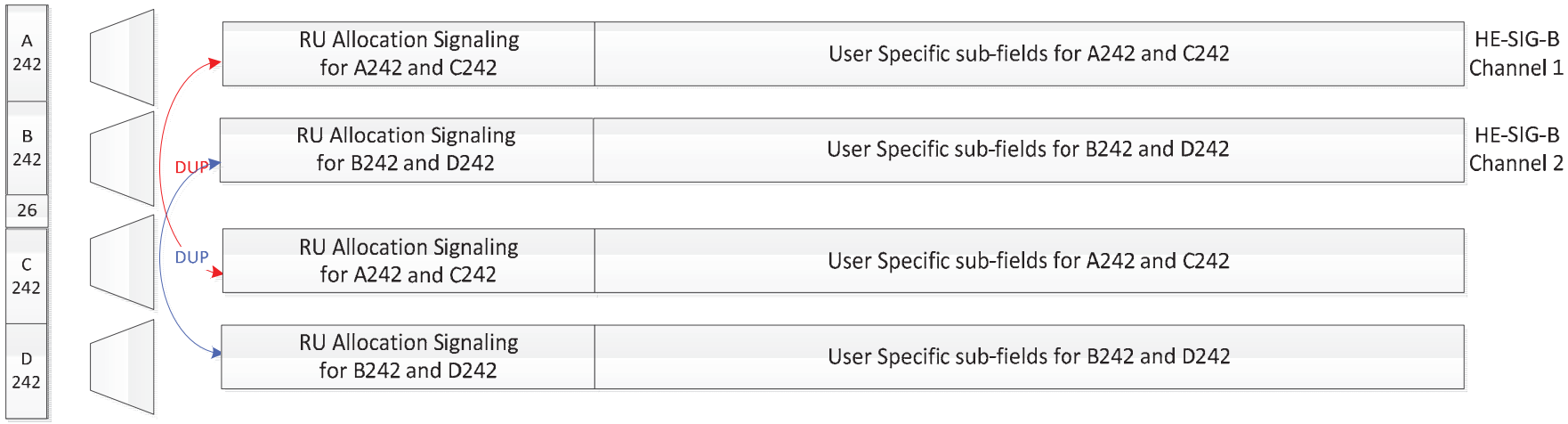
- **Do you agree to add 1x HE-LTF as an optional mode in 11ax for SU PPDU (TBD for MU-MIMO)?**
  - 1xLTF + 0.8us GI is one optional combination as indicated by the "GI and LTF size" sub-field in HE-SIG-A.

339

- **Y: 60**
- **N: 1**
- **A: 14**

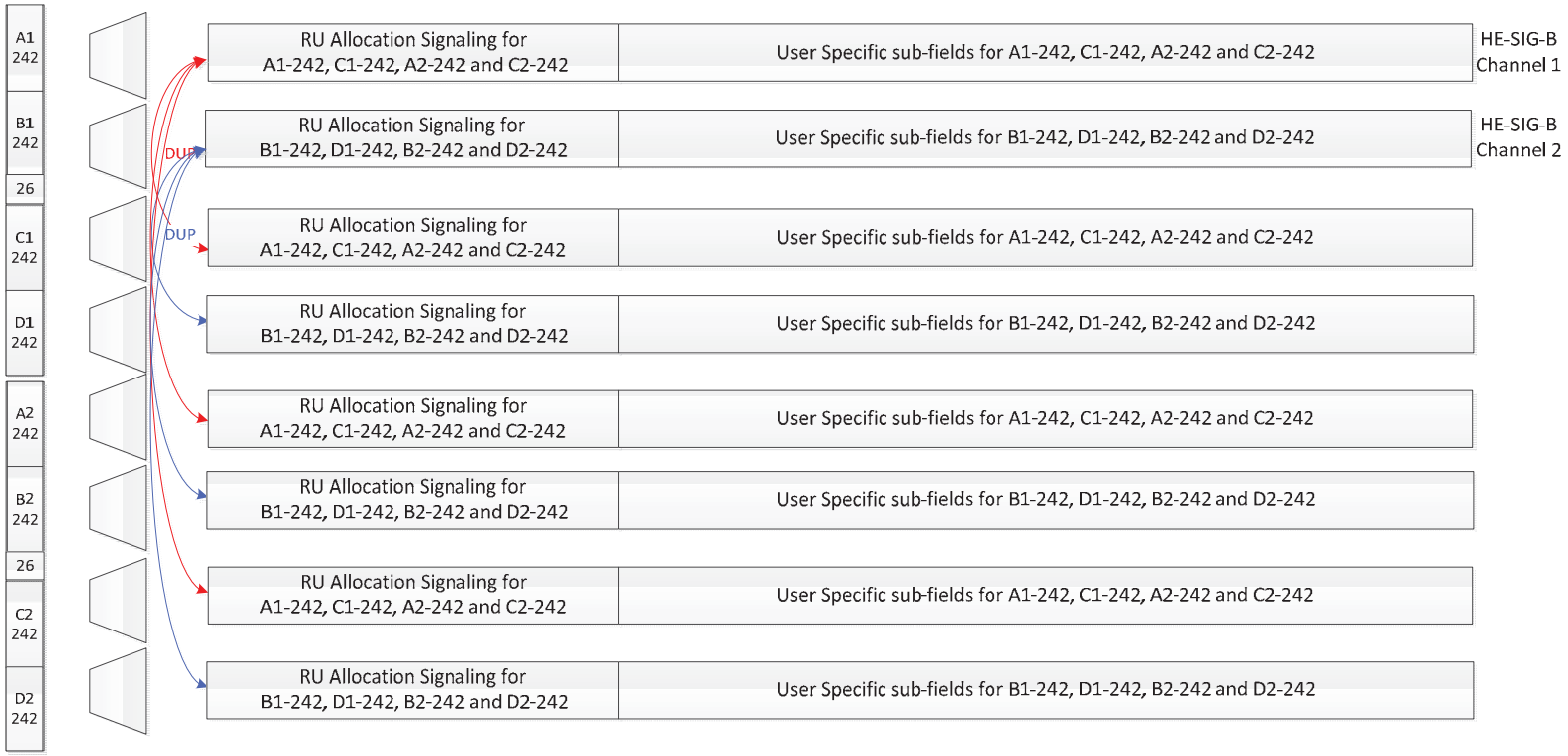
1315r1 Straw Poll #1

- **Do you agree to add the following text to the 11ax SFD:**
- The resource allocation signaling in the common control field and user specific subfields for an STA carried in the HE-SIG-B are transmitted in the same 20MHz sub-channel as the data for 20MHz and 40MHz PPDU.
- For an 80MHz PPDU, the default mapping per 20MHz as shown in the figure below.



340

- For a 160MHz PPDU , the default mapping per 20MHz is as shown in the figure below



No objection

1315r1 Straw Poll #2

- **Do you agree to add the following text to the 11ax SFD:**

- A compression bit is carried in the HE-SIG-A MU format to differentiate full BW MU-MIMO from OFDMA MU PPDU.
- In case of full BW MU-MIMO, the following conditions hold:
  - Only applicable for RU sizes 242,484,996,2*996
  - The RU information in HE-SIGB common is not signaled
  - For bandwidths > 20MHz, the user specific sub-fields are split equitably between the two HE-SIG-B Channels

342

- **No objection**

Wednesday PM2

- 11-15/1324 MCS for HE-SIG-B (Q&A, SP)

- 11-15/1335 HE-SIG-B Contents
- 11-15/1304 Supported Resource Allocations in SIG-B
- 11-15/1059 SIG-B Encoding Structure Part II
- 11-15/1350 Spatial Configuration And Signaling for MU-MIMO
- 11-15/1354 SIGA fields and Bitwidths

1324r0 Straw poll #1

- **Do you agree to add to TGax Specification Framework Document**
  - Signaling in the first encoded part (HE-SIG-A) has the following MCS values for HE-SIG-B:
    - MCS0, MCS1, MCS2, MCS3, MCS4, MCS5
    - Other MCS is TBD
  - Signaling for HE-SIG-B MCSs has 3 bits
    - If two MCS set for BW≥40MHz are to be signaled, additional TBD bits used
- **Y: 34**
- **N: 0**
- **A: 9**

344

1335r2 SP#1

- **Do you agree to modify the text in IEEE 802.11ax SFD(r9) as follows**
  - Change “The exact mapping of the 8 bit to the arrangement and the number of MU-MIMO allocations is TBD.” to “The mapping of the 8 bits to the arrangement and the number of MU-MIMO allocations is defined in the following lookup table.”

8 bits indices	#1	#2	#3	#4	#5	#6	#7	#8	#9	Num of entries
000 0 0000	26	26	26	26	26	26	26	26	26	1
000 0 0001	26	26	26	26	26	26	26	52		1
000 0 0010	26	26	26	26	26	52		26	26	1
000 0 0011	26	26	26	26	26	52		52		1
000 0 0100	26	26	52		26	26	26	26	26	1
000 0 0101	26	26	52		26	26	26	52		1
000 0 0110	26	26	52		26	52		26	26	1
000 0 0111	26	26	52		26	52		52		1
000 0 1000	52		26	26	26	26	26	26	26	1
000 0 1001	52		26	26	26	26	26	52		1
000 0 1010	52		26	26	26	52		26	26	1
000 0 1011	52		26	26	26	52		52		1
000 0 1100	52		52		26	26	26	26	26	1
000 0 1101	52		52		26	26	26	52		1
000 0 1110	52		52		26	52		26	26	1
000 0 1111	52		52		26	52		52		1
000 1 xxxx	Definition TBD									16
00100 yyy	26	26	26	26	26	106				8
00101 yyy	26	26	52		26	106				8
00110 yyy	52		26	26	26	106				8
00111 yyy	52		52		26	106				8
01000 yyy	106				26	26	26	26	26	8
01001 yyy	106				26	26	26	52		8
01010 yyy	106				26	52		26	26	8
01011 yyy	106				26	52		52		8
011 xxxxx	Definition TBD									32
10 yyy yyy	106				26	106				64
11 0 00yyy	242									8
11 0 01yyy	484									8
11 0 10yyy	996									8
11 0 11yyy	2*996									8
11 1 xxxxx	Definition TBD									32

Note: ‘yyy’ = 000~111 indicates number of MU-MIMO STAs.
Definition for entries with ‘x’ bits are TBD.

345

Y: 50
N: 4
A: 18

1335r2 SP#2

- **Do you agree to add the STAID size in the user specific subfields of HE-SIGB is 11bits?**

346

- **Y: 57**
- **N: 0**
- **A: 14**

1335r2 SP#3

- **Do you agree to add a DCM subfield (1-bit) to the user-specific subfields of HE-SIG-B in IEEE 802.11ax SFD(r9) (as shown in red)**
  - For single-user allocations in a RU: NSTS (Number of Spatial Streams), TxBF (transmit beamforming), MCS (Modulation and Coding Scheme), DCM (Dual Sub-Carrier Modulation) and Coding (Use of LDPC)
  - For each user in a multi-user allocation in a RU: Spatial Configuration Fields, MCS, DCM and Coding

347

- **Y: 54**
- **N: 0**
- **A: 19**

1304r1 Straw Poll #1

- **Do you agree to add the following text into the SFD?**
  - The 8 bits in the common field of HE SIG-B includes a state of ‘No STA Assigned’ for which no STA-specific field is transmitted

348

  - Y: 12
  - N: 26
  - A: 16

1304r1 Straw Poll #2

- **Do you agree to add the following text into the SFD?**
  - The number of spatially multiplexed STAs for 106 RU limited to 4
    - For RUs larger than 106, it can be 8 STAs as maximum

349

  - Y: 5
  - N: 34
  - A: 16

1304r1 Straw Poll #3

- **Do you agree to support the following text?**
  - The 8 bits in the common field of HE SIG-B includes explicit states for the existence of the center 26RU of 80MHz

350

  - Y: 9
  - N: 16
  - A: 25

1350r1 SP #1

- **Do you support to add the following text in Section x.x.x in current SFD:**
  - The number of spatially multiplexed user in a DL or UL MU-MIMO transmission is up to 8 (in a given RU)?

351

Y: 46

N: 5

A: 8

1350r1 SP #2

- **Do you support to add the following text in Section x.x.x current SFD:**
  - The Nsts value for each user in a MU-MIMO RU is less than or equal to 4?

352

- **Y: 41**
- **N: 1**
- **A: 7**

1350r1 SP #3

- **Do you support to add the following text in Section x.x.x in current SFD:**
  - A MU-MIMO user block includes a “spatial config” field of 4bit indicating the number of spatial streams for each multiplexed STA. The field is constructed by using the entries corresponding to the value of Nuser of this RU in the following table?

Nuser	B0…B3	Nsts[1]	Nsts[2]	Nsts[3]	Nsts[4]	Nsts[5]	Nsts[6]	Nsts[7]	Nsts[8]	#Entries
2	0000~0011	1~4	1							10
	0100~0110	2~4	2							
	0111~1000	3~4	3							
	1001	4	4							
3	0000~0011	1~4	1	1						13
	0100~0110	2~4	2	1						
	0111~1000	3~4	3	1						
	1001~1011	2~4	2	2						
	1100	3	3	2						
4	0000~0011	1~4	1	1	1					11
	0100~0110	2~4	2	1	1					
	0111	3	3	1	1					
	1000~1001	2~3	2	2	1					
	1010	2	2	2	2					
5	0000~0011	1~4	1	1	1	1				6
	0100~0101	2~3	2	1	1	1				
6	0000~0010	1~3	1	1	1	1	1			4
	0011	2	2	1	1	1	1			
7	0000~0001	1~2	1	1	1	1	1	1		2
8	0000	1	1	1	1	1	1	1	1	1

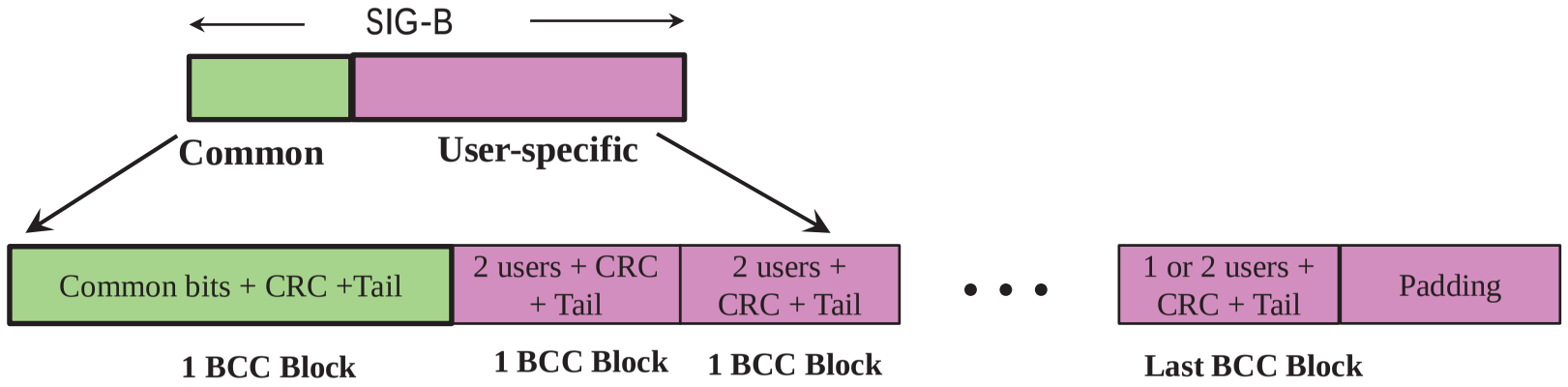
Y:48
N:1
A:10

353

1059r2 SP #1

Do you agree to modify the text in Section 3.2.4 of the SFD as follows

- **Two users are grouped together and jointly encoded in each BCC block in the user specific section of HE-SIG-B**
- ~~**The CRC in the common block is TBD**~~
- **The common block has a CRC separate from the CRC of the user specific blocks**
- **The last user information is immediately followed by tail bits (regardless of whether the number of users is odd or even) and padding bits are only added after those tail bits**



Yes: 56

No: 0

Abs: 7

1354r1 Strawpoll 1

- Do you agree to add to the TG Specification Frame work document: the HE-SIG-A field definitions for SU preamble format in [2] (PHY Motions 43, 46, 48, 54) shall be replaced with the table in slide 11?

355

- Yes: 54
- No: 0
- Abs: 7

1354r1 Strawpoll 2

- Do you agree to add to the TG Specification Frame work document: the HE-SIG-A field definition for the MU preamble format [2] (PHY Motions 44, 46, 54) shall be replaced with the table in slide 12?

356

- Yes: 50
- No: 0
- Abs: 7

1354r1 Strawpoll 3

- Do you agree to add to the TG Specification Frame work document: the HE-SIG-A field definition for trigger based UL preamble format in [2] (PHY Motion 45) shall be replaced with the table in slide 13?

357

- Yes: 51
- No: 0
- Abs: 10

Appendix AK

IEEE P802.11
Wireless LANs

IEEE 802.11 TGax

November 2015 Bangkok PHY Ad Hoc Meeting Minutes

Date: 2015-09-13

Author(s):

Name	Affiliation	Address	Phone	email
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Abstract

TGax meeting minutes from the IEEE 802.11 Dallas PHY Ad hoc session, November, 2015.

IEEE 802.11 Task Group ax PHY Ad Hoc
Nov 2015 Dallas Meeting

Tuesday, Nov 10th, 2015, AM2 TGax Session (10:30-12:30)

1. **Meeting called to order by Yakun Sun (Marvell) at 10:30.**
   1.1. The agenda is contained in 11-15/1385r0 which is on the server.

2. **Administrative Items**
   2.1. Chair reminded the IEEE 802 and IEEE 802.11 Policy and Procedure.
   2.2. Chair also reminded to do attendance.

3. **Set and approve agenda**
   3.1. Proposed agenda for Monday PM1
      3.1.1. Presentations follow the order of DCN.
      3.1.2. Recess
   3.2. Chair asked for approval of the proposed agenda. – Agenda approved.

4. **Presentations**

   4.1. 11-15-1309-01-00ax-extended-range-support-for-11ax
   Sameer Vermani (Qualcomm) presented.

   Discussions:
   Sigurd: The proposal is not mainly about range extension.
   Sameer: it assists to achieve real low MCS performance thus to guarantee extended range.
   Daewon: in slide 13, the gain is not in term of data payload. What's the real data gain performance?
   Sameer: Beacon can also be sent in data rate sometimes. It's not intend to achieve data rate performance but extended range.

   SP #1:

   - **Do you support adding the following to the spec framework**
     - **"L-STF power is boosted by 3 dB in the extended range preamble"**

   SP Result: Y50 N4 A18; SP passed.

   SP #2:

   - **Do you support adding the following to the spec framework**
     - **"L-LTF power is boosted by 3 dB in the extended range preamble"**

   SP Result: 51Y/0N/22A; SP passed.

4.2. 11-15-1353-00-00ax-preamble-formats
Ron Porat (BroadCom) Presented

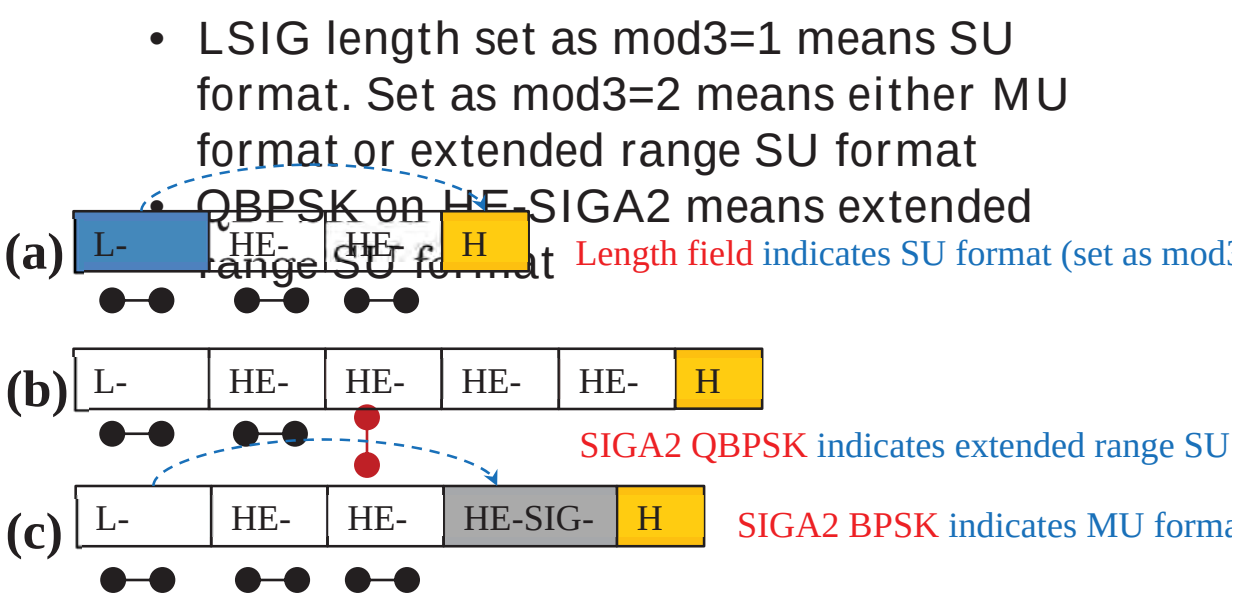
Discussions:
There's some clarification of the proposal.

SP #1:

- **Do you support that there are only three pre-HE-STF preamble formats defined as:**
  - SU format (mandatory) / Trigger based UL
  - MU format (mandatory)
  - Extended range SU format

SP Result: 51Y/2N/21A; SP passed

SP #2:
- **Do you support the signaling of the three preamble formats as shown on slide 15**



SP Result: 55Y/0N/21A; SP passed

SP #3
- **Do you support that the following are the only mandatory combinations of LTF size and CP size**
  - **2x LTF+ 0.8uS**
  - **2x LTF+ 1.6uS**
  - **4x LTF+ 3.2uS**

with HE-LTF and payload using the same CP size.

and that LTF size and CP size are jointly signaled using 3 bits.

SP Result: 57Y/0N/15A; SP passed

SP #4

– **Do you support that SIGB only has one CP size equal to 0.8uS.**

SP Result: 61Y/0N/14A; SP passed

4.3. 11-15-1357-01-00ax-extra-tones-in-the-preamble

Xiaogang Chen (Intel) Presented

Discussions:

No discussion

SP #1:

- **Do you support to:**
  - Allocate 4 extra subcarriers, two at each edge of each 20MHz sub-channel, for L-SIG, RL-SIG, HE-SIG-A and HE-SIG-B fields in 11ax PPDUs.
    - The 4 subcarriers added to the L-SIG and RL-SIG fields are transmitted with known TBD BPSK constellations (+-1).
    - The number of data subcarriers in HE-SIG-A and HE-SIG-B fields are increased by 4 in each 20MHz sub-channel.
    - L-SIG, RL-SIG, HE-SIG-A and HE-SIG-B fields are always transmitted with the same total power as L-LTF field (in cases when L-LTF is not being boosted?

SP Result: 46Y/0N/13A; SP passed

4.4. 11-15-1372-00-00ax-l-length-equation-updates

Hongyuan Zhang (Marvell) Presented

Discussions:

Sigurd: correct the typo of “L_LEGNTH” in the last formula for motion text.

SP #1:

- **Do you agree to make the following changes in red, on the equations in Section 3.3.5 of TGax SFD?**

$$L_LENGTH = \left\lceil \frac{TXTIME - 20}{4} \right\rceil \times 3 - 3 - m, m = 1 \text{ or } 2$$

$$TXTIME = T_{L_PREAMBLE} + T_{HE_PREAMBLE} + T_{HE_DATA} + T_{PE}$$

$$N_{SYM} = \left\lfloor \frac{\left(\frac{L_LENGTH + m + 3}{3} \times 4 - T_{HE_PREAMBLE}\right)}{T_{SYM}} \right\rfloor - b_{PE_Disambiguity}$$

$$T_{PE} = \left\lfloor \frac{\left(\frac{L_LEGNTH + m + 3}{3} \times 4 - T_{HE_PREAMBLE}\right) - N_{SYM} \times T_{SYM}}{4} \right\rfloor \times 4$$

SP Result: **71Y/0N/2A; SP passed**

4.5. **11-15-1289-01-00ax-non-uniform-constellations-for-1024-qam**
Dana Ciochina (Sony) Presented

Discussions:
Jianhan: any explanation why using non-uniform constellations is better? Different code rate has different modulation?
Dana: the reliability of uniform constellations is not evenly distributed.
MARVELL: how to handle non-integer in slide 17?
Dana: Both floating and quantified methods could be used.
Someone: this should be defined with new MCS, and the non-uniform constellation is considered for optional MCS modes.
Someone: is PAPR performance considered?
Dana: not considered this time.

SP #1:
- **Do you agree that is desirable to achieve the maximum possible gain for 1024-QAM (e.g. make also use of non-uniform constellations)?**

SP Result: **10Y/5N/Many A; Informative**

SP #2:
- **Do you agree that non-uniform constellations shall be used for 1024-QAM?**

SP Result: **Many Abstain; Informative**

4.6. 11-15-1310-00-00ax-11ax-ldpc-tone-mapper-for-160mhz
Bin Tian (Qualcomm) Presented

Discussions:
Daewon: Segment in 11ac needs special operation, any consideration on the impact of procedure on the proposed design?
Bin: will consider later.

SP #1:
- **Do you support to add the following text to 11ax SFD?**
  - **2x996RU employs a segment parser (as in 11ac) between two 996 tones (frequency segments) and the LDPC tone mapper in each 996 tone segment uses D_{TM}=20**

SP Result: 57Y/0N/3A; SP passed.

----------END OF AM2 TUESDAY----------

Tuesday, Nov 10th, 2015, EV1 TGax Session (19:30-21:30)

5. **Meeting called to order by Yakun Sun (Marvell) at 19:30.**
   5.1. The agenda is contained in 11-15/1385r1 which is on the server.

6. **Administrative Items**
   6.1. Chair reminded the IEEE 802 and IEEE 802.11 Policy and Procedure.
   6.2. Chair also reminded to do attendance.

7. **Presentations**

7.1. 11-15-1305-00-00ax-stbc-and-padding-discussions
Hongyuan Zhang (Marvell) Presented

Discussions:
Daewon: Agree generally with the conclusion. Wonder if SFBC can be used to replace STBC totally.
Hongyuan: will discuss it once the SFBC proposal is available.

SP #1:
- **Do you agree to add the following text in 11ax SFD?**
  - ***STBC is an optional feature in 11ax and it is ONLY defined for single spatial stream (Nss=1 and Nsts=2)***
  - ***In a MU PPDU all RUs are either STBC or not STBC.***

SP Result: 46Y/0N/12A; SP passed

7.2. 11-15-1311-00-00ax-11ax-sppectral-masks
Bin Tian (Qualcomm) Presented

Discussions:
Daewon: The spectrum mask used for PPDU transmission is based on PPDU bandwidth, it's different from 11ac.
Bin: Yes. We believe it's better to use a 20MHz mask for a20MHz PPDU.

SP #1:
Do you support to add the following to 11ax SFD?
- **The spectral masks for 11ax non-OFDMA 20/40/80/160/80+80 MHz PPDU are defined as in slides 13-15?**
  - **The bandwidth of the applied spectrum mask for a (non-OFDMA) PPDU shall be determined by the bandwidth occupied by the pre HE-STF portion of the preamble in this PPDU, regardless of the BSS bandwidth**
  - **The spectral mask requirements do not apply to LO leakage**

SP Result: 49Y/2N/8A; SP passed

7.3. 11-15-1327-00-00ax-diversity-mode-in-ofdma

Yujin Noh (Newracom) Presented

Discussions:
Bin: typically, 11ax will have more antennas which will cause lots of gain. How this transmission diversity behavior in this case?
Yujin: the proposal doesn't address the antenna gain.
Le: understanding the intention is to find a new RU. While in previous discussion of RU, it's evaluated against system level gain instead of link level gain.
Le: the new RU is only for multicast frame, e.g. trigger frame?
Daewon: It's likely. Though not limit it to trigger frame directly, but AP will not be so stupid to assign such a RU to a big data frame.
Brian: Multicast is not a big issue, and low rate of multicast will take longer time.

SP #1:
Do you agree to add the following to the SFD?
- **Transmission diversity mode (i.e. non-continuous transmission) shall be supported in 11ax.**
  - **Transmission diversity mode divides a single encoded packet in half and maps to 13 + 13 (26 RU) or 26 + 26 (52 RU) tones, that are spaced apart in frequency.**
  - **TBD whether only 26 RU, only 52 RU, or both 26 and 52 RU support transmit diversity mode.**

SP Result: 12Y/23N/21A; SP failed

7.4. 11-15-1329-00-00ax-link-adaptation-for-he-wlan

Yujin Noh (Newracom) Presented

Discussions:
Jianhan: The proposal could be one solution, there could be another solution.
Daewon: We offer this solution and want group's feedback.
Bin: Some of the SP2 content may relate to other group. Suggest to move the SP2 to TG meeting.
Ron: suggest to replace "is composed of " with "contains of" in SP2.

SP #1:
Do you agree to include the following text to TGax SFD:
- **HE link adaptation shall define reference payload size for the reported MCS in MFB.**
  - **Reference payload size may be dependent on the frames involved in link adaptation or fixed in specification. Details TBD.**

SP Result: 12Y/1N/Many A; SP passed

SP #2:
Do you agree to include the following text to TGax SFD:
- **HE link adaptation field, which is part of HE variant of HT control field, consists of MFB and TBD subfields. The MFB subfield consists of NSS and MCS subfield. The MFB subfield includes NSS and MCS subfield.**

SP Result: 17Y/0N/37A; SP passed

7.5. 11-15-1331-00-00ax-phy-padding-capability-signaling

Daewon Lee (Newracom) Presented

Discussions:

Hongyuan: it's too complex with consideration of STBC.
Daewon: Agree that's a challenge. But from our aspect, we prefer this proposal.
Someone: the processing time depends on the devices' capability to decode earlier or longer, not sure if AP can actually capture that information.

SP #1:

To you agree to added the following text in SFD:

- **HE padding and packet extension capability field shall be defined separately for STBC and non-STBC transmissions.**
- **HE padding and packet extension capability field content for STBC transmission is limited to Nss = 1.**

SP Result: 12Y/28N/16A; SP failed

SP #2:

Do you agree to the following concept:

- **Maximum T_{PE} of 0us, 8us, or 16us is determined by number of codewords in the last two OFDM symbols (denoted as $N_{CW,left}$) containing information payload.**
- **Maximum T_{PE} capability can be signaled using two threshold values threshold8 and threshold16, which determine the $N_{CW,left}$ threshold for using max T_{PE} of 8us or 16us, respectively. The threshold value will be common for all BW and N_{SS}.**

SP Result: 12Y/26N/13A; (For information)

----------END OF EV1 TUESDAY----------

Wednesdday, Nov 12th, 2015, EV1 TGax Session (13:30-15:30)

8. Meeting called to order by Yakun Sun (Marvell) at 13:30.

8.1. The agenda is contained in 11-15/1385r2 which is on the server.

9. Administrative Items

9.1. Chair reminded the IEEE 802 and IEEE 802.11 Policy and Procedure.

9.2. Chair also reminded to do attendance.

10. Presentations

10.1. 11-15-1323-01-00ax-he-stf-sequences

Eunsung Park (LGE) Presented

Discussions:

No discussion

SP #1:

- **Do you agree to add the following HE-STF sequences for 0.8us and 1.6us periodicity to the 11ax SFD:**
  - ***M* = {-1 -1 -1 +1 +1 +1 -1 +1 +1 +1 -1 +1 +1 -1 +1}**
  - **1x HE-STF sequences**
    - **20MHz**
      - **$HES_{-112,112}(-112:16:112) = M*(1+j)*sqrt(1/2)$**
      - **$HES_{-112,112}(0) = 0$**
    - **40MHz**
      - **$HES_{-240,240}(-240:16:240) = \{M, 0, -M\}*(1+j)*sqrt(1/2)$**
    - **80MHz**
      - **$HES_{-496,496}(-496:16:496) = \{M, 1, -M, 0, -M, 1, -M\}*(1+j)*sqrt(1/2)$**
  - **2x HE-STF sequences**
    - **20MHz**
      - **$HES_{-120,120}(-120:8:120) = \{M, 0, -M\}*(1+j)*sqrt(1/2)$**
    - **40MHz**
      - **$HES_{-248,248}(-248:8:248) = \{M, -1, -M, 0, M, -1, M\}*(1+j)*sqrt(1/2)$**
      - **$HES_{-248,248}(\pm 248) = 0$**
    - **80MHz**
      - **$HES_{-504,504}(-504:8:504) = \{M, -1, M, -1, -M, -1, M, 0, -M, 1, M, 1, -M, 1, -M\}*(1+j)*sqrt(1/2)$**
      - **$HES_{-504,504}(\pm 504) = 0$**

SP Result: 48Y/0N/14A; SP passed

10.2. 11-15-1303-00-00ax-ltf-sequence-designs

Sungho Moon (Newracom) Presented

Discussions:

Le: slide 6, pilot position is different from what we agreed in SFD. Maybe the PAPR performance re-check is needed. So your proposal is trying to reuse LTF long sequence?

Sungho: Yes.
Someone: the full-band PAPR design is possible.
Sungho: How long to run the sim depends on how many position to search. And our design is based on reuse existing LTF sequence the most as possible.

SPs withdrawn.

10.3. 11-15-1334-01-00ax-he-ltf-sequence-design

Le Liu (Huawei) Presented

Discussions:
Sungho: slide22, 40MHz should be more popular than 20MHz and the PAPR performance of 40MHz is not very good.
Le: not sure whether 40MHz is more popular. And the simulation result is for different cases.
Sungho: the proposed new sequence should have better performance over existing VHT sequence. But the performance over 26 tone RU is not good.
Le: we prioritize overall performance.

SP #1:
Do you support to add to SFD
- **4x/2x HE-LTF sequences for 80MHz in slide 13-15**
- **4x/2x HE-LTF sequences for 40MHz in slide 20-21**
- **4x/2x HE-LTF sequences for 20MHz in slide 26**

SP Result: 63Y/2N/16A; SP passed

SP #2:
Do you support to add to SFD
- **In all transmission modes, HE-STF and HE-LTF only populate RUs that are populated in the data field.**

SP Result: 74Y/0N/15A; SP passed

SP #3:
Do you support to add to SFD
- **Gamma (tone rotation as defined in 22.3.7.5) is not applied on HE-STF and beyond.**
  - **TBD in case of a duplicated HE PPDU (if ever defined)**

SP Result: 60Y/0N/13A; SP passed

10.4. 11-15-1322-00-00ax-channel-estimation-enhancement-and-transmission-efficiency-improvement-using-beam-change-indication-and-1x-he-ltf

Yakun Sun (Marvell) Presented

Discussions:
Sigurd: How the two streams for preamble is transmitted?
Jianhan: same as HE-LTF1
Someone: How to evaluate the bit left in HE-SIG-A?

Jianhan: most critical to PHY and performance enhancement features are prioritized to use HE-SIG-A.
Daewon: Is it necessary to use HE-STF with this design?
Jianhan: in some cases, the proposed bit is used to inform AGC update.
Daewon: in some cases, e.g. short package cases, the performance of proposal is not so good.
Yakun: the feature has promising performance and all implementation will support it. But it's not a right time to decide it's a mandatory IEEE feature or not.

SP #1:
Do you agree to add 1-bit beam-change indication into HE-SIGA?
- **Value "1" indicates that spatial mapping is changed**
- **Value "0" indicates that spatial mapping is unchanged**

SP Result: 63Y/0N/14A; SP passed

SP #2:
Do you agree that when beam-change indication is "0", the pre-HE-STF portion preamble shall be spatially mapped in the same way as HE-LTF1 on each tone?

SP Result: 62Y/0N/8A; SP passed

SP #3:
Do you agree to add 1x HE-LTF as an optional mode in 11ax for SU PPDU (TBD for MU-MIMO)?
- **1xLTF + 0.8us GI is one optional combination as indicated by the "GI and LTF size" sub-field in HE-SIG-A.**

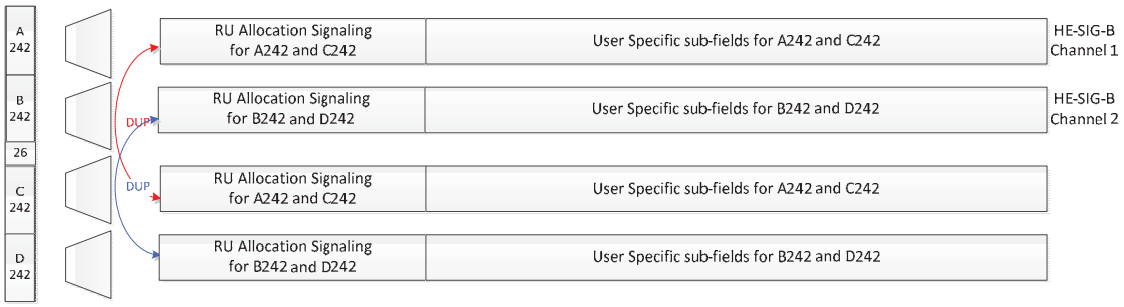
SP Result: 60Y/1N/14A; SP passed

10.5. 11-15-1315-01-00ax-he-sig-b-mapping-and-compression

Kaushik (Samsung) Presented

Discussions:
Sigurd: slide 11, how does the receiver know the position of SIG-B.
Kaushik: the receiver has to decode two 20MHz channels to get complete SIG-B anyway.

SP #1:
Do you agree to add the following text to the 11ax SFD:
- **The resource allocation signaling in the common control field and user specific subfields for an STA carried in the HE-SIG-B are transmitted in the same 20MHz sub-channel as the data for 20MHz and 40MHz PPDU.**
- **For an 80MHz PPDU, the default mapping per 20MHz as shown in the figure below.**



- **For a 160MHz PPDU , the default mapping per 20MHz is as shown in the figure below**

SP Result: **SP passed without objection**

SP #2:

Do you agree to add the following text to the 11ax SFD:

- **A compression bit is carried in the HE-SIG-A MU format to differentiate full BW MU-MIMO from OFDMA MU PPDU.**
- **In case of full BW MU-MIMO, the following conditions hold:**
  - **Only applicable for RU sizes 242,484,996,2*996**
  - **The RU information in HE-SIGB common is not signaled**
  - **For bandwidths > 20MHz, the user specific sub-fields are split equitably between the two HE-SIG-B Channels**

SP Result: **SP passed without objection**

10.6. 11-15-1324-00-00ax-mcs-for-he-sig-b

Dongguk (LG Electronic) Presented

Discussions:

No discussion

SP #1:

- Do you agree to add to TGax Specification Framework Document
  - Signaling in the first encoded part (HE-SIG-A) has the following MCS values for HE-SIG-B:
    - MCS0, MCS1, MCS2, MCS3, MCS4, MCS5
    - Other MCS is TBD
  - Signaling for HE-SIG-B MCSs has 3 bits
    - If two MCS set for BW≥40MHz are to be signaled, additional TBD bits used

SP Result: 34Y/0N/9A; SP passed (performed at the beginning of PM2, WEDNESDAY)

----------END OF PM1 WEDNESDAY----------

Wednesdday, Nov 12th, 2015, EV1 TGax Session (16:03-18:00)

11. Meeting called to order by Yakun Sun (Marvell) at 16:03.

11.1. The agenda is contained in 11-15/1385r2 which is on the server.

12. Administrative Items

12.1. Chair reminded the IEEE 802 and IEEE 802.11 Policy and Procedure.

12.2. Chair also reminded to do attendance.

13. Presentations

13.1. 11-15-1335-02-00ax-he-sig-b-contents

Le Liu (Huawei) Presented

Discussions:

Sungho: slide 13, the supported user number cannot meet 9 per 20MHz.

Le: the supported user number should be limited by SIG-B length.

SP #1:

Do you agree to modify the text in IEEE 802.11ax SFD(r9) as follows

- **Change "The exact mapping of the 8 bit to the arrangement and the number of MU-MIMO allocations is TBD." to "The mapping of the 8 bits to the arrangement and the number of MU-MIMO allocations is defined in the following lookup table."**

8 bits indices	#1	#2	#3	#4	#5	#6	#7	#8	#9	Num of entries
000 0 0000	26	26	26	26	26	26	26	26	26	1
000 0 0001	26	26	26	26	26	26	26	52		1
000 0 0010	26	26	26	26	26	52		26	26	1
000 0 0011	26	26	26	26	26	52		52		1
000 0 0100	26	26	52		26	26	26	26	26	1
000 0 0101	26	26	52		26	26	26	52		1
000 0 0110	26	26	52		26	52		26	26	1
000 0 0111	26	26	52		26	52		52		1
000 0 1000	52		26	26	26	26	26	26	26	1
000 0 1001	52		26	26	26	26	26	52		1
000 0 1010	52		26	26	26	52		26	26	1
000 0 1011	52		26	26	26	52		52		1
000 0 1100	52		52		26	26	26	26	26	1
000 0 1101	52		52		26	26	26	52		1
000 0 1110	52		52		26	52		26	26	1
000 0 1111	52		52		26	52		52		1
000 1 xxxx	Definition TBD									16
00100 yyy	26	26	26	26	26	106				8
00101 yyy	26	26	52		26	106				8
00110 yyy	52		26	26	26	106				8
00111 yyy	52		52		26	106				8
01000 yyy	106				26	26	26	26	26	8

01001 yyy	106		26	26	26	52		8
01010 yyy	106		26	52		26	26	8
01011 yyy	106		26	52		52		8
011 xxxxx	Definition TBD							32
10 yyy yyy	106		26	106				64
11 0 00yyy	242							8
11 0 01yyy	484							8
11 0 10yyy	996							8
11 0 11yyy	2*996							8
11 1 xxxxx	Definition TBD							32

Note: 'yyy' = 000~111 indicates number of MU-MIMO STAs.
Definition for entries with 'x' bits are TBD.

SP Result: 50Y4/N/18A; SP passed

SP #2:
Do you agree to add the STAID size in the user specific subfields of HE-SIGB is 11bits?

SP Result: 47Y/0N/14A; SP passed

SP #3:
Do you agree to add a DCM subfield (1-bit) to the user-specific subfields of HE-SIG-B in IEEE 802.11ax SFD(r9) (as shown in red) ?

- **For single-user allocations in a RU: NSTS (Number of Spatial Streams), TxBF (transmit beamforming), MCS (Modulation and Coding Scheme), DCM (Dual Sub-Carrier Modulation) and Coding (Use of LDPC)**
- **For each user in a multi-user allocation in a RU: Spatial Configuration Fields, MCS, DCM and Coding**

SP Result: 54Y/0N/19A; SP passed

13.2. 11-15-1304-01-00ax-supported-resource-allocations-in-sig-b

Sungho (Newracom) Presented

Discussions:
Le: slide 5, any consideration of some RU arrangement pattern not supported by the proposal?
Sungho: some cases are actually not used in practical.
Yakun: the receiver has to decode two SIG-B blocks anyway.
Lots of discussion regarding the necessity for receiver to check each of the SIG-B block.
Le: it's too early to define how to handle special cases. We need to discuss how to prioritize these special cases.

SP #1:
Do you agree to add the following text into the SFD?

- **The 8 bits in the common field of HE SIG-B includes a state of 'No STA Assigned' for which no STA-specific field is transmitted**

SP Result: 12Y/26N/16A; SP failed

SP #2:
Do you agree to add the following text into the SFD?
- **The number of spatially multiplexed STAs for 106 RU limited to 4**
  - **For RUs larger than 106, it can be 8 STAs as maximum**

SP Result: 5Y/34N/16A; SP failed

SP #3:
Do you agree to support the following text?
- **The 8 bits in the common field of HE SIG-B includes explicit states for the existence of the center 26RU of 80MHz**

SP Result: 9Y/16N/25A; Informative

13.3. 11-15-1350-01-00ax-spatial-configuration-and-signaling-for-mu-mimo

Yakun Sun (Marvell) Presented

Discussions:
No discussion

SP #1:
Do you support to add the following text in Section x.x.x in current SFD:
- **The number of spatially multiplexed user in a DL or UL MU-MIMO transmission is up to 8 (in a given RU)?**

SP Result: 46Y/5N/8A; SP passed

SP #2:
Do you support to add the following text in Section x.x.x current SFD:
- **The Nsts value for each user in a MU-MIMO RU is less than or equal to 4?**

SP Result: 41Y/1N/7A; SP passed

SP #3:
Do you support to add the following text in Section x.x.x in current SFD:
- **A MU-MIMO user block includes a "spatial config" field of 4bit indicating the number of spatial streams for each multiplexed STA. The field is constructed by using the entries corresponding to the value of Nuser of this RU in the following table?**

Nuser	B0…B3	Nsts[1]	Nsts[2]	Nsts[3]	Nsts[4]	Nsts[5]	Nsts[6]	Nsts[7]	Nsts[8]	#Entries
2	0000~0011	1~4	1							10

	0100~0110	2~4	2							
	0111~1000	3~4	3							
	1001	4	4							
3	0000~0011	1~4	1	1						13
	0100~0110	2~4	2	1						
	0111~1000	3~4	3	1						
	1001~1011	2~4	2	2						
	1100	3	3	2						
4	0000~0011	1~4	1	1	1					11
	0100~0110	2~4	2	1	1					
	0111	3	3	1	1					
	1000~1001	2~3	2	2	1					
	1010	2	2	2	2					
5	0000~0011	1~4	1	1	1	1				6
	0100~0101	2~3	2	1	1	1				
6	0000~0010	1~3	1	1	1	1	1			4
	0011	2	2	1	1	1	1			
7	0000~0001	1~2	1	1	1	1	1	1		2
8	0000	1	1	1	1	1	1	1	1	1

SP Result: **48Y/1N/10A; SP passed**

13.4. 11-15-1059-02-00ax-sig-b-encoding-structure-part-ii

Sriram Venkateswaran (BroadCom) Presented

Discussions:

No discussion

SP #1:

Do you agree to modify the text in Section 3.2.4 of the SFD as follows

- **Two users are grouped together and jointly encoded in each BCC block in the user specific section of HE-SIG-B**
- ~~**The CRC in the common block is TBD**~~
- **The common block has a CRC separate from the CRC of the user specific blocks**

- **The last user information is immediately followed by tail bits (regardless of whether the number of users is odd or even) and padding bits are only added after those tail bits**

SP Result: 56Y/0N/7A; SP passed

13.5. 11-15-1354-00-00ax-siga-fields-and-bitwidths

Ron Porat (BroadCom) Presented

Discussions:

Daewon: More compression mode TBD is not found in any proposal.
Ron: Something between pure MU-MIMO and other operation is under consideration.
Daewon: how to use BW bit for MU transmission?
Ron: potential BW would be 20/40/80/160MHz. But we would think more about BW rules for MU transmission.

SP #1:

Do you support replacing the HE-SIG-A field definitions for SU preamble format in [2] (PHY Motions 43, 46, 48, 54) with the table in slide 11?

Field	#Bits
DL/UL	1
Format Indication	1
BSS Color	6
Spatial Reuse	TBD
TXOP duration	TBD
Bandwidth	2
MCS	4
CP+LTF size	3
Coding	2
Nsts	3
STBC	1
TxBF	1
DCM	1
Packet Extension	3
Beam change	1
CRC	4
Tail	6

SP Result: 54Y/0N/7A; SP passed

SP #2:

Do you support replacing the HE-SIG-A field definition for the MU preamble format [2] (PHY Motions 44, 46, 54) with the table in slide 12?

Field	#Bits
DL/UL	1
BSS Color	6
Spatial Reuse	TBD
TXOP duration	TBD
Bandwidth	>=2
SIGB MCS	3
SIGB DCM	1
SIGB # of symbols	4
SIGB Compression Mode	>=1
# of HE-LTF	3
CP+LTF size	3
LDPC extra symbol	1
Packet Extension	3
CRC	4
Tail	6

SP Result: 50Y/0N/7A; SP passed

SP #3:

Do you support replacing the HE-SIG-A field definition for trigger based UL preamble format in [2] (PHY Motion 45) with the table in slide 13?

Field	#Bits
Format	1
BSS Color	6
TXOP	TBD
Spatial reuse	TBD
Bandwidth	TBD
CRC	4

Tail	6

SP Result: 51Y/0N/10A; SP passed

14. The chair adjourned at 17:40pm

Appendix AL

HE-SIG-B Contents

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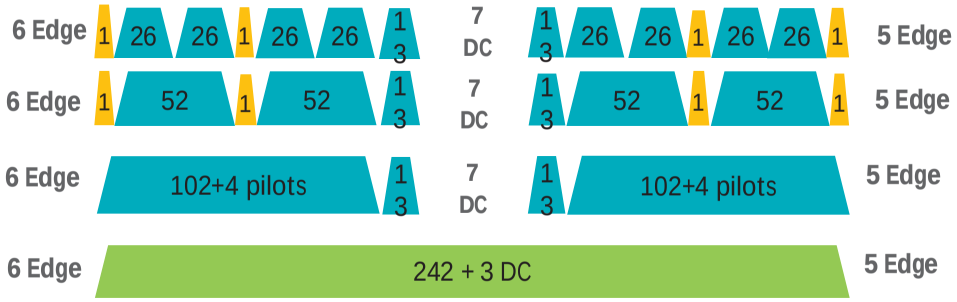
Re-cap

- Agreement on HE-SIG-B common field [1]
  - The RU allocation signaling in the common field of HE-SIG-B signals an 8 bit per 20 MHz PPDU BW for signaling
    - The RU arrangement in frequency domain
    - Number of MU-MIMO allocations: The RUs allocated for MU-MIMO and the number of users in the MU-MIMO allocations
  - The exact mapping of the 8 bit to the arrangement and the number of MU-MIMO allocations is TBD.
  - Signaling for the center 26 unit in 80 MHz is TBD.
- Agreement on HE-SIG-B user specific field [1]
  - The user specific subfields of HE-SIG-B containing the per user dedicated information include the following fields
    - STA-ID
    - For single-user allocations in a RU: NSTS (Number of Spatial Streams), TxBF (transmit beamforming), MCS (Modulation and Coding Scheme) and Coding (Use of LDPC)
    - For each user in a multi-user allocation in a RU: Spatial Configuraiton Fields, MCS and Coding.
  - Other fields are TBD.

In this presentation

- We further discuss the details based on the agreements from the last meeting
  - In HE-SIG-B common
    - Based on the tone plan and RU pattern in 20MHz [2], we design ‘the exact mapping of the 8 bit to the arrangement and the number of MU-MIMO allocations’



HE20 with 7DC for OFDMA

  - In HE-SIG-B user specific field
    - Specify the size of STA-ID
    - Add DCM indication for data portion with reliable performance

OFDMA RU Allocation Signalling

- In case of OFDMA transmission, we design the RU allocation signaling considering the following typical cases → 176 cases
  - All the possible combinations of 26/52/106/242-RU allocation within 20MHz
  - Also the allocation of 484/996/2*996-RU allocation larger than 20MHz
  - MU-MIMO allocation (on RU>=106) position and the number of MU-MIMO STAs
    - If RU>242, distribute the MU-MIMO STA number and user-specific information on each CH within the RU.
    - The total number of MU-MIMO STAs is the summation of the number of MU-MIMO STAs per 20MHz on the RU>242.
- For partial OFDMA (with unallocated RU), the indication of all the possible combination in HE-SIG-B common costs unbearable overhead.
  - There are already 2448 combination cases of partial OFDMA if RU<106.
  - Whether to prioritize and indicate some special cases is TBD.

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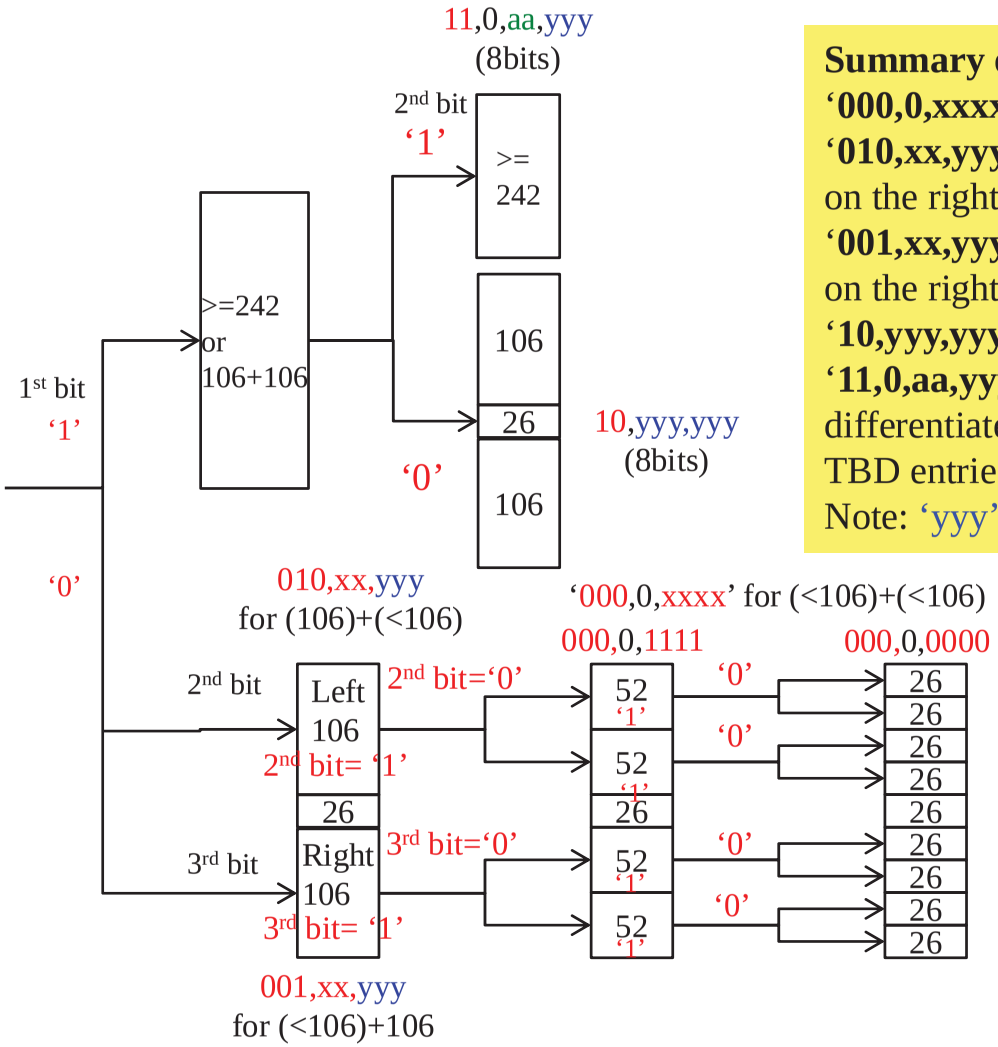
Hierarchical Indication RU allocation signaling



Summary of 8-bit RU allocation signaling:
'**000,0,xxxx**': 26/52 combinations;
'**010,xx,yyy**': 106 on the left +(26/52 combinations) on the right
'**001,xx,yyy**': (26/52 combinations) on the left + 106 on the right
'**10,yyy,yyy**': 106 on the left +106 on the right
'**11,0,aa,yyy**': large RU >=242, aa=00/01/10/11 to differentiate 242/484/996/2*996-RU respectively
TBD entries: '**011,xxxxx**', '**000,1,xxxx**', '**11,1,xxxxx**'
Note: 'yyy' indicate 1~8 STAs on the RU

Lookup Table for 8-bit RU allocation signaling

- 8-bit hierarchical mapping form is equivalent as a table with unique index

8 bits indices	#1	#2	#3	#4	#5	#6	#7	#8	#9	Num of entries
000 0 0000	26	26	26	26	26	26	26	26	26	1
000 0 0001	26	26	26	26	26	26	26	52		1
000 0 0010	26	26	26	26	26	52		26	26	1
000 0 0011	26	26	26	26	26	52		52		1
000 0 0100	26	26	52		26	26	26	26	26	1
000 0 0101	26	26	52		26	26	26	52		1
000 0 0110	26	26	52		26	52		26	26	1
000 0 0111	26	26	52		26	52		52		1
000 0 1000	52		26	26	26	26	26	26	26	1
000 0 1001	52		26	26	26	26	26	52		1
000 0 1010	52		26	26	26	52		26	26	1
000 0 1011	52		26	26	26	52		52		1
000 0 1100	52		52		26	26	26	26	26	1
000 0 1101	52		52		26	26	26	52		1
000 0 1110	52		52		26	52		26	26	1
000 0 1111	52		52		26	52		52		1
000 1 xxxx	Definition TBD									16
00100 yyy	26	26	26	26	26	106				8
00101 yyy	26	26	52		26	106				8
00110 yyy	52		26	26	26	106				8
00111 yyy	52		52		26	106				8
01000 yyy	106				26	26	26	26	26	8
01001 yyy	106				26	26	26	52		8
01010 yyy	106				26	52		26	26	8
01011 yyy	106				26	52		52		8
011 xxxxx	Definition TBD									32
10 yyy yyy	106				26	106				64
11 0 00yyy	242									8
11 0 01yyy	484									8
11 0 10yyy	996									8
11 0 11yyy	2*996									8
11 1 xxxxx	Definition TBD									32

Note: 'yyy' = 000~111 indicates number of MU-MIMO STAs.
Definition for entries with 'x' bits are TBD.

STAID Options for HE-SIG-B

- STAID is to identify the user specific subfields for the tended STAs.
  - Option1: MAC address (48bit)
    - unique in the whole network, no ambiguity.
    - but unbearable overhead in PHY preamble
  - Option2: AID (11bit)
    - unique within BSS,
    - already exist in MAC
    - moderate overhead, not always fully used
  - Option3: new defined STAID
    - assigned STAID to the active STA, e.g. STA with MU capability
    - Small overhead or variable overhead
    - AP require special mechanism to manage these ID to avoid ambiguity in scheduling.

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STA ID Ambiguity within BSS

- Although 9-bit AID is used to generate PAID in 11ac, STAs may have same PAID when the number of STA in one BSS is large (even sleeping STA occupies AID), especially for 11ax dense scenarios.

$$(dec(\text{AID}[0:8]) + dec(\text{BSSID}[44:47] \oplus \text{BSSID}[40:43]) \times 2^5) \bmod 2^9 \quad \text{(9-8a)}$$

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- The scheduler must set restriction not to schedule more than one STA with same PAID considering the complexity in STA.
- Otherwise, we have to rely on the RA in MAC header to let the STA finally identify the packet within BSS.
  - The overall overhead is not saved.
  - It is also not energy efficient for the STA with same PAID because he must decode the PSDU not for himself.

➔Opt2 of 11-bit STAID is preferred to uniquely indicate the scheduled STA.

DCM for Data payload

- Dual Sub-carrier Modulation (DCM) modulates the same information on a pair of sub-carrier *n* and *m* separated far apart, which is beneficial for performance improvement of SIGB as well as data portion [3].
  - Extend range for outdoor scenarios by enhancing the PER performance
  - Improve robustness against narrow-band interferences under dense deployment
    - MU-MIMO detection over RU>=106 also needs robust against instantaneous narrow-band interference.
- We has passed the motion [Motion 12, September 12, 2015]
  - Move to include dual sub carrier modulation (DCM) schemes for HE-SIGB and Payload in the SFD
    - DCM schemes are optional
    - DCM schemes are only applied to BPSK, QPSK, and 16-QAM modulations

DCM Indication

- For each user's data portion, we need 1-bit DCM indication in per user dedicated info in HE-SIG-B.
  - The per user dedicated info (in SIG-B) includes the following:
    - STA_ID + the following fields
      - For allocation that includes one user – Nsts, TxBF, MCS, DCM, Coding
      - For MU-MIMO allocation – Spatial config, MCS, DCM, Coding
    - Other fields are TBD.

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1-bit DCM bit indicates the modulation of payload

DCM bit per-user specific field of HE-SIGB	Modulation Schemes of Payload
1	MCS x with DCM
0	MCS x

Conclusion

- In HE-SIG-B common, we design ‘the exact mapping of the 8 bit to the arrangement and the number of MU-MIMO allocations’ per 20MHz.
  - The 8-bit lookup table is summarized in slide 14.

- In HE-SIG-B user specific field, we propose
  - STAID size is 11bits to uniquely indicate the tended STA.
  - For SU/MU-MIMO allocation,1-bit DCM indication is added for data portion with reliable performance.

References

[1] 11-15-1066-00-00ax-he-sig-b-contents

[2] 11-15-0330-05-00ax-ofdma-numerology-and-structure

[3] 11-15-1068-01-00ax-reliable-transmission-schemes-for-he-sig-b-and-data

400

SP#1

- Do you agree to modify the text in IEEE 802.11ax SFD(r9) as follows
  - Change “The exact mapping of the 8 bit to the arrangement and the number of MU-MIMO allocations is TBD.” to “The mapping of the 8 bits to the arrangement and the number of MU-MIMO allocations is defined in the following lookup table.”

8 bits indices	#1	#2	#3	#4	#5	#6	#7	#8	#9	Num of entries
000 0 0000	26	26	26	26	26	26	26	26	26	1
000 0 0001	26	26	26	26	26	26	26	52		1
000 0 0010	26	26	26	26	26	52		26	26	1
000 0 0011	26	26	26	26	26	52		52		1
000 0 0100	26	26	52		26	26	26	26	26	1
000 0 0101	26	26	52		26	26	26	52		1
000 0 0110	26	26	52		26	52		26	26	1
000 0 0111	26	26	52		26	52		52		1
000 0 1000	52		26	26	26	26	26	26	26	1
000 0 1001	52		26	26	26	26	26	52		1
000 0 1010	52		26	26	26	52		26	26	1
000 0 1011	52		26	26	26	52		52		1
000 0 1100	52		52		26	26	26	26	26	1
000 0 1101	52		52		26	26	26	52		1
000 0 1110	52		52		26	52		26	26	1
000 0 1111	52		52		26	52		52		1
000 1 xxxx	Definition TBD									16
00100 yyy	26	26	26	26	26	106				8
00101 yyy	26	26	52		26	106				8
00110 yyy	52		26	26	26	106				8
00111 yyy	52		52		26	106				8
01000 yyy	106				26	26	26	26	26	8
01001 yyy	106				26	26	26	52		8
01010 yyy	106				26	52		26	26	8
01011 yyy	106				26	52		52		8
011 xxxxx	Definition TBD									32
10 yyy yyy	106				26	106				64
11 0 00yyy	242									8
11 0 01yyy	484									8
11 0 10yyy	996									8
11 0 11yyy	2*996									8
11 1 xxxxx	Definition TBD									32

Note: ‘yyy’ = 000~111 indicates number of MU-MIMO STAs.
Definition for entries with ‘x’ bits are TBD.

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SP#2

- Do you agree to add the STAID size in the user specific subfields of HE-SIGB is 11bits**?**

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- **Y**
- **N**
- **A**

SP#3

- Do you agree to add a DCM subfield (1-bit) to the user-specific subfields of HE-SIG-B in IEEE 802.11ax SFD(r9) (as shown in red)
  - For single-user allocations in a RU: NSTS (Number of Spatial Streams), TxBF (transmit beamforming), MCS (Modulation and Coding Scheme), DCM (Dual Sub-Carrier Modulation) and Coding (Use of LDPC)
  - For each user in a multi-user allocation in a RU: Spatial Configuration Fields, MCS, DCM and Coding

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- **Y**
- **N**
- **A**

Appendix AM

Documents

Join group

Everything | All Years | TGax (inactive)

Compressed SIG-B

Created (ET) ▼	Year	DCN	Rev	Group	Title	Author (Affiliation)	Uploaded (ET)	Actions
25-Jan-2016 ET	2016	203	0	TGax	Signalling Support for Full Bandwidth MU-MIMO Compressed SIG-B Mode	Lei Huang (Panasonic)	09-Feb-2016 18:40:29 ET	Download
16-Jan-2016 ET	2016	40	0	TGax	Issues with Compressed SIG-B Mode	Yujin Noh (Newracom)	18-Jan-2016 09:16:31 ET	Download

Join group

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Appendix AN

Issues with Compressed SIG-B Mode

Date: 2016-01-18

Authors:

Name	Affiliations	Address	Phone	email
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Minho Cheong	Newracom	9008 Research Dr Irvine, CA 92618		minho.cheong at newracom.com
Heejung Yu	Yeungnam Univ./ Newracom			Heejung at yu.ac.kr

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Background

SFD states the following [1]:

- **The encoding structure of each BCC in HE-SIG-B was agreed:**
  - Two users are grouped together and jointly encoded in each BCC block in the user specific section of HE-SIG-B
  - The common block has a CRC separate from the CRC of the user specific blocks
  - The last user information is immediately followed by tail bits (regardless of whether the number of users is odd or even) and padding bits are only added after those tail bits
- **Compressed SIG-B structure was agreed:**
  - A compression bit is carried in the HE-SIG-A MU format to differentiate full BW MU-MIMO from OFDMA MU PPDU. In case of full BW MU-MIMO, the following conditions hold:
    - Only applicable for RU sizes 242, 484, 996, 2*996
    - The RU information in HE-SIG-B common is not signaled
    - For bandwidths > 20 MHz, the user specific sub-fields are split equitably between the two HE-SIG-B Channels

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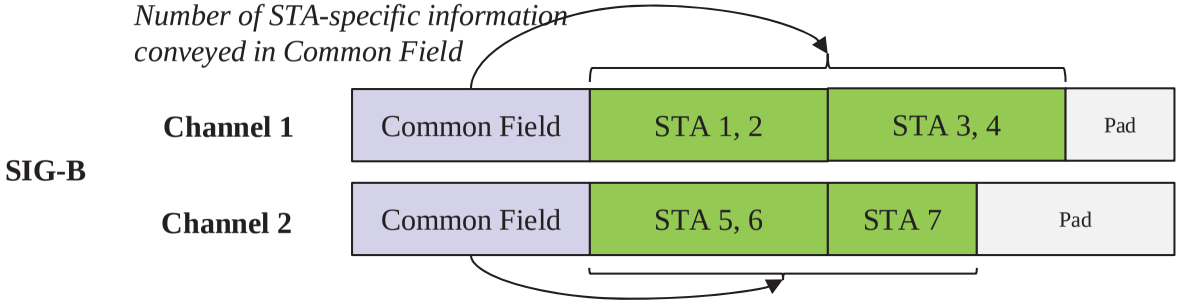
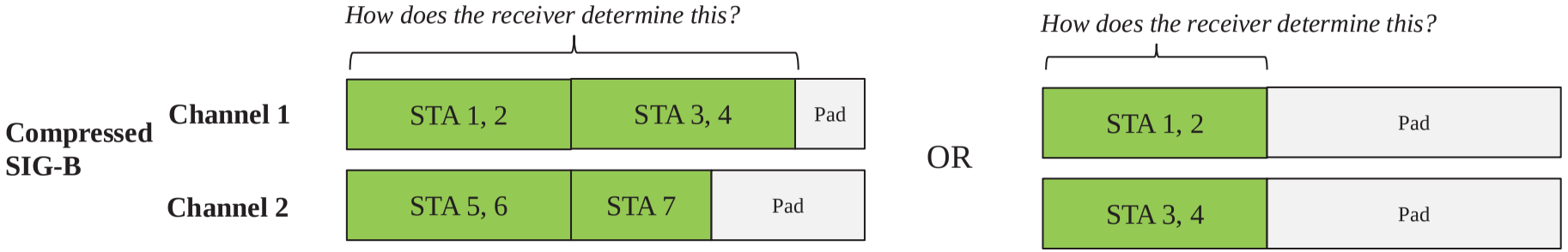
HE SIG-B Encoding Structure

In SIG-B, the RU information in the 'Common Field' conveys information regarding number of STA-specific information.



In the compressed SIG-B mode, the RU information in HE-SIG-B common is not signaled to reduce overhead.



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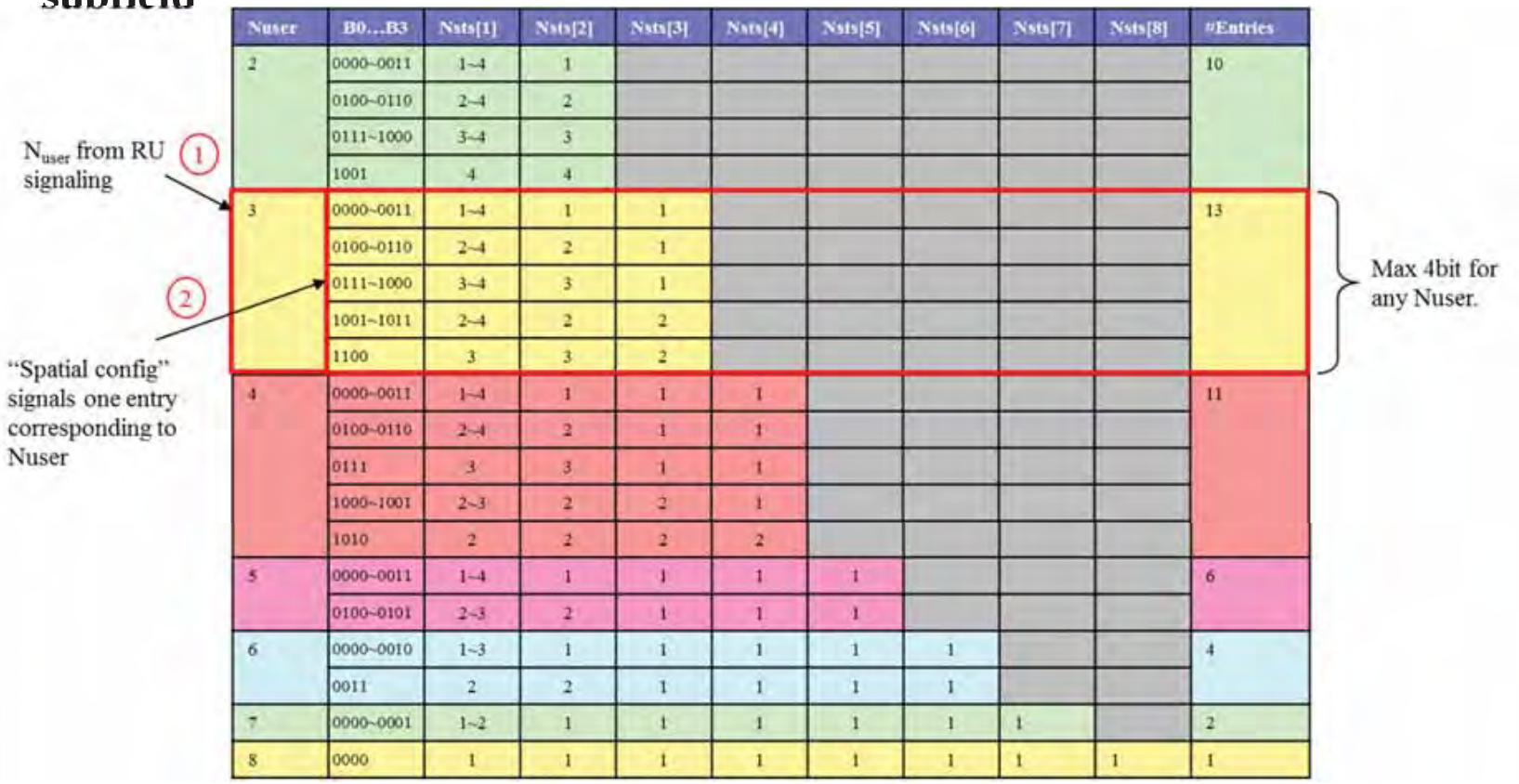
Ambiguity in the STA-Specific Field

- **Number of scheduled STAs is needed for Parsing 'Spatial configuration subfield'**



Nuser	B0…B3	Nsts[1]	Nsts[2]	Nsts[3]	Nsts[4]	Nsts[5]	Nsts[6]	Nsts[7]	Nsts[8]	#Entries
2	0000~0011	1~4	1							10
	0100~0110	2~4	2							
	0111~1000	3~4	3							
	1001	4	4							
3	0000~0011	1~4	1	1						13
	0100~0110	2~4	2	1						
	0111~1000	3~4	3	1						
	1001~1011	2~4	2	2						
	1100	3	3	2						
4	0000~0011	1~4	1	1	1					11
	0100~0110	2~4	2	1	1					
	0111	3	3	1	1					
	1000~1001	2~3	2	2	1					
	1010	2	2	2	2					
5	0000~0011	1~4	1	1	1	1				6
	0100~0101	2~3	2	1	1	1				
6	0000~0010	1~3	1	1	1	1	1			4
	0011	2	2	1	1	1	1			
7	0000~0001	1~2	1	1	1	1	1	1		2
8	0000	1	1	1	1	1	1	1	1	1

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Multiple Hypothesis at the Receiver

- **Blindly determining STA-specific fields**
  - Might be possible with additional receiver complexity.
  - Assumes that CRC of STA-specific fields all pass.
  - Detection and implementation challenges exist if CRC length is small such that false positive probability is quite high.
- **Number of hypothesis depends of number of STAs in compressed SIG-B.**
  - Number of STAs that can be transmitted a function of SIG-B MCS and Number of OFDM SIG-B symbols.
  - Some MCS and number of OFDM symbol combination does result in unique mapping. However, other combinations may require multiple hypothesis.
- **We prefer not to blindly detect this. Explicit signaling allows simpler receiver implementation.**

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Strawpoll #1

Do you agree to include the following text to TGax SFD:

- **In MU PPDU, the SIG-A shall indicate the number of STAs when compressed SIG-B mode is indicated (i.e. full bandwidth MU-MIMO indicated).**
  - Details TBD

Y/N/A

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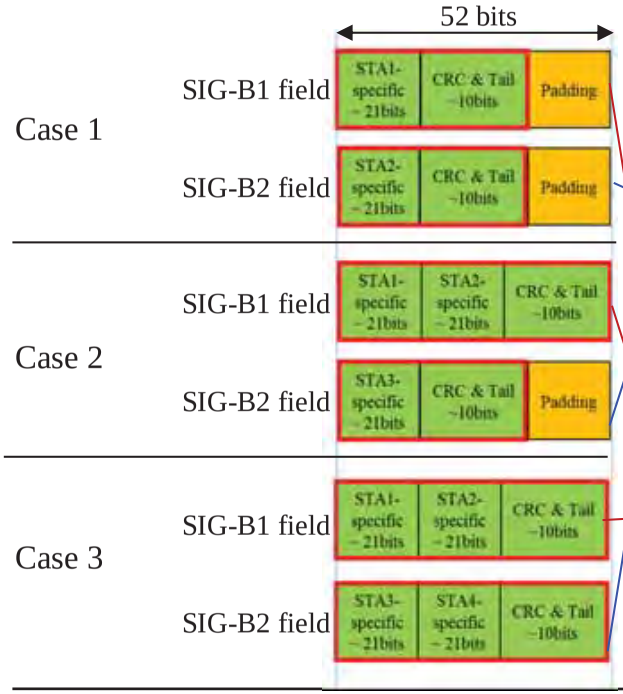
References

[1] 11-15-0132-13-00ax-spec-framework

413

Appendix: Multiple Hypothesis

- **With 2 OFDM symbols in MCS 0 (BPSK ½) 52 bits are available in SIG-B.**
- **Assuming each STA-specific field is approximately 21 bits, 2, 3, or 4 STAs can be multiplexed in 2 OFDM symbols.**
- **To reduce the hypothesis number, the test starts with SIG-B2 decoding .**



The SIG-B channel 2 field has two possibilities of the information lengths;
- Scenario 1) only one STA-specific subfield and CRC/Tail included
- Scenario 2) two STA-specific subfields and CRC/Tail included

➔ **After checking both two scenarios, the format of SIG-B2 determined**

In scenario 1, the same procedure as above is repeated in SIG-B channel 1 to find the number of users

In scenario 2, SIG-B channel 1 must contain 2 users

Appendix AO

TGax PHY Ad Hoc Jan 2016 Meeting Agenda

Date: 2016-01-18

Authors:

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Bo Sun	ZTE	ZTE R&D Zone, Xi'an, China		sun.bo1@zte.com.cn
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Jianhan Liu	Mediatek Inc.	2860 Junction Ave. San Jose, CA, 95131, USA		jianhan.liu@mediatek.com

IEEE 802.11 TGax
High Efficiency WLAN
PHY Ad Hoc

Co-Chairs:
Bo Sun (ZTE)
Yakun Sun (Marvell)
Jianhan Liu (Mediatek)

Agenda Items

- Call meeting to order
- Patent policy, etc. (Call for Potentially Essential Patents)
- Set and approve agenda

- Review ad hoc rules
- Technical Presentations approved by 802.11ax for presentation this week, and related straw polls
- Any other technical presentations

Meeting Protocol, Attendance, Voting & Document Status

- **Please announce your affiliation when you first address the group during a meeting slot**
- **Cell Phones to be silent or Off**
- **Register your attendance via https://imat.ieee.org while on meeting SSID (e.g. Verilan-secure)**
- **Make sure your badges are correct**
- **If you plan to make a submission be sure it does not contain company logos or advertising**
- **Questions on Voting status, Ballot pool, Access to Reflector, Documentation, Member's Area**
  - Contact Jon Rosdahl – jrosdahl@ieee.org

Patent Policy and Other Guidelines

- Following 5 slides

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Instructions for the WG Chair

The IEEE-SA strongly recommends that at each WG meeting the chair or a designee:

- **Show slides #1 through #4 of this presentation**
- **Advise the WG attendees that:**
  - The IEEE's patent policy is consistent with the ANSI patent policy and is described in Clause 6 of the *IEEE-SA Standards Board Bylaws*;
  - Early identification of patent claims which may be essential for the use of standards under development is strongly encouraged;
  - There may be Essential Patent Claims of which the IEEE is not aware. Additionally, neither the IEEE, the WG, nor the WG chair can ensure the accuracy or completeness of any assurance or whether any such assurance is, in fact, of a Patent Claim that is essential for the use of the standard under development.
- **Instruct the WG Secretary to record in the minutes of the relevant WG meeting:**
  - That the foregoing information was provided and that slides 1 through 4 (and this slide 0, if applicable) were shown;
  - That the chair or designee provided an opportunity for participants to identify patent claim(s)/patent application claim(s) and/or the holder of patent claim(s)/patent application claim(s) of which the participant is personally aware and that may be essential for the use of that standard
  - Any responses that were given, specifically the patent claim(s)/patent application claim(s) and/or the holder of the patent claim(s)/patent application claim(s) that were identified (if any) and by whom.
- The WG Chair shall ensure that a request is made to any identified holders of potential essential patent claim(s) to complete and submit a Letter of Assurance.
- It is recommended that the WG chair review the guidance in *IEEE-SA Standards Board Operations Manual* 6.3.5 and in FAQs 12 and 12a on inclusion of potential Essential Patent Claims by incorporation or by reference.

Note: **WG** includes Working Groups, Task Groups, and other standards-developing committees with a PAR approved by the IEEE-SA Standards Board.

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Participants, Patents, and Duty to Inform

All participants in this meeting have certain obligations under the IEEE-SA Patent Policy.

- **Participants [Note: Quoted text excerpted from IEEE-SA Standards Board Bylaws subclause 6.2]:**
  - **"Shall inform the IEEE (or cause the IEEE to be informed)" of the identity of each "holder of any potential Essential Patent Claims of which they are personally aware" if the claims are owned or controlled by the participant or the entity the participant is from, employed by, or otherwise represents**
  - **"Should inform the IEEE (or cause the IEEE to be informed)" of the identity of "any other holders of potential Essential Patent Claims" (that is, third parties that are not affiliated with the participant, with the participant's employer, or with anyone else that the participant is from or otherwise represents)**
- **The above does not apply if the patent claim is already the subject of an Accepted Letter of Assurance that applies to the proposed standard(s) under consideration by this group**
- **Early identification of holders of potential Essential Patent Claims is strongly encouraged**
- **No duty to perform a patent search**

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Slide #1

Patent Related Links

All participants should be familiar with their obligations under the IEEE-SA Policies & Procedures for standards development.

Patent Policy is stated in these sources:

IEEE-SA Standards Boards Bylaws

http://standards.ieee.org/develop/policies/bylaws/sect6-7.html#6

IEEE-SA Standards Board Operations Manual

http://standards.ieee.org/develop/policies/opman/sect6.html#6.3

Material about the patent policy is available at

http://standards.ieee.org/about/sasb/patcom/materials.html

If you have questions, contact the IEEE-SA Standards Board Patent Committee Administrator at patcom@ieee.org or visit http://standards.ieee.org/board/pat/index.html

This slide set is available at http://standards.ieee.org/board/pat/pat-slideset.ppt

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Slide #2

Call for Potentially Essential Patents

- **If anyone in this meeting is personally aware of the holder of any patent claims that are potentially essential to implementation of the proposed standard(s) under consideration by this group and that are not already the subject of an Accepted Letter of Assurance:**
  - Either speak up now or
  - Provide the chair of this group with the identity of the holder(s) of any and all such claims as soon as possible or
  - Cause an LOA to be submitted

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Slide #3

Other Guidelines for IEEE WG Meetings

- **All IEEE-SA standards meetings shall be conducted in compliance with all applicable laws, including antitrust and competition laws.**
  - **Don't discuss the interpretation, validity, or essentiality of patents/patent claims.**
  - **Don't discuss specific license rates, terms, or conditions.**
    - Relative costs, including licensing costs of essential patent claims, of different technical approaches may be discussed in standards development meetings.
      - Technical considerations remain primary focus
  - **Don't discuss or engage in the fixing of product prices, allocation of customers, or division of sales markets.**
  - **Don't discuss the status or substance of ongoing or threatened litigation.**
  - **Don't be silent if inappropriate topics are discussed … do formally object.**

See *IEEE-SA Standards Board Operations Manual*, clause 5.3.10 and "Promoting Competition and Innovation: What You Need to Know about the IEEE Standards Association's Antitrust and Competition Policy" for more details.

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Slide #4

Ad Hoc Groups Operation

- **Straw Polls are only allowed during Ad Hoc group meeting // no motions, anyone can vote**
- **A straw poll affecting the Spec Framework has to start with,**
  - Do you agree to add to the TG Specification Frame work document?
- **A straw poll needs to achieves at least 75% to be converted to a motion at the TG level.**
- **Each Presentation will be limited to 20 minutes.**

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Meeting Schedule

	Monday		Tuesday		Wednesday		Thursday
AM1					**TGax**		
AM2	**TGax**		PHY	MAC(SR)			**TGax**
PM1			PHY	MAC	PHY	MU	
PM2	PHY	MAC			PHY		**TGax**
EVE			**MU**				

Submissions

DCN	Title	Name	Ad Hoc
11-16/0030	Maximum Tone Grouping Size for 802.11ax Feedback with MU-MIMO	Kome Oteri	PHY
11-16/0033	1x HE-LTF for ULMUMIMO	Hongyuan Zhang	PHY
11-16/0034	Beamforming with HE-LTF Compression	Hongyuan Zhang	PHY
11-16/0036	CRC Generation for HE-SIG	Yakun Sun	PHY
11-16/0037	Continuous Puncturing for HE-SIGB Encoding	Yakun Sun	PHY
11-16/0038	Sequence for 1x LTF	Daewon Lee	PHY
11-16/0039	RU Allocation in SIG-B	Daewon Lee	PHY
11-16/0040	Issues with Compressed SIG-B Mode	Yujin Noh	PHY
11-16/0041	Link Adaptation for HE WLAN	Yujin Noh	PHY
11-16/0044	MCS Levels and TX EVM Requirement for 1024 QAM	Eunsung Park	PHY
11-16/0045	Flexible Wider Bandwidth Transmission	John Son	PHY
11-16/0046	Content for the extra tones in LSIG and RLSIG	Jiayin Zhang	PHY
11-16/0047	Discussion on the HE Extended Range SU PPDU	Jiayin Zhang	PHY
11-16/0052	Remaining HE-LTF Sequence Design	Le Liu	PHY
11-16/0053	Requirements for UL MU Transmissions	Arjun	PHY
11-16/0056	On QPSK DCM Modulation and LDPC Tone Mapper for DCM	Jianhan Liu	PHY
11-16/0071	Packet Extension Follow Up	Andrew Blanksby	PHY
11-16/0079	Allocation sizes for BCC in OFDMA	Ken Taniguchi	PHY
11-16/0080	1x/2x/4x OFDM Symbol in HE SU PPDU with BCC	Heejung Yu	PHY
11-16/0088	Ng for Compressed Beamforming feedback	Sriram Venkateswaran	PHY
11-16/0089	Single Stream Pilots in UL MU MIMO	Sriram Venkateswaran	PHY
11-16/0104	Rate Matching for HE-SIG-B	Daewon Lee	PHY

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Monday PM2

DCN	Title	Name	Ad Hoc
11-16/0030	Maximum Tone Grouping Size for 802.11ax Feedback with MU-MIMO	Kome Oteri	PHY
11-16/0088	Ng for Compressed Beamforming feedback	Sriram Venkateswaran	PHY
11-16/0033	1x HE-LTF for ULMUMIMO	Hongyuan Zhang	PHY
11-16/0034	Beamforming with HE-LTF Compression	Hongyuan Zhang	PHY
11-16/0036	CRC Generation for HE-SIG	Yakun Sun	PHY
11-16/0037	Continuous Puncturing for HE-SIGB Encoding	Yakun Sun	PHY
11-16/0104	Rate Matching for HE-SIG-B	Daewon Lee	PHY
11-16/0038	Sequence for 1x LTF	Daewon Lee	PHY

11-16/0030r1 Straw Poll #1

Do you agree to add the following to Section 7.3 of the Tgax SFD ?

- **802.11ax spec shall support *Ng = 4 and 16* for sounding feedback with SU/MU-MIMO-OFDM(A).**
- ***NOTE—The tone grouping factor, Ng is defined with respect to data tones of the HE PPDU.***

- **36Y/0N/8A**

SP PASSED

11-16/0030r1 Straw Poll #2

Do you agree to add the following to Section 7.3 of the Tgax SFD ?

- **802.11ax spec shall support *Ng = 2 and 8* for sounding feedback with SU/MU-MIMO-OFDM(A).**
- ***NOTE—The tone grouping factor, Ng is defined with respect to data tones of the HE PPDU.***

- **6Y/17N/19A**

SP Failed

11-16/0088r0 Straw Poll #2

- **Do you support adding to the TG Specification Framework:**

  In the MU Exclusive Beamforming Report for the delta SNR, the locations of the feedback tones shall be identical to the tone locations of the compressed V matrices fed back

- **Yes: 34**
- **No : 0**
- **Abstain: 11**

SP PASSED

11-16/0033r0 Straw Poll #1

- Do you agree to add the following text in SFD?
  - 11ax allows 1xLTF as an optional mode in the following cases:
    - SU, with GI = 0.8us only
    - Full-BW UL-MUMIMO, with GI=1.6us only?
    - Full BW DL-MUMIMO, with GI=0.8us TBD

433

- **Y 38**
- **N 0**
- **A 10**

SP PASSED

11-16/0034r0 Straw Poll #1

- Do you agree to add the following text in SFD?
  - *When 1x/2x HE-LTF is transmitted, it is recommended that the spatial mapping matrix applied to HE-STF and beyond is chosen such that it preserves the smoothness of the physical channel, achieved by limiting the variation of each element's real and imaginary values in the spatial mapping matrix across successive tones.*

434

- **Y 35**
- **N 0**
- **A 10**

SP PASSED

11-16/0036r0 Straw Poll

- **Do you support to add the following in the current SFD:**
  - The CRC bits of HE-SIG-A and each coding group of HE-SIG-B are generated as 4 LSB of HT CRC generator output?

435

- **Y 38**
- **N 3**
- **A 10**

SP PASSED

11-16/0037r1 Straw Poll

- **Do you support to add the following to the current SFD:**
  - SIGB bits for each SIGB content channel are continuously encoded with 1 BCC encoder?

436

- **Y 36**
- **N 0**
- **A 14**

SP PASSED

11-16/0104r0 Straw Poll

Do you agree to add the following text to SFD

- **When MCS 2, 4, or 6 is configured for HE-SIGB, up to 2 (zero valued) filler bits are added after each tail bits of HE-SIG-B encoding block (i.e. common field and STA-specific information field) such that length of an encoding block (including the filler bits) is multiple of 3.**

- **When MCS 5 is configured for HE-SIGB, up to 1 (zero valued) filler bits are added after each tail bits of HE-SIG-B encoding block (i.e. common field and STA-specific information field) such that length of an encoding block (including the filler bits) is multiple of 2.**

•Y 6
•N 22
•A 13

SP FAILED

Tuesday AM2

DCN	Title	Name	Ad Hoc
11-16/0038	Sequence for 1x LTF	Daewon Lee	PHY
11-16/0052	Remaining HE-LTF Sequence Design	Le Liu	PHY
11-16/0039	RU Allocation in SIG-B	Daewon Lee	PHY
11-16/0040	Issues with Compressed SIG-B Mode	Yujin Noh	PHY
11-16/0041	Link Adaptation for HE WLAN	Yujin Noh	PHY
11-16/0044	MCS Levels and TX EVM Requirement for 1024 QAM	Eunsung Park	PHY
11-16/0045	Flexible Wider Bandwidth Transmission	John Son	PHY
11-16/0046	Content for the extra tones in LSIG and RLSIG	Jiayin Zhang	PHY

11-16/0053r0 Straw Poll #1

- **Do you agree**
  - 4x HE-LTF$_{160MHz}$(-1012:1:1012) =[4x LTF$_{80MHz_primary}$, zeros(1,23), 4x LTF$_{80MHz_secondary}$]
    - 4x LTF$_{80MHz_primary}$ = [L-LTF$_{80M}$, 0, R-LTF$_{80M}$] as agreed for 80MHz 4x HE-LTF;
    - 4x LTF$_{80MHz_secondary}$ = [L-LTF$_{80M}$, 0, (-1)* R-LTF$_{80M}$]
  - 4x HE-LTF$_{80+80MHz}$ = [4x LTF$_{80MHz_primary}$, 4x LTF$_{80MHz_secondary}$]

439

- **Y 35**
- **N 0**
- **A 14**

SP PASSED

11-16/0053r0 Straw Poll #2

- **Do you agree**
  - 2x HE-LTF$_{160MHz}$(-1012:2:1012) = [2x LTF$_{80MHz_primary}$, zeros(1,11), 2x LTF$_{80MHz_secondary}$]
    - 2x LTF$_{80MHz_primary}$ as agreed for 80MHz 2x HE-LTF = [{1st 242-RU}, {2nd 242-RU}, {central 26-RU}, {3rd 242-RU}, {4th 242-RU}];
    - 2x LTF$_{80MHz_secondary}$ = [{1st 242-RU}, (-1)*{2nd 242-RU}, {central 26-RU}, {3rd 242-RU}, (-1)*{4th 242-RU}];
  - 2x HE-LTF$_{80+80MHz}$= [2x LTF$_{80MHz_primary}$, 2x LTF$_{80MHz_secondary}$]

440

- **Y 38**
- **N 0**
- **A 16**

SP PASSED

11-16/0053r0 Straw Poll #3

- **Do you agree to use the 20/40/80/160/80+80MHz 1x HE-LTF sequences in slide 21-24 of 11-16/0053r0?**

441

- **Y 35**
- **N 0**
- **A 15**

SP PASSED

11-16/0039r1 Straw Poll #1

Do you agree with to not support dynamic split (not precluding equal split) of MU-MIMO STA specific information for 2x996 RU (i.e 160MHz MU-MIMO).

442

8Y/6N/Many A

Informative

11-16/0039r1 Straw Poll #2

Do you agree with support equal split and no split (all STA information in one SIG-B channel) of MU-MIMO STA specific information for 2x996 RU (i.e. 160MHz MU-MIMO).

443

9Y/0N/Many A

Informative

11-16/0039r1 Straw Poll #3

Do you agree to include the following text to SFD?

- **At least 1 state is reserved in the 8 bit RU allocation subfield of the HE-SIG-B common field for "no STA-specific information field assigned by the RU allocation subfield'.**
  - Details TBD

444

21 Y/1 N/19A

SP PASSED

11-16/0040r0 Straw Poll #1

Do you agree to include the following text to TGax SFD:

- **In MU PPDU, the SIG-A shall indicate the number of STAs when compressed SIG-B mode is indicated (i.e. full bandwidth MU-MIMO indicated).**
  - Details TBD

13Y/0N/31A

SP PASSED

445

11-16/0041r1 Straw Poll #1

Do you agree to include the following text to TGax SFD:

- **HE link adaptation shall define a fixed reference payload size as MPDU length of Y octets in specifications**
  - "Y" is TBC

446

10Y/5N/26A

SP FAILED

Tuesday PM1

DCN	Title	Name	Ad Hoc
11-16/0044	MCS Levels and TX EVM Requirement for 1024 QAM	Eunsung Park	PHY
11-16/0046	Content for the extra tones in LSIG and RLSIG	Jiayin Zhang	PHY
11-16/0047	Discussion on the HE Extended Range SU PPDU	Jiayin Zhang	PHY
11-16/0045	Flexible Wider Bandwidth Transmission	John Son	PHY
11-16/0053	Requirements for UL MU Transmissions	Arjun	PHY
11-16/0056	On QPSK DCM Modulation and LDPC Tone Mapper for DCM	Jianhan Liu	PHY
11-16/0071	Packet Extension Follow Up	Andrew Blanksby	PHY
11-16/0079	Allocation sizes for BCC in OFDMA	Ken Taniguchi	PHY
11-16/0080	1x/2x/4x OFDM Symbol in HE SU PPDU with BCC	Heejung Yu	PHY
11-16/0089	Single Stream Pilots in UL MU MIMO	Sriram Venkateswaran	PHY

11-16/0044r0 Straw Poll #1

Do you agree to add the following new MCS levels as an optional feature to the 11ax SFD:

- MCS10: 1024 QAM with 3/4 code rate
- MCS11: 1024 QAM with 5/6 code rate

448

- **Y: 23**
- **N: 1**
- **A: 10**

SP PASSED

11-16/0044r0 Straw Poll #2

Do you agree to add the following text to the 11ax SFD:

- TX EVM requirement of -35dB is used for MCS 10 and 11

449

- **Y: 24**
- **N: 2**
- **A: 11**

SP PASSED

11-16/0046r0 Straw Poll #1

Do you support to add to the SFD

- The content of 4 extra tones **[-28,-27,27,28]** of L-SIG and RL-SIG in 20MHz HE PPDU is **[-1,-1,-1,1]**

450

- **Y: 33**
- **N: 0**
- **A: 11**

SP PASSED

11-16/0047r0 Straw Poll #1

Do you support to modify the SFD as the red text

- *There are only three pre-HE-STF preamble formats defined:*
  - *SU format (mandatory) / Trigger based UL*
  - *MU format (mandatory)*
  - *Extended range SU format (mandatory)*

  [PHY Motion 68, November 2015, see [6]]

- **Y: 32**
- **N: 9**
- **A: 10**

SP PASSED

451

11-16/0047r0 Straw Poll #2

Do you support to add to SFD

- The HE Extended Range SU PPDU is transmitted only on the primary 20Mhz.

452

- **Y: 38**
- **N: 0**
- **A: 13**

SP PASSED

11-16/0047r0 Straw Poll #3

Do you support to add to SFD

- The HE Extended Range SU PPDU can only be transmitted with MCS0, MCS1, MCS2 and only with 1 spatial stream.

453

- **Y: 37**
- **N: 0**
- **A: 16**

SP PASSED

11-16/0047r0 Straw Poll #4

Do you support to add to SFD

- HE-LTF/HE-STF power is boosted 3dB for BPSK and QPSK including DCM in the HE Extended Range SU PPDU preamble.

454

- **Y: 40**
- **N: 6**
- **A: 12**

SP PASSED

11-16/0045r2 Straw Poll #1

Do you agree to add the following text into 11ax SFD?

- 3.x.x The spec shall support occupied bandwidth of HE PPDU other than 20/40/80/160(80+80)MHz for HE MU PPDU format.

455

- **Y: 22**
- **N: 17**
- **A: 19**

SP FAILED

11-16/0053r0 Straw Poll #1

Do you agree to add the following text in SFD?

- There are two STA classes that support HE trigger-based PPDU with information exchanged as part of the device capability
  - Class A: STAs that are high capability devices and
  - Class B: STAs that are low capability devices

- **Y: 40**
- **N: 2**
- **A: 13**

SP PASSED

456

11-16/0053r0 Straw Poll #2

Do you agree to add the following text in SFD?

- STAs that participate in HE trigger-based PPDU shall support per chain max(P-32,-10dBm) as the min Tx power, with P the max power the STA can transmit at the antenna connector of that chain using MCS0 while meeting the TX EVM and spectral mask requirements. A STA transmitting at and above the min power shall support the EVM requirements for TBD MCS (but at least MCS7)

- **Y: 39**
- **N: 2**
- **A: 13**

SP PASSED

11-16/0053r0 Straw Poll #3

- **Do you agree to add the following text in SFD?**
  - STAs that participate in HE trigger-based PPDU shall support the following absolute Tx power requirements and the RSSI measurement accuracy requirements for the two device classes

Parameter	11ax Minimum Requirements		Comments
	Class A devices	Class B devices	
Absolute Transmit Power accuracy	+/-3dB	+/-9dB	Accuracy of achieving a specified transmit power level
RSSI Measurement Accuracy	+/- 2 dB	+/- 5 dB	Difference between the actual RSSI and the measured RSSI Requirements are valid from minimum RX to maximum RX input power

458

- **Y: 41**
- **N: 1**
- **A: 14**

SP PASSED

11-16/0053r0 Straw Poll #4

Do you agree to add the following text in SFD?

- STAs that participate in HE trigger-based PPDU shall pre-compensate for carrier frequency offset (CFO) error and timing drift. After compensation, the absolute value of residual CFO error with respect to the corresponding Trigger frame shall not exceed **350Hz** for data subcarriers when measured as the 10% point of CCDF of CFO errors in AWGN at a received power of -60dBm in the primary 20MHz. The residual CFO error measurement shall be made on the HE trigger-based PPDU packet after HE-SIGA.

459

- **Y: 39**
- **N: 0**
- **A: 17**

SP PASSED

11-16/0053r0 Straw Poll #5

Do you agree to add the following text in SFD?

- STA that participate in HE Trigger based PPDU transmission shall have timing accuracy of **+/-0.4μs** relative to the Trigger frame. This requirement does not include round trip delay.

- **Y: 39**
- **N: 0**
- **A: 10**

SP PASSED

11-16/0053r0 Straw Poll #6

Do you agree to add the following text in SFD?

- The following TX LO leakage requirements are supported for all transmission modes in 11ax:
  - The power measured at the location of the RF LO using resolution BW 78.125 kHz shall not exceed the maximum of –32 dB relative to the total transmit power and -20 dBm, or equivalently max(P-32,-20), where *P* is the transmit power per antenna in dBm. The transmit center frequency leakage is specified per antenna.

- **Y: 38**
- **N: 0**
- **A: 10**

SP PASSED

11-16/0053r0 Straw Poll #7

Do you agree to add the following text in SFD?

- Transmit center frequency and the symbol clock frequency for all transmit antennas and frequency segments shall be derived from the same reference oscillator

462

- **Y: 41**
- **N: 0**
- **A: 10**

SP PASSED

Wednesday PM

DCN	Title	Name	Ad Hoc
11-16/0056	On QPSK DCM Modulation and LDPC Tone Mapper for DCM	Jianhan Liu	PHY
11-16/0071	Packet Extension Follow Up	Andrew Blanksby	PHY
11-16/0079	Allocation sizes for BCC in OFDMA	Ken Taniguchi	PHY
11-16/0080	1x/2x/4x OFDM Symbol in HE SU PPDU with BCC	Heejung Yu	PHY
11-16/0089	Single Stream Pilots in UL MU MIMO	Sriram Venkateswaran	PHY

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Appendix AP

IEEE P802.11
Wireless LANs

IEEE 802.11 TGax

January 2016 Atlanta PHY Ad Hoc Meeting Minutes

Date: 2016-01-21

Author(s):

Name	Affiliation	Address	Phone	email
Jianhan Liu	Mediatek			jianhan.liu@mediatek.com

Abstract

TGax meeting minutes for the IEEE 802.11 Atlanta PHY ad hoc session, January, 2016.

IEEE 802.11 Task Group ax PHY Ad Hoc
January 2016 Atlanta Meeting

Monday, Jan. 18th, 2016, PM2 TGax Session

1. **Meeting called to order by Bo Sun (ZTE)**
   1.1. The agenda is contained in 11-15/1385r0 which is on the server.

2. **Administrative Items**
   2.1. Chair reminded the IEEE 802 and IEEE 802.11 Policy and Procedure.
   2.2. Chair also reminded to do attendance.

3. **Set and approve agenda**

4. **Presentations**

4.1
11-16-0030-01-00ax-maximum-tone-grouping-size-for-802-11ax-feedback-with-mu-mimo
Kome Oteri (InterDigital Inc.) presented.

Discussions:
Sriram: We have a similar contribution but with slightly different conclusions.
Kome: We do have a couple of strawpolls. Can we run our straw poll?
Chair: We will go through Sriram's contribution, and then have the straw poll.

SP #1:
Do you agree to add the following to Section 7.3 of the Tgax SFD ?
- 802.11ax spec shall support Ng = 4 and 16 for sounding feedback with SU/MU-MIMO-OFDM(A).
- NOTE—The tone grouping factor, Ng is defined with respect to data tones of the HE PPDU.

SP Result: 36Y/0N/15A; SP passed.

SP #2:
Discussions:
Mingyue: The tradeoff of using Ng=8 is not good.

Do you agree to add the following to Section 7.3 of the Tgax SFD ?
- 802.11ax spec shall support *Ng = 2 and 8* for sounding feedback with SU/MU-MIMO-OFDM(A).
- *NOTE—The tone grouping factor, Ng is defined with respect to data tones of the HE PPDU.*

SP Result: 6Y/17N/19A; SP failed

4.2
11-16-0088-00-00ax-ng-for-compressed-beamforming-feedback
Sriram Venkateswaran (Broadcom) Presented

Discussions:
SP #1:
Skipped since it is same as SP#1 in 11-16-0030r1

SP #2:
Do you support adding to the TG Specification Framework:
In the MU Exclusive Beamforming Report for the delta SNR, the locations of the feedback tones shall be identical to the tone locations of the compressed V matrices fed back

SP Result: 34Y/0N/11A; SP passed

4.3
11-16-0033-00-00ax-1x-he-ltf-for-ulmumimo
Hongyuan Zhang (Marvell) Presented

Discussions:

SP #1:
Do you agree to add the following text in SFD?
- **11ax allows 1xLTF as an optional mode in the following cases:**
  - **SU, with GI = 0.8us only**
  - **Full-BW UL-MUMIMO, with GI=1.6us only?**
  - **Full BW DL-MUMIMO, with GI=0.8us TBD**

SP Result: 38Y/0N/10A; SP passed

4.4
11-16-0034-00-00ax-beamforming-with-he-ltf-compression
Hongyuan Zhang (Marvell) Presented

Discussions:
Sigard: Interpolation at the receiver?
Hongyuan: yes.

SP #1:
Discussions:
Sigard: Does the TX have to do it?
Hongyuan: yes. Tx has to maintain the smoothness.

- **Do you agree to add the following text in SFD?**
  - When 1x/2x HE-LTF is transmitted, it is recommended that the spatial mapping matrix applied to HE-STF and beyond is chosen such that it preserves the smoothness of the

physical channel, achieved by limiting the variation of each element's real and imaginary values in the spatial mapping matrix across successive tones.

SP Result: 35Y/0N/10A; SP passed

4.5
11-16-0036-00-00ax-crc-generation-for-he-sig
Yakun Sun (Marvell) Presented

Discussions:
Daewon: if you just truncate the 8-bit CRC, the performance should not be better than the best polynomial.
Yakun: Our simulations show the performance is good enough.
Daewon: did you check the 1 bit or 2bits error cases?
Yakun: we did not.

SP #1:

- **Do you support to add the following in the current SFD:**
  - The CRC bits of HE-SIG-A and each coding group of HE-SIG-B are generated as 4 LSB of HT CRC generator output?

SP Result: 38Y/3N/10A; SP passed

4.6
11-16-0037-01-00ax-continuous-puncturing-for-he-sigb-encoding
Yakun Sun (Marvell) Presented

Discussions:
Daewon: My contribution #104 is related to the straw poll. I just ask if I can present after this presentation.
Chair: you can present after this straw poll.

SP #1:

- **Do you support to add the following to the current SFD:**
  - SIGB bits for each SIGB content channel are continuously encoded with 1 BCC encoder?

- **SP Result: 36Y/0N/14A; SP passed**

4.7
11-16-0104-00-00ax-rate-matching-for-he-sig-b
Daewon (Newracom) Presented

Discussions:
Yakun: In some cases, your padding method loses efficiency.
Daewon: I would say if you want to high efficiency, we should remove all the tail bits.

SP #1:

Do you agree to add the following text to SFD?

- When MCS 2, 4, or 6 is configured for HE-SIGB, up to 2 (zero valued) filler bits are added after each tail bits of HE-SIG-B encoding block (i.e. common field and STA-specific information field) such that length of an encoding block (including the filler bits) is multiple of 3.
- When MCS 5 is configured for HE-SIGB, up to 1 (zero valued) filler bits are added after each tail bits of HE-SIG-B encoding block (i.e. common field and STA-specific information field) such that length of an encoding block (including the filler bits) is multiple of 2.

SP Result: 6Y/22N/17A; SP failed

Tuesday, Jan.19th, 2016, AM2

5. Meeting called to order by Bo Sun (ZTE)

5.1. The agenda is contained in 11-15/1385r1 which is on the server.

6. Administrative Items

6.1. Chair reminded the IEEE 802 and IEEE 802.11 Policy and Procedure.
6.2. Chair also reminded to do attendance.

7. Presentations

7.1
11-16-0038-00-00ax-sequence-for-1x-ltf
Daewon (Newracom) Presented

Discussions:
Le: The index is not divided by 4
Daewon: These are typos.

No Straw poll.

7.2
11-16-0052-00-00ax-remaining-he-ltf-sequence-design
Le (Huawei) Presented

Discussions:
Yakun: The index is not divided by 4
Daewon: These are typos.

SP #1:

- **Do you agree**
  - 4x HE-LTF$_{160MHz}$(-1012:1:1012) =[4x LTF$_{80MHz_primary}$, zeros(1,23), 4x LTF$_{80MHz_secondary}$]
    - 4x LTF$_{80MHz_primary}$ = [L-LTF$_{80M}$, 0, R-LTF$_{80M}$] as agreed for 80MHz 4x HE-LTF;
    - 4x LTF$_{80MHz_secondary}$ = [L-LTF$_{80M}$, 0, (-1)* R-LTF$_{80M}$]
  - 4x HE-LTF$_{80+80MHz}$ = [4x LTF$_{80MHz_primary}$, 4x LTF$_{80MHz_secondary}$]

SP Result: **35Y/0N/14A; SP passed**

SP #2:

- **Do you agree**
  - 2x HE-LTF$_{160MHz}$(-1012:2:1012) = [2x LTF$_{80MHz_primary}$, zeros(1,11), 2x LTF$_{80MHz_secondary}$]
    - 2x LTF$_{80MHz_primary}$ as agreed for 80MHz 2x HE-LTF = [{1st 242-RU}, {2nd 242-RU}, {central 26-RU}, {3rd 242-RU}, {4th 242-RU}];
    - 2x LTF$_{80MHz_secondary}$ = [{1st 242-RU}, (-1)*{2nd 242-RU}, {central 26-RU}, {3rd 242-RU}, (-1)*{4th 242-RU}];
  - 2x HE-LTF$_{80+80MHz}$= [2x LTF$_{80MHz_primary}$, 2x LTF$_{80MHz_secondary}$]

SP Result: **38Y/0N/16A; SP passed**

SP #3:

- Do you agree to use the 20/40/80/160/80+80MHz 1x HE-LTF sequences in slide 21-24?

SP Result: **35Y/2N/15A; SP passed**

7.3
11-16-0039-01-00ax-ru-allocation-in-sig-b
Daewon (Newracom) Presented

Arjun: Your proposal requires STAs to successfully decode both content channels.
Daewon: If the STA does not know which channel its contents is on, the STA must decode both content channels.

SP #1:

Do you agree with not to support dynamic split (not precluding equal split) of MU-MIMO STA specific information for 2x996 RU (i.e. 160MHz MU-MIMO).

SP Result: **8Y/6N/many A; SP failed**

SP #2:
Do you agree with support equal split and no split (all STA information in one SIG-B channel) of MU-MIMO STA specific information for 2x996 RU (i.e. 160MHz MU-MIMO).

SP Result: **9Y/0N/many A; SP failed**

SP #3:

Do you agree to include the following text to SFD?

- At least 1 state is reserved in the 8 bit RU allocation subfield of the HE-SIG-B common field for 'no STA-specific information field assigned by the RU allocation subfield'.
- Details TBD

SP Result: 21Y/1N/19A; SP passed

7.4

11-16-0040-00-00ax-issues-with-compressed-sig-b-mode

Yujin Noh (Newracom) Presented

Discussions:

SP #1:

Do you agree to include the following text to TGax SFD:

- In MU PPDU, the SIG-A shall indicate the number of STAs when compressed SIG-B mode is indicated (i.e. full bandwidth MU-MIMO indicated).
  - Details TBD

SP Result: 13Y/0N/31A; SP passed

7.5

11-16-0041-01-00ax-link-adaptation-for-he-wlan

Yujin Noh (Newracom) Presented

Discussions:

Bin: How does the receiver knows the percentage of PER?
Daewon: The assumption is that you can measure the channel quality.
Hongyuan: The accuracy of the estimated per-tone SNR may be large than the link adation.
Daewon: If you have a better method, we are willing to accept.

SP #1

Do you agree to include the following text to TGax SFD:

- HE link adaptation shall define a fixed reference payload size as MPDU length of Y octets in specification.
  - "Y" is TBD.

SP Result: 10Y/5N/26A; SP failed

Tuesday, Jan 19th, 2016, PM1

8. Meeting called to order by Bo Sun (ZTE)

8.1. The agenda is contained in 11-15/1385r2 which is on the server.

9. Administrative Items

9.1. Chair reminded the IEEE 802 and IEEE 802.11 Policy and Procedure.

9.2. Chair also reminded to do attendance.

10. Presentations

10.1

11-16-0044-00-00ax-mcs-levels-and-tx-evm-requirement-for-1024-qam

Eunsung (LGE) Presented

SP #1:

- **Do you agree to add the following new MCS levels as an optional feature to the 11ax SFD:**
  - MCS10: 1024 QAM with 3/4 code rate
  - MCS11: 1024 QAM with 5/6 code rate

SP Result: 23Y/1N/10A; SP passed

SP #2:

- **Do you agree to add the following text to the 11ax SFD:**
  - TX EVM requirement of -35dB is used for MCS 10 and 11

SP Result: 24Y/2N/11A; SP passed

10.2

11-16-0046-00-00ax-content-for-the-extra-tones-in-lsig-and-rlsig

Jiayin Zhang (Huawei) Presented

SP #1:

Do you support to add to the SFD

- The content of 4 extra tones [-28,-27,27,28] of L-SIG and RL-SIG in 20MHz HE PPDU is [-1,-1,-1,1]

SP Result: 32Y/0N/11A; SP passed

10.3

11-16-0047-00-00ax-discussion-on-the-he-extended-range-su-ppdu

Jiayin Zhang (Huawei) Presented

Discussions:

Sigurd: Will you see the performance difference of extend preamble?

Jiayin: Without extend preamble; data portion will be the bottleneck.

Daewon: What we need to enhance the data portion?
Jiayin: For example, beamforming can be used to improve the data portion performance.
Daewon: I do not think the power boost is good for beamforming?
Jiayin: It depends on how you do beamforming.

SP #1:
Discussions:
Daewon: I will prefer to not making this mandatory.
Sigurd: I think more simulation results needed.

- **Do you support to modify the SFD as the red text**
  There are only three pre-HE-STF preamble formats defined:
    - SU format (mandatory) / Trigger based UL
    - MU format (mandatory)
    - Extended range SU format (mandatory)

SP Result: 32Y/9N/10A; SP passed

SP #2:
- **Do you support to add to SFD**
  - The HE Extended Range SU PPDU is transmitted only on the primary 20MHz.

SP Result: 38Y/0N/17A; SP passed

SP #3:
- **Do you support to add to SFD**
  - The HE Extended Range SU PPDU can only be transmitted with MCS0, MCS1, MCS2 and only with 1 spatial stream.

SP Result: 37Y/0N/16A; SP passed

SP #4:
Discussions:
Sigurd: Are you not compliant if you are not boosted?
Jiayin: Boost is a mandatory.
Jianhan: it is also transparent to the receiver.

- **Do you support to add to SFD**
  - HE-LTF/HE-STF power is boosted 3dB for BPSK and QPSK including DCM in the HE Extended Range SU PPDU preamble.

SP Result: 40Y/6N/12A; SP passed

10.4
11-16-0045-01-00ax-flexible-wider-bandwidth-transmission

John Son (WILUS) Presented

Discussions:
Hongyuan: You need some change on secondary CCA. Per 20MHz CCA, what is the level?
John: We do not have a specific level. Just a concept.
Hongyuan: should be occupied bandwidth.

SP #1:

- **Do you agree to add the following text into 11ax SFD?**
  - 3.x.x The spec shall support occupied HE PPDU bandwidth options other than 20/40/80/160(80+80)MHz for HE MU PPDU format.

SP Result: 22Y/17N/19A; SP failed

10.5
11-16-0053-00-00ax-requirements-for-ul-mu-transmissions
Arjun (Qualcomm) presented.

Discussions:
Daewon: Are both categories are mandatory.
Arjun: No.

SP #1:

- **Do you agree to add the following text in SFD?**

There are two STA classes that support HE trigger-based PPDU with information exchanged as part of the device capability
Class A: STAs that are high capability devices and
Class B: STAs that are low capability devices

SP Result: 40Y/2N/13A; SP passed

SP #2:

- **Do you agree to add the following text in SFD?**
  - STAs that participate in HE trigger-based PPDU shall support per chain max(P-32,-10dBm) as the min Tx power, with P the max power the STA can transmit at the antenna connector of that chain using MCS0 while meeting the TX EVM and spectral mask requirements. A STA transmitting at and above the min power shall support the EVM requirements for TBD MCS (but at least MCS7)
  –

SP Result: 39Y/2N/17A; SP passed

SP #3:

- Do you agree to add the following text in SFD?
  - STAs that participate in HE trigger-based PPDU shall support the following absolute Tx power requirements and the RSSI measurement accuracy requirements for the two device classes

Parameter	11ax Minimum Requirements	Comments

	Class A devices	Class B devices	
Absolute Transmit Power accuracy	+/-3dB	+/-9dB	Accuracy of achieving a specified transmit power level
RSSI Measurement Accuracy	+/- 2 dB	+/- 5 dB	Difference between the actual RSSI and the measured RSSI Requirements are valid from minimum RX to maximum RX input power

SP Result: 41Y/1N/14A; SP passed

SP #4:

- **Do you agree to add the following text in SFD?**
  - STAs that participate in HE trigger-based PPDU shall pre-compensate for carrier frequency offset (CFO) error and timing drift. After compensation, the absolute value of residual CFO error with respect to the corresponding Trigger frame shall not exceed 350Hz for data subcarriers when measured as the 10% point of CCDF of CFO errors in AWGN at a received power of -60dBm in the primary 20MHz. The residual CFO error measurement shall be made on the HE trigger-based PPDU packet after HE-SIGA.

SP Result: 39Y/0N/17A; SP passed

SP #5:

- Do you agree to add the following text in SFD?
  - STA that participate in HE Trigger based PPDU transmission shall have timing accuracy of **+/-0.4μs** relative to the Trigger frame. This requirement does not include round trip delay.

SP Result: 39Y/0N/10A; SP passed

SP #6:

- Do you agree to add the following text in SFD?
  - The following TX LO leakage requirements are supported for all transmission modes in 11ax:
    - The power measured at the location of the RF LO using resolution BW 78.125 kHz shall not exceed the maximum of –32 dB relative to the total transmit power and -20 dBm, or equivalently max(P-32,-20), where *P* is the transmit power per antenna in dBm. The transmit center frequency leakage is specified per antenna.

SP Result: 38Y/0N/17A; SP passed

SP #7:

- Do you agree to add the following text in SFD?
  - Transmit center frequency and the symbol clock frequency for all transmit antennas and frequency segments shall be derived from the same reference oscillator

SP Result: 41Y/0N/10A; SP passed

Appendix AQ

HE-SIG-B Compression Mode

Date: 2016-03-14

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HE-SIG-B Compression for MU-MIMO

- For MU-MIMO over the entire BW, 1 bit in HE-SIG-A indicates compression. [1]
  - RU Size is set to the largest RU for the BW (20MHz – 242 tone RU, 40 – 484, 80– 996, 160 – 2x996)
  - The SFD states that the user specific sub-fields are split equally between the two HE-SIG-B Channels for efficient load-balancing
  - Only RU signaling is absent in the HE-SIG-B common fields

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- **In this presentation**
  - Resolve Open Issue of number of user signaling
  - Clarify “equal split” between the two content channels
  - Optimize HE-SIG-B length by not requiring HE-SIG-B common field with compression.

Compression mode - TBDs

- Need to indicate number of users in full bandwidth MU-MIMO allocation
  - *Solution: The number of HE-SIG-B symbols field in HE-SIG-A is re-purposed to indicate the number of MU-MIMO users, when compression mode is enabled*

- The equal distribution of user fields in the two content channels needs to be clearly stated
  - *Solution: For k user MU-MIMO PPDU,* $1, \ldots \left\lceil \frac{k}{2} \right\rceil$ *user specific sub-fields in HE-SIG-B channel 1 and* $\left\lceil \frac{k}{2} \right\rceil + 1, \ldots, k$ *user specific sub-fields in HE-SIG-B channel 2*

- No common field in HE-SIG-B when full bandwidth MU-MIMO is used
  - *All required signaling fields for full bandwidth MU-MIMO are carried in HE-SIG-A and the user specific sub-fields. Maintains maximum signaling efficiency with respect to 11ac MU-MIMO.*

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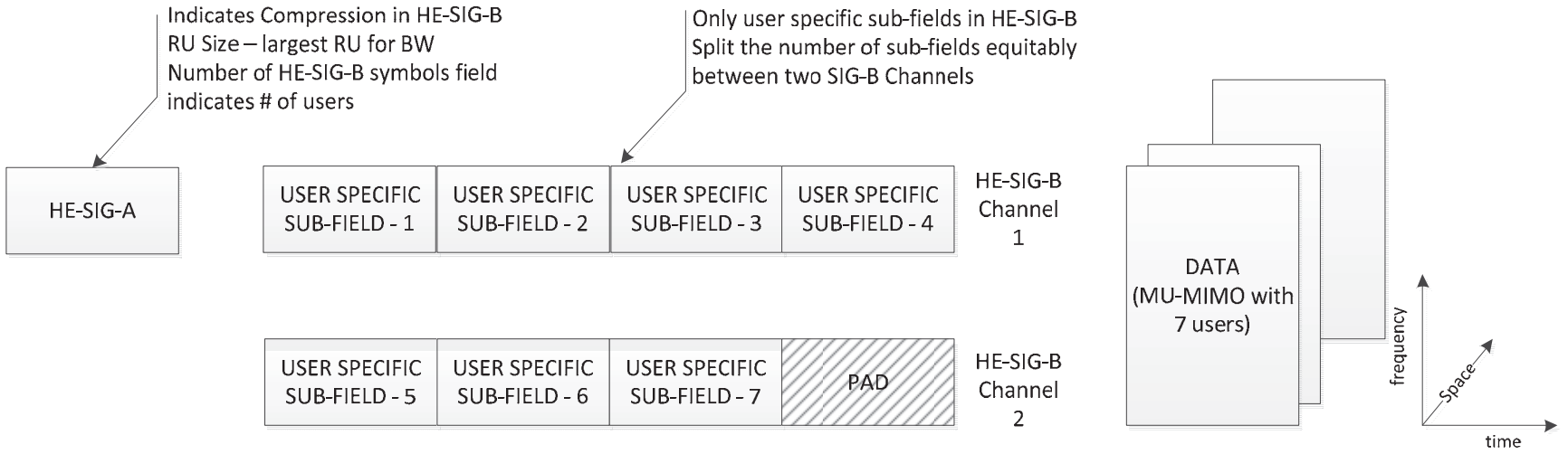
Summary


Indicates Compression in HE-SIG-B
RU Size – largest RU for BW
Number of HE-SIG-B symbols field indicates # of users
Only user specific sub-fields in HE-SIG-B
Split the number of sub-fields equitably between two SIG-B Channels
HE-SIG-A
USER SPECIFIC SUB-FIELD - 1
USER SPECIFIC SUB-FIELD - 2
USER SPECIFIC SUB-FIELD - 3
USER SPECIFIC SUB-FIELD - 4
HE-SIG-B Channel 1
USER SPECIFIC SUB-FIELD - 5
USER SPECIFIC SUB-FIELD - 6
USER SPECIFIC SUB-FIELD - 7
PAD
HE-SIG-B Channel 2
DATA (MU-MIMO with 7 users)
frequency
Space
time

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References

[1] 11-15-1315-01-00ax-HE-SIG-B Mapping and Compression.pptx

[2] 11-15-0132-15-00ax-spec-framework.docx

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Straw Poll #1

- Do you agree to add the following description to the SIGB number of symbols fields in Table 2 in the SFD: HE-SIG-A fields for the HE MU PPDU of the SFD?

Field	Length (bits)	Description	Encoding
SIGB Number Of Symbols	4	Support about 16 users using MCS0 per BCC. When SIGB compression mode is enabled, the SIGB number of symbols are re-purposed to indicate the number of MU-MIMO users	

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Straw Poll #2

- **Do you agree to modify the HE-SIG-B compression mode description in the SFD [Page 9, line 2-4 in 11-15-0132-15-00ax-spec-framework.docx] as follows:**

  In an HE MU PPDU the HE-SIG-A field shall indicate the number of STAs when full bandwidth MU-MIMO compressed SIG-B mode is indicated. ~~Details are TBD.~~ When SIGB compression mode is enabled, the SIGB number of symbols are re-purposed to indicate the number of MU-MIMO users

  [PHY Motion 111, Janaury 2016, see [26]]

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Straw Poll #3

- **Do you agree to modify the HE-SIG-B compression mode description in the SFD [Page 9, line 15-20 in 11-15-0132-15-00ax-spec-framework.docx] as follows:**

A compression bit is carried in the HE-SIG-A MU format to differentiate full BW MU-MIMO from OFDMA MU PPDU. In case of full BW MU-MIMO, the following conditions hold:

- Only applicable for RU sizes 242, 484, 996, 2*996
- The ~~RU information in~~ HE-SIG-B common field is not signaled
- For bandwidths > 20 MHz, the user specific sub-fields are split equitably between the two HE-SIG-B Channels i.e., For k user MU-MIMO PPDU, 1, … $\lceil \frac{k}{2} \rceil$ user specific sub-fields in HE-SIG-B channel 1 and $\lceil \frac{k}{2} \rceil + 1, \ldots, k$ user specific sub-fields in HE-SIG-B channel 2

[PHY Motion 87, November 2015, see [25]]

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Appendix AR

TGax PHY Ad Hoc March 2016 Meeting Agenda

Date: 2015-09-14

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IEEE 802.11 TGax
High Efficiency WLAN
PHY Ad Hoc

Co-Chairs:
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Agenda Items

- Call meeting to order
- Patent policy, etc. (Call for Potentially Essential Patents)
- Set and approve agenda

- Review ad hoc rules
- Technical Presentations approved by 802.11ax for presentation this week, and related straw polls
- Any other technical presentations

Meeting Protocol, Attendance, Voting & Document Status

- **Please announce your affiliation when you first address the group during a meeting slot**
- **Cell Phones to be silent or Off**
- **Register your attendance via https://imat.ieee.org while on meeting SSID (e.g. Verilan-secure)**
- **Make sure your badges are correct**
- **If you plan to make a submission be sure it does not contain company logos or advertising**
- **Questions on Voting status, Ballot pool, Access to Reflector, Documentation, Member's Area**
  - Contact Jon Rosdahl – jrosdahl@ieee.org

Patent Policy and Other Guidelines

- Following 5 slides

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Instructions for the WG Chair

The IEEE-SA strongly recommends that at each WG meeting the chair or a designee:

- **Show slides #1 through #4 of this presentation**
- **Advise the WG attendees that:**
  - The IEEE's patent policy is consistent with the ANSI patent policy and is described in Clause 6 of the *IEEE-SA Standards Board Bylaws*;
  - Early identification of patent claims which may be essential for the use of standards under development is strongly encouraged;
  - There may be Essential Patent Claims of which the IEEE is not aware. Additionally, neither the IEEE, the WG, nor the WG chair can ensure the accuracy or completeness of any assurance or whether any such assurance is, in fact, of a Patent Claim that is essential for the use of the standard under development.
- **Instruct the WG Secretary to record in the minutes of the relevant WG meeting:**
  - That the foregoing information was provided and that slides 1 through 4 (and this slide 0, if applicable) were shown;
  - That the chair or designee provided an opportunity for participants to identify patent claim(s)/patent application claim(s) and/or the holder of patent claim(s)/patent application claim(s) of which the participant is personally aware and that may be essential for the use of that standard
  - Any responses that were given, specifically the patent claim(s)/patent application claim(s) and/or the holder of the patent claim(s)/patent application claim(s) that were identified (if any) and by whom.
- The WG Chair shall ensure that a request is made to any identified holders of potential essential patent claim(s) to complete and submit a Letter of Assurance.
- It is recommended that the WG chair review the guidance in *IEEE-SA Standards Board Operations Manual* 6.3.5 and in FAQs 12 and 12a on inclusion of potential Essential Patent Claims by incorporation or by reference.

Note: **WG** includes Working Groups, Task Groups, and other standards-developing committees with a PAR approved by the IEEE-SA Standards Board.

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All participants in this meeting have certain obligations under the IEEE-SA Patent Policy. Participants:

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  - **"Personal awareness" means that the participant "is personally aware that the holder may have a potential Essential Patent Claim," even if the participant is not personally aware of the specific patents or patent claims**
- **"Should inform the IEEE (or cause the IEEE to be informed)" of the identity of "any other holders of such potential Essential Patent Claims" (that is, third parties that are not affiliated with the participant, with the participant's employer, or with anyone else that the participant is from or otherwise represents)**
- **The above does not apply if the patent claim is already the subject of an Accepted Letter of Assurance that applies to the proposed standard(s) under consideration by this group**

Quoted text excerpted from IEEE-SA Standards Board Bylaws subclause 6.2

- Early identification of holders of potential Essential Patent Claims is strongly encouraged
- No duty to perform a patent search

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Slide #1

Patent Related Links

All participants should be familiar with their obligations under the IEEE-SA Policies & Procedures for standards development.

Patent Policy is stated in these sources:

IEEE-SA Standards Boards Bylaws

http://standards.ieee.org/guides/bylaws/sect6-7.html#6

IEEE-SA Standards Board Operations Manual

http://standards.ieee.org/guides/opman/sect6.html#6.3

Material about the patent policy is available at

http://standards.ieee.org/board/pat/pat-material.html

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If you have questions, contact the IEEE-SA Standards Board Patent Committee Administrator at patcom@ieee.org or visit http://standards.ieee.org/board/pat/index.html

This slide set is available at http://standards.ieee.org/board/pat/pat-slideset.ppt

Slide #2

Call for Potentially Essential Patents

- **If anyone in this meeting is personally aware of the holder of any patent claims that are potentially essential to implementation of the proposed standard(s) under consideration by this group and that are not already the subject of an Accepted Letter of Assurance:**
  - Either speak up now or
  - Provide the chair of this group with the identity of the holder(s) of any and all such claims as soon as possible or
  - Cause an LOA to be submitted

504

Slide #3

Other Guidelines for IEEE WG Meetings

- All IEEE-SA standards meetings shall be conducted in compliance with all applicable laws, including antitrust and competition laws.
  - **Don't discuss the interpretation, validity, or essentiality of patents/patent claims.**
  - **Don't discuss specific license rates, terms, or conditions.**
    - Relative costs, including licensing costs of essential patent claims, of different technical approaches may be discussed in standards development meetings.
      - Technical considerations remain primary focus
  - **Don't discuss or engage in the fixing of product prices, allocation of customers, or division of sales markets.**
  - **Don't discuss the status or substance of ongoing or threatened litigation.**
  - **Don't be silent if inappropriate topics are discussed … do formally object.**

See *IEEE-SA Standards Board Operations Manual*, clause 5.3.10 and "Promoting Competition and Innovation: What You Need to Know about the IEEE Standards Association's Antitrust and Competition Policy" for more details.

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Slide #4

Ad Hoc Groups Operation

- **Straw Polls are only allowed during Ad Hoc group meeting // no motions, anyone can vote**
- **A straw poll affecting the Spec Framework has to start with,**
  - Do you agree to add to the TG Specification Frame work document?
- **A straw poll needs to achieves at least 75% to be converted to a motion at the TG level.**
- **Each Presentation will be limited to 15 minutes.**

506

TGax PHY Schedule in a Glance

	Monday		Tuesday		Wednesday		Thursday
AM1							
AM2			**PHY**	MAC			**TGax**
PM1	**TGax**				**PHY**	MAC	
PM2			SR	MAC	MAC	MU	**TGax**
EVE	SR	**MU**	**TGax**				

PHY Submissions

Notes:

- **Docs in green color have been presented.**
- **Docs in red color have been withdrawn.**
- **Docs in black color have NOT been presented.**

	DCN	Title	Author	Ad Hoc
~~1~~	~~11-16/0319~~	~~I Q Decoupled OFDM: A Solution To I/Q Imbalance~~	~~Shouxing Simon Qu~~	~~PHY~~
2	11-16/0335	HE-STF sequences for 160/80+80MHz	Eunsung Park	PHY
3	11-16/0343	Spectral Mask Discussion	Hongyuan Zhang	PHY
4	11-16/0344	PHY Padding Related Issues	Hongyuan Zhang	PHY
5	11-15/1354r2	SIGA fields and Bitwidths	Ron Porat	PHY
6	11-16/0346	11ax Pilot Sequence	Bin Tian	PHY
7	11-16/0349	HE-SIG-B Compression Mode	Kaushik Josiam	PHY
8	11-16/0367	Power Scaling of L-LTF and L-STF	Yakun Sun	PHY
9	11-16/0389	Sounding Design	Sriram Venkateswaran	PHY
10	11-16/0397	HE-SIG-B Signaling Discussions	John Son	PHY
11	11-16/0395	Preamble transmission for Uplink OFDMA	GanMing	PHY
12	11-16/0203	Signalling Support for Full Bandwidth MU-MIMO Compressed SIG-B Mode	Lei Huang	PHY

508

Straw poll #1

By Eunsung Park (**LG)**

Do you agree to add the following 1x/2x HE-STF sequences for 160/80+80MHz to the 11ax SFD?

1x HE-STF$_{160MHz}$(-1008:16:1008) = [*M*, 1, -*M*, 0, -*M*, 1, -*M*, 0, -*M*, -1, *M*, 0, -*M*, 1, -*M*] *(1+*j*)/sqrt(2)

M = {-1 -1 -1 +1 +1 +1 -1 +1 +1 +1 -1 +1 +1 -1 +1}

1x HE-STF$_{80+80MHz}$ = [1x HE-STF$_{80MHz,Prime}$, 1x HE-STF$_{80MHz,Second}$]

1x HE-STF$_{80MHz,Prime}$(-496:16:496) = [*M*, 1, -*M*, 0, -*M*, 1, -*M*] *(1+*j*)/sqrt(2)

1x HE-STF$_{80MHz, Second}$(-496:16:496) = [-*M*, -1, *M*, 0, -*M*, 1, -*M*] *(1+*j*)/sqrt(2)

2x HE-STF$_{160MHz}$(-1016:8:1016) = [*M*, -1, *M*, -1, -*M*, -1, *M*, 0, -*M*, 1, *M*, 1, -*M*, 1, -*M*, 0, -*M*, 1, -*M*, 1, *M*, 1, -*M*, 0, -*M*, 1, *M*, 1, -*M*, 1, -*M*] *(1+*j*)/sqrt(2)

2x HE-STF$_{160MHz}$(±1016) = 0

2x HE-STF$_{160MHz}$(±8) = 0

2x HE-STF$_{80+80MHz}$ = [2x HE-STF$_{80MHz,Prime}$, 2x HE-STF$_{80MHz,Second}$]

2x HE-STF$_{80MHz,Prime}$(-504:8:504) = [*M*, -1, *M*, -1, -*M*, -1, *M*, 0, -*M*, 1, *M*, 1, -*M*, 1, -*M*] *(1+*j*)/sqrt(2)

2x HE-STF$_{80MHz,Prime}$(±504) = 0

2x HE-STF$_{80MHz, Second}$(-504:8:504) = [-*M*, 1, -*M*, 1, *M*, 1, -*M*, 0, -*M*, 1, *M*, 1, -*M*, 1, -*M*] *(1+*j*)/sqrt(2)

2x HE-STF$_{80MHz,Second}$(±504) = 0

Y/N/A: 28/0/13

509

Straw Poll #2

By Hongyuan Zhang (Marvell)

Do you agree to add the following text in SFD chapter 3.4?

For 20MHz PPDU, the transmit spectrum shall not exceed the maximum of the interim transmit spectral mask and –53 dBm/MHz at any frequency offset, for both 2.4GHz and 5GHz bands.
For 40MHz PPDU, the transmit spectrum shall not exceed the maximum of the interim transmit spectral mask and –56 dBm/MHz at any frequency offset, for both 2.4GHz and 5GHz bands.
For 80MHz and 160MHz PPDUs, the transmit spectrum shall not exceed the maximum of the interim transmit spectral mask and –59 dBm/MHz at any frequency offset.

510

Y/N/A: 41/0/3

Straw Poll #3

By Hongyuan Zhang (Marvell)

- **Do you agree to replace *Table-3 $N_{SD.short}$* in 3.3.5 Padding and packet extension of SFD to the following table?**

RU Size	*DCM=0: $N_{SD.short}$*	*DCM=1: $N_{SD.short}$*
26	6	**2**
52	12	6
106	24	12
242	60	30
484	120	60
996	240	120
996x2	492	246

Y/N/A: 40/0/5

Straw Poll #4

By Hongyuan Zhang (Marvell)

- **Do you agree to add the following text in SFD 3.3.5**
  - The post-FEC bits are un-specified by 11ax spec
  - The content of PE field is un-specified by 11ax spec

512

Y/N/A: 41/0/5

Straw Poll #5

By Ron Porat (Broadcom)

- Do you agree to add a Doppler bit in SIGA for HE SU and HE SU extended range, in TBD location for HE MU and in the trigger frame?

513

Y/N/A: 37/0/5

Straw Poll #6

By Ron Porat (Broadcom)

Do you agree to add to the spec framework : 1bit is added for STBC indication in SIGA of the MU PPDU?

- This bit indicates STBC for all users in the payload and doesn't apply to SIGB STBC is not applied in MU-MIMO RUs

514

Y/N/A: 39/0/4

Straw Poll #7

By Ron Porat (Broadcom)

- Do you agree to add to the TG Specification Frame work document: in trigger based UL PPDUs, multiple SR fields (>=2) are signaled, where each SR field corresponds to a different subband of the PPDU

515

Y/N/A: 38/0/5

Straw Poll #8

By Bin Tian (QUALCOMM)

Do you agree that 11ax pilot sequences shall reuse the 11ac/ah pilot sequences as shown in slides 13 and 14 in the document 11-16-0346r0?

516

Y/N/A: 43/0/3

Straw Poll #9

By Bin Tian (QUALCOMM)

- **Do you agree that 11ax pilot sequence shall be applied in the same way as in 11ac SSP**
  - Pilot values are shifted on pilot tones from symbol to symbol for each RU
  - Overlaying pilot polarity value: same as in 11ac

Y/N/A:46/0/3

Straw Poll #10

By Kaushik Josiam (Samsung)

- Do you agree to add the following description to the SIGB number of symbols fields in Table 2 in the SFD: HE-SIG-A fields for the HE MU PPDU of the SFD?

Field	Length (bits)	Description	Encoding
SIGB Number Of Symbols	4	When SIGB compression mode is enabled, the number of symbols are re-purposed to indicate the number of MU-MIMO users	

518

Y/N/A:40/0/4

Straw Poll #11

By Kaushik Josiam (Samsung)

- **Do you agree to modify the HE-SIG-B compression mode description in the SFD [Page 9, line 2-4 in 11-15-0132-15-00ax-spec-framework.docx] as follows:**

  –In an HE MU PPDU the HE-SIG-A field shall indicate the number of STAs when full bandwidth MU-MIMO compressed SIG-B mode is indicated. ~~Details are TBD.~~ When SIGB compression mode is enabled, the SIGB number of symbols are re-purposed to indicate the number of MU-MIMO users

  –[PHY Motion 111, Janaury 2016, see [26]]

Y/N/A:42/0/4

519

Straw Poll #12

By Kaushik Josiam (Samsung)

- **Do you agree to modify the HE-SIG-B compression mode description in the SFD [Page 9, line 15-20 in 11-15-0132-15-00ax-spec-framework.docx] as follows:**

A compression bit is carried in the HE-SIG-A MU format to differentiate full BW MU-MIMO from OFDMA MU PPDU. In case of full BW MU-MIMO, the following conditions hold:

- Only applicable for RU sizes 242, 484, 996, 2*996
- The ~~RU information in~~ HE-SIG-B common field is not signaled
- For bandwidths > 20 MHz, the user specific sub-fields are split equitably between the two HE-SIG-B Channels i.e., For k user MU-MIMO PPDU, $1, \ldots \left\lceil \frac{k}{2} \right\rceil$ user specific sub-fields in HE-SIG-B channel 1 and $\left\lceil \frac{k}{2} \right\rceil + 1, \ldots, k$ user specific sub-fields in HE-SIG-B channel 2

[PHY Motion 87, November 2015, see [25]]

Y/N/A:43/0/3

520

Straw Poll #13

By Yakun Sun (Marvell)

Do you support to modify the current SFD as following

The L-SIG, RL-SIG, HE-SIG-A and HE-SIG-B fields are always transmitted with same ~~total~~ power per tone as L-LTF field (in cases when L-LTF is not being boosted). The L-STF has the same total power as the L-LTF?

521

Y/N/A:44/0/3

Straw Poll #14

By Sriram Venkateswaran (Broadcom)

Do you agree to add to the spec framework that

The tones used for channel feedback shall be a subset of the sets given below:

522

NDP bandwidth 20 MHz:
Ng = 4 → [-120:4:-4, 4:4:120] + edge(±2,±122)
Ng = 16 → [-116:16:-4, 4:16:116] + edge(±2,±122)

NDP bandwidth 40 MHz:
Ng = 4/16 → [-244:Ng:-4, 4:Ng:244]

NDP bandwidth 80 MHz:
Ng = 4/16 → [-500:Ng:-4, 4:Ng:500]

Y/N/A:43/0/4

Straw Poll #15

By Sriram Venkateswaran (Broadcom)

Do you agree to add to the spec framework that

2X HE-LTF sequence shall be the only mandatory mode for NDP. 4X HE-LTF shall not be supported in NDP.

523

Y/N/A:39/0/4

Straw Poll #16

By Sriram Venkateswaran (Broadcom)

Do you agree to add to the spec framework that

The NDP

- always has extension of 4uS
- shall support the CP values 0.8 us and 1.6 us

524

Y/N/A:40/0/2

Straw Poll #17

By Sriram Venkateswaran (Broadcom)

Do you agree to add to the spec framework that

AP can request beamforming feedback over partial BW which is less than the NDP BW. The indication of the feedback BW goes in NDPA.

525

Straw poll passed without objection

Straw Poll #18

By Sriram Venkateswaran (Broadcom)

Do you agree to add to the spec framework that

The granularity of channel feedback requested by the AP is a 26 tone RU. The AP signals *start* and *end* 26 tone RUs requested for feedback.

526

Straw poll passed without objection

Straw Poll #19

By Sriram Venkateswaran (Broadcom)

Do you agree to add to the spec framework that

The max Nc for sounding feedback that a BFee can support shall be negotiated through a capability exchange at association.

527

Straw poll passed without objection

Straw Poll #20

By Sriram Venkateswaran (Broadcom)

Do you agree to add to the spec framework that

AP shall control the Ng, quantization, and Nc of the sounding FB in NDPA except in the special case of a NDPA addressed to a single STA which requests SU type feedback. In the aforementioned special case, the STA controls these quantities.

528

Straw poll passed without objection

Straw Poll #21

By Sriram Venkateswaran (Broadcom)

Do you agree to add to the spec framework that

A channel quality indicator only (CQI-only) feedback (exact metric TBD) will be supported by the sounding protocol in 11ax. The request for CQI-only feedback goes in NDPA.

529

Straw poll passed without objection

Straw Poll #22

By John Son (WILUS)

- **Do you agree to add the following text into 11ax SFD?**
  - ***3.1 General***
  - *The non-contiguous channel bonding will be supported in 802.11ax by:*
    - *Transmitting using OFDMA PPDU format by nulling the tones of one or more secondary channels in 80 MHz and 160 (80+80) MHz;*
    - *Modes for non-contiguous channel bonding are TBD;*
    - *Non-contiguous channels within primary or secondary 80 MHz only exists at AP side.*
    - Signaling for non-contiguous channel bonding is contained in BW subfield of HE-SIG-A and/or RU allocation subfield in the common block of HE-SIG-B. Details are TBD.

530

Y/N/A:10/2/many

Straw Poll #23

By Ming Gan (Huawei)

- **Do you agree to add the following text to the IEEE 802.11ax SFD?**

531

UL pre-HE-STF preamble is sent only on the 20MHz- CH(s) where the HE modulated fields are located.

– The UL pre-HE-STF preamble includes legacy preamble, RL-SIG and HE-SIG-A and HE modulated fields refer to HE-STF, HE-LTF and data fields.

Y/N/A:38/0/7

Appendix AS

IEEE P802.11
Wireless LANs

Comment Resolutions on Clause 28.3.10.8.1

Date: 2017-03-8

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Abstract

This submission proposes resolutions for the following comments on 28.3.10.8.1 of TGax D1.0:

4918, 5264, 6117, 8935, 8936, 10062
This resolution is made based on the TGax Draft 1.1

Revisions:

— Rev 0: Initial version of the document.

Interpretation of a Motion to Adopt

A motion to approve this submission means that the editing instructions and any changed or added material are actioned in the TGax Draft. This introduction is not part of the adopted material.

Editing instructions formatted like this are intended to be copied into the TGax Draft (i.e. they are instructions to the 802.11 editor on how to merge the text with the baseline documents).

TGax Editor: Editing instructions preceded by "TGax Editor" are instructions to the TGax editor to modify existing material in the TGax draft. As a result of adopting the changes, the TGax editor will execute the instructions rather than copy them to the TGax Draft.

CID	Clause Number	P.L	Comment	Proposed Change	Resolution
4918	28.3.10.8.1	286.07	Figure is too small to read	Increase size of figure and text. Ditto figures on P286-288. Also, the curved arrows are quite unclear and seem to hide each other. What are they doing? Many seem to be missing - add	Revised TGax Editor : make the changes shown in 11-17/299r0
6117	28.3.10.8.1	286.05	Replace the figure with a high resolution one	As in comment	Revised TGax Editor : make the changes shown in 11-17/299r0
8936	28.3.10.8.1	286.06	Figure is hard to read	Replace with better illustration of HE-SIG-B field	Revised TGax Editor : make the changes shown in 11-17/299r0
10062	28.3.10.8.1	286.13	Figure 26-20 shows BCC block, which does not exist in the draft specification any more.	1 BCC Block in Common Field needs to be changed Common Block Field. 1 BCC Blcok in User Specfic Field needs to be changed as 1 User Block Field.	Revised TGax Editor : make the changes shown in 11-17/299r0

Discussion

As mentioned with multiple CIDs (i.e. 4918, 6117, 8936, 10062), the representation of figure 28-20 is not accurate and it does not apply the correct terminology. So, for the clarification of HE-SIG-B field encoding structure, it should be corrected. And, the terminology of HE-SIG-B field defined in 11-17/xxxxr0 is applied.

Changes to subclause 28.3.13.8.1 related to CIDS: 4918, 6117, 8936, 10062

TGax Editor: Please replace the figure 28-20 in P294L5 of D1.1 as the proposed following figure.

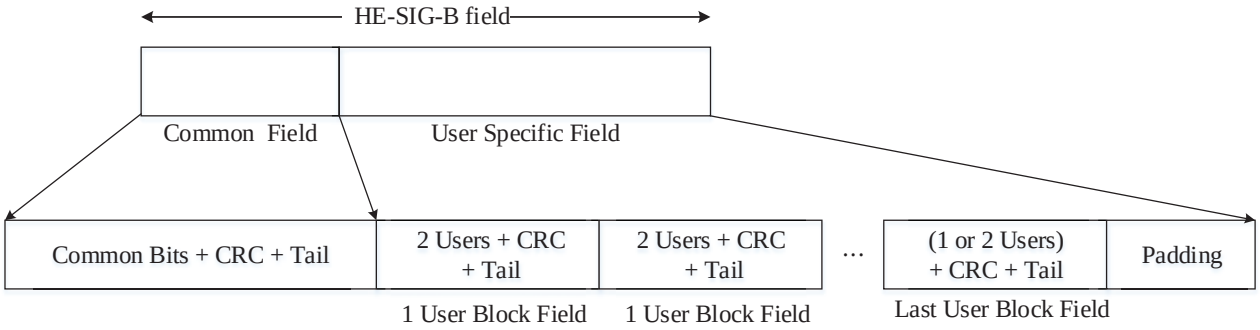

Figure 28-20 HE-SIG-B field encoding structure in each 20 MHz

CID	Clause Number	P.L	Comment	Proposed Change	Resolution
5264	28.3.10.8.1	286.00	Regarding "Each User Block field is made up of two user fields", is it allowed to use the HE MU PPDU for a single user? If so, this statement is incorrect. Please clarify.	as in comment	Revised TGax Editor : make the changes shown in 11-17/299r0
8935	28.3.10.8.1	285.60	"The HE-SIG-B field is separately encoded on each 20 MHz band.". This is not correct.	Replace with a better description, i.e.: two content channels repeated over up to eight 20 MHz subbands. This would be a good place to introduce the concept of content channels BTW.	Rejected

Discussion

CID 5264

Agree in principle with the commenter. The current text described that the User Block field consists of 2 User field except the last user block field. But, as described in P294L34, the HE-MU PPDU can be used for single user and then the HE-SIG-B field only include the one User field. So, it is proper to add the description to clarify after related description.

CID8935

As in comment, in the larger bandwidth than 20MHz (i.e. 40MHz, 80MHz, 160MHz), two content channel of HE-SIG-B is duplicated per 40MHz channel and each content channel is seperately encoded per 20MHz band. Here, the proposed change does not consider the case of one content channel of HE-SIG-B in 20MHz. And it is described well on clause 28.3.10.8.2. So, it does not need the additional description about it,

Changes to subclause 28.3.10.8.1 related to CIDS: 5264

TGax Editor: Please add the underlined texts on page 294 line 37 of D1.1 as following:

When the SIGB Compression field in the HE-SIG-A field of an HE MU PPDU is set to 1 (indicating full bandwidth MU-MIMO transmission) and the Number Of HE-SIG-B Symbols Or MU-MIMO Users field in the HE-SIG-A field of an HE MU PPDU is set to 0 (indicating 1 MU-MIMO user), the User Specific field in the HE-SIG-B field consists of a single User Block field containing one User field for a non-MU-MIMO allocation as shown in Table 28-22 (Fields of the User field for a non-MU-MIMO allocation).

References:

1. **IEEE P802.11ax™/D1.1, Feb 2017.**

Appendix AT

Documents

Join group

Everything | All Years | TGax (inactive)

D1.0

Created (ET) ▼	Year	DCN	Rev	Group	Title	Author (Affiliation)	Uploaded (ET)	Actions
03-Oct-2017 ET	2017	10	14	TGax	Comments on TGax D1.0	Robert Stacey (Intel)	03-Oct-2017 16:58:54 ET	Download
13-Sep-2017 ET	2017	1069	4	TGax	LB225 11ax D1.0 Comment Resolution 9.7.3	Liwen Chu (Marvell)	13-Sep-2017 23:24:42 ET	Download
13-Sep-2017 ET	2017	1069	3	TGax	LB225 11ax D1.0 Comment Resolution 9.7.3	Liwen Chu (Marvell)	13-Sep-2017 22:28:50 ET	Download
13-Sep-2017 ET	2017	1069	2	TGax	LB225 11ax D1.0 Comment Resolution 9.7.3	Liwen Chu (Marvell)	13-Sep-2017 03:18:07 ET	Download
13-Sep-2017 ET	2017	1069	1	TGax	LB225 11ax D1.0 Comment Resolution 9.7.3	Liwen Chu (Marvell)	13-Sep-2017 02:46:47 ET	Download
12-Sep-2017 ET	2017	1290	4	TGax	LB225 11ax D1.0 Comment Resolution HE PHY Capabilities, PPE	Liwen Chu (Marvell)	12-Sep-2017 23:49:43 ET	Download
12-Sep-2017 ET	2017	1290	3	TGax	LB225 11ax D1.0 Comment Resolution HE PHY Capabilities, PPE	Liwen Chu (Marvell)	12-Sep-2017 22:50:01 ET	Download
12-Sep-2017 ET	2017	1290	2	TGax	LB225 11ax D1.0 Comment Resolution HE PHY Capabilities, PPE	Liwen Chu (Marvell)	12-Sep-2017 22:11:00 ET	Download
12-Sep-2017 ET	2017	1290	1	TGax	LB225 11ax D1.0 Comment Resolution HE PHY Capabilities, PPE	Liwen Chu (Marvell)	12-Sep-2017 01:45:23 ET	Download
11-Sep-2017 ET	2017	1282	4	TGax	LB225 11ax D1.0 Comment Resolution 27.11.1, 27.11.2	Liwen Chu (Marvell)	11-Sep-2017 23:34:41 ET	Download
08-Sep-2017 ET	2017	1282	3	TGax	LB225 11ax D1.0 Comment Resolution 27.11.1, 27.11.2	Liwen Chu (Marvell)	08-Sep-2017 18:43:14 ET	Download
08-Sep-2017 ET	2017	1282	2	TGax	LB225 11ax D1.0 Comment Resolution 27.11.1, 27.11.2	Liwen Chu (Marvell)	08-Sep-2017 18:08:54 ET	Download
08-Sep-2017 ET	2017	1267	3	TGax	LB225 11ax D1.0 Comment Resolution	Liwen Chu (Marvell)	08-Sep-2017 16:59:53 ET	Download

					27.10.2, 27.10.3			
08-Sep-2017 ET	2017	1267	2	TGax	LB225 11ax D1.0 Comment Resolution 27.10.2, 27.10.3	Liwen Chu (Marvell)	08-Sep-2017 16:58:25 ET	Download
08-Sep-2017 ET	2017	1267	1	TGax	LB225 11ax D1.0 Comment Resolution 27.10.2, 27.10.3	Liwen Chu (Marvell)	08-Sep-2017 16:07:59 ET	Download
08-Sep-2017 ET	2017	553	8	TGax	LB225 11ax D1.0 Comment Resolution 27.10.4 Part 1	Liwen Chu (Marvell)	08-Sep-2017 13:30:48 ET	Download
08-Sep-2017 ET	2017	553	7	TGax	LB225 11ax D1.0 Comment Resolution 27.10.4 Part 1	Liwen Chu (Marvell)	08-Sep-2017 11:27:28 ET	Download
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04-Sep-2017 ET	2017	1282	1	TGax	LB225 11ax D1.0 Comment Resolution 27.11.1, 27.11.2	Liwen Chu (Marvell)	08-Sep-2017 18:07:55 ET	Download
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25-Aug-2017 ET	2017	1290	0	TGax	LB225 11ax D1.0 Comment Resolution HE PHY Capabilities, PPE	Liwen Chu (Marvell)	04-Sep-2017 15:45:18 ET	Download
23-Aug-2017 ET	2017	1282	0	TGax	LB225 11ax D1.0 Comment Resolution 27.11.1, 27.11.2	Liwen Chu (Marvell)	31-Aug-2017 00:19:15 ET	Download
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18-Aug-2017 ET	2017	10	13	TGax	Comments on TGax D1.0	Robert Stacey (Intel)	18-Aug-2017 17:13:34 ET	Download
17-Aug-2017 ET	2017	949	3	TGax	Refinement of the resolutions in 17/0553r2 (LB225 11ax D1.0 Comment Resolution 27.10.4 Part 1)	Mark RISON (Samsung), based on work by Liwen CHU (Marvell)	17-Aug-2017 08:56:30 ET	Download
03-Aug-2017 ET	2017	949	2	TGax	Refinement of the resolutions in 17/0553r2 (LB225 11ax D1.0 Comment Resolution 27.10.4 Part 1)	Mark RISON (Samsung), based on work by Liwen CHU (Marvell)	03-Aug-2017 12:18:04 ET	Download

20-Jul-2017 ET	2017	949	1	TGax	Refinement of the resolutions in 17/0553r2 (LB225 11ax D1.0 Comment Resolution 27.10.4 Part 1)	Mark RISON (Samsung), based on work by Liwen CHU (Marvell)	20-Jul-2017 08:58:20 ET	Download
13-Jul-2017 ET	2017	688	4	TGax	LB225 11ax D1.0 Comment Resolution 27.10.4 - Part II	Chittabrata Ghosh (Intel)	13-Jul-2017 03:18:47 ET	Download
13-Jul-2017 ET	2017	688	3	TGax	LB225 11ax D1.0 Comment Resolution 27.10.4 - Part II	Chittabrata Ghosh (Intel)	13-Jul-2017 02:20:58 ET	Download
12-Jul-2017 ET	2017	553	3	TGax	LB225 11ax D1.0 Comment Resolution 27.10.4 Part 1	Liwen Chu (Marvell)	12-Jul-2017 07:32:07 ET	Download
10-Jul-2017 ET	2017	1069	0	TGax	LB225 11ax D1.0 Comment Resolution 9.7.3	Liwen Chu (Marvell)	12-Sep-2017 22:09:23 ET	Download
29-Jun-2017 ET	2017	949	0	TGax	Refinement of the resolutions in 17/0553r2 (LB225 11ax D1.0 Comment Resolution 27.10.4 Part 1)	Mark RISON (Samsung), based on work by Liwen CHU (Marvell)	29-Jun-2017 09:51:34 ET	Download
15-Jun-2017 ET	2017	688	2	TGax	LB225 11ax D1.0 Comment Resolution 27.10.4 - Part II	Chittabrata Ghosh (Intel)	15-Jun-2017 18:45:06 ET	Download
02-Jun-2017 ET	2017	10	12	TGax	Comments on TGax D1.0	Robert Stacey (Intel)	02-Jun-2017 16:10:49 ET	Download
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10-May-2017 ET	2017	553	2	TGax	LB225 11ax D1.0 Comment Resolution 27.10.4 Part 1	Liwen Chu (Marvell)	10-May-2017 02:48:49 ET	Download
04-May-2017 ET	2017	553	1	TGax	LB225 11ax D1.0 Comment Resolution 27.10.4 Part 1	Liwen Chu (Marvell)	04-May-2017 22:10:04 ET	Download
02-May-2017 ET	2017	688	0	TGax	LB225 11ax D1.0 Comment Resolution 27.10.4 - Part II	Chittabrata Ghosh (Intel)	02-May-2017 21:56:13 ET	Download
14-Apr-2017 ET	2017	10	11	TGax	Comments on TGax D1.0	Robert Stacey (Intel)	14-Apr-2017 15:26:51 ET	Download

10-Apr-2017 ET	2017	10	10	TGax	Comments on TGax D1.0	Robert Stacey (Intel)	10-Apr-2017 19:10:07 ET	Download
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06-Apr-2017 ET	2017	10	8	TGax	Comments on TGax D1.0	Robert Stacey (Intel)	06-Apr-2017 22:23:16 ET	Download
31-Mar-2017 ET	2017	553	0	TGax	LB225 11ax D1.0 Comment Resolution 27.10.4 Part 1	Liwen Chu (Marvell)	31-Mar-2017 12:25:47 ET	Download
16-Mar-2017 ET	2017	341	2	TGax	LB225 11ax D1.0 Comment Resolution 10.13	Liwen Chu (Marvell)	16-Mar-2017 16:25:08 ET	Download
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09-Feb-2017 ET	2017	10	7	TGax	Comments on TGax D1.0	Robert Stacey (Intel)	09-Feb-2017 17:00:00 ET	Download
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10-Jan-2017 ET	2017	10	2	TGax	Comments on TGax D1.0	Robert Stacey (Intel)	10-Jan-2017 14:01:37 ET	Download
09-Jan-2017 ET	2017	10	1	TGax	Comments on TGax D1.0	Robert Stacey (Intel)	09-Jan-2017 19:54:19 ET	Download
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Appendix AU

IEEE P802.11 Wireless LANs
Submission
Designator: **doc.: IEEE 802.11-17/0010r0**
Venue Date: **January 2017**
First Author: Robert Stacey

Subject: **Comments on TGax/D1.0**
Full Date: 2017-01-09

Author(s): Robert Stacey
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Abstract: Comments on TGax D1.0

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Revision	Date	Description
0	2017-01-09	Initial export from DB

CID	Commenter	LB	Draft	Clause Number(C)	Page(C)	Line(C)	Type of Comment	Part of No Vote	Page	Clause	Duplicate of CID	Resn Status	Comment	Proposed Change	Resolution	Owning Ad-hoc	Comment Group	Ad-hoc Status	Ad-hoc Notes	Edit Status	Edit Notes	Edited in Draft	Last Updated	Last Updated By
3000	Abhishek Patil	225		1 4.3.14a	9	21	T	N	9.21	4.3.14a			Restructure the following sentence: "An HE non-AP STA shall support operation in 20 MHz channel bandwidth only"	"An HE non-AP STA shall support 20 MHz channel bandwidth only operation"									2017/1/9 9:42	
3001	Abhishek Patil	225		1 4.3.14a	9	26	T	N	9.26	4.3.14a			Restructure the following sentence: "An HE non-AP STA shall support operation in 20 MHz channel bandwidth only"	"An HE non-AP STA shall support 20 MHz channel bandwidth only operation"									2017/1/9 9:42	
3002	Abhishek Patil	225		1 4.3.14a	9	57	T	N	9.57	4.3.14a			Add BSS_COLOR, Dual Beaconing and Spatial Reuse to the list.	As in the comment									2017/1/9 9:42	
3003	Abhishek Patil	225		1 6.3.3.2	11	15	T	Y	11.15	6.3.3.2			MLME-SCAN.request should include HT/VHT/HE Capabilities since the Probe Request frames can carry these capabilities elements	Add HT/VHT/HE Capabilities to MLME-SCAN.request section									2017/1/9 9:42	
3004	Abhishek Patil	225		1 9.2.4.6.1	22	59	T	N	22.59	9.2.4.6.1			Add a sentence in the description that says the combined size shall not exceed 30 bits.	Update sentence as follows: "The A-Control subfield contains a sequence of one or more Control subfields whose combined length does not exceed 30 bits."									2017/1/9 9:42	
3005	Abhishek Patil	225		1 9.2.4.6.4.7	28	6	T	N	28.06	9.2.4.6.4.7			From the Table it is not clear if only Bit 0 can be set to 1 to indicate 20 MHz is available or any one of the bits can be set to indicate that that 20 MHz is available. Same is true for 40 and 80 MHz.	Presentation to be provided which would provide a mechanism to either consolidate the bits or provide more functionality and granularity.									2017/1/9 9:42	
3006	Abhishek Patil	225		1 9.3.1.8	33	49	T	N	33.49	9.3.1.8			What is the BAR Ack Policy subfield for MU-BAR?	Presentation to be provided which would reflect the requirements in the baseline.									2017/1/9 9:42	
3007	Abhishek Patil	225		1 9.3.1.9.1	34	10	T	N	34.10	9.3.1.9.1			Correct bit number: B6 to B5 in Figure 9-33	As in the comment									2017/1/9 9:42	
3008	Abhishek Patil	225		1 9.3.1.9.1	34	23	T	N	34.23	9.3.1.9.1			What is the BA Ack Policy subfield for M-BA in MU, ACK in SU, ACK in MU	Presentation to be provided which would reflect the requirements in the baseline.									2017/1/9 9:42	
3009	Abhishek Patil	225		1 9.3.1.9.3	37	16	T	Y	37.16	9.3.1.9.3			AMSDU fragmentation is allowed. Remove the sentence, "For an A-MSDU, only the first bit of the subbitmap is used, as fragmentation is not allowed in an A-MSDU."	Remove the sentence "For an A-MSDU, only the first bit of the subbitmap is used, as fragmentation is not allowed in an A-MSDU."									2017/1/9 9:42	
3010	Abhishek Patil	225		1 9.3.1.9.7	39	63	T	Y	39.63	9.3.1.9.7			AMSDU fragmentation is allowed. Remove the sentence, "For an A-MSDU, only the first bit of the subbitmap is used, as fragmentation is not allowed in an A-MSDU."	Remove the sentence "For an A-MSDU, only the first bit of the subbitmap is used, as fragmentation is not allowed in an A-MSDU."									2017/1/9 9:42	
3011	Abhishek Patil	225		1 9.3.1.23	41	46	T	N	41.46	9.3.1.23			There is no reason to have a bracket around RA as RA is always present in the trigger frame	Remove brackets around RA.									2017/1/9 9:42	
3012	Abhishek Patil	225		1 9.3.1.23	43	1	T	N	43.01	9.3.1.23			The expected behavior of a STA that receives the CS Required set to a certain value is somehow sparsed and confusing in all normative subclauses I checked. Please add a reference here to where the normative behaviro is defined. It should be something along this lines: If CS Required is 0 then STA is not requred to check ED and NAV, if CS Required is 1 then STA is required to check both ED and NAV.	As in comment.									2017/1/9 9:42	
3013	Abhishek Patil	225		1 9.3.1.23	45	7	T	N	45.07	9.3.1.23			The SR field 1 and SR field 2 definition should be bandwidth dependent and operating band agnostic. The definition of SR field 1 and SR field 2 for 40 MHz should not be specific for 2.4 GHz.	remove "in 2.4 GHz" in the sentence "When operating 40 MHz in 2.4GHz band, two SR fields, SR field 1 and SR field 2, are set to same values."									2017/1/9 9:42	
3014	Abhishek Patil	225		1 9.3.1.23	45	8	T	N	45.08	9.3.1.23			Shouldn't SR fields for 80+80 be defined in the same way as the SR field for 160 MHz?	On P45L6, remove: "When operating 80+80 MHz, SR field 3 is set to same value as SR field 1, and SR field 4 is set to the same value as SR field 2." Insert on P45L5: "For 80+80 MHz four SR fields for each 40 MHz"									2017/1/9 9:42	
3015	Abhishek Patil	225		1 9.3.1.23	47	7	T	N	47.07	9.3.1.23			The number of Spatial stream can't be 0. Therefore the number of spatial streams should be Nss-1.	Change "Number of Spatial Streams" to "NSS_1" and define Nss_1 as the Number of spatial streams -1.									2017/1/9 9:42	
3016	Abhishek Patil	225		1 9.3.1.23	47	7	T	N	47.07	9.3.1.23			The starting spatial stream can't be 0. Therefore the Starting spatial stream should be -1.	Change "Starting Spatial Stream" to "Starting spatial stream -1"									2017/1/9 9:42	
3017	Abhishek Patil	225		1 9.3.1.23	48	17	T	N	48.17	9.3.1.23			CCK and DSSS rates should also be disabled for Trigger frame transmission. Same observation for Short GI.	The Trigger frame shall not be transmitted using CCK or DSSS rates. The Trigger frame shall not be transmitted with Short GI.									2017/1/9 9:42	

3018 Abhishek Patil	225	1 9.3.1.23.1	49	6	T	N	49.06 9.3.1.23.1	The AC Preference level is not required. If the AP wants to set AC Preference level to 0 then it could as well set Preferred AC to 3 and allow the STA to send any type of traffic. This frees up one bit.	Remove AC Preference level and add statement, If the AP does not have a recommendation for preferred AC then Preferred AC level is set to 3.	2017/1/9 9:42
3019 Abhishek Patil	225	1 9.3.1.23.4	50	49	T	N	50.49 9.3.1.23.4	The setting of the CS required field is missing in some cases. Specify that the AP should set the CS Required to 1 when transmitting the MU-RTS frame	Insert on P50L47: "The CS Required is set to 1".	2017/1/9 9:42
3020 Abhishek Patil	225	1 9.3.3.1	52	13	E	N	52.13 9.3.3.1	Beacon Frame section number is 9.3.3.3 in REVmc. Same comment applies to Association Request/Response and Reassociation Request/Response frames.	Change section number to match Baseline. This also applies to Association request/response and Reassociation request/response frames.	2017/1/9 9:42
3021 Abhishek Patil	225	1 9.3.3.1	52	43	T	Y	52.43 9.3.3.1	MU EDCA Parameter missing in Beacon frame. Same comment applies to Association Request/Response and Reassociation Request/Response frames.	Add MU-EDCA Parameter to the table 9-27. Same applies to Association Response, Reassociation Response and Probe Response frames. Please add MU-EDCA Parameter to tables 9-30, 9-32 and 9-34.	2017/1/9 9:42
3022 Abhishek Patil	225	1 9.3.3.6	53	17	E	N	53.17 9.3.3.6	Order for TWT is incorrect in Table 9-30	11ah D11 shows TWT order as 38 in table 9-30	2017/1/9 9:42
3023 Abhishek Patil	225	1 9.4.1.11	55	51	T	N	55.51 9.4.1.11	HE Category has not been specified, specify the value.	Specify HE category	2017/1/9 9:42
3024 Abhishek Patil	225	1 9.4.1.62	57	21	T	N	57.21 9.4.1.62	The HE MIMO Control Field should refer to HE Compressed Beamforming frame not VHT Compressed beamforming frame Change "VHT Compressed Beamforming frame" to "HE Compressed Beamforming frame"	Change "VHT Compressed Beamforming frame" to "HE Compressed Beamforming frame"	2017/1/9 9:42
3025 Abhishek Patil	225	1 9.4.1.62	57	34	T	N	57.34 9.4.1.62	The HE MIMO Control Field should refer to HE Compressed Beamforming frame not VHT Compressed beamforming frame Change "VHT Compressed Beamforming frame" to "HE Compressed Beamforming frame"	Change "VHT Compressed Beamforming frame" to "HE Compressed Beamforming frame"	2017/1/9 9:42
3026 Abhishek Patil	225	1 9.4.2.1	67	29	T	Y	67.29 9.4.2.1	Add missing elements to table 9-77	Add BSS Color Change Announcement and Quiet time elements to table 9-77. Enter 'yes' under Extensible column for these entries	2017/1/9 9:42
3027 Abhishek Patil	225	1 9.4.2.1	67	16	E	N	67.16 9.4.2.1	Correct section reference for HE Capabilities and HE Operations	Change reference to 218 and 219 respectively	2017/1/9 9:42
3028 Abhishek Patil	225	1 9.4.2.6	67	57	T	N	67.57 9.4.2.6	Either TIM frame or FILS Discovery frame will included at the beginning of a broadcast TWT - replace and with or	replace 'and' with 'or'	2017/1/9 9:42
3029 Abhishek Patil	225	1 9.4.2.6	68	2	T	N	68.02 9.4.2.6	The operation applies to current TWT SP - the sentence doesn't need to discuss about what happens outside the current TWT SP	Remove: "and before the next TWT SP" and make reference to "current" TWT SP. Change sentence as following: "Bit number N in the traffic indication virtual bitmap is 0 if the AP does not intend to transmit to the STA or to trigger the STA for an UL MU transmission during the current TWT SP."	2017/1/9 9:42
3030 Abhishek Patil	225	1 9.4.2.139	68	65	T	Y	68.65 9.4.2.139	Level3 is missing from ADDBA	As in the comment	2017/1/9 9:42
3031 Abhishek Patil	225	1 9.4.2.200	70	4	T	Y	70.04 9.4.2.200	A TWT Scheduling STA that is responding to a TWT request to setup a wake TBTT will see the TBTT Negotiation subfield value to 1. Also see section 27.7.3.4 (pg 186, line 48)	Change the sentence to say that a TWT scheduling STA that is responding to a TWT request to setup a wake TBTT shall set the value of TBTT Negotiated subfield to 1.	2017/1/9 9:42
3032 Abhishek Patil	225	1 9.4.2.218.3	82	14	T	N	82.14 9.4.2.218.3	Channel width set allows a HE AP which also a STA to support only 20 MHz mode. Clarify that an HE AP shall support 20,40,80 MHz in 5GHz and 20,40 in 2.4 GHz.	P82.44 Insert a Note "A HE AP shall support 20,40,80 MHz mode in 5GHz band."	2017/1/9 9:42
3033 Abhishek Patil	225	1 9.4.2.218.3	86	21	T	N	86.21 9.4.2.218.3	What is the Power Boost Factor +²ʳ Support used for?	Define Power Boost factor	2017/1/9 9:42
3034 Abhishek Patil	225	1 9.4.2.219	91	1	T	N	91.01 9.4.2.219	MaxBSSID Indicator field is 1 octet in length and is only useful (i.e., valid) if the AP is part of a Multiple BSSID Set. Make MaxBSSID Indication separate (optional) field. Add a bit sub-field to HE Parameters to indicates if the AP is part of a Multiple BSSID set.	Add a new bit field in HE Operation Parameters call Multiple BSSID AP. Move MaxBSSID Indication sub-field out of HE Operation Parameter field and make it a separate (optional) field. MaxBSSID Indicator field is present in HE Operation element only when Multiple BSSID AP bit in HE Parameters field is 1. In addition, the value of Tx BSSID Indicator is ignored if the Multiple BSSID AP bit value is 0.	2017/1/9 9:42

3035 Abhishek Patil	225	1 9.4.2.219	91	1	T	N	91.01 9.4.2.219	VHT Operation Information field is useful only when operating in 5GHz. Make the 3-octet VHT Operation Information field option and add a bit in the HE Parameters to indicate the presence of VHT Operation Information field	As in comment	2017/1/9 9:42
3036 Abhishek Patil	225	1 9.4.2.219	91	39	T	Y	91.39 9.4.2.219	Remove text that doesn't apply anymore and is covered in the following paragraph	Remove paragraph starting on line 39. Paragraph starting on line 44 is correct and should be kept	2017/1/9 9:42
3037 Abhishek Patil	225	1 9.4.2.222	95	43	E	N	95.43 9.4.2.222	Correct typos	remove '-' in Announcement (ln 43), remove s in elements (ln 45)	2017/1/9 9:42
3038 Abhishek Patil	225	1 9.4.2.223	95	48	T	Y	95.48 9.4.2.223	Instead of defining 3 separate elements for Quiet time setup/Req/Resp, combined to one element which carries a code to indicate the sub-type of the element and the operation involved	Rename 9.4.2.223 as HE Quiet Time and remove 9.4.2.224 & 9.4.2.225. Add 3 sub-sections to this section - each section representing the sub-type of the HE Quiet Time: 1. 9.4.2.223.1 Quiet Time Period Announcement - This section will carry the description in 9.4.2.223 - change the figure & description to include a 1 octet code field (value 1 for this operation) 2. 9.4.2.223.2 Quiet Time Period Request - This section will carry the description in 9.4.2.224 - change the figure & description to include a 1 octet code field (value 2 for this operation) 3. 9.4.2.223.2 Quiet Time Period Response - This section will carry the description in 9.4.2.225 - change the figure & description to include a 1 octet code field (value 3 for this operation)	2017/1/9 9:42
3039 Abhishek Patil	225	1 9.4.2.223	95	50	E	N	95.50 9.4.2.223	Correct typo and section reference	Incorrect section reference - should be 27.16.3. Also on ln 55, change STA-2-STA to STA-to-STA	2017/1/9 9:42
3040 Abhishek Patil	225	1 9.4.2.223	96	15	E	N	96.15 9.4.2.223	Element ID Extension missing in description	The description of this section should mention Element ID Extension - same applies to 9.4.2.224 & 9.4.2.225	2017/1/9 9:42
3041 Abhishek Patil	225	1 9.4.2.223	96	24	T	N	96.24 9.4.2.223	Instead of IEEE defining/providing unique identifier for Vendor Specific Service Identifier, can STAs (involved in STA-to-STA) pick a (random) value for their STA-to-STA service and report it to their AP during the request? AP then advertises this value during the Quiet time setup. There is a chance of collision but it should be fairly small. This also helps the case where multiple disjoint set of STAs associated with the same AP request quiet time for the same type of service. This comment also applies to section 27.16.3	Rename'Vendor Specific Service Identifier' to 'Specific Service Identifier' in figure and related description from sections 9.4.2.223, 224 & 225. Add text that describes that the requesting STA (in its request to the AP) indicates the identifier it has picked for the STA-to-STA service it wishes to run during the quiet time.	2017/1/9 9:42
3042 Abhishek Patil	225	1 9.4.2.224	96	58	E	N	96.58 9.4.2.224	change order of description to match field order	Change the order of description for Quiet Period Interval and Quiet Duration field	2017/1/9 9:42
3043 Abhishek Patil	225	1 9.4.2.225	97	30	T	N	97.30 9.4.2.225	Quiet Time Period Response doesn't need to carry all the fields in the Request - it can simply carry a status code field to indicate whether the request was succesful	Remove fields (and corresponding description) between Dialog Token and Status code	2017/1/9 9:42
3044 Abhishek Patil	225	1 9.4.2.225	97	32	T	Y	97.32 9.4.2.225	The value of 'offset' field for the first quiet period should be consistent with the value indicated in the request	Change sentence to: "The reference time is the start of the preamble of the PPDU that contains request element to which this element is a response." Actually this field should be removed since it doesn't add any value. This element is in response to the request. It should only carry dialog token and status code.	2017/1/9 9:42
3045 Abhishek Patil	225	1 9.4.2.225	97	48	T	N	97.48 9.4.2.225	There is no reason for status code to be 2 octet long. Also define possible values and their meaning for status code field for status code	Change status code to 1 octet field. Add a table that define values for status code - for example, (0)success, (1)reject - requested period too long (2)reject - requested periodicity too long (3) so on....	2017/1/9 9:42

3046	Abhishek Patil	225	1 9.6.8.36	99	61	T	N	99.61 9.6.8.36	Presence of TIM Element in FILS Discovery can have wider application, and doesn't have to be tied to TWTOperation only	Remove the restriction, as in the comment	2017/1/9 9:42
3047	Abhishek Patil	225	1 9.6.5.1	99	14	T	N	99.14 9.6.5.1	Definition of L3 FRAG ADDBA Req/Resp is missing, though the values for Action field are defined in Table 9-302	Add the definition as in the comment	2017/1/9 9:42
3048	Abhishek Patil	225	1 9.6.29	104	20	T	Y	104.20 9.6.29	Don't need to define 3 separate action frames for Quiet Time Period - the 3 operations can be consolidated as one action frame with a code field separating each operation	See comment suggestion consolidating the 3 Quiet Time Period elements to one element with a code field value for each operation.	2017/1/9 9:42
3049	Abhishek Patil	225	1 9.6.29	104	14	T	N	104.14 9.6.29	Instead of defining a new action frame, Quiet Time Period frames can be of type HE Action frame.	Add Quiet Time Period category under HE Action frames and create a section that describes frames related to Quiet Time Period	2017/1/9 9:42
3050	Abhishek Patil	225	1 9.6.29.4	105	28	T	Y	105.28 9.6.29.4	Incorrect text	This paragraph describes the request operation - instead it should describe the response operation	2017/1/9 9:42
3051	Abhishek Patil	225	1 10.24.10.3	134	10	T	N	134.10 10.24.10.3	Add text clarifying that GCR mechanism is used only for STAs that have indicated support for GCR (via bit 51 / 52 of Extended Capabilities Element).	As in comment	2017/1/9 9:42
3052	Abhishek Patil	225	1	134	26	T	N	134.26	Why should AP send MU-BAR to solicit BA for a GCR session?	Remove MU BAR to solicit BA for GCR session	2017/1/9 9:42
3053	Abhishek Patil	225	1 10.24.10.3	134	41	T	Y	134.41 10.24.10.3	Procedure for GCR MU BAR reception is missing	Add procedure upon reception of GCR MU BAR	2017/1/9 9:42
3054	Abhishek Patil	225	1 11.1.3.10	141		T	Y	141.00 11.1.3.10	Action on non-AP STA needs to be described - esp how will the non-AP HE STA that is close to the HE AP (and can receive group address traffic in both the formats) manage filtering duplicate group address traffic	Need to specify non-AP STA action - for example, a non-AP STA that is close to the AP can receive both ER and non-ER frames. Need a mechanism to filter duplicate group addressed traffic and indicating preference for receiving unicast frames in one particular PHY (ER or non-ER) format. This can help with power-save. Need a mechanism to differentiate between group addressed and unicast so that STA can quickly filter a particular PHY format. For example, HE-SIG-A field could carry a particular combination of values to indicate groupcast traffic in ER format. A non-AP STA can choose to monitor all group address traffic on just one type of PPDU and ignore all group addressed traffic received on the other PPDU type. The criteria for a nearby HE non-AP STA to decide monitoring one type of PPDU versus the other is out of scope of the standard (a far off HE STA can only receive ER	2017/1/9 9:42
3055	Abhishek Patil	225	1 11.1.3.10	141		T	N	141.00 11.1.3.10	Only HE STAs can understand an HE Beacon in Extended PPDU format. Such beacon need not carry information that is relevant to non-HE/legacy STAs. This will help reduce the size of HE Beacon.	Add a sentence which implies that an HE beacon may not include fields/IEs that apply only to legacy STAs.	2017/1/9 9:42
3056	Abhishek Patil	225	1 27.2.1	149	48	T	Y	149.48 27.2.1	Need to capture the case when BSS_COLOR is 0	Frame is Inter BSS when BSS_COLOR is 0, Inter-BSS NAV is set	2017/1/9 9:42
3057	Abhishek Patil	225	1 27.2.2	150	42	T	N	150.42 27.2.2	Replace Duration with Duration/ID	Replace Duration field with Duration/ID field - this applies to several instances throughout this section	2017/1/9 9:42
3058	Abhishek Patil	225	1 27.2.2	151	56	E	N	151.56 27.2.2	Move paragraph to the beginning of this section	The description in this paragraph is informative and explains the importance of two NAVs. It should be moved to the beginning of this section.	2017/1/9 9:42
3059	Abhishek Patil	225	1 27.4.1	157	63	T	Y	157.63 27.4.1	Procedure for GCR MU BAR reception is missing	Add procedure upon reception of GCR MU BAR	2017/1/9 9:42
3060	Abhishek Patil	225	1 27.4.1	158	11	T	N	158.11 27.4.1	Current sentence is convoluted. Simplify it.	Change sentence to: "If an HE AP does not receive an HE Capabilities element with the Rx Control Frame To MultiBSS set to 1 from a STA, then the HE AP shall not send a Multi-STA Block Ack frame to the STA if the frame is destined for STAs associated with more than one AP that are part of the same multiple BSSID set."	2017/1/9 9:42

3061	Abhishek Patil	225	1 27.4.1	158	11	T	N	158.11 27.4.1	The AP's condition to responding with M-BA to a multi-BSS STAs is meaningless, since STAs that send HE Trigger-based PPDU get to decide the ack policy. So, the right way is to stop this condition happening by not sending the trigger frame to STAs belonging to multiple BSSs in a multi-BSS setup.	As in the comment		2017/1/9 9:42
3062	Abhishek Patil	225	1 27.4.1	158	17	T	N	158.17 27.4.1	The condition in following sentence is not complete: "An HE non-AP STA that is associated with a nontransmitted BSSID and has indicated support for receiving Control frames with TA set to the Transmitted BSSID (Rx Control Frame To MultiBSS set to 1 in HE Capabilities element).."	Suggest to modify as follows: "An HE non-AP STA that is associated with a nontransmitted BSSID and has indicated support for receiving Control frames receives Control frames from a multi-BSS AP with TA set to the Transmitted BSSID (Rx Control Frame To MultiBSS set to 1 in HE Capabilities element).."		2017/1/9 9:42
3063	Abhishek Patil	225	1 27.4.2	159	16	T	N	159.16 27.4.2	Add the condition for TID, when AckType=1 in the following sentence: "If the Ack Type field is 1 then the Per STA Info field indicates either the acknowledgement of a single MPDU identified by the value of the TID."	If the Ack Type field is 1, and if the TID is less than or equal to 7, or is equal to 15, then the Per STA Info field indicates the acknowledgement of a single MPDU identified by the value of the TID		2017/1/9 9:42
3064	Abhishek Patil	225	1 27.4.3	159	40	T	N	159.40 27.4.3	32-bit BA is used only if '32-bit BA bitmap' is supported per HE capabilities element format	Add the condition as in the comment		2017/1/9 9:42
3065	Abhishek Patil	225	1 27.4.4	160	30	T	N	160.30 27.4.4	Need to add the procedure for the case where SU Multi TID AMPDU soliciting SU PPDU response [for example, whether the response is always using M-BA, and not with Multi-TID BA if it receives a multi-TID frame in legacy PPDU format]	As in the comment		2017/1/9 9:42
3066	Abhishek Patil	225	1 27.4.4.2	160	52	E	N	160.52 27.4.4.2	Reference(10.3.2.11.2) is not correct in the sentence: "An AP that sends a DL MU PPDU that intends to solicit an immediate response carried in an SU PPDU shall set the Ack Policy to Normal Ack (or Implicit BAR) for at most one of the (A-)MPDUs contained in the soliciting DL MU PPDU (see 10.3.2.11.2 (MU acknowledgement procedure for DL MU PPDU in SU format) for an example of this sequence).	Correct the reference to: "10.3.2.10.2"		2017/1/9 9:42
3067	Abhishek Patil	225	1 27.4.4.3	161	13	E	N	161.13 27.4.4.3	Reference(10.3.2.11.3) is not correct in the sentence: "An AP that sends a DL MU PPDU that intends to solicit an immediate response carried in an HE triggerbased PPDU shall set the Ack Policy to MU Ack ('01') for each of the (A-)MPDUs for which it intends to solicit an immediate response (see 10.3.2.11.3 (MU acknowledgement procedure for HE MU PPDU in MU format) for an example of this sequence)."	Correct the reference to: "10.3.2.10.3"		2017/1/9 9:42
3068	Abhishek Patil	225	1 27.4.4.4	161	38	E	N	161.38 27.4.4.4	Reference(10.3.2.11.4) is not correct in the sentence: A non-AP STA that sends an HE trigger-based PPDU as a response to a Basic variant Trigger frame that intends to solicit an immediate response shall set the Ack Policy to Normal Ack/Implicit BAR (see 10.3.2.11.4 (MU acknowledgement procedure for an UL MU transmission) for an example of this sequence).	Correct the reference to: "10.3.2.10.4"		2017/1/9 9:42

3069 Abhishek Patil	225	1 27.4.4.5	162	14	T	N	162.14 27.4.4.5	AP should not be responding to a STA that sent S/A-MPDU (no Multi-TID) using M-BA if the M-BA is indivudually addressed to the STA.	Modify the sentence as follows: Original text: "The AP shall respond with Ack frame or an individually addressed Multi-STA BlockAck frame to each of the STAs from which a Single MPDU that solicited an immediate response was received, and with a Compressed BlockAck frame or a Multi-STA BlockAck frame to each of the STAs from which an A-MPDU that solicited an immediate response was received, or a Multi-STA BlockAck frame to each of the STA from which a multi-TID A-MPDU that solicited an immediate response was received." Proposed text: "The AP shall respond with Ack frame to each of the STAs from which a Single MPDU that solicited an immediate response was received, and with a Compressed BlockAck frame to each of the STAs from which an A-MPDU that solicited an immediate response was		2017/1/9 9:42
3070 Abhishek Patil	225	1 27.4.45	162	28	T	N	162.28 27.4.45	The following sentence is not relavent, since there can be only one group addressed M-BA in a DL MU PPDU: "A HE AP should only transmit a group addressed Multi-STA Block-Ack frame in a DL MU PPDU to a non-AP HE STA n on the (broadcast RU) RU (26/52/106/242/484/996) that includes the RU used for receiving the immediate preceding HE trigger-based PPDU from STA n"	Replace the sentence with: "The AP shall not include more than one group addressed M-BA in a DL MU PPDU"		2017/1/9 9:42
3071 Abhishek Patil	225	1 27.5.2.2.2	165	50	T	Y	165.50 27.5.2.2.2	Incorrect field reference. Also, the sentence needs to be simplified.	Change the sentence to: "The MAC address of the transmitted BSSID when dot11MultiBSSIDActivated is true and the Trigger frame is destined for STAs associated with more than one AP that are part of the same multiple BSSID set and have indicated support to received such frames via the Rx Control Frame to MultiBSS field in HE Capabilities element."		2017/1/9 9:42
3072 Abhishek Patil	225	1 27.5.2.2.2	165	60	T	N	165.60 27.5.2.2.2	Current sentence is convoluted. Simplify it.	Change sentence to: "If an HE AP does not receive an HE Capabilities element with the Rx Control Frame To MultiBSS field equal to 1 from a STA, then the HE AP shall not send the Trigger frame to the STA if the frame is destined for STAs associated with more than one AP that are part of the same multiple BSSID set."		2017/1/9 9:42
3073 Abhishek Patil	225	1 27.5.2.6.2	173	38	T	N	173.38 27.5.2.6.2	Condition for when the STA should use random access needs to be defined. In the absence of such restriction there will be a lot of un-necessary random access attempts	As in the comment		2017/1/9 9:42
3074 Abhishek Patil	225	1 27.5.2.6.2	173	38	T	N	173.38 27.5.2.6.2	Trigger frame should be able to indicate whether a pre-associated STA is allowed to respond. May be reserve a special AID, if only associated STAs are allowed to respond, Vs AID0 where any STA is allowed to respond	As in the comment		2017/1/9 9:42
3075 Abhishek Patil	225	1 27.6.2	176	20	T	N	176.20 27.6.2	Current sentence is convoluted. Simplify it.	Change sentence to: "If an HE AP does not receive an HE Capabilities element with the Rx Control Frame To MultiBSS subfield in the HE MAC Capabilities Information field equal to 1 from a STA, then the HE AP shall not send the NDP Announcement frame to the STA if the frame is destined for STAs associated with more than one AP that are part of the same multiple BSSID set."		2017/1/9 9:42

3076 Abhishek Patil	225	1 27.7.3.4	187	5	T	N	187.05 27.7.3.4	There needs to be a time limit up to which a TWT scheduled STA will remaining awake to catch the beacon. A non-AP STA which is power constrained sets up a wake TBTT TWT schedule. The current spec language seems to indicate that the STA will remain awake till it receives the beacons. What if the beacon was lost due to collision?	Specify a time period (in addition to the current language) for which the non-AP STA waits for the beacon. We could use the Nominal Minimum TWT Wake Duration field in TWT element to specify this time.	2017/1/9 9:42
3077 Abhishek Patil	225	1 27.8	188	29	T	N	188.29 27.8	The normative behavior for setting the OMI support Capabilities is missing. Please add the normative behavior on setting this field. In addition there needs to be normative behavior on how the AP indicates ROM changes to a plurality of STAs using the OMI A-Control.	Presentation to be provided which would provide normative text which would require the AP to send OMI and receive acknowladge indication from all STAs before changing the parameters.	2017/1/9 9:42
3078 Abhishek Patil	225	1 27.9.2.2	191	60	T	N	191.60 27.9.2.2	Add the ability for AP to set the OBSS PD Min and Max for managed APs	As in the comment	2017/1/9 9:42
3079 Abhishek Patil	225	1 27.9.2.2	191	60	T	N	191.60 27.9.2.2	Add the ability for AP to disable OBSS PD based reuse	As in the comment	2017/1/9 9:42
3080 Abhishek Patil	225	1 27.9.2.2	191	60	T	N	191.60 27.9.2.2	Add a mechanism for a STA to disable OBSS STAs from applying OBSS PD based reuse on top of the PPDU that it is sending.	As in the comment	2017/1/9 9:42
3081 Abhishek Patil	225	1 27.9.2.2	192	16	T	N	192.16 27.9.2.2	Define the rules for OBSS PD based transmissions on secondary channels. It is miissing in the current draft	As in the comment	2017/1/9 9:42
3082 Abhishek Patil	225	1 27.9.2.2	192	16	T	N	192.16 27.9.2.2	Define the interaction between OBSS PD based reuse and SRP based reuse. It is missing in the current draft.	As in the comment	2017/1/9 9:42
3083 Abhishek Patil	225	1 27.11.1	195		T	N	195.00 27.11.1	There are cases (like GCR, FMS) where the traffic is for a limited set of STAs (i.e., not broadcast to all) - in such cases, a STA needs to check the MAC header to see if it is one of the intended recipient.	Add text to clarify that when the STA_ID_LIST indicates 'more than one STA', a STA should check the MAC header to see if it is one of the intended recipient.	2017/1/9 9:42
3084 Abhishek Patil	225	1 27.11.4	196	39	T	N	196.39 27.11.4	Add section reference to setting NAV	Update sentence as follows: "the channel access rules as described in 27.9 (Spatial reuse operation) or reduce power consumption as described in 27.14.1 (Intra-PPDU power save for HE non-AP STAs) or set the NAV as described in 27.2.2 (Updating two NAVs)."	2017/1/9 9:42
3085 Abhishek Patil	225	1 27.11.4	196	43	T	N	196.43 27.11.4	Mention that BSS Color is a 6-bit value	Edit sentence as follows: "An HE STA transmitting an HE Operation element shall select a value in the range 1 to 63 to include in the 6-bit BSS Color subfield of the HE Operation element ..."	2017/1/9 9:42
3086 Abhishek Patil	225	1 27.11.4	196	43	T	N	196.43 27.11.4	Since BSS Color can change when AP determines a prolonged color collision, remove text that states that BSS Color is maintained for the lifetime of the BSS	Remove follow from the sentence: " and shall maintain that single value of the BSS Color subfield for the lifetime of the BSS"	2017/1/9 9:42
3087 Abhishek Patil	225	1 27.11.4	196	49	T	N	196.49 27.11.4	Need to capture the case where the received frame came from an unassociated STA with color value 0	Add text to clarify that this applies only when the received BSS Color value is non-zero	2017/1/9 9:42
3088 Abhishek Patil	225	1 27.11.4	197	8	T	Y	197.08 27.11.4	A non-AP STA may determine BSS Color overlap with a neighboring (OBSS) AP. In such cases, the non-AP STA needs a mechanism to report a color collision to its associated AP.	Define a mechanism where a non-AP STA can autonomously report a color collision to its associated AP.	2017/1/9 9:42
3089 Abhishek Patil	225	1 27.11.5	197	39	T	Y	197.39 27.11.5	HE AP continues to advertise BSS Color even when it has disabled the use of BSS Color. There should be mechanism which requires STAs to use the DURATION/ID value instead of BSS COLOR and TXOP_DURATION field	Add sentence to this section: "An HE AP that has set the BSS Color Disabled value to 1 in HE Operation element shall set the TXOP_DURATION to all 1s."	2017/1/9 9:42
3090 Abhishek Patil	225	1 27.14.1	199	13	E	N	199.13 27.14.1	Fix typo	Fix sentence as follows: "An HE non-AP STA that has dot11IntraPPDUPowerSaveOptionActivated equal to true operates in intra-PPDU power save mode."	2017/1/9 9:42
3091 Abhishek Patil	225	1 27.14.1	199	22	T	N	199.22 27.14.1	Change broadcast to group-addressed	Change broadcast to group-addressed to cover the case of GCR, FMS etc where a sub-set of STAs are addressed by the AP	2017/1/9 9:42

3092	Abhishek Patil	225	1 27.14.2	200	21	E	N	200.21 27.14.2	Clarify sub-field	Add the field name to which the sub-fields belongs to. Suggest changing the sentence as following: "An HE STA that receives a Beacon frame or a management frame containing a TWT element that has a value of 1 in the Broadcast subfield of Control field and a value of 2 in the TWT Flow Identifier subfield of Request Type field may enter the doze state until the start of that TWT SP as described in 27.7.3.3 (Rules for TWT scheduled STA)."	2017/1/9 9:42
3093	Abhishek Patil	225	1 27.14.3.1	200	63	T	N	200.63 27.14.3.1	The operation applies to current TWT SP - the sentence doesn't need to discuss about what happens outside the current TWT SP. Replace "before the next TWT SP" with "in the current TWT SP"	Change sentence as following: "For an HE non-AP STA for which their associated AP set their corresponding bit in the traffic indication virtual bitmap field of the TIM element to 1, if the STA was not served in the current TWT SP then the AP shall set its corresponding bit in the traffic indication virtual bitmap field of the TIM element to 1 in the subsequent TWT SP."	2017/1/9 9:42
3094	Abhishek Patil	225	1 27.16.3.1	207	51	E	N	207.51 27.16.3.1	Keep the field names consistent in the element definition and section description	The element description in section 9.4.2.224 call it dialog token while this section makes reference to a request token. Change reference to 'request token' to 'the token value in the Dialog Token field of the Request element'	2017/1/9 9:42
3095	Abhishek Patil	225	1 28.3.10.8.5	295	23	T	Y	295.23 28.3.10.8.5	There is no terms called Multi-BSSID	Suggest changing the sentence as follows: "For an AP belonging to Multiple BSSID set, the STAID for broadcast to a specific BSS will follow the group addressed AID assignment in the TIM according to the existing rules for TIM assignment in a Multiple BSSID set." Similarly, suggest changing the next bullet to: "For an AP belonging to multiple BSSID set, the STAID for broadcast to all BSS of the AP is et to 2047"	2017/1/9 9:42
3096	Adrian Stephens	225	1 Frontmatter			G	N	Frontmatter	The frontmatter list of dependencies is now out of date with the approval of REVmc, ah and ai.	Update to "IEEE Std 802.11x-2016"	2017/1/9 9:42
3097	Adrian Stephens	225	1 27.5.2.3	167	59	T	Y	167.59 27.5.2.3	There is a TBD in normative text. Gets my automatic "no" vote. "The UserInfo field is addressed to a STA if the AID12 subfield is equal to the AID of the STA and the STA is associated with the AP. If the STA is not associated withthe AP, TBD"	Delete cited text.	2017/1/9 9:42
3098	Adrian Stephens	225	1 G.5	427		T	Y	427.00 G.5	The changes to Annex G are incomplete. They look like a sketch of intended changes that nobody quite could be bothered to complete.	There is no change to ht-txop-sequence. Add alternative for he-mu-sequence. Editorial note - use lower-case in Annex G terms. I see both "He-" and "HE-". Add a definition of the terms "ul-mu-sequence" and "cascading-mu-sequence".	2017/1/9 9:42
3099	Adrian Stephens	225	1 C.3	419		T	Y	419.00 C.3	dot11HEOptionImplemented does not appear in a group	Add it to an dot11SMTbase<n> group. If any your dependencies have added objects to dot11SMTbase13 (which thereby breaks the MIB doctor rules) then add to this group. If dot11SMTbase has not been modified by any of your dependencies, then deprecate dot11SMTbase13, copy to ...14, insert the new object. Update the module compliance statement to cite ...base14.	2017/1/9 9:42
3100	Adrian Stephens	225	1	6	50	E	Y	6.50	"high efficient (HE) dual beacon" - wrong term	efficient->efficiency	2017/1/9 9:42
3101	Adrian Stephens	225	1 4.3.14a	9	21	T	Y	9.21 4.3.14a	"An HE non-AP STA shall support operation in 20 MHz channel bandwidth only" -- only does not live at the end of a sentence. Its intent is ambiguous. Ditto at line 27.	Move or delete the only. For example, move it to after the "support" verb.	2017/1/9 9:42

3102	Adrian Stephens	225	1 8.3.5.2.2	15	22	T	Y	15.22 8.3.5.2.2	Why do we need both USER_INDEX and STA_INDEX? They both seem to describe exactly the same concept. As these both support "multi-user" (not "multi-STA") operation, the existing term is preferable.	Throughout the draft, replace all references to STA_INDEX with USER_INDEX.	2017/1/9 9:42
3103	Adrian Stephens	225	1 9.2.4.5.4	20		E	N	20.00 9.2.4.5.4	"For a frame that is carried in a DL HE MU PPDU" REVmc fixed a lot of "For a". This is not done for a frame, it is present in a frame.	Review all "for a" language, and replace with alternatives, such as "in a" where it does not describe an action performed for a frame.	2017/1/9 9:42
3104	Adrian Stephens	225	1 9.2.6.3	22		E	Y	22.00 9.2.6.3	"Aggregated Control (A-Control)" - don't abbvt. Abvn is bd. Because people will randomly choose one of the two forms to use in different contexts. And, given the license to abbreviate, folks will choose to randomly abbrvt. Witness line 49 uses a different abbreviation of this name. And having a field name that embeds its own abbreviation is dumb (by which I mean that REVmc tediously went through and removed them all from .11ad-introduced material).	Either use "Aggregated Control" (preffered) or "A-Control" throughout.	2017/1/9 9:42
3105	Adrian Stephens	225	1 9.2.4.6.4.5	26	52	E	N	26.52 9.2.4.6.4.5	Scaling factor subfield definition is inherently tabular.	Turn value definitions into a table and reference from here.	2017/1/9 9:42
3106	Adrian Stephens	225	1 9.2.4.6.4.6	27	38	E	Y	27.38 9.2.4.6.4.6	"B5 of the UL Power Headroom subfield is set to 1 to indicate that theminimum transmit power for the current MCS is reached by the STA and set to 0 otherwise" Implementers frequently misinterpret this kind of statement.	Separate B5 into its own field and move description of it into its own para.	2017/1/9 9:42
3107	Adrian Stephens	225	1 9.2.4.6.4.6	27	47	E	Y	27.47 9.2.4.6.4.6	"HE DL HE MU" - ha ha. He He. Ho Ho Ho.	Expunge redundant HEs from this and similar occurances.	2017/1/9 9:42
3108	Adrian Stephens	225	1 9.2.4.6.4.7	28	6	E	N	28.06 9.2.4.6.4.7	Table 9-18d can be clarified.	Start by horizontally straddling cells with the same content. Then you might also replace the text of a cell with "See NOTE 1" (or create better names related to the content) and put the text of the condition in the table footer row. "NOTE 1 - Set to 1 if the lower ..."	2017/1/9 9:42
3109	Adrian Stephens	225	1 9.3.1.9.1	34	10	T	Y	34.10 9.3.1.9.1	Bit numbering of the Reserved field is inconsistent	Change reserved to B5-B11.	2017/1/9 9:42
3110	Adrian Stephens	225	1 9.3.1.9.1	34	25	E	Y	34.25 9.3.1.9.1	"data/management frames" 802.11 has a style guide about capitalization, to ensure consistency. Proper names (i.e., names of frames, elements, sub-elements, fields, subfields...) are capitalized. Also "/" is deprecated because it is often ambiguous - for example it change from "or" to "and" when changing from an inclusive condition to an exclusive one.	Change here to "Data or Management frames". Review all use of "/" and replace with "or" or "and" as appropriate. Review all use of "frame", "element", "field", "subfield" and ensure that a term on the left that names the item is upper case.	2017/1/9 9:42
3111	Adrian Stephens	225	1 9.3.1.9.3	36	24	E	N	36.24 9.3.1.9.3	Table 9-24a Block Ack Bitmap subfield length (octets) values redundantly include units.	Remove redundant "octets" in the values	2017/1/9 9:42
3112	Adrian Stephens	225	1 9.3.1.9.7	38	4	T	N	38.04 9.3.1.9.7	"NOTE--When a Multi-STA BlockAck frame is used to acknowledge a management frame, the TID value is set to 15." If not stated elsewhere, this should not be in a NOTE	If not stated elsewhere, remove "NOTE-".	2017/1/9 9:42
3113	Adrian Stephens	225	1 9.3.1.9.7	38	4	E	N	38.04 9.3.1.9.7	According to IEEE-SA style, Multiple NOTES in a subclause are seqentially numbered.	Number line 64 of previous page to "NOTE 1--" and this to "NOTE 2--" Review all uses of "NOTE--" and insert missing numbering.	2017/1/9 9:42
3114	Adrian Stephens	225	1	38	39	E	Y	38.39	"8 to 13" - inconsistent with previous row	change to "8<en-dash>13"	2017/1/9 9:42

3115 Adrian Stephens	225	1	38	30	E	N	38.30	Dashes in numeric ranges should be "en-dash". Minuses in equations should be en-dashes too.	Review all uses of hyphen separating two integers. (see aside below). Replace any such hyphen with an en-dash. One way to find these using a regular expression is to save the .pdf to accessible text (adobe acrobat), then run a regular expression search on it. AntConc is a free tool that I have used to good effect for this purpose, although other tools are available.	2017/1/9 9:42
3116 Adrian Stephens	225	1 9.3.1.20	40	32	T	Y	40.32 9.3.1.20	I don't see that all the fields in Figure 9-51b are defined in the text that follows it.	Review text that follows and ensure a proper definition for the field is provided. For example The AID11 field appears to have no definition. The definition of Disambiguation is not "proper" in the sense that it does not indicate the meaning of the values of the field, only the intended purpose of the field: "The Disambiguation subfield is set to 1 to prevent a VHT STA from wrongly determining it's AID in the HE STA Info."	2017/1/9 9:42
3117 Adrian Stephens	225	1	46	10	G	Y	46.10	Don't use binary values to represent numeric values - ever. REVmc can tell you why.	Replace binary strings with decimal equivalents in Table 9-25f and the text following it. Make similar changes near "B19-B13". Consider making this into a proper named subfield.	2017/1/9 9:42
3118 Adrian Stephens	225	1	47	56	E	N	47.56	Stylistically, the baseline does not include units in equations.	Remove "octets" from the equation. Insert "(in octets)" in the text above, e.g. after "length of the Padding field". Make similar change at 48.05.	2017/1/9 9:42
3119 Adrian Stephens	225	1	53	26	E	N	53.26	"that elicited this Association Response frame is one." spelled-out numeric values are reserved for small quantities "two frames" not the encoding of fields.	Change "one" to "1". Same change at 54.21 and doubtless other places too.	2017/1/9 9:42
3120 Adrian Stephens	225	1	55	26	E	N	55.26	"pre-sent" - typo	"present"	2017/1/9 9:42
3121 Adrian Stephens	225	1	59	56	E	N	59.56	Table format could do with a table header row	Turn header row into a framemaker table header row. Ditto for following table.	2017/1/9 9:42
3122 Adrian Stephens	225	1			T	N		"The NoFragmentation subfield is reserved when transmitted by an HE STA" When transmitted by an HE STA to an HT or VHT non-HE STA, this statement disallows the HE STA from indicating no use of fragmentation within that BA.	Consider adding "to another HE STA" at the end of the cited text.	2017/1/9 9:42
3123 Adrian Stephens	225	1 9.4.2.200	69	28	T	Y	69.28 9.4.2.200	802.11ah defines the TWT element as extensible. .11ax indicates that the body of the element can be repeated for Broadcast, and presumably relies on the Length field to determine the number of such repeats. These are incompatible.	Change the element ID definition to indicate it is not extensible, or add a count subfield in the Control field.	2017/1/9 9:42
3124 Adrian Stephens	225	1 8.4.2.218.1	76	8	T	Y	76.08 8.4.2.218.1	At 67.16, the HE Capabilities element is defined to be extensible. However at 76.08, the parsing of the PPE Thresholds field presumably relies on the Length field. These are incompatible.	Either add a count field for the PPE Thresholds in the frame format, or declare at 67.16 that the element is not extensible.	2017/1/9 9:42
3125 Adrian Stephens	225	1	78	3	T	N	78.03	Table 9-262 needs a real header row	Turn header row into a framemaker table header row.	2017/1/9 9:42
3126 Adrian Stephens	225	1	79	42	T	Y	79.42	The Maximum AMPDU Length Exponent field needs definition	Add one	2017/1/9 9:42
3127 Adrian Stephens	225	1	93	26	E	N	93.26	Lenght - typo	->Length	2017/1/9 9:42
3128 Adrian Stephens	225	1	67	30	T	Y	67.30	There are no element ID definitions in Table 9-77 for the BSS Color Change ... element and the three Quite Time elements.	Add them.	2017/1/9 9:42

3129	Adrian Stephens	225	1 9.4.2.223	96	24	T	Y	96.24 9.4.2.223	"The Vendor Specific Service ID field contains a public unique identifier assigned by the IEEE." Oh no it doesn't. The IEEE doesn't assign anything. The IEEE registration authority assigns various things like OUIs and CIDs - none of which are 2 octets. (OK, they do provide 2 octet EtherTypes, but there's no way they are going to use that resource for this purpose.)	Remove cited sentence here and wherever it occurs. Add sentence mapping how a value provided by the IEEE Registration Authority is mapped into this field. Define which of the namespaces provided by the IEEE Registration Authority can be used for this purpose.		2017/1/9 9:42
3130	Adrian Stephens	225	1	99	22	T	Y	99.22	The frame formats for the new L3 FRAG frames is not defined.	Add a subclause per new Block Ack frame type describing its format.		2017/1/9 9:42
3131	Adrian Stephens	225	1	99	13	E	Y	99.13	"L3 FRAG DELBA" - gratuitous abbreviation & gratuitous shouting Unnecessary abbreviation obscures meaning and encourages inconsistency. Shouting is just BAD MNNRS.	Replace "FRAG" with "Fragmentation" here and globally.		2017/1/9 9:42
3132	Adrian Stephens	225	1	101	26	T	Y	101.26	The additions to the Mesh Peering frames indicate that .11ax is intended to support mesh operation. But I don't see any changes to other mesh operation (sub-)clauses. For example, how does mesh CCAOP work with triggered frame sequences? What kinds of MU can mesh STAs do? How do the two types of mesh power saving work with .11ax OFDMA power-saving?	As HE is largely about an AP orchestrating its STAs, its model of efficient operation is fundamentally different from mesh. I propose that a statement be added in 4.3.14a that an HE STA is not a mesh STA. In that case remove the changes to 9.6.16. Alternatively define the subset of HE features (probably not including triggered operation, OFDMA, UL or DL MU) that can be used by mesh STAs and opdate the mesh (sub-)clauses to describe this operation.		2017/1/9 9:42
3133	Adrian Stephens	225	1	108	1	T	Y	108.01	"the conditions of various contexts" - tells me nada, zip, nuttin'	Delete sentence or make it say something useful.		2017/1/9 9:42
3134	Adrian Stephens	225	1	108	7	T	Y	108.07	"An HE MU PPDU does not carry more than one A-MPDU that contains one or more MPDUs soliciting an immediate response that is not carried in an HE trigger-based PPDU." Don't you just love the English language? Does the final "that" bind to the "HE MU PPDU", the "more than one A-MPDU" or the "one or more MPDUs"?	Make it unambiguous. For example, break similar conditions into a list. Break it into parts. Name conditions.		2017/1/9 9:42
3135	Adrian Stephens	225	1	110	7	E	N	110.07	"QoS Data frames with multiple TIDs which have no HT-immediate block ack agreement" - that/which confusion.	Request the editor reviews all use of "which" and corrects to "that" or ", which" depending on whether it is introducing a condition or a subsidiary clause. (OK, exception for <preposition> which, which can form a condition too).		2017/1/9 9:42
3136	Adrian Stephens	225	1 10.3.1	113	46	T	Y	113.46 10.3.1	"When HE duration-based RTS is disabled, " - how do we know?	Add reference to condition that describes how we can differentiate - e.g. in a MIB variable setting or a BSS operaton element. Ditto at line 50.		2017/1/9 9:42
3137	Adrian Stephens	225	1	114	5	E	N	114.05	The link to 10.3.2.8a is not a hyperlink.	OK, you can reject this comment, because we are notionally commenting on the printed draft. However, please take it from me that you will save yourself (and the REVmd editors) a heap of time to nip this in the bud now. Otherwise you will forever be correcting stale references. Regular expressions are your friend. 6) Search for (regexp) a) Table [0-9]- b) Figure [0-9]- c) Equation [0-9]- d) Clause [0-9] e) [0-9].[0-9].[0-9] etc...		2017/1/9 9:42

3138	Adrian Stephens	225	1 10.12	128	6	T	Y	128.06 10.12	"when the recipient has not indicated support forreception of fragmented A-MSDUs" This is not a well defined term, and occurs in normative text.	Specify the conditions in terms of mib values or on-the-air signalling.	2017/1/9 9:42
3139	Adrian Stephens	225	1	129	23	E	N	129.23	"one or more immediate response" - gramma. And granpa too.	response->responses	2017/1/9 9:42
3140	Adrian Stephens	225	1	149	10	E	Y	149.10	"The use of HCCA and TSPEC are banned at HE STAs." Multiple problems with this. - passive voice and unusual terminology.	Replace with "An HE STA shall not request the use of HCCA, nor shall it respond with data to a QoS CF-Poll frame. The STA shall not generate TXOP Request frames, nor shall it transmit TXOP Response frames." Note in the case of an HE AP with non-HE "clients", not responding to TXOP requets makes it non-QoS STA compliant. And you might want to allow an HE STA associated with a non-HE BSS to use TXOP requests.	2017/1/9 9:42
3141	Adrian Stephens	225	1	149	11	G	N	149.11	The HE MAC introduction would benefit from an explanation of the relationship of this clause to Clauses 10-11.	Add a more general description. For example you might state that an HE STA that supports a feature described in 27, supports that form of the feature if the feature is also described in Clause 10 or 11.	2017/1/9 9:42
3142	Adrian Stephens	225	1	170	26	G	N	170.26	"A NAV is considered in virtual CS" - awkward	"A non-zero value of NAV indicates virtual CS busy" or similar	2017/1/9 9:42
3143	Adrian Stephens	225	1	175	6	E	N	175.06	Figure style - serif font	Change figure font to Arial.	2017/1/9 9:42
3144	Adrian Stephens	225	1	177	43	E	N	177.43	Figure style - color. Figures should be legible in black and white.	Replace use of color, where necessary as a distinction, with hatching or other distinction.	2017/1/9 9:42
3145	Adrian Stephens	225	1	179	26	E	N	179.26	"us" as a unit of measurement should only be used where the character set is limited to ASCII.	Replace all "<number> us" with "<number> "<micro-glyph>s" See: http://www.fileformat.info/info/unicode/char/039c/index.htm	2017/1/9 9:42
3146	Adrian Stephens	225	1	191	16	E	Y	191.16	I look at figure 27-6 and I shudder	Redraw with appropriate fonts. Typically the font size should be no larger than body text, and can be smaller. Bold should not be used unless necessary to distinguish within the figure. The terms in the figure do not match the terms in the surrounding text - e.g. TX_PWR vs TXPWR. Make them match or provide a mapping key in the figure.	2017/1/9 9:42
3147	Adrian Stephens	225	1	28	53	T	N	28.53	"may not" is ambiguous	Replace "may" with "might"	2017/1/9 9:42
3148	Adrian Stephens	225	1			G	Y		Questionable "may" at: 58.25 (may take -> takes) 95.54 (may -> can) 114.08 (may -> might) 115.38 (may -> might) 115.50 (may -> might) 115.64 (may -> can) (ran out of time to complete review...)	Review the 225 instances of "may" and reword (see comment for examples) except where the instance is in baseline, boilerplate, or the single occurence that establishes a permission of some kind.	2017/1/9 9:42
3149	Ahmadreza Hedayat	225	1 4.3.14a	9	48	T	Y	9.48 4.3.14a	There are other MAC features not listed here, such as: optional support of multi-TID A-MPDU, optional support of Aggregated-Control in HTC field, ...	Add the additional listed features	2017/1/9 9:42
3150	Ahmadreza Hedayat	225	1 4.3.14a	9	29	T	Y	9.29 4.3.14a	There are other features not listed here, such as: optional support of preamble-puncturing, optional support of spatial reuse methods, ...	Add the additional listed features	2017/1/9 9:42
3151	Ahmadreza Hedayat	225	1 9.2.4.1.8	19	40	T	Y	19.40 9.2.4.1.8	This setnece is not clear and needs rewritting: "An HE AP indicates that it can set the More Data subfield to 1 by setting the More Data Ack subfield to 1 in the QoS Info field of frames it transmits". A STA indicates that it can set a bit to 1 by setting another bit to 1?	As in the comment	2017/1/9 9:42
3152	Ahmadreza Hedayat	225	1 9.2.4.1.9	19	49	T	Y	19.49 9.2.4.1.9	This setnece is not clear and needs rewritting: "An HE TDLS peer STA indicates that it can set the More Data subfield to 1 by setting the More Data Ack subfield to 1 in the QoS Capability element it transmits."	As in the comment	2017/1/9 9:42
3153	Ahmadreza Hedayat	225	1 9.2.4.6.4.2	24	21	T	Y	24.21 9.2.4.6.4.2	In 28.3.14.2, instead of TRSSI, Target_{RSSI} is used. Suggest to use the same notation here and there.	As in the comment	2017/1/9 9:42

3154	Ahmadreza Hedayat	225	1 9.2.4.6.4.4	25	5	T	Y	25.05 9.2.4.6.4.4	Need to specify the suggested NSS/MCS is for what bandwidth (if 20/40/80/160 MHz) and what specific RU.	As in the comment	2017/1/9 9:42
3155	Ahmadreza Hedayat	225	1 9.2.4.6.4.6	27	15	T	Y	27.15 9.2.4.6.4.6	Why there is a 2-bit rsereved subfield in UL power headroom? If it is for the purpose of byte-alignment, then need to consider that there is a Control ID of 4 bits for the UL power headroom, leading to total of 12 bits.	Either remove the reserved bits, or update the reserved subfield for what it was intended for.	2017/1/9 9:42
3156	Ahmadreza Hedayat	225	1 9.2.4.6.4.8	28	58	T	Y	28.58 9.2.4.6.4.8	Why there is a 6-bit rsereved subfield in RDP? If it is for the purpose of byte-alignment, then need to consider that there is a Control ID of 4 bits for RDP, leading to total of 10 bits.	Either remove the reserved bits, or update the reserved subfield for what it was intended for.	2017/1/9 9:42
3157	Ahmadreza Hedayat	225	1 9.2.4.6.4.7	27	45	T	Y	27.45 9.2.4.6.4.7	Need to specify whether the BQR is reported based on PD or ED, or e.g. current OBSS-PD or its min defalut value etc.	Specify for what thershold and for what type of channel sensing the BQR report is mesured and reported.	2017/1/9 9:42
3158	Ahmadreza Hedayat	225	1 9.2.4.6.4.7	27	64	T	Y	27.64 9.2.4.6.4.7	The BQR could help both UL MU and DL MU, so the following need to be revised: "Bandwidth Query Report used for bandwidth query report operation to assist DL HE MU transmission"	"Bandwidth Query Report used for bandwidth query report operation to assist DL HE MU transmission and scheduling of UL MU transmission"	2017/1/9 9:42
3159	Ahmadreza Hedayat	225	1 9.2.4.6.4.7	28	6	T	Y	28.06 9.2.4.6.4.7	Table 9-18d is too verbose. The content of this table can be described in a simpler way such as: "Set B_i to 1 if the i_th lower frequency 20MHz channel is available, set to 0 if the 20MHz channel is not available or if its channel availability is not measured".	Suggest to use a simpler description of the content of this table	2017/1/9 9:42
3160	Ahmadreza Hedayat	225	1 9.2.4.6.4.8	28	58	T	Y	28.58 9.2.4.6.4.8	In HE, a STA may grant a RD to its AP and the AP may use it to schedule UL MU transmission, which may include the STA or not. So there should be additional indications where a STA can indicate whether RD grant shall not be used for UL MU transmission, and if so whether the UL MU transmissions shall include the STA (i.e. the AP shall serve the STA during UL MU).	As in the comment	2017/1/9 9:42
3161	Ahmadreza Hedayat	225	1 9.3.1.9.1	34	28	T	Y	34.28 9.3.1.9.1	It is not clear why an AP can set the RA to the broadcast address in this case: "An HE AP that transmits a Multi-STA BlockAck frame with a single AID subfield or with the same values of the AID subfield in Per STA Info subfields sets the RA field to the address of the recipient STA that requested the Block Ack or to the broadcast address." It seems that setting the RA to "the address of the recipient STA that requested the Block Ack" helps unintended STAs in not unnecessarily process the MBA.	As in the comment	2017/1/9 9:42
3162	Ahmadreza Hedayat	225	1 9.3.1.9.7	38	54	T	Y	38.54 9.3.1.9.7	The content of the third colum of the last row of Table 9-24b seems strange; "N/A" is "Not present". Either set both either to "N/A" or set "Block Ack Bitmap" to "Not prsent".	As in the comment	2017/1/9 9:42
3163	Ahmadreza Hedayat	225	1 9.3.1.23	41	65	T	Y	41.65 9.3.1.23	Looks like this sentence needs more description for the case of a multi-BSSID AP: "The TA field value is the address of the STA transmitting the Trigger frame."	Describe what address a multi-BSSID AP shall set this value to when the AP addresses STAs from one/several BSS	2017/1/9 9:42
3164	Ahmadreza Hedayat	225	1 9.3.1.23	46	6	T	Y	46.06 9.3.1.23	Table 9-25f and the following description is unnecessarily verbose. It'd be more strightforward if similar to the tables 28-3, 28-4, and 28-5 the value of B19-B13 is associated with a set of tone indices.	Follow the same principle as clause 28 (HE PHY) and replace this table and the following description with a strighforward table that maps the value of B19-B13 to a set of tone indices.	2017/1/9 9:42
3165	Ahmadreza Hedayat	225	1 9.3.1.23	47	7	T	Y	47.07 9.3.1.23	There is no descripton of the subfields within SS Allocation.	Add the description and encoding of the two subfields within SS Allocation subfiield.	2017/1/9 9:42
3166	Ahmadreza Hedayat	225	1 9.3.1.23.4	49	28	T	Y	49.28 9.3.1.23.4	This sentence needs more description for the case of a multi-BSSID AP: "NOTE--The TA field value is the address of the STA transmitting the MU-RTS frame."	Describe what address a multi-BSSID AP shall set this value to when the AP addresses STAs from one/several BSS	2017/1/9 9:42

3167	Ahmadreza Hedayat	225	1 9.3.1.23.1	48	23	T	Y	48.23 9.3.1.23.1	The subfields listed in the Trigger-dependent User Info are all the attributes that are relevent to all the STAs in a Trigger frame. For instance the MPDU MU Spacing factor would be applicable to all STAs within a Triger frame equally and there would be no logic for an AP to set this value differently across the STAs. Similarly the TID Aggregation limit; if AP wishes to establish a TID limit would better to do it for all STAs. Also, all the discussions in the TGax related to the AC Preference Level and Preferred AC where related to such preference being established for all teh STAs with a Trigger frame ... There is little benefit to have these subfields in the User Info and better if these subfields appear in a Trigger -dependent Common Info.	As in the comment		2017/1/9 9:42
3168	Ahmadreza Hedayat	225	1 9.3.1.23.3	49	60	T	Y	49.60 9.3.1.23.3	Missing the setting of Trigger Type.	Add: "The Trigger Type subfield is set to 2 to indicate MU-BAR variant."		2017/1/9 9:42
3169	Ahmadreza Hedayat	225	1 9.3.1.23.2	49	33	T	Y	49.33 9.3.1.23.2	Missing the setting of Trigger Type.	Add: "The Trigger Type subfield is set to 1 to indicate Beamforming Report Poll variant."		2017/1/9 9:42
3170	Ahmadreza Hedayat	225	1 9.3.1.23.1	48	23	T	Y	48.23 9.3.1.23.1	Missing the setting of Trigger Type.	Add: "The Trigger Type subfield is set to 0 to indicate Basic variant."		2017/1/9 9:42
3171	Ahmadreza Hedayat	225	1 9.3.1.23.5	51	20	T	Y	51.20 9.3.1.23.5	Missing the setting of Trigger Type.	Add: "The Trigger Type subfield is set to 4 to indicate BSRP variant."		2017/1/9 9:42
3172	Ahmadreza Hedayat	225	1 9.3.1.23.6	51	33	T	Y	51.33 9.3.1.23.6	Missing the setting of Trigger Type.	Add: "The Trigger Type subfield is set to 5 to indicate GCR MU-BAR variant."		2017/1/9 9:42
3173	Ahmadreza Hedayat	225	1 9.3.1.23.7	51	58	T	Y	51.58 9.3.1.23.7	Missing the setting of Trigger Type.	Add: "The Trigger Type subfield is set to 6 to indicate BQRP variant."		2017/1/9 9:42
3174	Ahmadreza Hedayat	225	1 9.4.1.62	57	15	T	Y	57.15 9.4.1.62	Is it "Set to 2 for CQI feedback"? Or "Set to 2 for CQI-only feedback"?	As in the comment		2017/1/9 9:42
3175	Ahmadreza Hedayat	225	1			T	Y		CHECK if TWT clauses require additional features			2017/1/9 9:42
3176	Ahmadreza Hedayat	225	1 9.4.2.218.2	79	42	T	Y	79.42 9.4.2.218.2	Missing definition and encoding of "Maximum AMPDU Length Exponent" in Table 9-262z	Add the missing items		2017/1/9 9:42
3177	Ahmadreza Hedayat	225	1 9.4.2.219	91	39	T	Y	91.39 9.4.2.219	Duplicated sentences in this paragraph and the next one.	Unify the two paragraphs or remove one.		2017/1/9 9:42
3178	Ahmadreza Hedayat	225	1 9.4.2.219	91	47	T	Y	91.47 9.4.2.219	It is not cear why a setting in HE Opration parameters is related to the intended recepinets of an HE PPDU as in "except that a value of 0 in this field is used if one or more intended recipient STAs of an HE PPDU is not a member of a transmitting STA's BSS"	Either remove the sentence or describe how an AP can change this setting often		2017/1/9 9:42
3179	Ahmadreza Hedayat	225	1 9.4.2.222	95	22	T	Y	95.22 9.4.2.222	In this clause the refrences are to an HE AP and better to do the same in this one: "The Color Switch Countdown field is set to the number of TBTTs that remain until the STA sending the BSS Color Change Announcement element switches to the new BSS Color."	"The Color Switch Countdown field is set to the number of TBTTs that remain until the HE AP sending the BSS Color Change Announcement element switches to the new BSS Color."		2017/1/9 9:42
3180	Ahmadreza Hedayat	225	1 9.7.3	110	50	T	Y	110.50 9.7.3	BQRP and GCR MU-BAR should be added to: "One or more Trigger frames where the Trigger Type field is Basic Trigger, MU-BAR, or BSRP."	"One or more Trigger frames where the Trigger Type field is Basic Trigger, MU-BAR, GCR MU-BAR, BSRP or BQRP."		2017/1/9 9:42
3181	Ahmadreza Hedayat	225	1 9.7.3	111	24	T	Y	111.24 9.7.3	Should BQRP be added to: "If the A-MPDU is transmitted by an AP, one or more Trigger frames where the Trigger Type field is Basic Trigger or BSRP,"?	"If the A-MPDU is transmitted by an AP, one or more Trigger frames where the Trigger Type field is Basic Trigger, BSRP, and BQRP."		2017/1/9 9:42
3182	Ahmadreza Hedayat	225	1 10.3.2.4	114	51	T	Y	114.51 10.3.2.4	This is not clear and confusing: "If the STA is an HE STA, the STA is a TXOP holder, and the frame is solicited by the STA, then the STA shall not update its NAV."	Rewrite.		2017/1/9 9:42
3183	Ahmadreza Hedayat	225	1 10.3.2.10.2	119	55	T	Y	119.55 10.3.2.10.2	Add GCR MU-BAR to: "An AP may use an MU-BAR variant Trigger frame to solicit acknowledgment frames ..."	"An AP may use an MU-BAR variant or GCR MU-BAR variant Trigger frame to solicit acknowledgment frames ..."		2017/1/9 9:42
3184	Ahmadreza Hedayat	225	1 10.3.2.10.2	119	22	T	Y	119.22 10.3.2.10.2	Add GCR MU-BAR to: "A non-AP STA that is the recipient, within an HE MU PPDU, of a QoS Data frame or QoS Null frame that solicits an immediate response with Ack Policy equal to MU Ack in the QoS Control field, of an MU-BAR frame, ..."	"A non-AP STA that is the recipient, within an HE MU PPDU, of a QoS Data frame or QoS Null frame that solicits an immediate response with Ack Policy equal to MU Ack in the QoS Control field, of an MU-BAR frame, or GCR MU-BAR frame, ..."		2017/1/9 9:42

3185	Ahmadreza Hedayat	225	1 10.7.6.5.2	123	38	T	Y	123.38 10.7.6.5.2	Should DCM be included in this sentence, such that an AP transmits a <HE-MCS, NSS> tuple with DCM=1 when the tuple and DCM is supported by all the recipients etc? "An AP that transmits a Multi-STA BlockAck frame in a non-HT PPDU, HT PPDU, VHT PPDU or HE PPDU shall use a rate, HT-MCS, <VHT-MCS, NSS> tuple or <HE-MCS, NSS> tuple, respectively, that is supported by all the recipients."? Similarly P123L33.	Rewrite it to include DCM.		2017/1/9 9:42
3186	Ahmadreza Hedayat	225	1 10.9	127	22	T	Y	127.22 10.9	"A value of 1 in the Control ID subfield when the transmitting STA changes the receive operating mode, as described in 27.8 (Operating mode indication)."	"A value of 1 in the Control ID subfield when the transmitting STA changes the receive and/or transmit operating mode, as described in 27.8 (Operating mode indication)." or "A value of 1 in the Control ID subfield when the transmitting STA changes the operating mode, as described in 27.8 (Operating mode indication)."	2017/1/9 9:42
3187	Ahmadreza Hedayat	225	1 10.22.2.3	130	1	T	Y	130.01 10.22.2.3	Looks like regardless of receiving and ACK the STA resumes EDCAF backoff counter: "When an HE STA successfully receives the corresponding acknowledgement frame in response to the MPDU sent in HE trigger based PPDU, the backoff for the associated EDCAF resumes the backoff counter countdown. When an HE STA does not receive the corresponding acknowledgement frame in response to the MPDU sent in HE trigger based PPDU, the backoff for the associated EDCAF resumes the backoff counter count-down."	Rewrite. "An HE STA resumes the backoff counter countdown for the associated EDCAF after transmission of an MPDU in HE trigger based PPDU."	2017/1/9 9:42
3188	Ahmadreza Hedayat	225	1 10.22.2.8	133	28	T	Y	133.28 10.22.2.8	Also when the Duration value is non-zero, an HE STA may include frames that solicit an acknowledgment response frame but no other response frames.	"When the Duration field value in the MAC header of an HE trigger-based PPDU is set to 0, the HE trigger-based PPDU shall not include any frame that solicit a control response frame from the AP. When the Duration field value in the MAC header of an HE trigger-based PPDU is non-zero, the HE trigger-based PPDU shall not include any frame that solicit a control response frame from the AP other than Ack, Block-Ack, Multi-STA Block-Ack." Or similar to the language for an RD responder in 10.28.4 (P136L60 of 11ax D1.0): "An HE STA shall not transmit an MPDU (either individually or aggregated within an A-MPDU) in a trigger-based PPDU that is not one of the following frames: Ack, multi-STA BlockAck, QoS data, management"	2017/1/9 9:42
3189	Ahmadreza Hedayat	225	1 27.2.1	149	24	T	Y	149.24 27.2.1	Calrify the case where the STA has received a Color Change Ano. and color switch countdown is not over yet: "The RXVECTOR parameter BSS_COLOR in the received PPDU carrying the frame is the same as the BSS color announced by the AP to which the STA is associated"	As in the comment	2017/1/9 9:42
3190	Ahmadreza Hedayat	225	1 27.2.1	149	38	T	Y	149.38 27.2.1	Calrify the case where the STA has received a Color Change Ano. and color switch countdown is not over yet: "The value of RXVECTOR parameter PARTIAL_AID [5:8] in the received VHT PPDU with the RXVECTOR parameter GROUP_ID equal to 63 is the same as the partial BSS color announced by the AP to which the STA is associated when the Partial BSS Color field in the most recently received HE Operation element is 1."	As in the comment	2017/1/9 9:42

3191	Ahmadreza Hedayat	225	1 9.7.3	109	3	T	Y	109.03 9.7.3	There should be a restriction on aggregation of ACK/BA/M-BA for a STA with a Trigger frame that incudes a User Info for the same STA. Without this restriction, the STA might realize that it has to do a retransmission (from ACK/BA/..) and it has to do the retransmission a SIFS after the current PPDU that includes the ACK/BA and Trigger frames. Suggest to to modify the text in P110L47 third columnn to indicate that at most one of Basic Trigger frame or an ACK/BA/M-BA exists between two HE STAs.	As in the comment		2017/1/9 9:42
3192	Ahmadreza Hedayat	225	1 27.2.2	151	56	T	Y	151.56 27.2.2	This explanation that highlights the benefits of two-NAV setting is more useful to be at the beginning of 27.2.2, or under a general subclause at the beginning of 27.2.	As in the comment		2017/1/9 9:42
3193	Ahmadreza Hedayat	225	1 27.2.3	152	14	T	Y	152.14 27.2.3	The spec does not require an HE AP to send the MU EDCA Parameter set, hence an HE STA may have not received such set at all.	"An UL MU capable non-AP HE STA that receives a Basic Trigger frame that contains a Per User Info field with the AID of the STA, and that receives an immediate response from the AP for the transmitted Triggerbased PPDU, shall update its CWmin[AC], CWmax[AC], AIFSN[AC] and HEMUEDCATimer[AC] state variables to the values contained in the most recently received MU EDCA Parameter Set element sent by the AP to which the STA is associated, if any, for all the ACs from which QoS Data frames were transmitted in the HE trigger-based PPDU."		2017/1/9 9:42
3194	Ahmadreza Hedayat	225	1 27.2.3	152	19	T	Y	152.19 27.2.3	"Each HEMUEDCATimer[AC] shall uniformly count down to 0 when its value is nonzero."	"In an HE STA, each HEMUEDCATimer[AC] shall uniformly count down to 0 when its value is nonzero."		2017/1/9 9:42
3195	Ahmadreza Hedayat	225	1 27.9.1	190	11	T	Y	190.11 27.9.1	SR PPDU is not defined: "When the conditions specified in 27.9 (Spatial reuse operation) are met that allow the transmission of an SR PPDU, an HE STA may transmit an SR PPDU to either an HE STA or a non-HE STA."	Define SR PPDU. Or change SR PPDU to PPDU since there seems "SR" indicates no attributes of the PPDU and rather the channel access method for which the PPDU is being sent.		2017/1/9 9:42
3196	Ahmadreza Hedayat	225	1 27.9.1	190	22	T	Y	190.22 27.9.1	In "... not update its NAV timers based on frames carried in the PPDU ...", for consistency, it should be stated that the STA may not update its NAV based on TXOP field in the HE SIG-A if present	As in the comment		2017/1/9 9:42
3197	Ahmadreza Hedayat	225	1 27.9.1	192	4	T	Y	192.04 27.9.1	SR mode is not defined: "A STA can select an OBSS_PDlevel during its operation under SR mode." Also in P192L7.	Revise or define SR mode.		2017/1/9 9:42
3198	Ahmadreza Hedayat	225	1 27.9.1	191	62	T	Y	191.62 27.9.1	The relationship between OBSS_PD_min with OBSS_PD_min_default is not established. The spec needs to clarify what is the relationship between OBSS_PD_min with OBSS_PD_min_default.	As in the comment		2017/1/9 9:42
3199	Ahmadreza Hedayat	225	1 27.9.1	191	62	T	Y	191.62 27.9.1	The relationship between OBSS_PD_max with OBSS_PD_max_default is not established. The spec needs to clarify what is the relationship between OBSS_PD_max with OBSS_PD_max_default.	As in the comment		2017/1/9 9:42
3200	Ahmadreza Hedayat	225	1 27.9.1	191	1	T	Y	191.01 27.9.1	It is not clear from this clause whether the STA or the AP decides the value of OBSS_PD_min/OBSS_PD_max. Figure 27.6 shows the relationship of OBSS_PD_min and OBSS_PD_max relatively and it does not establish the values of OBSS_PD_min/OBSS_PD_max. The text later introduces OBSS_PD_min_default/OBSS_PD_max_default, but it does not clarify states whether and how an AP or a STA decides on OBSS_PD_min/OBSS_PD_max values.	Clarify whetehr and how a STA or an AP should choose the OBSS_PD_min/OBSS_PD_max values. State whether a non-AP STA shall obtain operating OBSS_PD_min and OBSS_PD_max from its associated AP.		2017/1/9 9:42

3201	Ahmadreza Hedayat	225	1 27.4.1	157	61	T	Y	157.61 27.4.1	Include GCR MU-BAR as well: "An HE STA that receives a BlockAckReq frame or a MU-BAR variant Trigger frame that contains a Compressed BlockAckReq variant in the User Info field addressed to the STA shall respond with a BlockAck frame as defined in 10.24.7 (HT-immediate block ack extensions) or a Multi-STA BlockAck frame as defined in 27.4 (Block acknowledgement).". Also similarly in P158L2: "An HE STA that receives a Multi-TID BlockAckReq frame or a MU-BAR variant Trigger frame that contains a Multi-TID BlockAckReq variant in the User Info field addressed to the STA shall respond with a Multi-STA BlockAck frame ..."	"An HE STA that receives a BlockAckReq frame, a MU-BAR variant Trigger frame that contains a Compressed BlockAckReq variant in the User Info field addressed to the STA, or a GCR MU-BAR variant Trigger frame that contains a Compressed BlockAckReq variant in the Common Info field shall respond with a BlockAck frame as defined in 10.24.7 (HT-immediate block ack extensions) or a Multi-STA BlockAck frame as defined in 27.4 (Block acknowledgement)," and for P158L2: "An HE STA that receives a Multi-TID BlockAckReq frame, a MU-BAR variant Trigger frame that contains a Multi-TID BlockAckReq variant in the User Info field addressed to the STA, or a GCR MU-BAR variant Trigger frame that contains a Multi-TID BlockAckReq variant in the Common Info field shall respond with a Multi-STA	2017/1/9 9:42
3202	Ahmadreza Hedayat	225	1 27.4.2	158	62	T	Y	158.62 27.4.2	"... contained in the BlockAckReq frame ..."	"... contained in the BlockAckReq, MU-BAR or GCR MU-BAR frame ..."	2017/1/9 9:42
3203	Ahmadreza Hedayat	225	1 27.4.2	158	37	T	Y	158.37 27.4.2	" ... that MPDUs to indicate the successful reception of that MPDU."	"... that MPDU to indicate the successful reception of that MPDU."	2017/1/9 9:42
3204	Ahmadreza Hedayat	225	1 27.4.3	159	62	T	Y	159.62 27.4.3	"A recipient that is the intended receiver of an (multi-TID) A-MPDU, (multi-TID) BlockAckReq frame or MU-BAR variant Trigger frame that solicits an immediate BlockAck frame response for each TID shall follow the rules ..."	"A recipient that is the intended receiver of an (multi-TID) A-MPDU, (multi-TID) BlockAckReq frame, MU-BAR or BGR MU-BAR variant Trigger frame that solicits an immediate BlockAck frame response for each TID shall follow the rules ..."	2017/1/9 9:42
3205	Ahmadreza Hedayat	225	1 27.4.4	160	37	T	Y	160.37 27.4.4	"An HE AP may solicit BlockAck frame responses from multiple HE STAs using a MU-BAR variant Trigger frame. If an MU-BAR variant Trigger frame is aggregated in an A-MPDU then no other BlockAckReq frames shall be present in the same A-MPDU... (Multi-TID) BlockAckReq, BlockAckReq, and MU-BAR variant Trigger frames indicate the length of the soliciting block ack responses according to the FN settings defined in 9.3.1.9 (BlockAck frame format)."	"An HE AP may solicit BlockAck frame responses from multiple HE STAs using an MU-BAR variant Trigger frame or a GCR MU-BAR variant Trigger frame. If an MU-BAR variant Trigger frame or a GCR MU-BAR variant Trigger frame is aggregated in an A-MPDU then no other BlockAckReq frames shall be present in the same A-MPDU... (Multi-TID) BlockAckReq, BlockAckReq, MU-BAR variant Trigger and GCR MU-BAR variant Trigger frames indicate the length of the soliciting block ack responses according to the FN settings defined in 9.3.1.9 (BlockAck frame format)."	2017/1/9 9:42
3206	Ahmadreza Hedayat	225	1 27.4.4	160	57	T	Y	160.57 27.4.4	Does this apply to all AMPDUs or all except the one set to Normal ACK? "The A-MPDUs carried in the soliciting DL MU PPDU shall not contain an Action frame or a MMPDU that solicits a response."	As in the comment	2017/1/9 9:42
3207	Ahmadreza Hedayat	225	1 10.24.10.3	134	26	T	Y	134.26 10.24.10.3	"Upon reception of the BlockAck frame from one or more HE STAs, the originator may send an MU-BAR frame to one or more other HE STAs that have a GCR block ack agreement, and this process may be repeated multiple times."	"Upon reception of the BlockAck frame from one or more HE STAs, the originator may send an MU-BAR variant Trigger frame or a GCR MU-BAR variant Trigger frame to one or more other HE STAs that have a GCR block ack agreement, and this process may be repeated multiple times."	2017/1/9 9:42
3208	Ahmadreza Hedayat	225	1 10.24.10.3	134	39	T	Y	134.39 10.24.10.3	"When an HE STA receives an MU-BAR frame with User Identifier subfield set to the AID of the HE STA, the HE STA shall transmit BlockAck frame in the indicated resource unit SIFS after the Trigger frame. The BlockAck frames report the HE STA's reception status of the block of group addressed frames requested by the MU-BAR frame."	"When an HE STA receives an MU-BAR variant Trigger frame or a GCR MU-BAR variant Trigger frame with User Identifier subfield set to the AID of the HE STA, the HE STA shall transmit Ack, BlockAck, or Multi-STABlockAck frame carried in the HE trigger-based PPDU sent as a response SIFS after the Trigger frame. The BlockAck frames report the HE STA's reception status of the block of group addressed frames requested by the MU-BAR variant Trigger frame or the GCR MU-BAR variant Trigger frame."	2017/1/9 9:42

3209	Ahmadreza Hedayat	225	1 10.24.10.3	135	35	T	Y	135.35 10.24.10.3	"After completing the BlockAckReq or MU-BAR and BlockAck frame exchanges ..."	"After completing the BlockAckReq frame, MU-BAR variant Trigger frame, or GCR MU-BAR variant Trigger frame and BlockAck frame exchanges ..."	2017/1/9 9:42
3210	Ahmadreza Hedayat	225	1 10.24.10.3	135	53	T	Y	135.53 10.24.10.3	"An originator may also send an MU-BAR frame with AID12 fields set to AIDs of HE STAs that transmit the BlockAck frames and the Block Ack Starting Sequence Control subfield set to the Sequence Number field of the earliest A-MSDU of the GCR stream that has not been acknowledged by all group members and has not expired due to lifetime limits, in order to minimize buffering latency at receivers in the GCR group."	"An originator may also send an MU-BAR variant Trigger frame or a GCR MU-BAR variant Trigger frame with the AID12 fields set to the AIDs of HE STAs that are expected to transmit the BlockAck frames and the Block Ack Starting Sequence Control subfield set to the Sequence Number field of the earliest A-MSDU of the GCR stream that has not been acknowledged by all group members and has not expired due to lifetime limits, in order to minimize buffering latency at receivers in the GCR group."	2017/1/9 9:42
3211	Ahmadreza Hedayat	225	1 10.24.10.3	136	3	T	Y	136.03 10.24.10.3	"If the beginning of such reception does not occur during the first slot time following a SIFS, then the originator may perform error recovery by retransmitting a BlockAckReq frame or an MU-BAR frame PIFS after the previous BlockAckReq frame or an MU-BAR frame when both of the following conditions are met"	"If the beginning of such reception does not occur during the first slot time following a SIFS, then the originator may perform error recovery by retransmitting a BlockAckReq fram, an MU-BAR variant Trigger frame, or a GCR MU-BAR variant Trigger frame PIFS after the previous BlockAckReq frame or an MU-BAR variant Trigger frame or a GCR MU-BAR variant Trigger frame when both of the following conditions are met ..."	2017/1/9 9:42
3212	Ahmadreza Hedayat	225	1 10.24.10.3	136	11	T	Y	136.11 10.24.10.3	"The remaining duration of the GCR TXOP is longer than the total time required to retransmit the GCR BlockAckReq frame or an MU-BAR frame plus one slot time"	"The remaining duration of the GCR TXOP is longer than the total time required to retransmit the GCR BlockAckReq frame, an MU-BAR variant Trigger frame, or a GCR MU-BAR variant Trigger frame plus one slot time"	2017/1/9 9:42
3213	Ahmadreza Hedayat	225	1 27.4	161	10	T	Y	161.10 27.4	Both S-MPDU and single-MPDU are used in this clause (P162L10, P161L56, etc). Suggest to use S-MPDU throughout this clause.	As in the comment	2017/1/9 9:42
3214	Ahmadreza Hedayat	225	1 27.4.4.5	162	20	T	Y	162.20 27.4.4.5	"The control response frames for each STA shall be sent in the allocated RU that is identified by the AID of each STA." This is not clear; what is the relation between "allocated RU" and "AID of a STA"? Also there would be one control response frame for each STA, so it should be "The Control response frame for each STA ..."	As in the comment	2017/1/9 9:42
3215	Ahmadreza Hedayat	225	1 27.5.2.6	172	33	T	Y	172.33 27.5.2.6	Identfying each RU for RA by a subfield with AID12=0 is too redundant particularly considering tha 5-byte (out of 6-byte) User Info would practically be the same for all RA RUs. Suggest to allow indication of multiple RA RUs using a single Per-User Info. "An RU for random access shall be identified by an AID12 subfield equal to 0 contained in a User Info field of a Trigger frame."	As in the comment	2017/1/9 9:42
3216	Ahmadreza Hedayat	225	1 9.3.1.23.1	48	20	T	Y	48.20 9.3.1.23.1	Allow a way to indicate the number of RA RUs available in a Trigger frame within the Common-Info field. This helps a STA's implementation/operation.	E.g. add a Trigger-dependent Common Info field for the Basic Trigger frame with a subfield that indicated the number of RA RUs.	2017/1/9 9:42
3217	Ahmadreza Hedayat	225	1 27.8.3	189	18	T	Y	189.18 27.8.3	Should there be a similar sentence for TOM as this sentence from ROM 27.8.2: "The ROM indication allows the OMI initiator to adapt the maximum operating channel width and/or the maximum number of spatial streams it can receive from the OMI responder."	As in the comment	2017/1/9 9:42

3218	Ahmadreza Hedayat	225	1 27.8.2	188	60	T	Y	188.60 27.8.2	"When the OMI initiator changes an OMI parameter from lower to higher, it should make the change for that parameter either after ACK Timeout has expired or after receiving the immediate acknowledgement from the OMI responder." Does an OMI initiator has to wait per this clause? Or if it can perform the transition from lower to higher within a SIFS it should be allowed to do so.	As in the comment		2017/1/9 9:42
3219	Ahmadreza Hedayat	225	1 27.8.2	189	1	T	Y	189.01 27.8.2	There should be a distiction between higher-to-lower vs lower-to-higher BW/SS change for this sentence: "If an OMI mode change is reported during a TXOP then the change should occur at least after that TXOP."	As in the comment		2017/1/9 9:42
3220	Ahmadreza Hedayat	225	1 27.8.2	189	8	T	Y	189.08 27.8.2	Needs rewrtting: "After transmitting the acknowledgement frame immediate response immediate acknowledgement for the frame containing the OMI A-Control field, ..."	"After transmitting the acknowledgement frame immediate response for the frame containing the OMI A-Control field, ..."?		2017/1/9 9:42
3221	Ahmadreza Hedayat	225	1 27.8.2	189	54	T	Y	189.54 27.8.2	" Shall indicate a channel width in the RU Allocation subfield of the Per User Info field of a Trigger frame, containing the AID of the OMI initiator, that is less than or equal to the value specified in the Channel Width subfield of the OMI A-Control field received by the OMI initiator". The relationship between the Channel Width subfield and the RU Allocation subfield should be specified more percisely.	"Shall indicate a channel width in the RU Allocation subfield of the Per User Info field of a Trigger frame, containing the AID of the OMI initiator, that is within the bandwidth specified by the Channel Width subfield of the OMI A-Control field received by the OMI initiator"		2017/1/9 9:42
3222	Ahmadreza Hedayat	225	1 27.9.2.1	190	30	T	Y	190.30 27.9.2.1	There should be an exception for response frames (e.g. CTS, ACK, and BA etc) here. Otherwise a STA ignores an OBSS TXOP whose intended recipient happens to be nearby, e.g. within -62dBm or -72dBm reach. This causes significant interference to the OBSS recipient which could have been ignored if response frames where excluded from OBSS-PD rule.	Suggest to add exceptions for any response frame such as CTS, ACK, BA etc. The exception could be similar to the currently-listed exceptions for Public Action frames.		2017/1/9 9:42
3223	Ahmadreza Hedayat	225	1 27.5.1.2	163	3	T	Y	163.03 27.5.1.2	It'd be worthwhile to clarify the restrictions on group-addressed MPDUs across RUs; e.g, only one RU can carry MPDUs with broadcast address, and at most one RU for a given group-address ID etc. "The Type and Subtype subfields in the Frame Control field and address type (individually addressed or group addressed) of MPDUs may be different across A-MPDUs in different RUs within a same HE MU PPDU."	As in the comment		2017/1/9 9:42
3224	Ahmadreza Hedayat	225	1 27.5.1.2	163	43	T	Y	163.43 27.5.1.2	If a STA gain access via RA and sends BQR then it's an unsolicied BQR and should be gathered in the upper clause P163L26: "... the STA shall follow the rules defined in 27.5.2.6 (UL OFDMA-based random access) to gain access to a random RU and generate the HE trigger-based PPDU when the Trigger frame contains one or more random RU(s)."	As in the comment		2017/1/9 9:42
3225	Ahmadreza Hedayat	225	1 27.5.2.2.2	167	15	T	Y	167.15 27.5.2.2.2	"The AP may assign any value defined in Table 9-25i (Preferred AC subfield encoding) in the AC Preference Level subfield in the Trigger Dependent User Info field to 1 for an HE STA and identified by the AID12 subfield of the User Info field of a Basic Trigger frame." This paragraph needs rewritting; the Preferred AC subfield (table 9-25i) is a 2-bit subfield and the doesn't related to AC Preference Level subfield with 1 bit.	As in the comment		2017/1/9 9:42
3226	Ahmadreza Hedayat	225	1 27.5.2.2.2	167	15	T	Y	167.15 27.5.2.2.2	There should be a behavior for the AP in what value to set for the Preferred AC subfield, and the Preferred AC subfield should be set according to the winning AC etc.	As in the comment		2017/1/9 9:42

3227	Ahmadreza Hedayat	225	1 27.5.2.2.2	167	38	T	Y	167.38 27.5.2.2.2	These sentence "An AP may use any AC for sending a PPDU that contains only Trigger frames." needs to be combined with the following paragraph: "An AP may send the Trigger frame using any access category and follows the rules defined in 10.22.2 (HCF contention based channel access (EDCA)) for obtaining and sharing the TXOP."	As in the comment		2017/1/9 9:42
3228	Ahmadreza Hedayat	225	1 27.5.2.2.2	166	49	T	Y	166.49 27.5.2.2.2	Better to refer to "... HE variant HT Control fields with an UL MU Response Scheduling A-Control subfield" as "UL MU Response Scheduling A-Control field" as in the rest of 27.5.	As in the comment		2017/1/9 9:42
3229	Ahmadreza Hedayat	225	1 27.5.2.3	167	58	T	Y	167.58 27.5.2.3	Cover the case of random access and AID=0 here as well: "If the STA is not associated with the AP, TBD."	As in the comment		2017/1/9 9:42
3230	Ahmadreza Hedayat	225	1 27.5.2.3	167	58	T	Y	167.58 27.5.2.3	"If the STA is not associated with the AP, TBD." Specify the TBD.	As in the comment		2017/1/9 9:42
3231	Ahmadreza Hedayat	225	1 27.5.2.4	170	61	T	Y	170.61 27.5.2.4	By "The AP shall set the CS Required subfield to 1 except when all solicited HE trigger-based PPDUs contain an Ack or BlockAck frame and the Length subfield in the Common Info field of the Trigger frame is less than or equal to 418.", only when all RUs seek a response frame CS=0, leading to the cases where one or more RUs (but not all) seel a response frame and the AP would set CS=1; i.e. those STAs sending response frame have to sense the medium for transmitting their response frame. This is a departure from legacy behavior where STAs sende response frames (except CTS) without CS. Need to fix this either by having individual CS or by defining the AP behvior to avoid such cases.	As in the comment		2017/1/9 9:42
3232	Ahmadreza Hedayat	225	1 27.5.2.3	169	56	T	Y	169.56 27.5.2.3	Add the BQRP and GCR MU-BAR: "If the Trigger Type field of a Trigger frame is not Basic Trigger, then the STA shall include in the response A-MPDU at least one MPDU of the required type. A Beamforming Report Poll Trigger frame solicits HE Compressed Beamforming Feedback frames (see 27.6 (HE sounding protocol), an MU BAR Trigger frame solicits BlockAck frames (see 27.4 (Block acknowledgement)), and a BSRP Trigger frame solicits QoS Null frames (see 27.5.2.5 (HE buffer status feedback operation for UL MU). The MPDUs included in the response shall not solicit a response."	"If the Trigger Type field of a Trigger frame is not Basic Trigger, then the STA shall include in the response A-MPDU at least one MPDU of the required type. A Beamforming Report Poll Trigger frame solicits HE Compressed Beamforming Feedback frames (see 27.6 (HE sounding protocol), an MU BAR Trigger frame or a GCR MU-BAR frame solicits BlockAck frames (see 27.4 (Block acknowledgement)), a BSRP Trigger frame solicits QoS Null frames (see 27.5.2.5 (HE buffer status feedback operation for UL MU), and a BQRP Trigger frame solicits QoS Null frames. The MPDUs included in the response shall not solicit a response."	2017/1/9 9:42
3233	Ahmadreza Hedayat	225	1 27.5.2.3	170	1	T	Y	170.01 27.5.2.3	Is there a required type frame for Basic Trigger frame? If so then need to clarify it here ... "If the Trigger Type field of the soliciting Trigger frame is Basic Trigger and the STA does not have a frame of the required type, the STA shall either not transmit a response or transmit one or more QoS Null frames."	As in the comment		2017/1/9 9:42
3234	Ahmadreza Hedayat	225	1 27.5.2.3	170	9	T	Y	170.09 27.5.2.3	This needs to be revised to consider the role of Preferred AC subfield of a Basic Trigger frame: "A STA that is an intended receiver of a Basic Trigger frame may include MPDUs with any TID in the HE trigger-based PPDU sent in response to a Trigger frame subject the rules of 27.10.4 (AMPDU with multiple TIDs)."	As in the comment		2017/1/9 9:42

3235	Ahmadreza Hedayat	225	1 27.5.2.4	170	50	T	Y	170.50 27.5.2.4	If any of the 20MHz channels containing the allocated RU is not ailde then the STA shall not sent the TB PPDU; "... if the STA detects that the 20 MHz channels containing the allocated RUs are not all idle, then the STA shall not transmit anything in the allocated RUs."	" ... if the STA detects that any of the 20 MHz channels containing the allocated RUs is not all idle, then the STA shall not transmit anything in the allocated RUs."	2017/1/9 9:42
3236	Ahmadreza Hedayat	225	1 27.5.2.6	172	35	T	Y	172.35 27.5.2.6	In D1.0, random access RUs are only allowed to be within a Basic Trigger frame; "An HE AP may transmit a Basic Trigger frame or a BSRP Trigger frame that contains one or more RUs for random access."	Either remove the reference to BSRP, or update the spec so that RA RUs can be included withion a BSRP Trigger frame (and if so then any other variant should be included?)	2017/1/9 9:42
3237	Ahmadreza Hedayat	225	1 27.5.2.6.2	173	30	T	Y	173.30 27.5.2.6.2	"For an initial HE trigger-based PPDU transmission or following a successful HE trigger-based PPDU transmission, when an HE STA obtains the value of OCWmin from the HE AP indicated in the RAPS element, it shall set the value of OCW to the OCWmin and shall initialize its OBO counter to a random value in the range of 0 and OCWmin."	"For an initial HE trigger-based PPDU transmission or following a successful HE trigger-based PPDU transmission, an HE STA shall set the value of OCW to the OCWmin obtained from the most recent OCWmin indicated in the RAPS element from the HE AP, and shall initialize its OBO counter to a random value in the range of 0 and OCWmin."	2017/1/9 9:42
3238	Ahmadreza Hedayat	225	1 27.5.2.6.2	173	49	T	Y	173.49 27.5.2.6.2	This is not the best use of RA RUs: "If the selected RU is considered busy as a result of either physical or virtual carrier sensing, then the HE STA shall not transmit its HE trigger-based PPDU in the randomly selected RU and it randomly selects any one of the RUs that are assigned to AID value 0 in the subsequent Trigger frame." It'd be better if the spec let the STA to pick another RA RU from the same Trigger frame (instead of referring to the next Trigger frame).	As in the comment	2017/1/9 9:42
3239	Ahmadreza Hedayat	225	1 27.5.2.6.2	174	1	T	Y	174.01 27.5.2.6.2	The STA may seek to retransmit the frame via other access methods (and not to seek RA again); "If a STA transmits an HE trigger-based PPDU that solicits an immediate response in a random access RU and the expected response is not received, the transmission is considered unsuccessful and the STA invokes the UL OFDMA-based random access retransmission procedure as defined in 27.5.2.6.3 (Retransmission procedure for random access)."	"... the STA invokes the UL OFDMA-based random access retransmission procedure as defined in 27.5.2.6.3 (Retransmission procedure for random access), if the STA decides to retransmit during an upcoming random access opportunity."	2017/1/9 9:42
3240	Albert Petrick	225	1 27.7.4	186	8	T	Y	186.08 27.7.4	TWT scheduling STA and TWT scheduled STA are described. The text states "Either STA can tear down an established negotiation...." It's not clear if "Either STA" means the scheduling STA and the scheduled STA.	Rewrite sentence for clarity and expand on "Either STA"	2017/1/9 9:42
3241	Albert Petrick	225	1 10.13.2	128	42	T	Y	128.42 10.13.2	HE Capabilities Element clause number incorrect	Change clause number to "9.4.2.218"	2017/1/9 9:42
3242	Albert Petrick	225	1 28.5	373	28	E	Y	373.28 28.5	Units "Mbps" in Table 28-47 through Tables 28-102 not consistent with units "Mb/s" in text, tables and figures in IEEE 802.11-2016.	Change "Mbps" to "Mb/s" in Tables 28-47 through Table 28-102. There are 54 tables that need updating!	2017/1/9 9:42
3243	Albert Petrick	225	1 28.3.12	338	43	E	Y	338.43 28.3.12	Figure 28-35 to small to read or print	Redraw figure use larger text font and align across page	2017/1/9 9:42
3244	Albert Petrick	225	1 9.4.2.221	94	56	T	Y	94.56 9.4.2.221	MUEDCATimer not defined	Add definition for MUEDCATimer in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
3245	Albert Petrick	225	1 28.3.12	338	50	E	Y	338.50 28.3.12	Equation 28-114 brackets cutoff	Resize font of brackets and vertically center between paragraphs	2017/1/9 9:42
3246	Albert Petrick	225	1 27.16.1	204	56	E	Y	204.56 27.16.1	Sentence center justified should be left justified	Left justify sentence; "A STA for which dot11HEOptionImplemented is true shall set dot11VeryHighThroughputOptionImplemented or dot11HighThroughputOptionImplemented to true."	2017/1/9 9:42
3247	Albert Petrick	225	1 28.1.1	210	33	E	Y	210.33 28.1.1	Period missing at end of sentence	Add period at the of sentence after "5"	2017/1/9 9:42
3248	Albert Petrick	225	1 27.7.4	187	23	E	Y	187.23 27.7.4	Period missing at end of sentence	Add period at the of sentence after "TWT"	2017/1/9 9:42
3249	Albert Petrick	225	1 26.6.2	178	63	T	Y	178.63 26.6.2	HE Capabilities Element clause number incorrect	Change clause number to "9.4.2.218"	2017/1/9 9:42
3250	Albert Petrick	225	1 28.1.1	209	16	E	Y	209.16 28.1.1	Period missing at end of sentence	Add period at the of sentence after "band"	2017/1/9 9:42

3251	Albert Petrick	225	1 28.3.11.5	317	32	T	Y	317.32 28.3.11.5		BCC acronym not defined	Add definition for "BCC = binary convolutional code" in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
3252	Albert Petrick	225	1 28.3.11.5	317	33	T	Y	317.33 28.3.11.5		LDPC acronym not defined	Add definition for "LDPC = low density parity check " in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
3253	Albert Petrick	225	1 28.3.12	338	56	E	Y	338.56 28.3.12		Equation 28-114 brackets cutoff	Resize font of brackets and vertically center between paragraphs	2017/1/9 9:42
3254	Albert Petrick	225	1 28.1.1	210	35	E	Y	210.35 28.1.1		Period missing at end of sentence	Add period at the of sentence after "PPDUs"	2017/1/9 9:42
3255	Albert Petrick	225	1 9.3.1.23	42	7	E	Y	42.07 9.3.1.23		Space missing between words in GIAnd LTF Type subfield of Figure 9-52	Add character space between the letters "IA" in "GIAnd LTF Type". Should read as "GI And LTF Type"	2017/1/9 9:42
3256	Albert Petrick	225	1 27.15.4.1	203	18	T	Y	203.18 27.15.4.1		HE Capabilities Element clause number incorrect	Change clause number to "9.4.2.218"	2017/1/9 9:42
3257	Albert Petrick	225	1 27.7.4	187	26	E	Y	187.26 27.7.4		Period missing at end of sentence	Add period at the of sentence after "is 1"	2017/1/9 9:42
3258	Albert Petrick	225	1 28.1.1	209	19	E	Y	209.19 28.1.1		Period missing at end of sentence	Add period at the of sentence after "band"	2017/1/9 9:42
3259	Albert Petrick	225	1 9.4.1.62	56	15	E	Y	56.15 9.4.1.62		Table 9-121a bit positions misaligned	Fix bit alignment with each subfield and resize Figure 9-121a to fit center of page.	2017/1/9 9:42
3260	Albert Petrick	225	1 9.4.2.1	67	16	T	Y	67.16 9.4.2.1		HE Capabilities Element clause number incorrect in Table 9-77 Element IDs	Change clause number to "9.4.2.218"	2017/1/9 9:42
3261	Albert Petrick	225	1 9.4.1.62	56	4	T	Y	56.04 9.4.1.62		The text in Clause 9.4.1.62 HE MIMO Control field) needs clarification. The text should call out number of bits and range of bits for Figure 9-121a.	Add the following underlined text (not underlined text) . The HE MIMO Control field is included in every HE Compressed Beamforming frame (see 9.4.1.63 (HE Compressed Beamforming Report field)). The HE MIMO Control field is 40-bits (B0-B39) and is defined in Figure 9-121a (HE MIMO Control field). The subfields and bit assignments (B0-B39) are defined and described in Table 9-7a (HE MIMO Control field encoding).	2017/1/9 9:42
3262	Albert Petrick	225	1 28.3.12	338	44	E	Y	338.44 28.3.12		Equation 28-115 brackets cutoff	Resize font of brackets and vertically center between paragraphs	2017/1/9 9:42
3263	Albert Petrick	225	1 9.4.2.1	67	20	T	Y	67.20 9.4.2.1		The HE Operation Element clause number is incorrect in Table 9-77 Element IDs.	Change clause number to "9.4.2.219"	2017/1/9 9:42
3264	Albert Petrick	225	1 28.1.1	210	38	E	Y	210.38 28.1.1		Period missing at end of sentence	Add period at the of sentence after "receive)"	2017/1/9 9:42
3265	Albert Petrick	225	1 28.1.1	209	22	E	Y	209.22 28.1.1		Period missing at end of sentence	Add period at the of sentence after "band"	2017/1/9 9:42
3266	Albert Petrick	225	1 27.7.4	187	31	E	Y	187.31 27.7.4		Period missing at end of sentence	Add period at the of sentence after "TWT"	2017/1/9 9:42
3267	Albert Petrick	225	1 9.4.2.218.3	84	6	T	Y	84.06 9.4.2.218.3		Add clarity and call out bit positions in Table 9-262aa for subfield "Beamforemee STS For < 80 MHz" corresponding to those bit positions in Figure 9-589cl. Missing period at the end of sentence.	Add bits B34-B36 in Definition column Change to: "B34-B36 indicates the maximum number of space-time streams the STA can receive in an HE NDP."	2017/1/9 9:42
3268	Albert Petrick	225	1 28.1.1	211	62	E	Y	211.62 28.1.1		Period missing at end of sentence	Add period at the of sentence after "least 4"	2017/1/9 9:42
3269	Albert Petrick	225	1 28.3.12	338	56	E	Y	338.56 28.3.12	3253	Equation 28-114 brackets cutoff	Resize font of brackets and vertically center between paragraphs	2017/1/9 9:42
3270	Albert Petrick	225	1 9.4.2.218.3	81	35	T	Y	81.35 9.4.2.218.3		In Figure 9-589cl - (HE PHY Capabilities Information field format) subfield "Number Of Sounding Dimensions For > 80 MHz" is labeled as 1-bit. There are 3-bits (B49 -B51).	Change Bits "1" to "3" for subfield "NSTS Total for > 80 MHz" in Figure 9-589cl	2017/1/9 9:42
3271	Albert Petrick	225	1 9.4.2.218.2	79	9	T	Y	79.09 9.4.2.218.2		Add clarity and call out bit position in Table 9-262z for subfield "MU Cascade Support" corresponding to those bit positions in Figure 9-589ck.	Add bit "B22:" in Definition column before the word "Indicates" Add bits "B22:" in Encoding column before the word "Set"	2017/1/9 9:42
3272	Albert Petrick	225	1 9.4.2.218.3	84	56	T	Y	84.56 9.4.2.218.3		Add clarity and call out bit positions in Table 9-262aa for subfield "NTST Total For < 80 MHz" corresponding to those bit positions in Figure 9-589cl. Missing period at the end of sentence.	Add bits B37-B39 in Definition column Change to: "B37-B39 indicates the maximum value for.....partial bandwidth."	2017/1/9 9:42
3273	Albert Petrick	225	1 28.1.1	211	13	E	Y	211.13 28.1.1		Period missing at end of sentence	Add period at the of sentence after "DL OFDMA)"	2017/1/9 9:42
3274	Albert Petrick	225	1 9.4.2.218.3	83	6	T	Y	83.06 9.4.2.218.3		Add clarity. Call out bit positions in Table 9-262aa for subfield "Device Class" corresponding to those bit positions in Figure 9-589cl	In "Definition" column: Add "B12:" at the beginning of the sentence." In the "Encoding" column: Before sentence Add "B12:" "Set to 1 to indicate STA is a Class A device." In the "Encoding" column: Before sentence Add "B12:" Set to 0 to indicate STA is a Class B device. Note: This field is reserved when transmitting STA is an AP STA."	2017/1/9 9:42

3275	Albert Petrick	225	1 9.4.2.218.2	79	15	T	Y	79.15 9.4.2.218.2		Add clarity and call out bit position in Table 9-262z for subfield "Ack-Enabled Multi-TID Aggregation Support" corresponding to those bit positions in Figure 9-589ck.	Add bit "B23:" in Definition column before the word "Indicates" Add bits "B23:" in Encoding column before the word "Set"	2017/1/9 9:42
3276	Albert Petrick	225	1 9.4.2.218.3	85	6	T	Y	85.06 9.4.2.218.3		Add clarity and call out bit positions in Table 9-262aa for subfield "Beamformee STS for > 80 MHz" corresponding to those bit positions in Figure 9-589cl. Missing period at the end of sentence.	Add bits B40-B42 in Definition column Change to: "B40-B42 indicates the maximum number for.....HE NDP."	2017/1/9 9:42
3277	Albert Petrick	225	1 9.4.2.218.3	83	13	T	Y	83.13 9.4.2.218.3		Add clarity and call out bit positions in Table 9-262aa for subfield "LDPC Coding In Payload" corresponding to those bit positions in Figure 9-589cl	Change text in "Definition" column to read: "B13: Indicates support of transmission....." Change text in "Encoding" column to read: "B13: Set to 1 to indicate STA.... B13: Set to 9 otherwise. "	2017/1/9 9:42
3278	Albert Petrick	225	1 9.4.2.218.2	79	22	T	Y	79.22 9.4.2.218.2		Add clarity and call out bit position in Table 9-262z for subfield "Group Addressed Multi-STA BlockAck In DL MU Support" corresponding to those bit positions in Figure 9-589ck.	Add bit "B24:" in Definition column before the word "Indicates" Add bits "B24:" in Encoding column before the word "Set"	2017/1/9 9:42
3279	Albert Petrick	225	1 28.3.12	338	44	E	Y	338.44 28.3.12	3262	Equation 28-115 brackets cutoff	Resize font of brackets and vertically center between paragraphs	2017/1/9 9:42
3280	Albert Petrick	225	1 28.1.1	212	2	E	Y	212.02 28.1.1		Period missing at end of sentence	Add period at the of sentence after "applicable"	2017/1/9 9:42
3281	Albert Petrick	225	1 9.4.2.218.3	85	13	T	Y	85.13 9.4.2.218.3		Add clarity and call out bit positions in Table 9-262aa for subfield "NSTS Total For > 80 MHz" corresponding to those bit positions in Figure 9-589cl. Missing period at the end of sentence.	Add bits B44-B45 in Definition column Change to: "B43-B45 indicates the maximum value for.....partial bandwidth."	2017/1/9 9:42
3282	Albert Petrick	225	1 9.4.2.218.3	83	16	T	Y	83.16 9.4.2.218.3		Add clarity and call out bit positions in Table 9-262 aa for subfield "HE-LTF And GI For HE PPDUs" corresponding to those bit positions in Figure 9-589cl	Change text in "Encoding column to read: "For B14 and B15: Set to 1 if supported by the STA. Set to 0 otherwise."	2017/1/9 9:42
3283	Albert Petrick	225	1 28.1.1	211	15	E	Y	211.15 28.1.1		Period missing at end of sentence	Add period at the of sentence after "UL OFDMA)"	2017/1/9 9:42
3284	Albert Petrick	225	1 9.4.2.218.2	79	28	T	Y	79.28 9.4.2.218.2		Add clarity and call out bit position in Table 9-262z for subfield "OMI A-Control Support" corresponding to those bit positions in Figure 9-589ck.	Add bit "B25:" in Definition column before the word "Indicates" Add bits "B25:" in Encoding column before the word "If"	2017/1/9 9:42
3285	Albert Petrick	225	1 9.4.2.218.3	85	20	T	Y	85.20 9.4.2.218.3		Add clarity and call out bit positions in Table 9-262aa for subfield "Number Of Sounding Dimensions For < 80 MHz" corresponding to those bit positions in Figure 9-589cl. Missing period at the end of sentence.	Add bits B46-B48 in Definition column Change to: "B46-B48 represents the beamformer's capability.....for an HE NDP."	2017/1/9 9:42
3286	Albert Petrick	225	1 9.4.2.218.3	82	15	E	Y	82.15 9.4.2.218.3		Table 9-262aa, "Definition column" missing period at end of sentence	Fix. Add period after 2.4 GHz.	2017/1/9 9:42
3287	Albert Petrick	225	1		2	T	Y			.11ax D1.0 makes reference to IEEE P802.11REVmc-D8.0, which is essentially IEEE P802.11-2016 (the new rollup baseline standard) and soon to be published in 2017. Once it is published, P802.11REVmc-D8.0 will be removed from the IEEE 802.11 working group members area on the website and will not be available in public domain on the IEEE 802.11 work group document server for public use. All references in .11ax D1.0 to clauses in the baseline standard should be made to IEEE P802.11-2016 and not to IEEE P802.11REVmc-D8.0.	Remove IEEE P802.11REVmc(TM)/D8.0 and replace with IEEE P802.11-2016	2017/1/9 9:42
3288	Albert Petrick	225	1			G	Y			The title of the column headers in ALL of the tables need to be formatted; 1) center text in title. 2) lock 1st row of table to continue on next page.	Fix and format ALL tables headers (1st row) and enable 1st row to roll-over on next page when tables don't fit on current page.	2017/1/9 9:42
3289	Albert Petrick	225	1			G	Y			Throughout .11ax D1.0 there are references where some bits have hyphens and others do not e.g., 1 bit, and 1-bit . The text, Tables and Figures should be consistent using "hyphens" as used in IEEE 802.11-2016.	Fix. Include hyphens in text, Tables and Figures similar to the format utilized in baseline IEEE 802.11-2016	2017/1/9 9:42
3290	Albert Petrick	225	1			G	Y			Throughout .11ax D1.0 cross-reference links in text to tables, figures, equations, clauses and sub-clauses either broken, and non-existent.	Fix cross-reference links in text, tables, figures, equations and external links	2017/1/9 9:42

3291	Albert Petrick	225	1			G	Y			Throughout .11ax D1.0 the alignment of the terms in equations and spacing between paragraph text and equations need to be centered on the pages.	Fix spacing of terms in equations and space of text between equations.	2017/1/9 9:42
3292	Albert Petrick	225	1 3.4	7	13	E	Y	7.13 3.4		hyphen error -- hyphen between the words frequency and division "Orthogonal frequency-division multiple access" The use of hyphens should be consistent with what is used in IEEE 802.11-2016.	Remove hyphen after "frequency"	2017/1/9 9:42
3293	Albert Petrick	225	1 4.3.14a	9	33	T	Y	9.33 4.3.14a		"RU" not defined	Add definition for "RU" in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
3294	Albert Petrick	225	1 6.3.4.2.2	11		E	Y	11.00 6.3.4.2.2		primitive parameter misaligned	Fix alignment	2017/1/9 9:42
3295	Albert Petrick	225	1 6.3.7.4.2	12	25	E	Y	12.25 6.3.7.4.2		primitive parameter misaligned	Fix alignment	2017/1/9 9:42
3296	Albert Petrick	225	1 27.4.2	158	30	E	Y	158.30 27.4.2		multi-TID not capitalized	change "multi-TID" to "Multi-TID"	2017/1/9 9:42
3297	Albert Petrick	225	1 27.4.2	158	51	E	Y	158.51 27.4.2		multi-TID not capitalized	change "multi-TID" to "Multi-TID"	2017/1/9 9:42
3298	Albert Petrick	225	1 27.4.4	160	160	E	Y	161.60 27.4.4		multi-TID not capitalized	change "multi-TID" to "Multi-TID"	2017/1/9 9:42
3299	Albert Petrick	225	1 27.4.4.1	160	45	E	Y	160.45 27.4.4.1		multi-TID not capitalized	change "multi-TID" to "Multi-TID"	2017/1/9 9:42
3300	Albert Petrick	225	1			E	Y			multi-TID not capitalized	Make global change in .11ax D1.0: change "multi-TID to Multi-TID"	2017/1/9 9:42
3301	Albert Petrick	225	1 25.5.2.3	167	69	T	Y	167.69 25.5.2.3		"TBD" is a placeholder and not allowed in drafts in WG letter ballots as per IEEE 802.11 WG policies.	Remove TBD	2017/1/9 9:42
3302	Albert Petrick	225	1 27.3.3.4	154	39	T	Y	154.39 27.3.3.4		The "L3 Frag BA Request frame", "L3 Frag BA Response" and "BA Response frame" are not defined and ambiguous. There are no figures, tables, text or timing flow between Requests and Responses.	Define "L3 Frag BA Request frame" and "L3 Frag BA Response", BA Response frames, add figures, tables and describe a procedure for L3 dynamic fragmentation.	2017/1/9 9:42
3303	Albert Petrick	225	1 27.6.2	177	19	T	Y	177.19 27.6.2		Text in sentence references table "Table YY-1". Table doesn't exist in .11ax D1.0 or in IEEE 802.11-2016	Fix reference and add table or delete sentence referencing table	2017/1/9 9:42
3304	Albert Petrick	225	1 27.6.2	177	43	T	Y	177.43 27.6.2		Figure 27-3 Example of sounding protocol not correct.	Re-draw diagram. Fix sounding protocol diagram to illustrate alignment of SIFS timing as beamformee from beamformer.	2017/1/9 9:42
3305	Albert Petrick	225	1 27.6.2	178	6	T	Y	178.06 27.6.2		Figure 27-4 Example of sounding protocol not correct.	Re-draw diagram. Fix sounding protocol diagram to illustrate alignment of SIFS timing, identify the beamformee "1 thru n" and spell out the word "TRIG" in UL TRIG PPDU	2017/1/9 9:42
3306	Albert Petrick	225	1 27.6.2	178	7	T	Y	178.07 27.6.2		"CSI" in Figure 27-4 is not defined or referenced in text	Expand on the term "CSI" and describe this term in the text with relationship with HE beamformee.	2017/1/9 9:42
3307	Albert Petrick	225	1 27.16.1	204	56	E	Y	204.56 27.16.1		Sentence misaligned spacing	Left just "A STA fro which do11HEOptionImplemented..... "	2017/1/9 9:42
3308	Albert Petrick	225	1 28.3.14.3	342	47	E	Y	342.47 28.3.14.3		Period missing at end of sentence	Add period at the end of sentence.	2017/1/9 9:42
3309	Albert Petrick	225	1 28.3.17.6.4	349	16	E	Y	349.16 28.3.17.6.4		Sentence misaligned spacing	left justify "issue a PHY-CCA.inidication(BUSY, {secondary40}),"	2017/1/9 9:42
3310	Albert Petrick	225	1 28.3.17.6.4	349	44	E	Y	349.44 28.3.17.6.4		Sentence misaligned spacing	left justify "PHYCCA. Indication(BUSY, {primary}),.....and"	2017/1/9 9:42
3311	Albert Petrick	225	1 28.3.17.6.4	349	27	E	Y	349.27 28.3.17.6.4		Sentence misaligned spacing	left justify "present and on of the ....or"	2017/1/9 9:42
3312	Albert Petrick	225	1 28.3.17.6.4	349	46	E	Y	349.46 28.3.17.6.4		Sentence misaligned spacing	Change "BUSY, {secondary40}}" to "BUSY,{secondary40}}"	2017/1/9 9:42
3313	Albert Petrick	225	1 28.3.17.6.4	349	21	E	Y	349.21 28.3.17.6.4		Sentence misaligned spacing	Change "max(-72 dBm, OBSS_PD)" to " "max (-72 dBm, OBSS_PD)"	2017/1/9 9:42
3314	Albert Petrick	225	1 28.3.18.2	353	62	T	Y	353.62 28.3.18.2		Spectral flatness procedure needs more clarity	Delete the sentence: "Demodulate the HE PPDUs .....procedure:" and place with the following sentence. " The HE PPDUs shall be demodulated using the following (or equivalent) procedure:"	2017/1/9 9:42
3315	Albert Petrick	225	1 28.4.3	372	48	T	Y	372.48 28.4.3		Table 28-46 - HE PHY characteristics lists the aPSDUMaxLength set to 6,500,631 octets. It's not clear in the table or text what assumptions were made and how the length is calculated.	Add a NOTE at the bottom of Table 28-46 stating the assumptions and the calculation (Eq.) for determining the PSDU maximum. E.g., 1024-QAM 5/6 rate coding rate, LDPC, 160 MHz channel bandwidth, 8 spatial streams, LDPC.	2017/1/9 9:42
3316	Albert Petrick	225	1 28.3.10.7.2	277	58	E	N	277.58 28.3.10.7.2		LDPC misspelled in Table 28-17	Change "LPDC" to "LDPC" in Bandwidth column of Table 28-17	2017/1/9 9:42
3317	Albert Petrick	225	1 28.3.6.4	250	43	T	Y	250.43 28.3.6.4		Four extra tones insertion; mapping not correct for Construction of L-SIG.	In f) Change "{-1, -1, -1, 1}" to {-1, -1, 1, 1}"	2017/1/9 9:42

3318	Albert Petrick	225	1 28.3.6.5	251	11	T	Y	251.11 28.3.6.5		Four extra tones insertion; mapping not correct for Construction of RL-SIG	In f) Change "{-1, -1, -1, 1}" to {-1, -1, 1, 1}"	2017/1/9 9:42
3319	Albert Petrick	225	1 9.3.1.23	45	11	T	Y	45.11 9.3.1.23		"Doppler subfield indicates a high doppler mode of transmission." Definition, clarification and technical details are not in .11axD1.0 with respect to the range of doppler spread and operating conditions triggering "high doppler mode". In Table 9-262aa pg. 83 "doppler procedure" defines 2-bits and references for "doppler" and makes reference to STAs using a "Doppler Procedure" for HE PPDUs transmissions. Critical technical details on the doppler procedure are lacking in .11axD1.0.	Either remove all references to Doppler in .11axD1.0 (text and in Table 9-262aa) including STA doppler support or add detailed technical content on Doppler Procedure for HE PPDU transmissions in support of clause of 9.3.1.23 and Table 9-262aa.	2017/1/9 9:42
3320	Albert Petrick	225	1 9.4.2.218.3	83	41	T	Y	83.41 9.4.2.218.3		Table 9-262aa defines HE-PHY Capabilities Information field. Doppler subfield makes reference to Doppler Procedure. There is no text on "Doppler procedure" procedure needs to be defined.	Add technical detail content or remove "Doppler subfield from Table 262aa	2017/1/9 9:42
3321	Albert Petrick	225	1 9.3.1.23	45	11	T	Y	45.11 9.3.1.23		Doppler is not defined in clause 3.4 of IEEE 802.11-2016 (802.11 REVmc D8.0)	Add "Doppler" definition in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
3322	Albert Petrick	225	1 27.3.3.1	153	19	E	Y	153.19 27.3.3.1		Extra period	Remove extra period from the end of the sentence.	2017/1/9 9:42
3323	Albert Petrick	225	1 27.3.4.1	155	44	E	Y	155.44 27.3.4.1		Paragraph misaligned	left justify paragraph	2017/1/9 9:42
3324	Albert Petrick	225	1 27.5.2.5	171	43	E	Y	171.43 27.5.2.5		Extra parenthesis	Remove extra parenthesis at the end of sentence.	2017/1/9 9:42
3325	Albert Petrick	225	1 27.5.2.5	171	40	T	Y	171.40 27.5.2.5		"ACs (#2190, 2191)" are remaining CID placeholders and not part of draft .11ax D1.0	Remove references to CIDs #2190, and 2191	2017/1/9 9:42
3326	Albert Petrick	225	1 27.5.2.5	171	41	E	Y	171.41 27.5.2.5		Table number missing for Table 9-XX (Delta TID subfield encoding).	Add Table number 9-18c	2017/1/9 9:42
3327	Albert Petrick	225	1 9.3.1.22	42	7	E	Y	42.07 9.3.1.22		Figure 9-52d Common Info field B20-B21 has a spelling error for "GIAnd LTF Type"	Change "GIAnd" to "GI And"	2017/1/9 9:42
3328	Albert Petrick	225	1 9.4.2.218.1	76	2	E	Y	76.02 9.4.2.218.1		Extra period	Remove extra period from the end of sentence.	2017/1/9 9:42
3329	Albert Petrick	225	1 9.4.2.218.5	89	38	E	Y	89.38 9.4.2.218.5		Extra period	Remove extra period from the end of sentence.	2017/1/9 9:42
3330	Albert Petrick	225	1 9.4.2.218.5	89	13	E	Y	89.13 9.4.2.218.5		Bit positions B0 - Bn not labeled on Figure 9-589cp--PPE Thresholds Info field format	Update Figure 9-589cp with Bit positions B0-Bn for groups of 3 bits per PPET16 and PPET8 subfields.	2017/1/9 9:42
3331	Albert Petrick	225	1 10.3.2.8a.1	116	3	E	Y	116.03 10.3.2.8a.1		Extra period	Remove extra period from the end of sentence.	2017/1/9 9:42
3332	Albert Petrick	225	1 27.4.4.5	162	26	E	Y	162.26 27.4.4.5		Extra period	Remove extra period at the end of sentence after the word "context"	2017/1/9 9:42
3333	Albert Petrick	225	1 27.5.2.2.1	164	46	E	Y	164.46 27.5.2.2.1		Extra period	Remove extra period at the end of sentence after the word "allocation)"	2017/1/9 9:42
3334	Albert Petrick	225	1		2	T	Y		3287	.11ax D1.0 makes reference to IEEE P802.11REVmc-D8.0, which is essentially IEEE P802.11-2016 (the new rollup baseline standard) and soon to be published in 2017. Once it is published, P802.11REVmc-D8.0 will be removed from the IEEE 802.11 working group members area on the website and will not be available in public domain on the IEEE 802.11 work group document server for public use. All references in .11ax D1.0 to clauses in the baseline standard should be made to IEEE P802.11-2016 and not to IEEE P802.11REVmc-D8.0.	Remove IEEE P802.11REVmc(TM)/D8.0 and replace with IEEE P802.11-2016	2017/1/9 9:42
3335	Albert Petrick	225	1 27.5.2.2.1	164	53	E	Y	164.53 27.5.2.2.1		Period missing at end of sentence	Add period at end of sentence after the word "S-MPDUs))"	2017/1/9 9:42
3336	Albert Petrick	225	1			G	Y		3288	The title of the column headers in ALL of the tables need to be formatted; 1) center text in title. 2) lock 1st row of table to continue on next page.	Fix and format ALL tables headers (1st row) and enable 1st row to roll-over on next page when tables don't fit on current page.	2017/1/9 9:42
3337	Albert Petrick	225	1			G	Y		3289	Throughout .11ax D1.0 there are references where some bits have hyphens and others do not e.g., 1 bit, and 1-bit . The text, Tables and Figures should be consistent using "hyphens" as used in IEEE 802.11-2016.	Fix. Include hyphens in text, Tables and Figures similar to the format utilized in baseline IEEE 802.11-2016	2017/1/9 9:42
3338	Albert Petrick	225	1 27.5.2.2.1	164	56	E	Y	164.56 27.5.2.2.1		Period missing at end of sentence	Add period at end of sentence after the word "behavior))"	2017/1/9 9:42

3339 Albert Petrick	225	1			G	Y		3290	Throughout .11ax D1.0 cross-reference links in text to tables, figures, equations, clauses and sub-clauses either broken, and non-existent.	Fix cross-reference links in text, tables, figures, equations and external links	2017/1/9 9:42
3340 Albert Petrick	225	1			G	Y		3291	Throughout .11ax D1.0 the alignment of the terms in equations and spacing between paragraph text and equations need to be centered on the pages.	Fix spacing of terms in equations and space of text between equations.	2017/1/9 9:42
3341 Albert Petrick	225	1 3.4	7	13	E	Y	7.13 3.4	3292	hyphen error -- hyphen between the words frequency and division "Orthogonal frequency-division multiple access" The use of hyphens should be consistent with what is used in IEEE 802.11-2016.	Remove hyphen after "frequency"	2017/1/9 9:42
3342 Albert Petrick	225	1 27.5.2.2.1	164	59	E	Y	164.59 27.5.2.2.1		Period missing at end of sentence	Add period at end of sentence after the word "TIDs))"	2017/1/9 9:42
3343 Albert Petrick	225	1 4.3.14a	9	33	T	Y	9.33 4.3.14a	3293	"RU" not defined	Add definition for "RU" in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
3344 Albert Petrick	225	1 6.3.4.2.2	11		E	Y	11.00 6.3.4.2.2	3294	primitive parameter misaligned	Fix alignment	2017/1/9 9:42
3345 Albert Petrick	225	1 27.5.2.3	170	15	E	Y	170.15 27.5.2.3		Extra period	Add period at end of sentence after the word "PPDU"	2017/1/9 9:42
3346 Albert Petrick	225	1 6.3.7.4.2	12	25	E	Y	12.25 6.3.7.4.2	3295	primitive parameter misaligned	Fix alignment	2017/1/9 9:42
3347 Albert Petrick	225	1 27.4.2	158	30	E	Y	158.30 27.4.2	3296	multi-TID not capitalized	change "multi-TID" to "Multi-TID"	2017/1/9 9:42
3348 Albert Petrick	225	1 28.3.3.2	229	31	E	Y	229.31 28.3.3.2		Extra period	Add period at end of sentence after the word "width)"	2017/1/9 9:42
3349 Albert Petrick	225	1 9.4.2.218.2	77	55	E	Y	77.55 9.4.2.218.2		Table 9-262z misaligned Equation in "Encoding" column. "OfF" misspelled	Fix alignment of Eq Nmax = 2Maximum Number OFF-MPDUs. Change "OfF" to "Off". Increase line spacing between sentences for aligning equation.	2017/1/9 9:42
3350 Albert Petrick	225	1 10.13.2	128	42	T	Y	128.42 10.13.2	3241	HE Capabilities Element clause number incorrect	Change clause number to "9.4.2.218"	2017/1/9 9:42
3351 Albert Petrick	225	1 27.4.2	158	51	E	Y	158.51 27.4.2	3297	multi-TID not capitalized	change "multi-TID" to "Multi-TID"	2017/1/9 9:42
3352 Albert Petrick	225	1 26.6.2	178	63	T	Y	178.63 26.6.2	3249	HE Capabilities Element clause number incorrect	Change clause number to "9.4.2.218"	2017/1/9 9:42
3353 Albert Petrick	225	1 27.4.4	160	160	E	Y	161.60 27.4.4	3298	multi-TID not capitalized	change "multi-TID" to "Multi-TID"	2017/1/9 9:42
3354 Albert Petrick	225	1 27.15.4.1	203	18	T	Y	203.18 27.15.4.1	3256	HE Capabilities Element clause number incorrect	Change clause number to "9.4.2.218"	2017/1/9 9:42
3355 Albert Petrick	225	1 27.4.4.1	160	45	E	Y	160.45 27.4.4.1	3299	multi-TID not capitalized	change "multi-TID" to "Multi-TID"	2017/1/9 9:42
3356 Albert Petrick	225	1 9.4.2.1	67	16	T	Y	67.16 9.4.2.1	3260	HE Capabilities Element clause number incorrect in Table 9-77 Element IDs	Change clause number to "9.4.2.218"	2017/1/9 9:42
3357 Albert Petrick	225	1 9.4.2.1	67	20	T	Y	67.20 9.4.2.1	3263	The HE Operation Element clause number is incorrect in Table 9-77 Element IDs.	Change clause number to "9.4.2.219"	2017/1/9 9:42
3358 Albert Petrick	225	1			E	Y		3300	multi-TID not capitalized	Make global change in .11ax D1.0: change "multi-TID to Multi-TID"	2017/1/9 9:42
3359 Albert Petrick	225	1 28.3.14.3	342	53	T	Y	342.53 28.3.14.3		CCDF not defined	Change "CCDF" to "complementary cumulative distribution function (CCDF)". Add definition for CCDF in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
3360 Albert Petrick	225	1 25.5.2.3	167	69	T	Y	167.69 25.5.2.3	3301	"TBD" is a placeholder and not allowed in drafts in WG letter ballots as per IEEE 802.11 WG policies.	Remove TBD	2017/1/9 9:42
3361 Albert Petrick	225	1 9.3.1.20	40	1	E	Y	40.01 9.3.1.20		Clause title should not be underlined.	Remove underline; Change to "VHT/HE NDP"	2017/1/9 9:42
3362 Albert Petrick	225	1 27.3.3.4	154	39	T	Y	154.39 27.3.3.4	3302	The "L3 Frag BA Request frame", "L3 Frag BA Response" and "BA Response frame" are not defined and ambiguous. There are no figures, tables, text or timing flow between Requests and Responses.	Define "L3 Frag BA Request frame" and "L3 Frag BA Response", BA Response frames, add figures, tables and describe a procedure for L3 dynamic fragmentation.	2017/1/9 9:42
3363 Albert Petrick	225	1 9.3.1.23	41	47	E	Y	41.47 9.3.1.23		Parenthesis not needed in Figure 9-52c-Trigger frame	Remove parenthesis - Change "(RA)" to "RA" in Figure 9-52c-Trigger frame	2017/1/9 9:42
3364 Albert Petrick	225	1 27.6.2	177	19	T	Y	177.19 27.6.2	3303	Text in sentence references table "Table YY-1". Table doesn't exist in .11ax D1.0 or in IEEE 802.11-2016	Fix reference and add table or delete sentence referencing table	2017/1/9 9:42
3365 Albert Petrick	225	1 9.3.1.23	41	59	E	Y	41.59 9.3.1.23		Add space between sentences	Add space at end of sentence after the word "STA."	2017/1/9 9:42
3366 Albert Petrick	225	1 27.6.2	177	43	T	Y	177.43 27.6.2	3304	Figure 27-3 Example of sounding protocol not correct.	Re-draw diagram. Fix sounding protocol diagram to illustrate alignment of SIFS timing as beamformee from beamformer.	2017/1/9 9:42
3367 Albert Petrick	225	1 27.6.2	178	6	T	Y	178.06 27.6.2	3305	Figure 27-4 Example of sounding protocol not correct.	Re-draw diagram. Fix sounding protocol diagram to illustrate alignment of SIFS timing, identify the beamformee "1 thru n" and spell out the word "TRIG" in UL TRIG PPDU	2017/1/9 9:42

3368	Albert Petrick	225	1 27.6.2	178	7	T	Y	178.07 27.6.2	3306	"CSI" in Figure 27-4 is not defined or referenced in text	Expand on the term "CSI" and describe this term in the text with relationship with HE beamformee.	2017/1/9 9:42
3369	Albert Petrick	225	1 9.3.1.23	41	61	E	Y	41.61 9.3.1.23		Add space between sentences	Add space at end of sentence after the word "address."	2017/1/9 9:42
3370	Albert Petrick	225	1 27.16.1	204	56	E	Y	204.56 27.16.1	3307	Sentence misaligned spacing	Left just "A STA fro which do11HEOptionImplemented..... "	2017/1/9 9:42
3371	Albert Petrick	225	1 9.3.3.6	53	36	E	Y	53.36 9.3.3.6		spelling hyphen error in Table 9-30	In Table 9-30 remove hyphen change "pre-sent" to "present"	2017/1/9 9:42
3372	Albert Petrick	225	1 28.3.14.3	342	47	E	Y	342.47 28.3.14.3	3308	Period missing at end of sentence	Add period at the end of sentence.	2017/1/9 9:42
3373	Albert Petrick	225	1 9.3.3.8	54	30	E	Y	54.30 9.3.3.8		spelling hyphen error in Table 9-32	In Table 9-32 remove hyphen change "pre-sent" to "present"	2017/1/9 9:42
3374	Albert Petrick	225	1 9.3.3.11	55	26	E	Y	55.26 9.3.3.11		spelling hyphen error in Table 9-34	In Table 9-34 remove hyphen change "pre-sent" to "present"	2017/1/9 9:42
3375	Albert Petrick	225	1 9.2.4.1.10	20	5	T	Y	20.05 9.2.4.1.10		"HCT/Order subfield" naming should be consistent when referenced in text. It's referenced as "HTC/Order field"	Change to "HCT/Order subfield" on lines 5 and 7	2017/1/9 9:42
3376	Albert Petrick	225	1 28.3.17.6.4	349	16	E	Y	349.16 28.3.17.6.4	3309	Sentence misaligned spacing	left justify "issue a PHY-CCA.inidication(BUSY, {secondary40}),"	2017/1/9 9:42
3377	Albert Petrick	225	1 9.2.4.6.4.1	23	37	E	Y	23.37 9.2.4.6.4.1		Reverse Direction Protocol (RDP) in Table 9-18a is missing reference "subclause reference" in the Content of the Control Information subfield.	Add the following clause reference: "See 9.2.4.6.4.8 (Reverse direction protocol (RDP))"	2017/1/9 9:42
3378	Albert Petrick	225	1 9.2.4.6.4.1	22	59	T	Y	22.59 9.2.4.6.4.1		In clause A-Control 9.2.6.4 the text needs to clarify the bit length in the Control ID subfields, describe the sequence ordering and state how many Control IDs are defined and reserved. The text should flow with Table 9-15b, and Table 9-18a.	Add the following: The A-Control subfield contains a sequence of one or more Control subfields. The format of each Control subfield is (DELETE defined) [ADD TEXT: shown] in Figure 9-15b (Control subfield format). [DELETE SENTENCE: The Control subfield with Control ID subfield equal to 0, if present, is the first subfield of the sequence.] The Control ID subfield [ADD TEXT: as shown in Figure 9-15b (Control subfield format) is 4-bits in length and] indicates the type of information carried in the Control Information subfield. The [ADD TEXT: bit] length of the Control Information subfield is fixed for each value of the Control ID subfield that is not reserved. The values of the Control ID subfield and the associated length of the Control Information subfield are defined in Table 9-18a (Control	2017/1/9 9:42
3379	Albert Petrick	225	1 28.3.17.6.4	349	44	E	Y	349.44 28.3.17.6.4	3310	Sentence misaligned spacing	left justify "PHYCCA. Indication(BUSY, {primary}),.....and"	2017/1/9 9:42
3380	Albert Petrick	225	1 9.2.4.6.4.2	24	20	E	Y	24.20 9.2.4.6.4.2		Editorial formatting error with Target receiver power, TRSSI,	Remove comma "," before TRSSI and change ", TRSSI" to "(TRSSI)"	2017/1/9 9:42
3381	Albert Petrick	225	1 9.2.4.6.4.2	23	59	T	Y	23.59 9.2.4.6.4.2		Provide more clarity: UL PPDU subfield. The text should reference the "5-bits" for UL PPDU Length field in Figure 9-15c.	Insert text "is 5-bits (B0-B4) that" after the word subfield.	2017/1/9 9:42
3382	Albert Petrick	225	1 9.2.4.6.4.6	27	39	T	Y	27.39 9.2.4.6.4.6		No reference to the bits in the Reserve subfield In 9.2.4.6.4.6.	Add the following sentence "Bits (B6-B7) are reserved." after the sentence on line 39.	2017/1/9 9:42
3383	Albert Petrick	225	1 28.3.17.6.4	349	27	E	Y	349.27 28.3.17.6.4	3311	Sentence misaligned spacing	left justify "present and on of the .....or"	2017/1/9 9:42
3384	Albert Petrick	225	1 9.2.4.6.4.8	28	60	T	Y	28.60 9.2.4.6.4.8		The bits in Table 9-15i should be called in the text for clarification.	Add the following underlined text. The Control Information 8-bit subfield for the RDP Trigger frame is shown in Figure 9-15i (Control Information subfield format when the Control ID subfield is 6), 6-bits (B2-B7) are reserved. The AC Constraint subfield bit (B0) of the RDP field indicates whether the mapped AC of an RD Data frame is constrained to a single AC, and is defined in Table 9-10 (AC Constraint subfield values), except that if B0 equals a value of 1 indicates that the response from an HE STA contains Data frames from the same AC or higher AC as defined in 10.28.4 (Rules for RD responder). The RDG/More PPDU subfield bit (B1) is defined in Table 9-11 (RDG/More PPDU subfield values).	2017/1/9 9:42

3385	Albert Petrick	225	1 9.3.1.24	41	23	T	Y	41.23 9.3.1.24		CQI acronym not defined in Table 9-25a	Add definition for CQI in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
3386	Albert Petrick	225	1 28.3.17.6.4	349	46	E	Y	349.46 28.3.17.6.4	3312	Sentence misaligned spacing	Change "BUSY, {secondary40})" to "BUSY,{secondary40})"	2017/1/9 9:42
3387	Albert Petrick	225	1 9.4.2.218.3	82	12	E	Y	82.12 9.4.2.218.3		Missing period after sentences in Table 9-262aa	Add "periods" after each sentence in the Definition and Encoding columns in Table 9-262aa	2017/1/9 9:42
3388	Albert Petrick	225	1 9.4.2.218.5	89	36	T	Y	89.36 9.4.2.218.5		PPET, PPET8 and PPET16 acronym not defined	Add definitions for PPET, PPET8 and PPET16 in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
3389	Albert Petrick	225	1 9.4.2.221	94	56	T	Y	94.56 9.4.2.221	3244	MUEDCATimer not defined	Add definition for MUEDCATimer in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
3390	Albert Petrick	225	1 28.3.17.6.4	349	21	E	Y	349.21 28.3.17.6.4	3313	Sentence misaligned spacing	Change "max(-72 dBm, OBSS_PD)" to " "max (-72 dBm, OBSS_PD)"	2017/1/9 9:42
3391	Albert Petrick	225	1 27.16.1	204	56	E	Y	204.56 27.16.1	3246	Sentence center justified should be left justified	Left justify sentence; "A STA for which dot11HEOptionImplemented is true shall set dot11VeryHighThroughputOptionImplemented or dot11HighThroughputOptionImplemented to true."	2017/1/9 9:42
3392	Albert Petrick	225	1 28.3.18.2	353	62	T	Y	353.62 28.3.18.2	3314	Spectral flatness procedure needs more clarity	Delete the sentence: "Demodulate the HE PPDUs .....procedure:" and place with the following sentence. " The HE PPDUs shall be demodulated using the following (or equivalent) procedure:"	2017/1/9 9:42
3393	Albert Petrick	225	1 28.3.11.5	317	32	T	Y	317.32 28.3.11.5	3251	BCC acronym not defined	Add definition for "BCC = binary convolutional code" in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
3394	Albert Petrick	225	1 28.4.3	372	48	T	Y	372.48 28.4.3	3315	Table 28-46 - HE PHY characteristics lists the aPSDUMaxLength set to 6,500,631 octets. It's not clear in the table or text what assumptions were made and how the length is calculated.	Add a NOTE at the bottom of Table 28-46 stating the assumptions and the calculation (Eq.) for determining the PSDU maximum. E.g., 1024-QAM 5/6 rate coding rate, LDPC, 160 MHz channel bandwidth, 8 spatial streams, LDPC.	2017/1/9 9:42
3395	Albert Petrick	225	1 28.3.11.5	317	33	T	Y	317.33 28.3.11.5	3252	LDPC acronym not defined	Add definition for "LDPC = low density parity check" in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
3396	Albert Petrick	225	1 28.3.10.7.2	277	58	E	N	277.58 28.3.10.7.2	3316	LDPC misspelled in Table 28-17	Change "LPDC" to "LDPC" in Bandwidth column of Table 28-17	2017/1/9 9:42
3397	Albert Petrick	225	1 28.3.6.4	250	43	T	Y	250.43 28.3.6.4	3317	Four extra tones insertion; mapping not correct for Construction of L-SIG.	In f) Change "{-1, -1, -1, 1}" to {-1, -1, 1, 1}"	2017/1/9 9:42
3398	Albert Petrick	225	1 9.3.1.23	42	7	E	Y	42.07 9.3.1.23	3255	Space missing between words in GIAnd LTF Type subfield of Figure 9-52	Add character space between the letters "IA" in "GIAnd LTF Type". Should read as "GI And LTF Type"	2017/1/9 9:42
3399	Albert Petrick	225	1 28.3.6.5	251	11	T	Y	251.11 28.3.6.5	3318	Four extra tones insertion; mapping not correct for Construction of RL-SIG	In f) Change "{-1, -1, -1, 1}" to {-1, -1, 1, 1}"	2017/1/9 9:42
3400	Albert Petrick	225	1 9.4.1.62	56	15	E	Y	56.15 9.4.1.62	3259	Table 9-121a bit positions misaligned	Fix bit alignment with each subfield and resize Figure 9-121a to fit center of page.	2017/1/9 9:42
3401	Albert Petrick	225	1 9.3.1.23	45	11	T	Y	45.11 9.3.1.23	3319	"Doppler subfield indicates a high doppler mode of transmission." Definition, clarification and technical details are not in ,11axD1.0 with respect to the range of doppler spread and operating conditions triggering "high doppler mode". In Table 9-262aa pg. 83 "doppler procedure" defines 2-bits and references for "doppler" and makes reference to STAs using a "Doppler Procedure" for HE PPDUs transmissions. Critical technical details on the doppler procedure are lacking in .11axD1.0.	Either remove all references to Doppler in .11axD1.0 (text and in Table 9-262aa) including STA doppler support or add detailed technical content on Doppler Procedure for HE PPDU transmissions in support of clause of 9.3.1.23 and Table 9-262aa.	2017/1/9 9:42
3402	Albert Petrick	225	1 9.4.1.62	56	4	T	Y	56.04 9.4.1.62	3261	The text in Clause 9.4.1.62 HE MIMO Control field) needs clarification. The text should call out number of bits and range of bits for Figure 9-121a.	Add the following underlined text (not underlined text) . The HE MIMO Control field is included in every HE Compressed Beamforming frame (see 9.4.1.63 (HE Compressed Beamforming Report field)). The HE MIMO Control field is 40-bits (B0-B39) and is defined in Figure 9-121a (HE MIMO Control field). The subfields and bit assignments (B0-B39) are defined and described in Table 9-7a (HE MIMO Control field encoding).	2017/1/9 9:42

3403	Albert Petrick	225	1 9.4.2.218.3	83	41	T	Y	83.41 9.4.2.218.3	3320	Table 9-262aa defines HE-PHY Capabilities Information field. Doppler subfield makes reference to Doppler Procedure. There is no text on "Doppler procedure" procedure needs to be defined.	Add technical detail content or remove "Doppler subfield from Table 262aa	2017/1/9 9:42
3404	Albert Petrick	225	1 9.4.1.62	56	30	T	Y	56.30 9.4.1.62		Add clarity. Call out bit positions in Table 9-76a for subfield "Nc Index " corresponding to those bit positions in Figure 9-121a HE MIMO Control field	Add underlined text (without the underline) in "Description" column to read: "Indicates the number of columns, Nc, in the compressed beamforming feed-back matrix minus 1: For 3-bits (B0-B2): Set to 0 for Nc = 1 Set to 1 for Nc = 2 ... Set to 7 for Nc = 8"	2017/1/9 9:42
3405	Albert Petrick	225	1 9.3.1.23	45	11	T	Y	45.11 9.3.1.23	3321	Doppler is not defined in clause 3.4 of IEEE 802.11-2016 (802.11 REVmc D8.0)	Add "Doppler" definition in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
3406	Albert Petrick	225	1 9.4.1.62	56	38	T	Y	56.38 9.4.1.62		Add clarity. Call out bit positions in Table 9-76a for subfield "Nr Index" corresponding to those bit positions in Figure 9-121a HE MIMO Control field	Add underlined text in "Description" column to read: "Indicates the number of rows, Nr, in the compressed beamforming feed-back matrix minus 1: For 3-bits (B3-B5): Set to 0 for Nr = 1 Set to 1 for Nr = 2 ... Set to 7 for Nr = 8"	2017/1/9 9:42
3407	Albert Petrick	225	1 27.3.3.1	153	19	E	Y	153.19 27.3.3.1	3322	Extra period	Remove extra period from the end of the sentence.	2017/1/9 9:42
3408	Albert Petrick	225	1 9.4.1.62	56	45	T	Y	56.45 9.4.1.62		Add clarity. Call out bit positions in Table 9-76a for subfield "BW" corresponding to those bit positions in Figure 9-121a HE MIMO Control field	Add underlined text (without the underline) in "Description" column to read: "Indicates the channel width used to determine the starting and ending subcarrier indexes when interpreting the RU Start Index and RU End Index subfields. For 2-bits (B6-B7): Set to 0 for 20 MHz Set to 1 for 40 MHz Set to 2 for 80 MHz Set to 3 for 160 MHz and 80+80 MHz"	2017/1/9 9:42
3409	Albert Petrick	225	1 27.3.4.1	155	44	E	Y	155.44 27.3.4.1	3323	Paragraph misaligned	left justify paragraph	2017/1/9 9:42
3410	Albert Petrick	225	1 9.4.1.62	56	53	T	Y	56.53 9.4.1.62		Add clarity. Call out bit positions in Table 9-76a for subfield "Grouping" corresponding to the bit positions in Figure 9-121a HE MIMO Control field	Add underlined text (without the underline) in "Description" column to read: "Indicates the subcarrier grouping, Ng, used for the compressed beamforming feedback matrix: Set bit (B8) as follows: Set to 0 for Ng = 4 Set to 1 for Ng = 16"	2017/1/9 9:42
3411	Albert Petrick	225	1 27.5.2.5	171	43	E	Y	171.43 27.5.2.5	3324	Extra parenthesis	Remove extra parenthesis at the end of sentence.	2017/1/9 9:42
3412	Albert Petrick	225	1 9.4.1.62	57	4	T	Y	57.04 9.4.1.62		Add clarity. Call out bit positions in Table 9-76a for subfield "Codebook Information" corresponding to the bit positions in Figure 9-121a HE MIMO Control field	Add underlined text (without the underline)in "Description" column to read: "Indicates the size of codebook entries: Set bit B9 for SU and MU Feedback types as follows: If Feedback Type is ....."	2017/1/9 9:42
3413	Albert Petrick	225	1 27.5.2.5	171	40	T	Y	171.40 27.5.2.5	3325	"ACs (#2190, 2191)" are remaining CID placeholders and not part of draft .11ax D1.0	Remove references to CIDs #2190, and 2191	2017/1/9 9:42
3414	Albert Petrick	225	1 9.4.1.62	57	14	T	Y	57.14 9.4.1.62		The bit positions in Table 9-76a for subfield "Feedback Type" should correspond to those bit positions in Figure 9-121a HE MIMO Control field	Add underlined text (without the underline) in "Description" column to read: "Indicates the feedback type: For 2-bits (B10-B11) Set to 0 for SU Set to 1 for MU Set to 2 for CQI feedback 3 is reserved"	2017/1/9 9:42
3415	Albert Petrick	225	1 27.5.2.5	171	41	E	Y	171.41 27.5.2.5	3326	Table number missing for Table 9-XX (Delta TID subfield encoding).	Add Table number 9-18c	2017/1/9 9:42
3416	Albert Petrick	225	1 9.4.1.62	57	21	T	Y	57.21 9.4.1.62		Add clarity. Call out bit positions in Table 9-76a for subfield "Remaining Feedback Segments" corresponding to those bit positions in Figure 9-121a HE MIMO Control field	Add underlined text (as not underlined text) in "Description" column to read: "Indicates the number of remaining feedback segments for the associated VHT Compressed Beamforming frame: For 3-bits (B12-B14) Set to 0 for the last feedback segment of a segmented report....."	2017/1/9 9:42
3417	Albert Petrick	225	1 9.3.1.22	42	7	E	Y	42.07 9.3.1.22	3327	Figure 9-52d Common Info field B20-B21 has a spelling error for "GIAnd LTF Type"	Change "GIAnd" to "GI And"	2017/1/9 9:42

3418	Albert Petrick	225	1 9.4.1.62	57	32	T	Y	57.32 9.4.1.62		Add clarity. Call out bit positions in Table 9-76a for subfield "First Feedback Segments" corresponding to the bit positions in Figure 9-121a HE MIMO Control field	Add underlined text (without the underline) in "Description" column to read: "Set bit (B15) as follows: Set to 1 for the first feedback segment of a segmented report or the only feedback segment of an unsegmented report. Set to 0 if not the first feedback segment or if the VHT....."	2017/1/9 9:42
3419	Albert Petrick	225	1 9.4.1.62	57	40	T	Y	57.40 9.4.1.62		Add clarity. Call out bit positions in Table 9-76a for subfield "RU Start Index" corresponding to those bit positions in Figure 9-121a HE MIMO Control field	Add underlined text in "Description" column to read: "The starting RU index 7-Bits (B16-B22) indicates the first 26-tone RU for which the HE beamformer is requesting feedback."	2017/1/9 9:42
3420	Albert Petrick	225	1 9.4.2.218.1	76	2	E	Y	76.02 9.4.2.218.1	3328	Extra period	Remove extra period from the end of sentence.	2017/1/9 9:42
3421	Albert Petrick	225	1 9.4.1.62	57	43	T	Y	57.43 9.4.1.62		Add clarity. Call out bit positions in Table 9-76a for subfield "RU End Index" corresponding to those bit positions in Figure 9-121a HE MIMO Control field.	Add the following underlined text (without the underline) in "Description" column to read: "The ending RU index 7-Bits (B23-B29) indicates the first 26-tone RU for which the HE beamformer is requesting feedback."	2017/1/9 9:42
3422	Albert Petrick	225	1 9.4.1.62	57	46	T	Y	57.46 9.4.1.62		The description of the Sounding Dialog Token Number in Table 9-76a is not correct. This should be similar to the description in Table 9-66.	Delete the following text from the Description column: "The ending RU index indicates the last RU26 for which the HE beamformer is requesting feedback." Add the following text: The sounding dialog token is from the HE NDP Announcement frame soliciting feedback. "	2017/1/9 9:42
3423	Albert Petrick	225	1 9.4.1.62	57	49	T	Y	57.49 9.4.1.62		The "Reserved" subfield and description is missing in Table 9-76a. corresponding to Figure 121a.	At the end of Table 9-76a insert a new row and add the following underlined text (without the underline) "Reserved" in Subfield column, and the following text in Description column. "4-bits (B36-B39) are reserved."	2017/1/9 9:42
3424	Albert Petrick	225	1 9.4.2.218.5	89	38	E	Y	89.38 9.4.2.218.5	3329	Extra period	Remove extra period from the end of sentence.	2017/1/9 9:42
3425	Albert Petrick	225	1 9.4.1.63	58	28	T	Y	58.28 9.4.1.63		Equation (8-1) missing	Add reference and/or detailed equation (8-1)	2017/1/9 9:42
3426	Albert Petrick	225	1 9.4.2.218.5	89	13	E	Y	89.13 9.4.2.218.5	3330	Bit positions B0 - Bn not labeled on Figure 9-589cp--PPE Thresholds Info field format	Update Figure 9-589cp with Bit positions B0-Bn for groups of 3 bits per PPET16 and PPET8 subfields.	2017/1/9 9:42
3427	Albert Petrick	225	1 9.4.1.63	59	57	T	Y	59.57 9.4.1.63		In Table 9-76c, "FB" in 20, 40 and 80 MHz (S, E) FB tone labels need to be defined to follow the foregoing text.	Change "FB" to "Feedback" in column label headers: 80 MHz FB tone, 40 MHz FB tone and 20 MHz FB tone.	2017/1/9 9:42
3428	Albert Petrick	225	1 9.4.1.63	61	57	T	Y	61.57 9.4.1.63		In Table 9-76d, "FB" in 20,40, 80 MHz (S, E) FB tone labels need to be defined to follow the foregoing text.	Change "FB" to "Feedback" in column label headers: 80 MHz FB tone, 40 MHz FB tone and 20 MHz FB tone.	2017/1/9 9:42
3429	Albert Petrick	225	1 10.3.2.8a.1	116	3	E	Y	116.03 10.3.2.8a.1	3331	Extra period	Remove extra period from the end of sentence.	2017/1/9 9:42
3430	Albert Petrick	225	1 9.4.1.63	59	38	T	Y	59.38 9.4.1.63		The S-tone and E-tone description needs clarification when comparing and referencing tables 9-76c and 9-76d.	Should read as follows lines 38 to 49: The S-tone and E-tone corresponding to the possible RU indices for 20MHz, 40MHz and 80 MHz channels are listed in Table 9-76c and Table 9-76d. Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for Ng = 4 are shown in Table 9-76c, and for Ng = 16 in Table 9-76d. For 160 MHz, to determine the S-tone and E-tone, RUs 37 to 73 occupying the higher 80 MHz use the same entries in Table 9-76c for Ng = 4 and Table 9-76d Ng = 16 as RUs 0 to 36 occupying the lower 80 MHz. For 20 MHz, scidx(i), where 1 ≤ i ≤ Ns ≤ 2, includes all subcarrier indices between the S-tone and the E-tone subcarrier indices described in Table 9-76e (Feedback subcarrier indices for 20 MHz bandwidth for Ng = 4 and Ng =	2017/1/9 9:42

3431	Albert Petrick	225	1 9.4.1.63	63	21	T	Y	63.21 9.4.1.63		Calculating the AveSNRi needs more clarification.	Add the following underlined text (without the underline) and remove the strikethrough text from lines 21 through 30 as follows: The AvgSNRi in Table 9-71 (Average SNR of Space-Time Stream i subfield) is found determined by computing the SNR per subcarrier in decibels for the subcarriers in 20 MHz channel bandwidth identified in Table 9-76c (Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for Ng = 4) for Ng = 4 , and for Ng = 16 in Table 9-76d. (Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for Ng = 16) for Ng = 16, and then The computing tThe arithmetic mean is calculated of for those values. Each SNR value per subcarrier in stream i (before being averaged) corresponds to the SNR associated with the column i of the beamforming feedback matrix V determined	2017/1/9 9:42
3432	Albert Petrick	225	1 9.4.1.63	63	4	E	Y	63.04 9.4.1.63		Spelling error "indeces" in Table 9-763	Change "indeces" to "indices"	2017/1/9 9:42
3433	Albert Petrick	225	1 27.4.4.5	162	26	E	Y	162.26 27.4.4.5	3332	Extra period	Remove extra period at the end of sentence after the word "context"	2017/1/9 9:42
3434	Albert Petrick	225	1 9.4.1.64	64	48	T	Y	64.48 9.4.1.64		Missing number of bits for Delta SNR for k=scidx(Ns-1)	Add number of bits for (Ns-1) for Delta SNR	2017/1/9 9:42
3435	Albert Petrick	225	1 27.5.2.2.1	164	46	E	Y	164.46 27.5.2.2.1	3333	Extra period	Remove extra period at the end of sentence after the word "allocation)"	2017/1/9 9:42
3436	Albert Petrick	225	1 9.4.1.64	64	53	T	Y	64.53 9.4.1.64		Missing number of bits for Delta SNR for k=scidx(Ns-1)	Add number of bits for (Ns-1) for Delta SNR	2017/1/9 9:42
3437	Albert Petrick	225	1 9.4.1.64	64	13	E	Y	64.13 9.4.1.64		Remove paragraph indent	Fix paragraph alignment starting at "No padding is present....."	2017/1/9 9:42
3438	Albert Petrick	225	1 27.5.2.2.1	164	53	E	Y	164.53 27.5.2.2.1	3335	Period missing at end of sentence	Add period at end of sentence after the word "S-MPDUs))"	2017/1/9 9:42
3439	Albert Petrick	225	1 9.4.1.64	64	18	T	Y	64.18 9.4.1.64		Equation (9-2) is referenced in the text and in Table 9-76f HE MU Exclusive Beamforming Report information, and is not linked or referenced to any other documents. Equation (9-2) should be linked and referenced to its location IEEE 802.11-2016 (Rev D8.0) and clarified as a "Note" at the end of Table 9-76f.	Add note for equation 9-2 in text and/or add the following underlined text (without the underline) and reference link in Table 9-76f as a Note: "as defined in Equation (9-2) in clause 9.4.1.51 (MU Exclusive Beamforming Report Field)"	2017/1/9 9:42
3440	Albert Petrick	225	1 9.4.1.64	64	30	T	Y	64.30 9.4.1.64		Equation (9-2) reference in Table 9-76f calls out subcarrier k=scidx(0) and k=scidx(1). Equation 9-2 in IEEE 802.11-2016 (Rev D8.0) in clause 9.4.1.51 specifies k=sscidx(0) and k=sscidx(1) There appears to be an ambiguity in equation in 9-2 and with k=scidx(_)	Fix references for subcarrier k=scidx(0) and k=scidx(1) in Table 9-76f (lines 30-54) to match assumptions with equation 9-2 in clause 9.4.1.51 in IEEE 802.11-2016 (Rev D8.0)	2017/1/9 9:42
3441	Albert Petrick	225	1 28.4.2	371	36	T	Y	371.36 28.4.2		Clarify "aSignalExtension" referenced from Table 19-25	Add the following underlined text (without the underline): and is aSignalExtension (0us for 5 GHz band, 6us for 2.4 GHz band)	2017/1/9 9:42
3442	Albert Petrick	225	1 27.5.2.2.1	164	56	E	Y	164.56 27.5.2.2.1	3338	Period missing at end of sentence	Add period at end of sentence after the word "behavior))"	2017/1/9 9:42
3443	Albert Petrick	225	1 28.4.2	371	39	E	Y	371.39 28.4.2		Missing period	Add period at the end of sentence after "false"	2017/1/9 9:42
3444	Albert Petrick	225	1 9.2.5.2	32	1	E	Y	32.01 9.2.5.2		Format error - sentence alignment	Sentence format needs to be left justified.	2017/1/9 9:42
3445	Albert Petrick	225	1 27.5.2.2.1	164	59	E	Y	164.59 27.5.2.2.1	3342	Period missing at end of sentence	Add period at end of sentence after the word "TIDs))"	2017/1/9 9:42
3446	Albert Petrick	225	1 9.3.1.9.1	34	12	T	Y	34.12 9.3.1.9.1		In Figure 9-33 (BA Control Field) Bit (B5) in the Reserve sub-field is marked as deleted (strikethrough) as shown. The Reserved subfield now shows 7-bits (B6-B11). The text does not describe B5. Define B5 or correct Figure 9-33	Fix as commented	2017/1/9 9:42
3447	Albert Petrick	225	1 B.4.27.2	413	45	E	Y	413.45 B.4.27.2		Numbering / letter (5GHz) spacing issue in Table B.4.27.2 HEW PHY features	Change "5GHz" to "5 GHz"	2017/1/9 9:42
3448	Albert Petrick	225	1 27.5.2.3	170	15	E	Y	170.15 27.5.2.3	3345	Extra period	Add period at end of sentence after the word "PPDU"	2017/1/9 9:42
3449	Albert Petrick	225	1 9.3.1.23	45	6	E	Y	45.06 9.3.1.23		Number / letter (2.4GHz) spacing issue in Table B.4.27.2 HEW PHY features	Change "2.4GHz" to "2.4 GHz"	2017/1/9 9:42
3450	Albert Petrick	225	1 9.4.2.218.2	76	24	E	Y	76.24 9.4.2.218.2		Format error - sentence alignment	Fix paragraph alignment - left justify.	2017/1/9 9:42

3451 Albert Petrick	225	1 28.3.3.2	229	31	E	Y	229.31 28.3.3.2	3348	Extra period	Add period at end of sentence after the word "width)"	2017/1/9 9:42
3452 Albert Petrick	225	1 9.4.2.218.2	77	55	E	Y	77.55 9.4.2.218.2	3349	Table 9-262z misaligned Equation in "Encoding" column. "OfF" misspelled	Fix alignment of Eq Nmax = 2Maximum Number OFF-MPDUs. Change "OfF" to "Off". Increase line spacing between sentences for aligning equation.	2017/1/9 9:42
3453 Albert Petrick	225	1 9.4.2.218.3	81	35	E	Y	81.35 9.4.2.218.3		In Figure 9-589cl - (HE PHY Capabilities Information field format) subfield NSTA Total For < 80 MHz is labeled as having 2-bits. There are 3-bits (B37 -B39).	Change Bits "2" to "3" for subfield "NSTS Total for < 80 MHz" in Figure 9m-589cl	2017/1/9 9:42
3454 Albert Petrick	225	1 10.13.2	128	42	T	Y	128.42 10.13.2	3241	HE Capabilities Element clause number incorrect	Change clause number to "9.4.2.218"	2017/1/9 9:42
3455 Albert Petrick	225	1 9.4.2.218.3	81	35	T	Y	81.35 9.4.2.218.3		In Figure 9-589cl - (HE PHY Capabilities Information field format) subfield "Number Of Sounding Dimensions For < 80 MHz" is mark as having 1-bit. There are 3-bits (B46 -B48).	Change Bits "1" to "3" for subfield "NSTS Total for < 80 MHz" in Figure 9-589cl	2017/1/9 9:42
3456 Albert Petrick	225	1 9.4.2.218.3	81	35	T	Y	81.35 9.4.2.218.3	3270	In Figure 9-589cl - (HE PHY Capabilities Information field format) subfield "Number Of Sounding Dimensions For > 80 MHz" is labeled as 1-bit. There are 3-bits (B49 -B51).	Change Bits "1" to "3" for subfield "NSTS Total for > 80 MHz" in Figure 9-589cl	2017/1/9 9:42
3457 Albert Petrick	225	1 9.4.2.218.3	83	6	T	Y	83.06 9.4.2.218.3	3274	Add clarity. Call out bit positions in Table 9-262aa for subfield "Device Class" corresponding to those bit positions in Figure 9-589cl	In "Definition" column: Add "B12:" at the beginning of the sentence." In the "Encoding" column: Before sentence Add "B12:" "Set to 1 to indicate STA is a Class A device." In the "Encoding" column: Before sentence Add "B12:" Set to 0 to indicate STA is a Class B device. Note: This field is reserved when transmitting STA is an AP STA."	2017/1/9 9:42
3458 Albert Petrick	225	1 26.6.2	178	63	T	Y	178.63 26.6.2	3249	HE Capabilities Element clause number incorrect	Change clause number to "9.4.2.218"	2017/1/9 9:42
3459 Albert Petrick	225	1 9.4.2.218.3	83	13	T	Y	83.13 9.4.2.218.3	3277	Add clarity and call out bit positions in Table 9-262aa for subfield "LDPC Coding In Payload" corresponding to those bit positions in Figure 9-589cl	Change text in "Definition" column to read: "B13: Indicates support of transmission....." Change text in "Encoding" column to read: "B13: Set to 1 to indicate STA.... B13: Set to 9 otherwise. "	2017/1/9 9:42
3460 Albert Petrick	225	1 9.4.2.218.3	83	16	T	Y	83.16 9.4.2.218.3	3282	Add clarity and call out bit positions in Table 9-262 aa for subfield "HE-LTF And GI For HE PPDUs" corresponding to those bit positions in Figure 9-589cl	Change text in "Encoding column to read: "For B14 and B15: Set to 1 if supported by the STA. Set to 0 otherwise."	2017/1/9 9:42
3461 Albert Petrick	225	1 27.15.4.1	203	18	T	Y	203.18 27.15.4.1	3256	HE Capabilities Element clause number incorrect	Change clause number to "9.4.2.218"	2017/1/9 9:42
3462 Albert Petrick	225	1 9.4.2.218.3	82	15	E	Y	82.15 9.4.2.218.3	3286	Table 9-262aa, "Definition column" missing period at end of sentence	Fix. Add period after 2.4 GHz.	2017/1/9 9:42
3463 Albert Petrick	225	1 9.4.2.1	67	16	T	Y	67.16 9.4.2.1	3260	HE Capabilities Element clause number incorrect in Table 9-77 Element IDs	Change clause number to "9.4.2.218"	2017/1/9 9:42
3464 Albert Petrick	225	1 9.4.2.1	67	20	T	Y	67.20 9.4.2.1	3263	The HE Operation Element clause number is incorrect in Table 9-77 Element IDs.	Change clause number to "9.4.2.219"	2017/1/9 9:42
3465 Albert Petrick	225	1 9.4.2.218.3	82	18	E	Y	82.18 9.4.2.218.3		Table 9-262aa, "Definition column" missing period at end of sentence	Fix. Add period after 5 GHz.	2017/1/9 9:42
3466 Albert Petrick	225	1 28.3.14.3	342	53	T	Y	342.53 28.3.14.3	3359	CCDF not defined	Change "CCDF" to "complementary cumulative distribution function (CCDF)". Add definition for CCDF in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
3467 Albert Petrick	225	1 9.3.1.20	40	1	E	Y	40.01 9.3.1.20	3361	Clause title should not be underlined.	Remove underline; Change to "VHT/HE NDP"	2017/1/9 9:42
3468 Albert Petrick	225	1 9.4.2.218.3	82	20	E	Y	82.20 9.4.2.218.3		Table 9-262aa, "Definition column" missing period at end of sentence	Fix. Add period after 5 GHz.	2017/1/9 9:42
3469 Albert Petrick	225	1 9.3.1.23	41	47	E	Y	41.47 9.3.1.23	3363	Parenthesis not needed in Figure 9-52c-Trigger frame	Remove parenthesis - Change "(RA)" to "RA" in Figure 9-52c-Trigger frame	2017/1/9 9:42
3470 Albert Petrick	225	1 9.3.1.23	41	59	E	Y	41.59 9.3.1.23	3365	Add space between sentences	Add space at end of sentence after the word "STA."	2017/1/9 9:42
3471 Albert Petrick	225	1 9.4.2.218.3	82	23	E	Y	82.23 9.4.2.218.3		Table 9-262aa, "Definition column" missing period at end of sentence	Fix. Add period after 5 GHz.	2017/1/9 9:42
3472 Albert Petrick	225	1 9.4.2.218.3	82	18	E	Y	82.18 9.4.2.218.3		Table 9-262aa, "Encoding column" missing period at end of sentence	Fix. Change "Note" to "NOTE" and add colon ":" after "NOTE:"	2017/1/9 9:42
3473 Albert Petrick	225	1 9.3.1.23	41	61	E	Y	41.61 9.3.1.23	3369	Add space between sentences	Add space at end of sentence after the word "address."	2017/1/9 9:42
3474 Albert Petrick	225	1 9.4.2.218.3	82	44	T	Y	82.44 9.4.2.218.3		Table 9-262aa, grammar issue	Change "of" to "on"	2017/1/9 9:42
3475 Albert Petrick	225	1 9.3.3.6	53	36	E	Y	53.36 9.3.3.6	3371	spelling hyphen error in Table 9-30	In Table 9-30 remove hyphen change "pre-sent" to "present"	2017/1/9 9:42

3476	Albert Petrick	225	1 9.4.2.218.3	82	47	E	Y	82.47 9.4.2.218.3		Table 9-262aa, "Definition column" missing period at end of sentence and line between paragraphs	Fix. In the Definition column Add period "." after "punctured." and carriage return before B9, B10, and B11 on lines 47, 51, and 56. On line 60 add period after "is present."	2017/1/9 9:42
3477	Albert Petrick	225	1 9.3.3.8	54	30	E	Y	54.30 9.3.3.8	3373	spelling hyphen error in Table 9-32	In Table 9-32 remove hyphen change "pre-sent" to "present"	2017/1/9 9:42
3478	Albert Petrick	225	1 9.3.3.11	55	26	E	Y	55.26 9.3.3.11	3374	spelling hyphen error in Table 9-34	In Table 9-34 remove hyphen change "pre-sent" to "present"	2017/1/9 9:42
3479	Albert Petrick	225	1 9.4.2.218.3	93	25	E	Y	93.25 9.4.2.218.3		Table 9-262aa, missing period at the end of sentence	Fix. In the "Definition column", Add period "." after the "duration" on lines 25 and 29.	2017/1/9 9:42
3480	Albert Petrick	225	1 9.2.4.1.10	20	5	T	Y	20.05 9.2.4.1.10	3375	"HCT/Order subfield" naming should be consistent when referenced in text. It's referenced as "HTC/Order field"	Change to "HCT/Order subfield" on lines 5 and 7	2017/1/9 9:42
3481	Albert Petrick	225	1 9.4.2.218.3	83	34	E	Y	83.34 9.4.2.218.3		Table 9-262aa, missing period and colon in sentence.	Fix. In the "Definition column, Add period "." after the "stream" on lines 35 and 39. In Encoding column Add ":" after B18 on line 34 and B19 on line 37.	2017/1/9 9:42
3482	Albert Petrick	225	1 9.2.4.6.4.1	23	37	E	Y	23.37 9.2.4.6.4.1	3377	Reverse Direction Protocol (RDP) in Table 9-18a is missing reference "subclause reference" in the Content of the Control Information subfield.	Add the following clause reference: "See 9.2.4.6.4.8 (Reverse direction protocol (RDP))"	2017/1/9 9:42
3483	Albert Petrick	225	1 9.2.4.6.4.1	22	59	T	Y	22.59 9.2.4.6.4.1		In clause A-Control 9.2.6.4 the text needs to clarify the bit length in the Control ID subfields, describe the sequence ordering and state how many Control IDs are defined and reserved. The text should flow with Table 9-15b, and Table 9-18a.	Add the following underlined text (without the underline), and remove the strikethrough text from lines 59 to 65 on page 22 and lines 11 - 12 to read as follows: The A-Control subfield contains a sequence of one or more Control subfields. The format of each Control subfield is defined shown in Figure 9-15b (Control subfield format). The Control subfield with Control ID subfield equal to 0, if present, is the first subfield of the sequence. The Control ID subfield as shown in Figure 9-15b (Control subfield format) is 4-bits in length and indicates the type of information carried in the Control Information subfield. The bit length of the Control Information subfield is fixed for each value of the Control ID subfield that is not reserved. The values of the Control ID subfield and the associated length of the Control	2017/1/9 9:42
3484	Albert Petrick	225	1 9.4.2.218.3	83	40	E	Y	83.40 9.4.2.218.3		Table 9-262aa, missing period and colon in sentence.	In the Definition column, Add colon ":" after B20 and B21. Add period after "procedure." on lines 41 and 43. In Encoding column Add colon after B20 on line 40 and B21 on line 43. Add extra line space between lines 41 and 42.	2017/1/9 9:42
3485	Albert Petrick	225	1 9.2.4.6.4.2	24	20	E	Y	24.20 9.2.4.6.4.2	3380	Editorial formatting error with Target receiver power, TRSSI,	Remove comma "," before TRSSI and change ", TRSSI" to "(TRSSI)"	2017/1/9 9:42
3486	Albert Petrick	225	1 9.4.2.218.3	83	58	E	Y	83.58 9.4.2.218.3		Table 9-262aa, missing period at the end of sentence.	Add period after "MU-MIMO" on line 58.	2017/1/9 9:42
3487	Albert Petrick	225	1 9.2.4.6.4.2	23	59	T	Y	23.59 9.2.4.6.4.2	3381	Provide more clarity: UL PPDU subfield. The text should reference the "5-bits" for UL PPDU Length field in Figure 9-15c.	Insert text "is 5-bits (B0-B4) that" after the word subfield.	2017/1/9 9:42
3488	Albert Petrick	225	1 9.4.2.218.3	82	11	T	Y	82.11 9.4.2.218.3		Add clarity and call out bit position in Table 9-262aa for subfield "Dual Band Support" corresponding to those bit positions in Figure 9-589cl	Add bit B0 in Definition column Change to: "B0 indicates support of both...."	2017/1/9 9:42
3489	Albert Petrick	225	1 9.2.4.6.4.6	27	39	T	Y	27.39 9.2.4.6.4.6	3382	No reference to the bits in the Reserve subfield In 9.2.4.6.4.6.	Add the following sentence "Bits (B6-B7) are reserved." after the sentence on line 39.	2017/1/9 9:42
3490	Albert Petrick	225	1 9.4.2.218.3	84	26	T	Y	84.26 9.4.2.218.3		Add clarity and call out bit position in Table 9-262aa for subfield "UL HE MU PPDU Payload Support" corresponding to those bit positions in Figure 9-589cl	Add bit B30 in Definition column Change to: "B30 indicates that the STA supports the reception of....."	2017/1/9 9:42

3491	Albert Petrick	225	1 9.2.4.6.4.8	28	60	T	Y	28.60 9.2.4.6.4.8	3384	The bits in Table 9-15i should be called in the text for clarification.	Add the following underlined text. The Control Information 8-bit subfield for the RDP Trigger frame is shown in Figure 9-15i (Control Information subfield format when the Control ID subfield is 6), 6-bits (B2-B7) are reserved. The AC Constraint subfield bit (B0) of the RDP field indicates whether the mapped AC of an RD Data frame is constrained to a single AC, and is defined in Table 9-10 (AC Constraint subfield values), except that if B0 equals a value of 1 indicates that the response from an HE STA contains Data frames from the same AC or higher AC as defined in 10.28.4 (Rules for RD responder). The RDG/More PPDU subfield bit (B1) is defined in Table 9-11 (RDG/More PPDU subfield values).	2017/1/9 9:42
3492	Albert Petrick	225	1 9.4.2.218.3	84	31	T	Y	84.31 9.4.2.218.3		Add clarity and call out bit position in Table 9-262aa for subfield "SU Beamformer" corresponding to those bit positions in Figure 9-589cl	Add bit B31 in Definition column Change to: "B31 indicates support for operation as an SU beamformer."	2017/1/9 9:42
3493	Albert Petrick	225	1 9.3.1.24	41	23	T	Y	41.23 9.3.1.24	3385	CQI acronym not defined in Table 9-25a	Add definition for CQI in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
3494	Albert Petrick	225	1 9.4.2.218.3	84	36	T	Y	84.36 9.4.2.218.3		Add clarity and call out bit position in Table 9-262aa for subfield "SU Beamformee" corresponding to those bit positions in Figure 9-589cl	Add bit B32 in Definition column Change to: "B32 indicates support for operation as an SU beamformee."	2017/1/9 9:42
3495	Albert Petrick	225	1 9.4.2.218.3	82	12	E	Y	82.12 9.4.2.218.3	3387	Missing period after sentences in Table 9-262aa	Add "periods" after each sentence in the Definition and Encoding columns in Table 9-262aa	2017/1/9 9:42
3496	Albert Petrick	225	1 9.4.2.218.3	84	40	T	Y	84.40 9.4.2.218.3		Add clarity and call out bit position in Table 9-262aa for subfield "MU Beamformer" corresponding to those bit positions in Figure 9-589cl	Add bit B33 in Definition column Change to: "B33 indicates support for operation as an MU beamformer."	2017/1/9 9:42
3497	Albert Petrick	225	1 9.4.2.218.5	89	36	T	Y	89.36 9.4.2.218.5	3388	PPET, PPET8 and PPET16 acronym not defined	Add definitions for PPET, PPET8 and PPET16 in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
3498	Albert Petrick	225	1 9.4.2.218.3	84	6	T	Y	84.06 9.4.2.218.3	3267	Add clarity and call out bit positions in Table 9-262aa for subfield "Beamforemee STS For < 80 MHz" corresponding to those bit positions in Figure 9-589cl. Missing period at the end of sentence.	Add bits B34-B36 in Definition column Change to: "B34-B36 indicates the maximum number of space-time streams the STA can receive in an HE NDP."	2017/1/9 9:42
3499	Albert Petrick	225	1 9.4.2.221	94	56	T	Y	94.56 9.4.2.221	3244	MUEDCATimer not defined	Add definition for MUEDCATimer in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
3500	Albert Petrick	225	1 27.16.1	204	56	E	Y	204.56 27.16.1	3246	Sentence center justified should be left justified	Left justify sentence; "A STA for which dot11HEOptionImplemented is true shall set dot11VeryHighThroughputOptionImplemented or dot11HighThroughputOptionImplemented to true."	2017/1/9 9:42
3501	Albert Petrick	225	1 9.4.2.218.3	84	56	T	Y	84.56 9.4.2.218.3	3272	Add clarity and call out bit positions in Table 9-262aa for subfield "NTST Total For < 80 MHz" corresponding to those bit positions in Figure 9-589cl. Missing period at the end of sentence.	Add bits B37-B39 in Definition column Change to: "B37-B39 indicates the maximum value for.....partial bandwidth."	2017/1/9 9:42
3502	Albert Petrick	225	1 28.3.11.5	317	32	T	Y	317.32 28.3.11.5	3251	BCC acronym not defined	Add definition for "BCC = binary convolutional code" in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
3503	Albert Petrick	225	1 9.4.2.218.3	85	6	T	Y	85.06 9.4.2.218.3	3276	Add clarity and call out bit positions in Table 9-262aa for subfield "Beamformee STS for > 80 MHz" corresponding to those bit positions in Figure 9-589cl. Missing period at the end of sentence.	Add bits B40-B42 in Definition column Change to: "B40-B42 indicates the maximum number for.....HE NDP."	2017/1/9 9:42
3504	Albert Petrick	225	1 28.3.11.5	317	33	T	Y	317.33 28.3.11.5	3252	LDPC acronym not defined	Add definition for "LDPC = low density parity check " in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
3505	Albert Petrick	225	1 9.4.2.218.3	85	13	T	Y	85.13 9.4.2.218.3	3281	Add clarity and call out bit positions in Table 9-262aa for subfield "NSTS Total For > 80 MHz" corresponding to those bit positions in Figure 9-589cl. Missing period at the end of sentence.	Add bits B44-B45 in Definition column Change to: "B43-B45 indicates the maximum value for.....partial bandwidth."	2017/1/9 9:42
3506	Albert Petrick	225	1 9.3.1.23	42	7	E	Y	42.07 9.3.1.23	3255	Space missing between words in GIAnd LTF Type subfield of Figure 9-52	Add character space between the letters "IA" in "GIAnd LTF Type". Should read as "GI And LTF Type"	2017/1/9 9:42

3507	Albert Petrick	225	1 9.4.2.218.3	85	20	T	Y	85.20 9.4.2.218.3	3285	Add clarity and call out bit positions in Table 9-262aa for subfield "Number Of Sounding Dimensions For < 80 MHz" corresponding to those bit positions in Figure 9-589cl. Missing period at the end of sentence.	Add bits B46-B48 in Definition column Change to: "B46-B48 represents the beamformer's capability.....for an HE NDP."	2017/1/9 9:42
3508	Albert Petrick	225	1 9.4.1.62	56	15	E	Y	56.15 9.4.1.62	3259	Table 9-121a bit positions misaligned	Fix bit alignment with each subfield and resize Figure 9-121a to fit center of page.	2017/1/9 9:42
3509	Albert Petrick	225	1 9.4.2.218.3	85	22	E	Y	85.22 9.4.2.218.3		Missing period at end of sentence in Definition column of Table 9-262aa.	Add period at the end of sentence "HE NDP"	2017/1/9 9:42
3510	Albert Petrick	225	1 9.4.1.62	56	4	T	Y	56.04 9.4.1.62	3261	The text in Clause 9.4.1.62 HE MIMO Control field) needs clarification. The text should call out number of bits and range of bits for Figure 9-121a.	Add the following underlined text (not underlined text) . The HE MIMO Control field is included in every HE Compressed Beamforming frame (see 9.4.1.63 (HE Compressed Beamforming Report field)). The HE MIMO Control field is 40-bits (B0-B39) and is defined in Figure 9-121a (HE MIMO Control field). The subfields and bit assignments (B0-B39) are defined and described in Table 9-7a (HE MIMO Control field encoding).	2017/1/9 9:42
3511	Albert Petrick	225	1 9.4.2.218.3	85	26	T	Y	85.26 9.4.2.218.3		Add clarity and call out bit positions in Table 9-262aa for subfield "Number Of Sounding Dimensions For > 80 MHz" corresponding to those bit positions in Figure 9-589cl. Missing period at the end of sentence.	Add bits B48-B51 in Definition column Change to: "B49-B51 represents the beamformer's capability.....for an HE NDP."	2017/1/9 9:42
3512	Albert Petrick	225	1 9.4.1.62	56	30	T	Y	56.30 9.4.1.62	3404	Add clarity. Call out bit positions in Table 9-76a for subfield "Nc Index " corresponding to those bit positions in Figure 9-121a HE MIMO Control field	Add underlined text (without the underline) in "Description" column to read: "Indicates the number of columns, Nc, in the compressed beamforming feed-back matrix minus 1: For 3-bits (B0-B2): Set to 0 for Nc = 1 Set to 1 for Nc = 2 ... Set to 7 for Nc = 8"	2017/1/9 9:42
3513	Albert Petrick	225	1 9.4.1.62	56	38	T	Y	56.38 9.4.1.62	3406	Add clarity. Call out bit positions in Table 9-76a for subfield "Nr Index" corresponding to those bit positions in Figure 9-121a HE MIMO Control field	Add underlined text in "Description" column to read: "Indicates the number of rows, Nr, in the compressed beamforming feed-back matrix minus 1: For 3-bits (B3-B5): Set to 0 for Nr = 1 Set to 1 for Nr = 2 ... Set to 7 for Nr = 8"	2017/1/9 9:42
3514	Albert Petrick	225	1 9.4.2.218.3	85	28	E	Y	85.28 9.4.2.218.3		Missing period at end of sentence in Definition column of Table 9-262aa.	Fix. Add period at the end of sentence "HE NDP."	2017/1/9 9:42
3515	Albert Petrick	225	1 9.4.1.62	56	45	T	Y	56.45 9.4.1.62	3408	Add clarity. Call out bit positions in Table 9-76a for subfield "BW" corresponding to those bit positions in Figure 9-121a HE MIMO Control field	Add underlined text (without the underline) in "Description" column to read: "Indicates the channel width used to determine the starting and ending subcarrier indexes when interpreting the RU Start Index and RU End Index subfields. For 2-bits (B6-B7): Set to 0 for 20 MHz Set to 1 for 40 MHz Set to 2 for 80 MHz Set to 3 for 160 MHz and 80+80 MHz"	2017/1/9 9:42
3516	Albert Petrick	225	1 9.4.2.218.3	85	29	E	Y	85.29 9.4.2.218.3		Missing period at end of sentence in Encoding column in Table 9-262aa.	Add period at the end of sentence "reserved."	2017/1/9 9:42
3517	Albert Petrick	225	1 9.4.1.62	56	53	T	Y	56.53 9.4.1.62	3410	Add clarity. Call out bit positions in Table 9-76a for subfield "Grouping" corresponding to the bit positions in Figure 9-121a HE MIMO Control field	Add underlined text (without the underline) in "Description" column to read: "Indicates the subcarrier grouping, Ng, used for the compressed beamforming feedback matrix: Set bit (B8) as follows: Set to 0 for Ng = 4 Set to 1 for Ng = 16"	2017/1/9 9:42
3518	Albert Petrick	225	1 9.4.1.62	57	4	T	Y	57.04 9.4.1.62	3412	Add clarity. Call out bit positions in Table 9-76a for subfield "Codebook Information" corresponding to the bit positions in Figure 9-121a HE MIMO Control field	Add underlined text (without the underline)in "Description" column to read: "Indicates the size of codebook entries: Set bit B9 for SU and MU Feedback types as follows: If Feedback Type is ....."	2017/1/9 9:42
3519	Albert Petrick	225	1 9.4.1.62	57	14	T	Y	57.14 9.4.1.62	3414	The bit positions in Table 9-76a for subfield "Feedback Type" should correspond to those bit positions in Figure 9-121a HE MIMO Control field	Add underlined text (without the underline) in "Description" column to read: "Indicates the feedback type: For 2-bits (B10-B11) Set to 0 for SU Set to 1 for MU Set to 2 for CQI feedback 3 is reserved"	2017/1/9 9:42

3520	Albert Petrick	225	1 9.4.2.218.3	85	24	E	Y	85.24 9.4.2.218.3		Missing period at end of sentence in Encoding column in Table 9-262aa.	Add period at the end of sentence "reserved."	2017/1/9 9:42
3521	Albert Petrick	225	1 9.4.1.62	57	21	T	Y	57.21 9.4.1.62	3416	Add clarity. Call out bit positions in Table 9-76a for subfield "Remaining Feedback Segments" corresponding to those bit positions in Figure 9-121a HE MIMO Control field	Add underlined text (as not underlined text) in "Description" column to read: "Indicates the number of remaining feedback segments for the associated VHT Compressed Beamforming frame: For 3-bits (B12-B14) Set to 0 for the last feedback segment of a segmented report....."	2017/1/9 9:42
3522	Albert Petrick	225	1 9.4.2.218.3	85	31	T	Y	85.31 9.4.2.218.3		Add clarity and call out bit positions in Table 9-262aa for subfield "Ng = 16 For SU Feedback Support" corresponding to those bit positions in Figure 9-589cl. Missing period at the end of sentence.	Add bit B52 in Definition column Change to: "B52 indicates if the HE beamformee....."	2017/1/9 9:42
3523	Albert Petrick	225	1 9.4.1.62	57	32	T	Y	57.32 9.4.1.62	3418	Add clarity. Call out bit positions in Table 9-76a for subfield "First Feedback Segments" corresponding to the bit positions in Figure 9-121a HE MIMO Control field	Add underlined text (without the underline) in "Description" column to read: "Set bit (B15) as follows: Set to 1 for the first feedback segment of a segmented report or the only feedback segment of an unsegmented report. Set to 0 if not the first feedback segment or if the VHT....."	2017/1/9 9:42
3524	Albert Petrick	225	1 9.4.2.218.3	85	35	T	Y	85.35 9.4.2.218.3		Add clarity and call out bit positions in Table 9-262aa for subfield "Ng = 16 For MU Feedback Support" corresponding to those bit positions in Figure 9-589cl. Missing period at the end of sentence.	Add bit B53 in Definition column Change to: "B53 indicates if the HE beamformee....."	2017/1/9 9:42
3525	Albert Petrick	225	1 9.4.1.62	57	40	T	Y	57.40 9.4.1.62	3419	Add clarity. Call out bit positions in Table 9-76a for subfield "RU Start Index" corresponding to those bit positions in Figure 9-121a HE MIMO Control field	Add underlined text in "Description" column to read: "The starting RU index 7-Bits (B16-B22) indicates the first 26-tone RU for which the HE beamformer is requesting feedback."	2017/1/9 9:42
3526	Albert Petrick	225	1 9.4.2.218.3	85	37	E	Y	85.37 9.4.2.218.3		In Table 9-262aa missing period at the end of sentence.	Add period after "MU-type feedback."	2017/1/9 9:42
3527	Albert Petrick	225	1 9.4.1.62	57	43	T	Y	57.43 9.4.1.62	3421	Add clarity. Call out bit positions in Table 9-76a for subfield "RU End Index" corresponding to those bit positions in Figure 9-121a HE MIMO Control field.	Add the following underlined text (without the underline) in "Description" column to read: "The ending RU index 7-Bits (B23-B29) indicates the first 26-tone RU for which the HE beamformer is requesting feedback."	2017/1/9 9:42
3528	Albert Petrick	225	1 9.4.2.218.3	85	39	T	Y	85.39 9.4.2.218.3		Add clarity and call out bit positions in Table 9-262aa for subfield "Codebook Size (nⅈ, nΩ) = {4, 2} For SU Support" corresponding to those bit positions in Figure 9-589cl.	Add bit B54 in Definition column Change to: "B54 indicates if the HE beamformee....."	2017/1/9 9:42
3529	Albert Petrick	225	1 9.4.1.62	57	46	T	Y	57.46 9.4.1.62		The description of the Sounding Dialog Token Number in Table 9-76a is not correct. This should be similar to the description in Table 9-66.	Add the following underlined text (without the underline) and remove the strikethrough text in "Description" column to read: "The ending RU index indicates the last RU26 for which the HE beamformer is requesting feedback. The sounding dialog token is from the HE NDP Announcement frame soliciting feedback. "	2017/1/9 9:42
3530	Albert Petrick	225	1 9.4.2.218.3	85	44	T	Y	85.44 9.4.2.218.3		Add clarity and call out bit positions in Table 9-262aa for subfield "Codebook Size (nⅈ, nΩ) = {7,5} For MU Support" corresponding to those bit positions in Figure 9-589cl.	Add bit B55 in Definition column Change to: "B55 indicates if the HE beamformee....."	2017/1/9 9:42
3531	Albert Petrick	225	1 9.4.1.62	57	49	T	Y	57.49 9.4.1.62	3423	The "Reserved" subfield and description is missing in Table 9-76a. corresponding to Figure 121a.	At the end of Table 9-76a insert a new row and add the following underlined text (without the underline) "Reserved" in Subfield column, and the following text in Description column. "4-bits (B36-B39) are reserved."	2017/1/9 9:42
3532	Albert Petrick	225	1 9.4.2.218.3	85	50	E	Y	85.50 9.4.2.218.3		In Table 9-262aa, Missing periods and line spacing between sentences.	In the "Definition" column, Add period at the end of sentences e.i., after "feedback." on lines 50, 52, 54, 57, 59 and 61. Add line space carriage return after "feedback on lines 50, 52, 54, 57 and 59. In "Encoding" column, Add line spacing carriage return after "otherwise." on line 55.	2017/1/9 9:42
3533	Albert Petrick	225	1 9.4.1.63	58	28	T	Y	58.28 9.4.1.63	3425	Equation (8-1) missing	Add reference and/or detailed equation (8-1)	2017/1/9 9:42

3534	Albert Petrick	225	1 9.4.2.218.3	86	6	T	Y	86.06 9.4.2.218.3		Add clarity and call out bit position in Table 9-262aa for subfield "HE ER SU Payload" corresponding to those bit positions in Figure 9-589cl.	Add bit B59 in Definition column Change to: "B59: indicates the support of transmission....."	2017/1/9 9:42
3535	Albert Petrick	225	1 9.4.1.63	59	57	T	Y	59.57 9.4.1.63	3427	In Table 9-76c, "FB" in 20, 40 and 80 MHz (S, E) FB tone labels need to be defined to follow the foregoing text.	Change "FB" to "Feedback" in column label headers: 80 MHz FB tone, 40 MHz FB tone and 20 MHz FB tone.	2017/1/9 9:42
3536	Albert Petrick	225	1 9.4.2.218.3	86	11	T	Y	86.11 9.4.2.218.3		Add clarity and call out bit position in Table 9-262aa for subfield "DL MU-MIMO on Partial BW" corresponding to those bit positions in Figure 9-589cl.	Add bit B60 in Definition column Change to: "B60: indicates the non-AP STA supports....."	2017/1/9 9:42
3537	Albert Petrick	225	1 9.4.1.63	61	57	T	Y	61.57 9.4.1.63	3428	In Table 9-76d, "FB" in 20,40, 80 MHz (S, E) FB tone labels need to be defined to follow the foregoing text.	Change "FB" to "Feedback" in column label headers: 80 MHz FB tone, 40 MHz FB tone and 20 MHz FB tone.	2017/1/9 9:42
3538	Albert Petrick	225	1 9.4.2.218.3	86	14	T	Y	86.14 9.4.2.218.3		Add clarity and call out a "Note" reference in Table 9-262aa for subfield "DL MU-MIMO on Partial BW" in the Encoding column.	Add change to read: "Note: This field is reserved for an AP."	2017/1/9 9:42
3539	Albert Petrick	225	1 9.4.1.63	59	38	T	Y	59.38 9.4.1.63		The S-tone and E-tone description needs clarification when comparing and referencing tables 9-76c and 9-76d.	Add underlined text (without the underline) and remove strikethrough text from line 38 to 49 as follows: The S-tone and E-tone corresponding to the possible RU indices for 20MHz, 40MHz and 80 MHz channels are listed in Table 9-76c and Table 9-76d. (Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for Ng = 4) for Ng = 4 are shown in Table 9-76c, and for Ng = 16 for in Table 9-76d. (Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for Ng = 16) for Ng = 16. For 160 MHz, to determine the S-tone and E-tone, RUs 37 to 73 occupying the higher 80 MHz use the same entries in Table 9-76c (Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for Ng = 4) and Table 9-76d (Feedback subcarrier indices indicating start 26-tone RU index and end	2017/1/9 9:42
3540	Albert Petrick	225	1 9.4.2.218.3	86	16	T	Y	86.16 9.4.2.218.3		Add clarity and call out bit position in Table 9-262aa for subfield "PPE Threshold Present" corresponding to those bit position in Figure 9-589cl.	Add bit B61 in Definition column Change to: "B61: indicates whether or no the PPE....."	2017/1/9 9:42
3541	Albert Petrick	225	1 9.4.1.63	63	21	T	Y	63.21 9.4.1.63	3431	Calculating the AveSNRi needs more clarification.	Add the following underlined text (without the underline) and remove the strikethrough text from lines 21 through 30 as follows: The AvgSNRi in Table 9-71 (Average SNR of Space-Time Stream i subfield) is found determined by computing the SNR per subcarrier in decibels for the subcarriers in 20 MHz channel bandwidth identified in Table 9-76c (Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for Ng = 4) for Ng = 4 , and for Ng = 16 in Table 9-76d. (Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for Ng = 16) for Ng = 16, and then The computing tThe arithmetic mean is calculated of for those values. Each SNR value per subcarrier in stream i (before being averaged) corresponds to the SNR associated with the column i of the beamforming feedback matrix V determined	2017/1/9 9:42
3542	Albert Petrick	225	1 9.4.2.218.3	86	18	T	Y	86.18 9.4.2.218.3		Add clarity and call out bit position in Table 9-262aa for subfield "SRP-based SR Support" corresponding to those bit position in Figure 9-589cl.	Add bit B62 in Definition column Change to: "B62: indicates that the STA supports SRP-based....."	2017/1/9 9:42
3543	Albert Petrick	225	1 9.4.1.63	63	4	E	Y	63.04 9.4.1.63	3432	Spelling error "indeces" in Table 9-763	Change "indeces" to "indices"	2017/1/9 9:42
3544	Albert Petrick	225	1 9.4.2.218.3	86	19	E	Y	86.19 9.4.2.218.3		In Table 9-262aa, missing period after sentence.	Add period "." at the end of sentence after "operation."	2017/1/9 9:42
3545	Albert Petrick	225	1 9.4.1.64	64	48	T	Y	64.48 9.4.1.64	3434	Missing number of bits for Delta SNR for k=scidx(Ns-1)	Add number of bits for (Ns-1) for Delta SNR	2017/1/9 9:42

3546	Albert Petrick	225	1 9.4.2.218.3	86	21	T	Y	86.21 9.4.2.218.3		Add clarity and call out bit position in Table 9-262aa for subfield "Power Boost Factor +4r Support" corresponding to those bit position in Figure 9-589cl.	Add bit B63 in Definition column Change to: "B63: indicates that the STA supports....."	2017/1/9 9:42
3547	Albert Petrick	225	1 9.4.1.64	64	53	T	Y	64.53 9.4.1.64	3436	Missing number of bits for Delta SNR for k=scidx(Ns-1)	Add number of bits for (Ns-1) for Delta SNR	2017/1/9 9:42
3548	Albert Petrick	225	1 9.4.2.218.3	86	22	E	Y	86.22 9.4.2.218.3		In Table 9-262aa, missing period after sentence.	Add period at the end of sentence after "range [0.5, 2]."	2017/1/9 9:42
3549	Albert Petrick	225	1 9.4.1.64	64	13	E	Y	64.13 9.4.1.64	3437	Remove paragraph indent	Fix paragraph alignment starting at "No padding is present....."	2017/1/9 9:42
3550	Albert Petrick	225	1 9.4.2.218.3	86	24	T	Y	86.24 9.4.2.218.3		Add clarity and call out bit position in Table 9-262aa for subfield "4x HE-LTF And 0.8 us GI Support For HE PPDUs" corresponding to those bit position in Figure 9-589cl.	Add bit B64 in Definition column Change to: "B64: indicates for the reception of 4x LTF....."	2017/1/9 9:42
3551	Albert Petrick	225	1 9.4.1.64	64	18	T	Y	64.18 9.4.1.64	3439	Equation (9-2) is referenced in the text and in Table 9-76f HE MU Exclusive Beamforming Report information, and is not linked or referenced to any other documents. Equation (9-2) should be linked and referenced to its location IEEE 802.11-2016 (Rev D8.0) and clarified as a "Note" at the end of Table 9-76f.	Add note for equation 9-2 in text and/or add the following underlined text (without the underline) and reference link in Table 9-76f as a Note: "as defined in Equation (9-2) in clause 9.4.1.51 (MU Exclusive Beamforming Report Field)"	2017/1/9 9:42
3552	Albert Petrick	225	1 9.4.2.218.3	86	28	T	Y	86.28 9.4.2.218.3		Missing "Reserve" Subfield, and text for Definition and Encoding in Table 9-262aa. The Reserve subfield should correspond to the 7 bit positions B65 -B71 in Figure 9-589CI.	At the end of Table 9-262-aa. Add "Reserved" in Subfield column. Add text (see underlined text) "B65 - B71 (7-bits) are reserved." Encoding column leave blank.	2017/1/9 9:42
3553	Albert Petrick	225	1 9.4.1.64	64	30	T	Y	64.30 9.4.1.64	3440	Equation (9-2) reference in Table 9-76f calls out subcarrier k=scidx(0) and k=scidx(1). Equation 9-2 in IEEE 802.11-2016 (Rev D8.0) in clause 9.4.1.51 specifies k=sscidx(0) and k=sscidx(1) There appears to be an ambiguity in equation in 9-2 and with k=scidx(_)	Fix references for subcarrier k=scidx(0) and k=scidx(1) in Table 9-76f (lines 30-54) to match assumptions with equation 9-2 in clause 9.4.1.51 in IEEE 802.11-2016 (Rev D8.0)	2017/1/9 9:42
3554	Albert Petrick	225	1 9.4.2.218.3	86	31	T	Y	86.31 9.4.2.218.3		Class A STAs are declared "high capability devices" and class B STAs as "low capability devices" This is the only reference in .11axD1.0 to these terms. Class A and class B STAs are defined in sub-clause 28.3.14 (Transmit requirements for an HE trigger-based PPDU). Transmit power accuracy and RSSI measurement accuracy are discussed in detail e.g., Table 28-40. To eliminate ambiguities, "low and high capability devices" should be defined and referenced back to clause 28.3.14.	Add definition for "low and high capability" devices in clause 28.3.14, and add text reference back to clause 28.3.14. Add underline text (without the underline) to read: "Class A STAs are high capability devices and class B STAs are low capability devices as described in 28.3.14 (Transmit requirements for an HE trigger-based PPDU).	2017/1/9 9:42
3555	Albert Petrick	225	1 28.4.2	371	36	T	Y	371.36 28.4.2	3441	Clarify "aSignalExtension" referenced from Table 19-25	Add the following underlined text (without the underline): and is aSignalExtension (0us for 5 GHz band, 6us for 2.4 GHz band)	2017/1/9 9:42
3556	Albert Petrick	225	1 18.2	147	15	T	Y	147.15 18.2		The "Value" column in Table 18-1 (TXVECTOR parameters) is defined for the Parameter. For example, the "Value" for CBW20 or CBW40 are ambiguous. The description of these Values need additional clarification and a reference subclause, similar to those in Table 17-1 in subclause 17.2.2.1 of .11axD1.0, or Table 18-1, 18-3 in IEEE 802.11-2016, and IEEE 802.11-REVmc - D8.0.	Add text to describe what is meant by CBW20 or CBW40, Static or Dynamic in the Value column and provide reference subclauses.	2017/1/9 9:42
3557	Albert Petrick	225	1 28.4.2	371	39	E	Y	371.39 28.4.2	3443	Missing period	Add period at the end of sentence after "false"	2017/1/9 9:42
3558	Albert Petrick	225	1 18.2	147	15	T	Y	147.15 18.2		The "Value" column in Table 18-3 (RXVECTOR parameters) is defined for the Parameter. For example, the "Value" for CBW20 or CBW40 are ambiguous. The description of these Values need additional clarification and a reference subclause, similar to those in Table 18-3 in subclause 17.2.2.1 of .11axD1.0, or Tables 18-1, 18-3, in IEEE 802.11-2016, and IEEE 802.11-REVmc - D8.0.	Add text to describe what is meant by CBW20 or CBW40, Static or Dynamic in the Value column and provide reference subclauses.	2017/1/9 9:42
3559	Albert Petrick	225	1 9.2.5.2	32	1	E	Y	32.01 9.2.5.2	3444	Format error - sentence alignment	Sentence format needs to be left justified.	2017/1/9 9:42

3560	Albert Petrick	225	1 28.3.18.4.4	355	38	T	Y	355.38 28.3.18.4.4		The EVM for MCS7 (-27 dB) is based on the maximum tx power of MCS7. Clarification is needed why it is being used for BPSK...64-QAM as shown in Table 28-45. The EVM value was selected for UL OFDMA PPDUs. This should be noted or expanded in the text in clause 28.3.18.4.4	Add the following underlined text (without the underline) in the "Note" on line 40 in Table 28-45 as follows: "which EVM is test is conducted. "EVM of -27 dB, is used when the Tx Power is less than the maximum power of MCS7, and assists the AP in managing RUs for UL OFDMA PPDU transmissions."	2017/1/9 9:42
3561	Albert Petrick	225	1 9.3.1.9.1	34	12	T	Y	34.12 9.3.1.9.1	3446	In Figure 9-33 (BA Control Field) Bit (B5) in the Reserve sub-field is marked as deleted (strikethrough) as shown. The Reserved subfield now shows 7-bits (B6-B11). The text does not describe B5. Define B5 or correct Figure 9-33	Fix as commented	2017/1/9 9:42
3562	Albert Petrick	225	1 9.4.2.218.2	76	47	E	Y	76.47 9.4.2.218.2		In Figure 9-589ck - (HE MAC PHY Capabilities Information field format) subfield "Group Addressed Multi-STA BlockAck In DL MU Support" is mark as having 4-bits. This is not correct. There is 1-bit assigned (B24).	Change Bits "4" to "1" for subfield "Group Addressed Multi-STA BlockAck In DL MU Support" in Figure 9-589ck.	2017/1/9 9:42
3563	Albert Petrick	225	1 B.4.27.2	413	45	E	Y	413.45 B.4.27.2	3447	Numbering / letter (5GHz) spacing issue in Table B.4.27.2 HEW PHY features	Change "5GHz" to "5 GHz"	2017/1/9 9:42
3564	Albert Petrick	225	1 28.3.17.3	345	64	E	Y	345.64 28.3.17.3		Missing Table number reference in clause 28.3.17.3	Change "Table xx-a" to "Table 28-41"	2017/1/9 9:42
3565	Albert Petrick	225	1		2	T	Y		3287	.11ax D1.0 makes reference to IEEE P802.11REVmc-D8.0, which is essentially IEEE P802.11-2016 (the new rollup baseline standard) and soon to be published in 2017. Once it is published, P802.11REVmc-D8.0 will be removed from the IEEE 802.11 working group members area on the website and will not be available in public domain on the IEEE 802.11 work group document server for public use. All references in .11ax D1.0 to clauses in the baseline standard should be made to IEEE P802.11-2016 and not to IEEE P802.11REVmc-D8.0.	Remove IEEE P802.11REVmc(TM)/D8.0 and replace with IEEE P802.11-2016	2017/1/9 9:42
3566	Albert Petrick	225	1 9.3.1.23	45	6	E	Y	45.06 9.3.1.23	3449	Number / letter (2.4GHz) spacing issue in Table B.4.27.2 HEW PHY features	Change "2.4GHz" to "2.4 GHz"	2017/1/9 9:42
3567	Albert Petrick	225	1 28.3.17.6.4	349	16	E	Y	349.16 28.3.17.6.4		Paragraph formatting misalignment in clause 28.3.17.6.4	Fix. Left justify paragraph	2017/1/9 9:42
3568	Albert Petrick	225	1			G	Y		3288	The title of the column headers in ALL of the tables need to be formatted; 1) center text in title. 2) lock 1st row of table to continue on next page.	Fix and format ALL tables headers (1st row) and enable 1st row to roll-over on next page when tables don't fit on current page.	2017/1/9 9:42
3569	Albert Petrick	225	1			G	Y		3289	Throughout .11ax D1.0 there are references where some bits have hyphens and others do not e.g., 1 bit, and 1-bit . The text, Tables and Figures should be consistent using "hyphens" as used in IEEE 802.11-2016.	Fix. Include hyphens in text, Tables and Figures similar to the format utilized in baseline IEEE 802.11-2016	2017/1/9 9:42
3570	Albert Petrick	225	1 9.4.2.218.2	76	24	E	Y	76.24 9.4.2.218.2	3450	Format error - sentence alignment	Fix paragraph alignment - left justify.	2017/1/9 9:42
3571	Albert Petrick	225	1			G	Y		3290	Throughout .11ax D1.0 cross-reference links in text to tables, figures, equations, clauses and sub-clauses either broken, and non-existent.	Fix cross-reference links in text, tables, figures, equations and external links	2017/1/9 9:42
3572	Albert Petrick	225	1 28.3.17.6.4	349	44	E	Y	349.44 28.3.17.6.4		Paragraph formatting misalignment in clause 28.3.17.6.4	Fix. Left justify paragraph	2017/1/9 9:42
3573	Albert Petrick	225	1 9.4.2.218.3	81	35	E	Y	81.35 9.4.2.218.3	3453	In Figure 9-589cl - (HE PHY Capabilities Information field format) subfield NSTA Total For < 80 MHz is labeled as having 2-bits. There are 3-bits (B37 -B39).	Change Bits "2" to "3" for subfield "NSTS Total for < 80 MHz" in Figure 9m-589cl	2017/1/9 9:42
3574	Albert Petrick	225	1			G	Y		3291	Throughout .11ax D1.0 the alignment of the terms in equations and spacing between paragraph text and equations need to be centered on the pages.	Fix spacing of terms in equations and space of text between equations.	2017/1/9 9:42
3575	Albert Petrick	225	1 28.3.18.4.4	357	11	E	Y	357.11 28.3.18.4.4		Sentence formatting misalignment in clause 28.3.17.6.4	Fix. Left justify sentence	2017/1/9 9:42
3576	Albert Petrick	225	1 9.4.2.218.3	81	35	T	Y	81.35 9.4.2.218.3	3455	In Figure 9-589cl - (HE PHY Capabilities Information field format) subfield "Number Of Sounding Dimensions For < 80 MHz" is mark as having 1-bit. There are 3-bits (B46 -B48).	Change Bits "1" to "3" for subfield "NSTS Total for < 80 MHz" in Figure 9-589cl	2017/1/9 9:42

3577	Albert Petrick	225	1 3.4	7	13	E	Y	7.13 3.4	3292	hyphen error -- hyphen between the words frequency and division "Orthogonal frequency-division multiple access" The use of hyphens should be consistent with what is used in IEEE 802.11-2016.	Remove hyphen after "frequency"	2017/1/9 9:42
3578	Albert Petrick	225	1 9.4.2.218.3	81	35	T	Y	81.35 9.4.2.218.3	3270	In Figure 9-589cl - (HE PHY Capabilities Information field format) subfield "Number Of Sounding Dimensions For > 80 MHz" is labeled as 1-bit. There are 3-bits (B49 -B51).	Change Bits "1" to "3" for subfield "NSTS Total for > 80 MHz" in Figure 9-589cl	2017/1/9 9:42
3579	Albert Petrick	225	1 4.3.14a	9	33	T	Y	9.33 4.3.14a	3293	"RU" not defined	Add definition for "RU" in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
3580	Albert Petrick	225	1 28.3.18.4.4	357	14	E	Y	357.14 28.3.18.4.4		Sentence formatting misalignment in clause 28.3.17.6.4	Fix. Left justify sentence	2017/1/9 9:42
3581	Albert Petrick	225	1 9.4.2.218.3	83	6	T	Y	83.06 9.4.2.218.3	3274	Add clarity. Call out bit positions in Table 9-262aa for subfield "Device Class" corresponding to those bit positions in Figure 9-589cl	In "Definition" column: Add "B12:" at the beginning of the sentence." In the "Encoding" column: Before sentence Add "B12:" "Set to 1 to indicate STA is a Class A device." In the "Encoding" column: Before sentence Add "B12:" Set to 0 to indicate STA is a Class B device. Note: This field is reserved when transmitting STA is an AP STA."	2017/1/9 9:42
3582	Albert Petrick	225	1 6.3.4.2.2	11		E	Y	11.00 6.3.4.2.2	3294	primitive parameter misaligned	Fix alignment	2017/1/9 9:42
3583	Albert Petrick	225	1 28.3.11.13	331	48	E	Y	331.48 28.3.11.13		Misspelling in PPDU BW in Table 28-31 Pilot indices for 52-tone transmission	Change header "PPD BW" to "PPDU BW" in Table 28-31	2017/1/9 9:42
3584	Albert Petrick	225	1 9.4.2.218.3	83	13	T	Y	83.13 9.4.2.218.3	3277	Add clarity and call out bit positions in Table 9-262aa for subfield "LDPC Coding In Payload" corresponding to those bit positions in Figure 9-589cl	Change text in "Definition" column to read: "B13: Indicates support of transmission....." Change text in "Encoding" column to read: "B13: Set to 1 to indicate STA.... B13: Set to 9 otherwise. "	2017/1/9 9:42
3585	Albert Petrick	225	1 28.3.11.13	332	30	E	Y	332.30 28.3.11.13		Misspelling in PPDU BW in Table 28-33 Pilot indices for 106-tone transmission	Change header "PPD BW" to "PPDU BW" in Table 28-33	2017/1/9 9:42
3586	Albert Petrick	225	1 9.4.2.218.3	83	16	T	Y	83.16 9.4.2.218.3	3282	Add clarity and call out bit positions in Table 9-262 aa for subfield "HE-LTF And GI For HE PPDUs" corresponding to those bit positions in Figure 9-589cl	Change text in "Encoding column to read: "For B14 and B15: Set to 1 if supported by the STA. Set to 0 otherwise."	2017/1/9 9:42
3587	Albert Petrick	225	1 6.3.7.4.2	12	25	E	Y	12.25 6.3.7.4.2	3295	primitive parameter misaligned	Fix alignment	2017/1/9 9:42
3588	Albert Petrick	225	1 9.4.2.218.3	82	15	E	Y	82.15 9.4.2.218.3	3286	Table 9-262aa, "Definition column" missing period at end of sentence	Fix. Add period after 2.4 GHz.	2017/1/9 9:42
3589	Albert Petrick	225	1 28.3.11.13	333	11	E	Y	333.11 28.3.11.13		Misspelling in PPDU BW in Table 28-34 Pilot indices for 242-tone transmission	Change header "PPD BW" to "PPDU BW" in Table 28-34	2017/1/9 9:42
3590	Albert Petrick	225	1 27.4.2	158	30	E	Y	158.30 27.4.2	3296	multi-TID not capitalized	change "multi-TID" to "Multi-TID"	2017/1/9 9:42
3591	Albert Petrick	225	1 28.3.11.13	333	11	E	Y	333.11 28.3.11.13		Misspelling in PPDU BW in Table 28-36 Pilot indices for 484-tone transmission	Change header "PPD BW" to "PPDU BW" in Table 28-36	2017/1/9 9:42
3592	Albert Petrick	225	1 28.3.11.13	334	43	E	Y	334.43 28.3.11.13		Misspelling in PPDU BW in Table 28-37 Pilot indices for 484-tone transmission	Change header "PPD BW" to "PPDU BW" in Table 28-37	2017/1/9 9:42
3593	Albert Petrick	225	1 9.4.2.218.3	82	18	E	Y	82.18 9.4.2.218.3	3465	Table 9-262aa, "Definition column" missing period at end of sentence	Fix. Add period after 5 GHz.	2017/1/9 9:42
3594	Albert Petrick	225	1 28.3.12	339	3	E	Y	339.03 28.3.12		Grammar error in text referencing Table 28-38 in clause 28.3.12	Add underlined text (without the underline) to read: "The 3-bit Packet Extension field in HE-SIG-A is defined as shown in Table 28-38.....HE-SIG-A)."	2017/1/9 9:42
3595	Albert Petrick	225	1 27.4.2	158	51	E	Y	158.51 27.4.2	3297	multi-TID not capitalized	change "multi-TID" to "Multi-TID"	2017/1/9 9:42
3596	Albert Petrick	225	1 28.3.11.1	314	36	E	Y	314.36 28.3.11.1		Spelling error "non STBC" in several clauses in .11axD1.0. Not consistent with IEEE 802.11-2016.	Global change text "non STBC" to "non-STBC" (add hyphen after non) throughout .11axD1.0, in text, Figures, Tables and subclause headers.	2017/1/9 9:42
3597	Albert Petrick	225	1 9.4.2.218.3	82	20	E	Y	82.20 9.4.2.218.3	3468	Table 9-262aa, "Definition column" missing period at end of sentence	Fix. Add period after 5 GHz.	2017/1/9 9:42
3598	Albert Petrick	225	1 28.3.10.7.2	281		E	Y	281.00 28.3.10.7.2		Missing period in Table 28-18	Add period. Change "is punctured" to "is punctured."	2017/1/9 9:42
3599	Albert Petrick	225	1 27.4.4	160	160	E	Y	161.60 27.4.4	3298	multi-TID not capitalized	change "multi-TID" to "Multi-TID"	2017/1/9 9:42
3600	Albert Petrick	225	1 28.3.10.7.2	276	44	T	Y	276.44 28.3.10.7.2		Table 28-17 referencing B11-B14 Spatial Reuse suggests the need for more development. This is a place holder e.g., TBD.	Delete note in Table 28-17: NOTE: this part needs further development.	2017/1/9 9:42
3601	Albert Petrick	225	1 9.4.2.218.3	82	23	E	Y	82.23 9.4.2.218.3	3471	Table 9-262aa, "Definition column" missing period at end of sentence	Fix. Add period after 5 GHz.	2017/1/9 9:42

3602	Albert Petrick	225	1 27.4.4.1	160	45	E	Y	160.45 27.4.4.1	3299	multi-TID not capitalized	change "multi-TID" to "Multi-TID"	2017/1/9 9:42
3603	Albert Petrick	225	1 9.4.2.218.3	82	18	E	Y	82.18 9.4.2.218.3	3472	Table 9-262aa, "Encoding column" missing period at end of sentence	Fix. Change "Note" to "NOTE" and add colon ":" after "NOTE:"	2017/1/9 9:42
3604	Albert Petrick	225	1 28.3.14.3	342	47	E	Y	342.47 28.3.14.3		Period missing at end of sentence	Add period at the end of the sentence after "preamble".	2017/1/9 9:42
3605	Albert Petrick	225	1 9.4.2.218.3	82	44	T	Y	82.44 9.4.2.218.3	3474	Table 9-262aa, grammar issue	Change "of" to "on"	2017/1/9 9:42
3606	Albert Petrick	225	1 28.3.14.3	342	45	T	Y	342.45 28.3.14.3		In clause 28.3.14.3 transmit power requirements and RSSI measurement accuracy requirements are defined for signal level ranges in dBm operating in the 2.4 GHz and 5GHz bands. The requirements are defined for nominal (room) temperature conditions. Specifying transmit power measurements and RSSI accuracy measurements over temperature is implementation dependent and could be regulatory dependent. Specifying a specific operation temperature drives an implementation and is out-of-scope of the standard.	Delete sentence: "The requirements are for nominal (room) temperature conditions."	2017/1/9 9:42
3607	Albert Petrick	225	1 9.4.2.218.3	82	47	E	Y	82.47 9.4.2.218.3	3476	Table 9-262aa, "Definition column" missing period at end of sentence and line between paragraphs	Fix. In the Definition column Add period "." after "punctured." and carriage return before B9, B10, and B11 on lines 47, 51, and 56. On line 60 add period after "is present."	2017/1/9 9:42
3608	Albert Petrick	225	1			E	Y		3300	multi-TID not capitalized	Make global change in .11ax D1.0: change "multi-TID to Multi-TID"	2017/1/9 9:42
3609	Albert Petrick	225	1 28.3.14.3	342	46	T	Y	342.46 28.3.14.3		In clause 28.3.14.3 the RSSI is measured during the "PHY legacy preamble". The RSSI_LEGACY is defined, but the PHY legacy preamble is not. It's not define or referenced in the IEEE 802.11-2016 baseline. This should be defined and referenced back to the IEEE 802.11-2016 baseline standard.	Add definition for PHY legacy preamble in clause 3.4 Definitions, acronyms, and abbreviations with reference back to IEEE 802.11-2016 figures, text or subclause	2017/1/9 9:42
3610	Albert Petrick	225	1 9.4.2.218.3	93	25	E	Y	93.25 9.4.2.218.3	3479	Table 9-262aa, missing period at the end of sentence	Fix. In the "Definition column", Add period "." after the "duration" on lines 25 and 29.	2017/1/9 9:42
3611	Albert Petrick	225	1 25.5.2.3	167	69	T	Y	167.69 25.5.2.3	3301	"TBD" is a placeholder and not allowed in drafts in WG letter ballots as per IEEE 802.11 WG policies.	Remove TBD	2017/1/9 9:42
3612	Albert Petrick	225	1 28.3.18.2	354	46	E	Y	354.46 28.3.18.2		Extra digit in Table 28-44	Change "+3441" to "+344"	2017/1/9 9:42
3613	Albert Petrick	225	1 9.4.2.218.3	83	34	E	Y	83.34 9.4.2.218.3	3481	Table 9-262aa, missing period and colon in sentence.	Fix. In the "Definition column, Add period "." after the "stream" on lines 35 and 39. In Encoding column Add ":" after B18 on line 34 and B19 on line 37.	2017/1/9 9:42
3614	Albert Petrick	225	1 27.3.3.4	154	39	T	Y	154.39 27.3.3.4	3302	The "L3 Frag BA Request frame", "L3 Frag BA Response" and "BA Response frame" are not defined and ambiguous. There are no figures, tables, text or timing flow between Requests and Responses.	Define "L3 Frag BA Request frame" and "L3 Frag BA Response", BA Response frames, add figures, tables and describe a procedure for L3 dynamic fragmentation.	2017/1/9 9:42
3615	Albert Petrick	225	1 28.3.14.3	342	12	E	Y	342.12 28.3.14.3		Spelling error with MCS 7	Change "MCS 7" to "MCS7"	2017/1/9 9:42
3616	Albert Petrick	225	1 27.6.2	177	19	T	Y	177.19 27.6.2	3303	Text in sentence references table "Table YY-1". Table doesn't exist in .11ax D1.0 or in IEEE 802.11-2016	Fix reference and add table or delete sentence referencing table	2017/1/9 9:42
3617	Albert Petrick	225	1 28.3.14.3	342	10	E	Y	342.10 28.3.14.3		Spelling error with MCS 0	Change "MCS 0" to "MCS0"	2017/1/9 9:42
3618	Albert Petrick	225	1 27.6.2	177	43	T	Y	177.43 27.6.2	3304	Figure 27-3 Example of sounding protocol not correct.	Re-draw diagram. Fix sounding protocol diagram to illustrate alignment of SIFS timing as beamformee from beamformer.	2017/1/9 9:42
3619	Albert Petrick	225	1 28.3.14.3	342	36	E	Y	342.36 28.3.14.3		In Table 28-40 in the Case A column, there is a hyphen character.	Remove hyphen "-" character and leave cell blank	2017/1/9 9:42
3620	Albert Petrick	225	1 9.4.2.218.3	83	40	E	Y	83.40 9.4.2.218.3	3484	Table 9-262aa, missing period and colon in sentence.	In the Definition column, Add colon ":" after B20 and B21. Add period after "procedure." on lines 41 and 43. In Encoding column Add colon after B20 on line 40 and B21 on line 43. Add extra line space between lines 41 and 42.	2017/1/9 9:42
3621	Albert Petrick	225	1 27.6.2	178	6	T	Y	178.06 27.6.2	3305	Figure 27-4 Example of sounding protocol not correct.	Re-draw diagram. Fix sounding protocol diagram to illustrate alignment of SIFS timing, identify the beamformee "1 thru n" and spell out the word "TRIG" in UL TRIG PPDU	2017/1/9 9:42

3622	Albert Petrick	225	1 28.3.16	344	45	E	Y	344.45 28.3.16		In Figure 28-36 (HE NDP PPDU format) the PE field is the Packet Extension field. The text should reference this field.	Change "Packet Extension" to "Packet Extension (PE)"	2017/1/9 9:42
3623	Albert Petrick	225	1 9.4.2.218.3	83	58	E	Y	83.58 9.4.2.218.3	3486	Table 9-262aa, missing period at the end of sentence.	Add period after "MU-MIMO" on line 58.	2017/1/9 9:42
3624	Albert Petrick	225	1 27.6.2	178	7	T	Y	178.07 27.6.2	3306	"CSI" in Figure 27-4 is not defined or referenced in text	Expand on the term "CSI" and describe this term in the text with relationship with HE beamformee.	2017/1/9 9:42
3625	Albert Petrick	225	1 9.4.2.218.3	82	11	T	Y	82.11 9.4.2.218.3	3488	Add clarity and call out bit position in Table 9-262aa for subfield "Dual Band Support" corresponding to those bit positions in Figure 9-589cl	Add bit B0 in Definition column Change to: "B0 indicates support of both...."	2017/1/9 9:42
3626	Albert Petrick	225	1 27.16.1	204	56	E	Y	204.56 27.16.1	3307	Sentence misaligned spacing	Left just "A STA fro which do11HEOptionImplemented..... "	2017/1/9 9:42
3627	Albert Petrick	225	1 9.4.2.218.3	84	26	T	Y	84.26 9.4.2.218.3	3490	Add clarity and call out bit position in Table 9-262aa for subfield "UL HE MU PPDU Payload Support" corresponding to those bit positions in Figure 9-589cl	Add bit B30 in Definition column Change to: "B30 indicates that the STA supports the reception of....."	2017/1/9 9:42
3628	Albert Petrick	225	1 28.3.16	344	36	E	Y	344.36 28.3.16		Remove space between sentences	Delete lines 35 and 36. The text should read as follows: NDP is the only HE sounding format. The format of an HE NDP PPDU is shown in Figure 28-36 (HE NDP PPDU format).	2017/1/9 9:42
3629	Albert Petrick	225	1 28.3.14.3	342	47	E	Y	342.47 28.3.14.3	3308	Period missing at end of sentence	Add period at the end of sentence.	2017/1/9 9:42
3630	Albert Petrick	225	1 9.4.2.218.3	84	31	T	Y	84.31 9.4.2.218.3	3492	Add clarity and call out bit position in Table 9-262aa for subfield "SU Beamformer" corresponding to those bit positions in Figure 9-589cl	Add bit B31 in Definition column Change to: "B31 indicates support for operation as an SU beamformer."	2017/1/9 9:42
3631	Albert Petrick	225	1 28.3.17.4	347	13	E	Y	347.13 28.3.17.4		Extra line space between paragraphs	Remove line 13	2017/1/9 9:42
3632	Albert Petrick	225	1 9.4.2.218.3	84	36	T	Y	84.36 9.4.2.218.3	3494	Add clarity and call out bit position in Table 9-262aa for subfield "SU Beamformee" corresponding to those bit positions in Figure 9-589cl	Add bit B32 in Definition column Change to: "B32 indicates support for operation as an SU beamformee."	2017/1/9 9:42
3633	Albert Petrick	225	1 9.4.2.218.3	84	40	T	Y	84.40 9.4.2.218.3	3496	Add clarity and call out bit position in Table 9-262aa for subfield "MU Beamformer" corresponding to those bit positions in Figure 9-589cl	Add bit B33 in Definition column Change to: "B33 indicates support for operation as an MU beamformer."	2017/1/9 9:42
3634	Albert Petrick	225	1 28.3.17.6.4	349	16	E	Y	349.16 28.3.17.6.4	3309	Sentence misaligned spacing	left justify "issue a PHY-CCA.inidication(BUSY, {secondary40}),"	2017/1/9 9:42
3635	Albert Petrick	225	1 9.4.2.218.3	84	6	T	Y	84.06 9.4.2.218.3	3267	Add clarity and call out bit positions in Table 9-262aa for subfield "Beamforemee STS For < 80 MHz" corresponding to those bit positions in Figure 9-589cl. Missing period at the end of sentence.	Add bits B34-B36 in Definition column Change to: "B34-B36 indicates the maximum number of space-time streams the STA can receive in an HE NDP."	2017/1/9 9:42
3636	Albert Petrick	225	1 28.3.17.6.4	349	15	E	Y	349.15 28.3.17.6.4		Paragraph misaligned	Left justify paragraph	2017/1/9 9:42
3637	Albert Petrick	225	1 9.4.2.218.3	84	56	T	Y	84.56 9.4.2.218.3	3272	Add clarity and call out bit positions in Table 9-262aa for subfield "NTST Total For < 80 MHz" corresponding to those bit positions in Figure 9-589cl. Missing period at the end of sentence.	Add bits B37-B39 in Definition column Change to: "B37-B39 indicates the maximum value for.....partial bandwidth."	2017/1/9 9:42
3638	Albert Petrick	225	1 28.5	373	28	E	Y	373.28 28.5	3242	Units "Mbps" in Table 28-47 through Tables 28-102 not consistent with units "Mb/s" in text, tables and figures in IEEE 802.11-2016.	Change "Mbps" to "Mb/s" in Tables 28-47 through Table 28-102. There are 54 tables that need updating!	2017/1/9 9:42
3639	Albert Petrick	225	1 28.3.17.6.4	349	44	E	Y	349.44 28.3.17.6.4	3310	Sentence misaligned spacing	left justify "PHYCCA. Indication(BUSY, {primary}),.....and"	2017/1/9 9:42
3640	Albert Petrick	225	1 9.4.2.218.3	85	6	T	Y	85.06 9.4.2.218.3	3276	Add clarity and call out bit positions in Table 9-262aa for subfield "Beamformee STS for > 80 MHz" corresponding to those bit positions in Figure 9-589cl. Missing period at the end of sentence.	Add bits B40-B42 in Definition column Change to: "B40-B42 indicates the maximum number for.....HE NDP."	2017/1/9 9:42
3641	Albert Petrick	225	1 9.4.2.218.3	85	13	T	Y	85.13 9.4.2.218.3	3281	Add clarity and call out bit positions in Table 9-262aa for subfield "NSTS Total For > 80 MHz" corresponding to those bit positions in Figure 9-589cl. Missing period at the end of sentence.	Add bits B44-B45 in Definition column Change to: "B43-B45 indicates the maximum value for.....partial bandwidth."	2017/1/9 9:42
3642	Albert Petrick	225	1 28.1.1	209	16	E	Y	209.16 28.1.1	3250	Period missing at end of sentence	Add period at the of sentence after "band"	2017/1/9 9:42
3643	Albert Petrick	225	1 28.3.17.6.4	349	27	E	Y	349.27 28.3.17.6.4	3311	Sentence misaligned spacing	left justify "present and on of the .....or"	2017/1/9 9:42
3644	Albert Petrick	225	1 9.4.2.218.3	85	20	T	Y	85.20 9.4.2.218.3	3285	Add clarity and call out bit positions in Table 9-262aa for subfield "Number Of Sounding Dimensions For < 80 MHz" corresponding to those bit positions in Figure 9-589cl. Missing period at the end of sentence.	Add bits B46-B48 in Definition column Change to: "B46-B48 represents the beamformer's capability.....for an HE NDP."	2017/1/9 9:42

3645	Albert Petrick	225	1		2	T	Y		3287	.11ax D1.0 makes reference to IEEE P802.11REVmc-D8.0, which is essentially IEEE P802.11-2016 (the new rollup baseline standard) and soon to be published in 2017. Once it is published, P802.11REVmc-D8.0 will be removed from the IEEE 802.11 working group members area on the website and will not be available in public domain on the IEEE 802.11 work group document server for public use. All references in .11ax D1.0 to clauses in the baseline standard should be made to IEEE P802.11-2016 and not to IEEE P802.11REVmc-D8.0.	Remove IEEE P802.11REVmc(TM)/D8.0 and replace with IEEE P802.11-2016	2017/1/9 9:42
3646	Albert Petrick	225	1 9.4.2.218.3	85	22	E	Y	85.22 9.4.2.218.3	3509	Missing period at end of sentence in Definition column of Table 9-262aa.	Add period at the end of sentence "HE NDP"	2017/1/9 9:42
3647	Albert Petrick	225	1			G	Y		3288	The title of the column headers in ALL of the tables need to be formatted; 1) center text in title. 2) lock 1st row of table to continue on next page.	Fix and format ALL tables headers (1st row) and enable 1st row to roll-over on next page when tables don't fit on current page.	2017/1/9 9:42
3648	Albert Petrick	225	1 9.4.2.218.3	85	26	T	Y	85.26 9.4.2.218.3	3511	Add clarity and call out bit positions in Table 9-262aa for subfield "Number Of Sounding Dimensions For > 80 MHz" corresponding to those bit positions in Figure 9-589cl. Missing period at the end of sentence.	Add bits B48-B51 in Definition column Change to: "B49-B51 represents the beamformer's capability.....for an HE NDP."	2017/1/9 9:42
3649	Albert Petrick	225	1 28.3.17.6.4	349	46	E	Y	349.46 28.3.17.6.4	3312	Sentence misaligned spacing	Change "BUSY, {secondary40}}" to "BUSY,{secondary40}}"	2017/1/9 9:42
3650	Albert Petrick	225	1 28.1.1	209	19	E	Y	209.19 28.1.1	3258	Period missing at end of sentence	Add period at the of sentence after "band"	2017/1/9 9:42
3651	Albert Petrick	225	1			G	Y		3289	Throughout .11ax D1.0 there are references where some bits have hyphens and others do not e.g., 1 bit, and 1-bit . The text, Tables and Figures should be consistent using "hyphens" as used in IEEE 802.11-2016.	Fix. Include hyphens in text, Tables and Figures similar to the format utilized in baseline IEEE 802.11-2016	2017/1/9 9:42
3652	Albert Petrick	225	1			G	Y		3290	Throughout .11ax D1.0 cross-reference links in text to tables, figures, equations, clauses and sub-clauses either broken, and non-existent.	Fix cross-reference links in text, tables, figures, equations and external links	2017/1/9 9:42
3653	Albert Petrick	225	1			G	Y		3291	Throughout .11ax D1.0 the alignment of the terms in equations and spacing between paragraph text and equations need to be centered on the pages.	Fix spacing of terms in equations and space of text between equations.	2017/1/9 9:42
3654	Albert Petrick	225	1 9.4.2.218.3	85	28	E	Y	85.28 9.4.2.218.3	3514	Missing period at end of sentence in Definition column of Table 9-262aa.	Fix. Add period at the end of sentence "HE NDP."	2017/1/9 9:42
3655	Albert Petrick	225	1 28.3.17.6.4	349	21	E	Y	349.21 28.3.17.6.4	3313	Sentence misaligned spacing	Change "max(-72 dBm, OBSS_PD)" to " "max (-72 dBm, OBSS_PD)"	2017/1/9 9:42
3656	Albert Petrick	225	1 28.1.1	209	22	E	Y	209.22 28.1.1	3265	Period missing at end of sentence	Add period at the of sentence after "band"	2017/1/9 9:42
3657	Albert Petrick	225	1 3.4	7	13	E	Y	7.13 3.4	3292	hyphen error -- hyphen between the words frequency and division "Orthogonal frequency-division multiple access" The use of hyphens should be consistent with what is used in IEEE 802.11-2016.	Remove hyphen after "frequency"	2017/1/9 9:42
3658	Albert Petrick	225	1 9.4.2.218.3	85	29	E	Y	85.29 9.4.2.218.3	3516	Missing period at end of sentence in Encoding column in Table 9-262aa.	Add period at the end of sentence "reserved."	2017/1/9 9:42
3659	Albert Petrick	225	1 28.3.18.2	353	62	T	Y	353.62 28.3.18.2	3314	Spectral flatness procedure needs more clarity	Delete the sentence: "Demodulate the HE PPDUs .....procedure:" and place with the following sentence. " The HE PPDUs shall be demodulated using the following (or equivalent) procedure:"	2017/1/9 9:42
3660	Albert Petrick	225	1 4.3.14a	9	33	T	Y	9.33 4.3.14a	3293	"RU" not defined	Add definition for "RU" in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
3661	Albert Petrick	225	1 28.4.3	372	48	T	Y	372.48 28.4.3	3315	Table 28-46 - HE PHY characteristics lists the aPSDUMaxLength set to 6,500,631 octets. It's not clear in the table or text what assumptions were made and how the length is calculated.	Add a NOTE at the bottom of Table 28-46 stating the assumptions and the calculation (Eq.) for determining the PSDU maximum. E.g., 1024-QAM 5/6 rate coding rate, LDPC, 160 MHz channel bandwidth, 8 spatial streams, LDPC.	2017/1/9 9:42
3662	Albert Petrick	225	1 6.3.4.2.2	11		E	Y	11.00 6.3.4.2.2	3294	primitive parameter misaligned	Fix alignment	2017/1/9 9:42
3663	Albert Petrick	225	1 28.1.1	210	6	E	Y	210.06 28.1.1		Period missing at end of sentence	Add period at the of sentence after "bandwidth"	2017/1/9 9:42

3664	Albert Petrick	225	1 28.3.10.7.2	277	58	E	N	277.58 28.3.10.7.2	3316	LDPC misspelled in Table 28-17	Change "LPDC" to "LDPC" in Bandwidth column of Table 28-17	2017/1/9 9:42
3665	Albert Petrick	225	1 9.4.2.218.3	85	24	E	Y	85.24 9.4.2.218.3	3520	Missing period at end of sentence in Encoding column in Table 9-262aa.	Add period at the end of sentence "reserved."	2017/1/9 9:42
3666	Albert Petrick	225	1 28.3.6.4	250	43	T	Y	250.43 28.3.6.4	3317	Four extra tones insertion; mapping not correct for Construction of L-SIG.	In f) Change "{-1, -1, -1, 1}" to {-1, -1, 1, 1}"	2017/1/9 9:42
3667	Albert Petrick	225	1 9.4.2.218.3	85	31	T	Y	85.31 9.4.2.218.3	3522	Add clarity and call out bit positions in Table 9-262aa for subfield "Ng = 16 For SU Feedback Support" corresponding to those bit positions in Figure 9-589cl. Missing period at the end of sentence.	Add bit B52 in Definition column Change to: "B52 indicates if the HE beamformee....."	2017/1/9 9:42
3668	Albert Petrick	225	1 6.3.7.4.2	12	25	E	Y	12.25 6.3.7.4.2	3295	primitive parameter misaligned	Fix alignment	2017/1/9 9:42
3669	Albert Petrick	225	1 28.3.6.5	251	11	T	Y	251.11 28.3.6.5	3318	Four extra tones insertion; mapping not correct for Construction of RL-SIG	In f) Change "{-1, -1, -1, 1}" to {-1, -1, 1, 1}"	2017/1/9 9:42
3670	Albert Petrick	225	1 9.4.2.218.3	85	35	T	Y	85.35 9.4.2.218.3	3524	Add clarity and call out bit positions in Table 9-262aa for subfield "Ng = 16 For MU Feedback Support" corresponding to those bit positions in Figure 9-589cl. Missing period at the end of sentence.	Add bit B53 in Definition column Change to: "B53 indicates if the HE beamformee....."	2017/1/9 9:42
3671	Albert Petrick	225	1 28.1.1	210	9	E	Y	210.09 28.1.1		Period missing at end of sentence	Add period at the of sentence after "bandwidth"	2017/1/9 9:42
3672	Albert Petrick	225	1 9.3.1.23	45	11	T	Y	45.11 9.3.1.23	3319	"Doppler subfield indicates a high doppler mode of transmission." Definition, clarification and technical details are not in .11axD1.0 with respect to the range of doppler spread and operating conditions triggering "high doppler mode". In Table 9-262aa pg. 83 "doppler procedure" defines 2-bits and references for "doppler" and makes reference to STAs using a "Doppler Procedure" for HE PPDUs transmissions. Critical technical details on the doppler procedure are lacking in .11axD1.0.	Either remove all references to Doppler in .11axD1.0 (text and in Table 9-262aa) including STA doppler support or add detailed technical content on Doppler Procedure for HE PPDU transmissions in support of clause of 9.3.1.23 and Table 9-262aa.	2017/1/9 9:42
3673	Albert Petrick	225	1 27.4.2	158	30	E	Y	158.30 27.4.2	3296	multi-TID not capitalized	change "multi-TID" to "Multi-TID"	2017/1/9 9:42
3674	Albert Petrick	225	1 9.4.2.218.3	85	37	E	Y	85.37 9.4.2.218.3	3526	In Table 9-262aa missing period at the end of sentence.	Add period after "MU-type feedback."	2017/1/9 9:42
3675	Albert Petrick	225	1 9.4.2.218.3	83	41	T	Y	83.41 9.4.2.218.3	3320	Table 9-262aa defines HE-PHY Capabilities Information field. Doppler subfield makes reference to Doppler Procedure. There is no text on "Doppler procedure" procedure needs to be defined.	Add technical detail content or remove "Doppler subfield from Table 262aa	2017/1/9 9:42
3676	Albert Petrick	225	1 9.4.2.218.3	85	39	T	Y	85.39 9.4.2.218.3	3528	Add clarity and call out bit positions in Table 9-262aa for subfield "Codebook Size (ñ≥, ñΩ) = {4, 2} For SU Support" corresponding to those bit positions in Figure 9-589cl.	Add bit B54 in Definition column Change to: "B54 indicates if the HE beamformee....."	2017/1/9 9:42
3677	Albert Petrick	225	1 28.1.1	210	13	E	Y	210.13 28.1.1		Period missing at end of sentence	Add period at the of sentence after "MHz"	2017/1/9 9:42
3678	Albert Petrick	225	1 9.3.1.23	45	11	T	Y	45.11 9.3.1.23	3321	Doppler is not defined in clause 3.4 of IEEE 802.11-2016 (802.11 REVmc D8.0)	Add "Doppler" definition in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
3679	Albert Petrick	225	1 9.4.2.218.3	85	44	T	Y	85.44 9.4.2.218.3	3530	Add clarity and call out bit positions in Table 9-262aa for subfield "Codebook Size (ñ≥, ñΩ) = {7,5} For MU Support" corresponding to those bit positions in Figure 9-589cl.	Add bit B55 in Definition column Change to: "B55 indicates if the HE beamformee....."	2017/1/9 9:42
3680	Albert Petrick	225	1 27.4.2	158	51	E	Y	158.51 27.4.2	3297	multi-TID not capitalized	change "multi-TID" to "Multi-TID"	2017/1/9 9:42
3681	Albert Petrick	225	1 27.3.3.1	153	19	E	Y	153.19 27.3.3.1	3322	Extra period	Remove extra period from the end of the sentence.	2017/1/9 9:42
3682	Albert Petrick	225	1 9.4.2.218.3	85	50	E	Y	85.50 9.4.2.218.3	3532	In Table 9-262aa, Missing periods and line spacing between sentences.	In the "Definition" column, Add period at the end of sentences e.i., after "feedback." on lines 50, 52, 54, 57, 59 and 61. Add line space carriage return after "feedback on lines 50, 52, 54, 57 and 59. In "Encoding" column, Add line spacing carriage return after "otherwise." on line 55.	2017/1/9 9:42
3683	Albert Petrick	225	1 27.3.4.1	155	44	E	Y	155.44 27.3.4.1	3323	Paragraph misaligned	left justify paragraph	2017/1/9 9:42
3684	Albert Petrick	225	1 9.4.2.218.3	86	6	T	Y	86.06 9.4.2.218.3	3534	Add clarity and call out bit position in Table 9-262aa for subfield "HE ER SU Payload" corresponding to those bit positions in Figure 9-589cl.	Add bit B59 in Definition column Change to: "B59: indicates the support of transmission....."	2017/1/9 9:42
3685	Albert Petrick	225	1 28.1.1	210	15	E	Y	210.15 28.1.1		Period missing at end of sentence	Add period at the of sentence after "subcarriers"	2017/1/9 9:42
3686	Albert Petrick	225	1 27.4.4	160	160	E	Y	161.60 27.4.4	3298	multi-TID not capitalized	change "multi-TID" to "Multi-TID"	2017/1/9 9:42
3687	Albert Petrick	225	1 27.5.2.5	171	43	E	Y	171.43 27.5.2.5	3324	Extra parenthesis	Remove extra parenthesis at the end of sentence.	2017/1/9 9:42

3688	Albert Petrick	225	1 9.4.2.218.3	86	11	T	Y	86.11 9.4.2.218.3	3536	Add clarity and call out bit position in Table 9-262aa for subfield "DL MU-MIMO on Partial BW" corresponding to those bit positions in Figure 9-589cl.	Add bit B60 in Definition column Change to: "B60: indicates the non-AP STA supports....."	2017/1/9 9:42
3689	Albert Petrick	225	1 27.5.2.5	171	40	T	Y	171.40 27.5.2.5	3325	"ACs (#2190, 2191)" are remaining CID placeholders and not part of draft .11ax D1.0	Remove references to CIDs #2190, and 2191	2017/1/9 9:42
3690	Albert Petrick	225	1 9.4.2.218.3	86	14	T	Y	86.14 9.4.2.218.3	3538	Add clarity and call out a "Note" reference in Table 9-262aa for subfield "DL MU-MIMO on Partial BW" in the Encoding column.	Add change to read: "Note: This field is reserved for an AP."	2017/1/9 9:42
3691	Albert Petrick	225	1 28.1.1	210	17	E	Y	210.17 28.1.1		Period missing at end of sentence	Add period at the of sentence after "4"	2017/1/9 9:42
3692	Albert Petrick	225	1 27.5.2.5	171	41	E	Y	171.41 27.5.2.5	3326	Table number missing for Table 9-XX (Delta TID subfield encoding).	Add Table number 9-18c	2017/1/9 9:42
3693	Albert Petrick	225	1 27.4.4.1	160	45	E	Y	160.45 27.4.4.1	3299	multi-TID not capitalized	change "multi-TID" to "Multi-TID"	2017/1/9 9:42
3694	Albert Petrick	225	1 9.4.2.218.3	86	16	T	Y	86.16 9.4.2.218.3	3540	Add clarity and call out bit position in Table 9-262aa for subfield "PPE Threshold Present" corresponding to those bit position in Figure 9-589cl.	Add bit B61 in Definition column Change to: "B61: indicates whether or no the PPE....."	2017/1/9 9:42
3695	Albert Petrick	225	1 9.3.1.22	42	7	E	Y	42.07 9.3.1.22	3327	Figure 9-52d Common Info field B20-B21 has a spelling error for "GIAnd LTF Type"	Change "GIAnd" to "GI And"	2017/1/9 9:42
3696	Albert Petrick	225	1 9.4.2.218.3	86	18	T	Y	86.18 9.4.2.218.3	3542	Add clarity and call out bit position in Table 9-262aa for subfield "SRP-based SR Support" corresponding to those bit position in Figure 9-589cl.	Add bit B62 in Definition column Change to: "B62: indicates that the STA supports SRP-based....."	2017/1/9 9:42
3697	Albert Petrick	225	1 9.4.2.218.3	86	19	E	Y	86.19 9.4.2.218.3	3544	In Table 9-262aa, missing period after sentence.	Add period "." at the end of sentence after "operation."	2017/1/9 9:42
3698	Albert Petrick	225	1 28.1.1	210	18	E	Y	210.18 28.1.1		Period missing at end of sentence	Add period at the of sentence after "11"	2017/1/9 9:42
3699	Albert Petrick	225	1			E	Y		3300	multi-TID not capitalized	Make global change in .11ax D1.0: change "multi-TID to Multi-TID"	2017/1/9 9:42
3700	Albert Petrick	225	1 9.4.2.218.3	86	21	T	Y	86.21 9.4.2.218.3	3546	Add clarity and call out bit position in Table 9-262aa for subfield "Power Boost Factor +Yr Support" corresponding to those bit position in Figure 9-589cl.	Add bit B63 in Definition column Change to: "B63: indicates that the STA supports....."	2017/1/9 9:42
3701	Albert Petrick	225	1 28.1.1	210	18	E	Y	210.18 28.1.1		Referencing "MCS 10" not consistent in text in .11ax D1.0. Should use "MCS10"	Change "MCS 10" to MCS10" Change "11" to "MCS11"	2017/1/9 9:42
3702	Albert Petrick	225	1 9.4.2.218.1	76	2	E	Y	76.02 9.4.2.218.1	3328	Extra period	Remove extra period from the end of sentence.	2017/1/9 9:42
3703	Albert Petrick	225	1 25.5.2.3	167	69	T	Y	167.69 25.5.2.3	3301	"TBD" is a placeholder and not allowed in drafts in WG letter ballots as per IEEE 802.11 WG policies.	Remove TBD	2017/1/9 9:42
3704	Albert Petrick	225	1 27.3.3.4	154	39	T	Y	154.39 27.3.3.4	3302	The "L3 Frag BA Request frame", "L3 Frag BA Response" and "BA Response frame" are not defined and ambiguous. There are no figures, tables, text or timing flow between Requests and Responses.	Define "L3 Frag BA Request frame" and "L3 Frag BA Response", BA Response frames, add figures, tables and describe a procedure for L3 dynamic fragmentation.	2017/1/9 9:42
3705	Albert Petrick	225	1 27.6.2	177	19	T	Y	177.19 27.6.2	3303	Text in sentence references table "Table YY-1". Table doesn't exist in .11ax D1.0 or in IEEE 802.11-2016	Fix reference and add table or delete sentence referencing table	2017/1/9 9:42
3706	Albert Petrick	225	1 9.4.2.218.3	86	22	E	Y	86.22 9.4.2.218.3	3548	In Table 9-262aa, missing period after sentence.	Add period at the end of sentence after "range [0.5, 2]."	2017/1/9 9:42
3707	Albert Petrick	225	1 28.1.1	210	22	E	Y	210.22 28.1.1		Period missing at end of sentence	Add period at the of sentence after "20 MHz"	2017/1/9 9:42
3708	Albert Petrick	225	1 9.4.2.218.5	89	38	E	Y	89.38 9.4.2.218.5	3329	Extra period	Remove extra period from the end of sentence.	2017/1/9 9:42
3709	Albert Petrick	225	1 27.6.2	177	43	T	Y	177.43 27.6.2	3304	Figure 27-3 Example of sounding protocol not correct.	Re-draw diagram. Fix sounding protocol diagram to illustrate alignment of SIFS timing as beamformee from beamformer.	2017/1/9 9:42
3710	Albert Petrick	225	1 9.4.2.218.3	86	24	T	Y	86.24 9.4.2.218.3	3550	Add clarity and call out bit position in Table 9-262aa for subfield "4x HE-LTF And 0.8 us GI Support For HE PPDUs" corresponding to those bit position in Figure 9-589cl.	Add bit B64 in Definition column Change to: "B64: indicates for the reception of 4x LTF....."	2017/1/9 9:42
3711	Albert Petrick	225	1 9.4.2.218.5	89	13	E	Y	89.13 9.4.2.218.5	3330	Bit positions B0 - Bn not labeled on Figure 9-589cp--PPE Thresholds Info field format	Update Figure 9-589cp with Bit positions B0-Bn for groups of 3 bits per PPET16 and PPET8 subfields.	2017/1/9 9:42
3712	Albert Petrick	225	1 27.6.2	178	6	T	Y	178.06 27.6.2	3305	Figure 27-4 Example of sounding protocol not correct.	Re-draw diagram. Fix sounding protocol diagram to illustrate alignment of SIFS timing, identify the beamformee "1 thru n" and spell out the word "TRIG" in UL TRIG PPDU	2017/1/9 9:42

3713 Albert Petrick	225	1 9.4.2.218.3	86	28	T	Y	86.28 9.4.2.218.3	3552	Missing "Reserve" Subfield, and text for Definition and Encoding in Table 9-262aa. The Reserve subfield should correspond to the 7 bit positions B65 -B71 in Figure 9-589CI.	At the end of Table 9-262-aa. Add "Reserved" in Subfield column. Add text (see underlined text) "B65 - B71 (7-bits) are reserved." Encoding column leave blank.	2017/1/9 9:42
3714 Albert Petrick	225	1 28.1.1	210	26	E	Y	210.26 28.1.1		Period missing at end of sentence	Add period at the of sentence after "STA"	2017/1/9 9:42
3715 Albert Petrick	225	1 27.6.2	178	7	T	Y	178.07 27.6.2	3306	"CSI" in Figure 27-4 is not defined or referenced in text	Expand on the term "CSI" and describe this term in the text with relationship with HE beamformee.	2017/1/9 9:42
3716 Albert Petrick	225	1 9.4.2.218.3	86	31	T	Y	86.31 9.4.2.218.3	3554	Class A STAs are declared "high capability devices" and class B STAs as "low capability devices" This is the only reference in .11axD1.0 to these terms. Class A and class B STAs are defined in sub-clause 28.3.14 (Transmit requirements for an HE trigger-based PPDU). Transmit power accuracy and RSSI measurement accuracy are discussed in detail e.g., Table 28-40. To eliminate ambiguities, "low and high capability devices" should be defined and referenced back to clause 28.3.14.	Add definition for "low and high capability" devices in clause 28.3.14, and add text reference back to clause 28.3.14. Add underline text (without the underline) to read: "Class A STAs are high capability devices and class B STAs are low capability devices as described in 28.3.14 (Transmit requirements for an HE trigger-based PPDU).	2017/1/9 9:42
3717 Albert Petrick	225	1 10.3.2.8a.1	116	3	E	Y	116.03 10.3.2.8a.1	3331	Extra period	Remove extra period from the end of sentence.	2017/1/9 9:42
3718 Albert Petrick	225	1 27.16.1	204	56	E	Y	204.56 27.16.1	3307	Sentence misaligned spacing	Left just "A STA fro which do11HEOptionImplemented..... "	2017/1/9 9:42
3719 Albert Petrick	225	1 18.2	147	15	T	Y	147.15 18.2	3556	The "Value" column in Table 18-1 (TXVECTOR parameters) is defined for the Parameter. For example, the "Value" for CBW20 or CBW40 are ambiguous. The description of these Values need additional clarification and a reference subclause, similar to those in Table 17-1 in subclause 17.2.2.1 of .11axD1.0, or Table 18-1, 18-3 in IEEE 802.11-2016, and IEEE 802.11-REVmc - D8.0.	Add text to describe what is meant by CBW20 or CBW40, Static or Dynamic in the Value column and provide reference subclauses.	2017/1/9 9:42
3720 Albert Petrick	225	1 28.3.14.3	342	47	E	Y	342.47 28.3.14.3	3308	Period missing at end of sentence	Add period at the end of sentence.	2017/1/9 9:42
3721 Albert Petrick	225	1 18.2	147	15	T	Y	147.15 18.2	3558	The "Value" column in Table 18-3 (RXVECTOR parameters) is defined for the Parameter. For example, the "Value" for CBW20 or CBW40 are ambiguous. The description of these Values need additional clarification and a reference subclause, similar to those in Table 18-3 in subclause 17.2.2.1 of .11axD1.0, or Tables 18-1, 18-3, in IEEE 802.11-2016, and IEEE 802.11-REVmc - D8.0.	Add text to describe what is meant by CBW20 or CBW40, Static or Dynamic in the Value column and provide reference subclauses.	2017/1/9 9:42
3722 Albert Petrick	225	1 28.1.1	210	30	E	Y	210.30 28.1.1		Period missing at end of sentence	Add period at the of sentence after "STA"	2017/1/9 9:42
3723 Albert Petrick	225	1 27.4.4.5	162	26	E	Y	162.26 27.4.4.5	3332	Extra period	Remove extra period at the end of sentence after the word "context"	2017/1/9 9:42
3724 Albert Petrick	225	1 28.3.18.4.4	355	38	T	Y	355.38 28.3.18.4.4	3560	The EVM for MCS7 (-27 dB) is based on the maximum tx power of MCS7. Clarification is needed why it is being used for BPSK...64-QAM as shown in Table 28-45. The EVM value was selected for UL OFDMA PPDUs. This should be noted or expanded in the text in clause 28.3.18.4.4	Add the following underlined text (without the underline) in the "Note" on line 40 in Table 28-45 as follows: "which EVM is test is conducted. "EVM of -27 dB, is used when the Tx Power is less than the maximum power of MCS7, and assists the AP in managing RUs for UL OFDMA PPDU transmissions."	2017/1/9 9:42
3725 Albert Petrick	225	1 9.4.2.218.2	76	47	E	Y	76.47 9.4.2.218.2	3562	In Figure 9-589ck - (HE MAC PHY Capabilities Information field format) subfield "Group Addressed Multi-STA BlockAck In DL MU Support" is mark as having 4-bits. This is not correct. There is 1-bit assigned (B24).	Change Bits "4" to "1" for subfield "Group Addressed Multi-STA BlockAck In DL MU Support" in Figure 9-589ck.	2017/1/9 9:42
3726 Albert Petrick	225	1 28.3.17.6.4	349	16	E	Y	349.16 28.3.17.6.4	3309	Sentence misaligned spacing	left justify "issue a PHY-CCA.inidication(BUSY, {secondary40}),"	2017/1/9 9:42
3727 Albert Petrick	225	1 28.1.1	210	31	E	Y	210.31 28.1.1		Period missing at end of sentence	Add period at the of sentence after "MSC11"	2017/1/9 9:42
3728 Albert Petrick	225	1 28.3.17.3	345	64	E	Y	345.64 28.3.17.3	3564	Missing Table number reference in clause 28.3.17.3	Change "Table xx-a" to "Table 28-41"	2017/1/9 9:42
3729 Albert Petrick	225	1 27.5.2.2.1	164	46	E	Y	164.46 27.5.2.2.1	3333	Extra period	Remove extra period at the end of sentence after the word "allocation)"	2017/1/9 9:42
3730 Albert Petrick	225	1 28.3.17.6.4	349	16	E	Y	349.16 28.3.17.6.4	3567	Paragraph formatting misalignment in clause 28.3.17.6.4	Fix. Left justify paragraph	2017/1/9 9:42
3731 Albert Petrick	225	1 28.3.17.6.4	349	44	E	Y	349.44 28.3.17.6.4	3310	Sentence misaligned spacing	left justify "PHYCCA. Indication(BUSY, {primary}),.....and"	2017/1/9 9:42

3732	Albert Petrick	225	1 28.1.1	210	33	E	Y	210.33 28.1.1	3247	Period missing at end of sentence	Add period at the of sentence after "5"	2017/1/9 9:42
3733	Albert Petrick	225	1 27.5.2.2.1	164	53	E	Y	164.53 27.5.2.2.1	3335	Period missing at end of sentence	Add period at end of sentence after the word "S-MPDUs))"	2017/1/9 9:42
3734	Albert Petrick	225	1 28.3.17.6.4	349	44	E	Y	349.44 28.3.17.6.4	3572	Paragraph formatting misalignment in clause 28.3.17.6.4	Fix. Left justify paragraph	2017/1/9 9:42
3735	Albert Petrick	225	1 28.3.17.6.4	349	27	E	Y	349.27 28.3.17.6.4	3311	Sentence misaligned spacing	left justify "present and on of the .....or"	2017/1/9 9:42
3736	Albert Petrick	225	1 28.3.18.4.4	357	11	E	Y	357.11 28.3.18.4.4	3575	Sentence formatting misalignment in clause 28.3.17.6.4	Fix. Left justify sentence	2017/1/9 9:42
3737	Albert Petrick	225	1 28.1.1	210	35	E	Y	210.35 28.1.1	3254	Period missing at end of sentence	Add period at the of sentence after "PPDUs"	2017/1/9 9:42
3738	Albert Petrick	225	1 27.5.2.2.1	164	56	E	Y	164.56 27.5.2.2.1	3338	Period missing at end of sentence	Add period at end of sentence after the word "behavior))"	2017/1/9 9:42
3739	Albert Petrick	225	1 28.3.17.6.4	349	46	E	Y	349.46 28.3.17.6.4	3312	Sentence misaligned spacing	Change "BUSY,{secondary40})" to "BUSY,{secondary40})"	2017/1/9 9:42
3740	Albert Petrick	225	1 28.3.18.4.4	357	14	E	Y	357.14 28.3.18.4.4	3580	Sentence formatting misalignment in clause 28.3.17.6.4	Fix. Left justify sentence	2017/1/9 9:42
3741	Albert Petrick	225	1 28.1.1	210	38	E	Y	210.38 28.1.1	3264	Period missing at end of sentence	Add period at the of sentence after "receive)"	2017/1/9 9:42
3742	Albert Petrick	225	1 27.5.2.2.1	164	59	E	Y	164.59 27.5.2.2.1	3342	Period missing at end of sentence	Add period at end of sentence after the word "TIDs))"	2017/1/9 9:42
3743	Albert Petrick	225	1 28.3.11.13	331	48	E	Y	331.48 28.3.11.13	3583	Misspelling in PPDU BW in Table 28-31 Pilot indices for 52-tone transmission	Change header "PPD BW" to "PPDU BW" in Table 28-31	2017/1/9 9:42
3744	Albert Petrick	225	1 28.3.17.6.4	349	21	E	Y	349.21 28.3.17.6.4	3313	Sentence misaligned spacing	Change "max(-72 dBm, OBSS_PD)" to " "max (-72 dBm, OBSS_PD)"	2017/1/9 9:42
3745	Albert Petrick	225	1 28.3.11.13	332	30	E	Y	332.30 28.3.11.13	3585	Misspelling in PPDU BW in Table 28-33 Pilot indices for 106-tone transmission	Change header "PPD BW" to "PPDU BW" in Table 28-33	2017/1/9 9:42
3746	Albert Petrick	225	1 28.3.18.2	353	62	T	Y	353.62 28.3.18.2	3314	Spectral flatness procedure needs more clarity	Delete the sentence: "Demodulate the HE PPDUs .....procedure:" and place with the following sentence. " The HE PPDUs shall be demodulated using the following (or equivalent) procedure:"	2017/1/9 9:42
3747	Albert Petrick	225	1 28.1.1	210	41	E	Y	210.41 28.1.1		Period missing at end of sentence	Add period at the of sentence after "MIMO)"	2017/1/9 9:42
3748	Albert Petrick	225	1 28.3.11.13	333	11	E	Y	333.11 28.3.11.13	3589	Misspelling in PPDU BW in Table 28-34 Pilot indices for 242-tone transmission	Change header "PPD BW" to "PPDU BW" in Table 28-34	2017/1/9 9:42
3749	Albert Petrick	225	1 27.5.2.3	170	15	E	Y	170.15 27.5.2.3	3345	Extra period	Add period at end of sentence after the word "PPDU"	2017/1/9 9:42
3750	Albert Petrick	225	1 28.4.3	372	48	T	Y	372.48 28.4.3	3315	Table 28-46 - HE PHY characteristics lists the aPSDUMaxLength set to 6,500,631 octets. It's not clear in the table or text what assumptions were made and how the length is calculated.	Add a NOTE at the bottom of Table 28-46 stating the assumptions and the calculation (Eq.) for determining the PSDU maximum. E.g., 1024-QAM 5/6 rate coding rate, LDPC, 160 MHz channel bandwidth, 8 spatial streams, LDPC.	2017/1/9 9:42
3751	Albert Petrick	225	1 28.3.11.13	333	11	E	Y	333.11 28.3.11.13	3591	Misspelling in PPDU BW in Table 28-36 Pilot indices for 484-tone transmission	Change header "PPD BW" to "PPDU BW" in Table 28-36	2017/1/9 9:42
3752	Albert Petrick	225	1 28.3.10.7.2	277	58	E	N	277.58 28.3.10.7.2	3316	LDPC misspelled in Table 28-17	Change "LPDC" to "LDPC" in Bandwidth column of Table 28-17	2017/1/9 9:42
3753	Albert Petrick	225	1 28.3.11.13	334	43	E	Y	334.43 28.3.11.13	3592	Misspelling in PPDU BW in Table 28-37 Pilot indices for 484-tone transmission	Change header "PPD BW" to "PPDU BW" in Table 28-37	2017/1/9 9:42
3754	Albert Petrick	225	1 28.1.1	210	44	E	Y	210.44 28.1.1		Period missing at end of sentence	Add period at the of sentence after "receive)"	2017/1/9 9:42
3755	Albert Petrick	225	1 28.3.3.2	229	31	E	Y	229.31 28.3.3.2	3348	Extra period	Add period at end of sentence after the word "width)"	2017/1/9 9:42
3756	Albert Petrick	225	1 28.3.6.4	250	43	T	Y	250.43 28.3.6.4	3317	Four extra tones insertion; mapping not correct for Construction of L-SIG.	In f) Change "{-1, -1, -1, 1}" to {-1, -1, 1, 1}"	2017/1/9 9:42
3757	Albert Petrick	225	1 28.3.12	339	3	E	Y	339.03 28.3.12	3594	Grammar error in text referencing Table 28-38 in clause 28.3.12	Add underlined text (without the underline) to read: "The 3-bit Packet Extension field in HE-SIG-A is defined as shown in Table 28-38.....HE-SIG-A)."	2017/1/9 9:42
3758	Albert Petrick	225	1 28.3.6.5	251	11	T	Y	251.11 28.3.6.5	3318	Four extra tones insertion; mapping not correct for Construction of RL-SIG	In f) Change "{-1, -1, -1, 1}" to {-1, -1, 1, 1}"	2017/1/9 9:42
3759	Albert Petrick	225	1 9.4.2.218.2	77	55	E	Y	77.55 9.4.2.218.2	3349	Table 9-262z misaligned Equation in "Encoding" column. "OfF" misspelled	Fix alignment of Eq Nmax = 2Maximum Number OFF-MPDUs. Change "OfF" to "Off". Increase line spacing between sentences for aligning equation.	2017/1/9 9:42
3760	Albert Petrick	225	1 28.3.11.1	314	36	E	Y	314.36 28.3.11.1	3596	Spelling error "non STBC" in several clauses in .11axD1.0. Not consistent with IEEE 802.11-2016.	Global change text "non STBC" to "non-STBC" (add hyphen after non) throughout .11axD1.0, in text, Figures, Tables and subclause headers.	2017/1/9 9:42

3761 Albert Petrick	225	1 9.3.1.23	45	11	T	Y	45.11 9.3.1.23	3319	"Doppler subfield indicates a high doppler mode of transmission." Definition, clarification and technical details are not in .11axD1.0 with respect to the range of doppler spread and operating conditions triggering "high doppler mode". In Table 9-262aa pg. 83 "doppler procedure" defines 2-bits and references for "doppler" and makes reference to STAs using a "Doppler Procedure" for HE PPDUs transmissions. Critical technical details on the doppler procedure are lacking in .11axD1.0.	Either remove all references to Doppler in .11axD1.0 (text and in Table 9-262aa) including STA doppler support or add detailed technical content on Doppler Procedure for HE PPDU transmissions in support of clause of 9.3.1.23 and Table 9-262aa.	2017/1/9 9:42
3762 Albert Petrick	225	1 10.13.2	128	42	T	Y	128.42 10.13.2	3241	HE Capabilities Element clause number incorrect	Change clause number to "9.4.2.218"	2017/1/9 9:42
3763 Albert Petrick	225	1 28.1.1	210	46	E	Y	210.46 28.1.1		Period missing at end of sentence	Add period at the of sentence after "receive)"	2017/1/9 9:42
3764 Albert Petrick	225	1 28.3.10.7.2	281		E	Y	281.00 28.3.10.7.2	3598	Missing period in Table 28-18	Add period. Change "is punctured" to "is punctured."	2017/1/9 9:42
3765 Albert Petrick	225	1 9.4.2.218.3	83	41	T	Y	83.41 9.4.2.218.3	3320	Table 9-262aa defines HE-PHY Capabilities Information field. Doppler subfield makes reference to Doppler Procedure. There is no text on "Doppler procedure" procedure needs to be defined.	Add technical detail content or remove "Doppler subfield from Table 262aa	2017/1/9 9:42
3766 Albert Petrick	225	1 28.3.10.7.2	276	44	T	Y	276.44 28.3.10.7.2	3600	Table 28-17 referencing B11-B14 Spatial Reuse suggests the need for more development. This is a place holder e.g., TBD.	Delete note in Table 28-17: NOTE: this part needs further development.	2017/1/9 9:42
3767 Albert Petrick	225	1 9.3.1.23	45	11	T	Y	45.11 9.3.1.23	3321	Doppler is not defined in clause 3.4 of IEEE 802.11-2016 (802.11 REVmc D8.0)	Add "Doppler" definition in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
3768 Albert Petrick	225	1 26.6.2	178	63	T	Y	178.63 26.6.2	3249	HE Capabilities Element clause number incorrect	Change clause number to "9.4.2.218"	2017/1/9 9:42
3769 Albert Petrick	225	1 28.1.1	210	48	E	Y	210.48 28.1.1		Period missing at end of sentence	Add period at the of sentence after "PPDUs"	2017/1/9 9:42
3770 Albert Petrick	225	1 27.3.3.1	153	19	E	Y	153.19 27.3.3.1	3322	Extra period	Remove extra period from the end of the sentence.	2017/1/9 9:42
3771 Albert Petrick	225	1 28.3.14.3	342	47	E	Y	342.47 28.3.14.3	3604	Period missing at end of sentence	Add period at the end of the sentence after "preamble".	2017/1/9 9:42
3772 Albert Petrick	225	1 27.3.4.1	155	44	E	Y	155.44 27.3.4.1	3323	Paragraph misaligned	left justify paragraph	2017/1/9 9:42
3773 Albert Petrick	225	1 28.3.14.3	342	45	T	Y	342.45 28.3.14.3	3606	In clause 28.3.14.3 transmit power requirements and RSSI measurement accuracy requirements are defined for signal level ranges in dBm operating in the 2.4 GHz and 5GHz bands. The requirements are defined for nominal (room) temperature conditions. Specifying transmit power measurements and RSSI accuracy measurements over temperature is implementation dependent and could be regulatory dependent. Specifying a specific operation temperature drives an implementation and is out-of-scope of the standard.	Delete sentence: "The requirements are for nominal (room) temperature conditions."	2017/1/9 9:42
3774 Albert Petrick	225	1 27.5.2.5	171	43	E	Y	171.43 27.5.2.5	3324	Extra parenthesis	Remove extra parenthesis at the end of sentence.	2017/1/9 9:42
3775 Albert Petrick	225	1 27.15.4.1	203	18	T	Y	203.18 27.15.4.1	3256	HE Capabilities Element clause number incorrect	Change clause number to "9.4.2.218"	2017/1/9 9:42
3776 Albert Petrick	225	1 28.1.1	210	50	E	Y	210.50 28.1.1		Period missing at end of sentence	Add period at the of sentence after "receive)"	2017/1/9 9:42
3777 Albert Petrick	225	1 28.3.14.3	342	46	T	Y	342.46 28.3.14.3	3609	In clause 28.3.14.3 the RSSI is measured during the "PHY legacy preamble". The RSSI_LEGACY is defined, but the PHY legacy preamble is not. It's not define or referenced in the IEEE 802.11-2016 baseline. This should be defined and referenced back to the IEEE 802.11-2016 baseline standard.	Add definition for PHY legacy preamble in clause 3.4 Definitions, acronyms, and abbreviations with reference back to IEEE 802.11-2016 figures, text or subclause	2017/1/9 9:42
3778 Albert Petrick	225	1 27.5.2.5	171	40	T	Y	171.40 27.5.2.5	3325	"ACs (#2190, 2191)" are remaining CID placeholders and not part of draft .11ax D1.0	Remove references to CIDs #2190, and 2191	2017/1/9 9:42
3779 Albert Petrick	225	1 9.4.2.1	67	16	T	Y	67.16 9.4.2.1	3260	HE Capabilities Element clause number incorrect in Table 9-77 Element IDs	Change clause number to "9.4.2.218"	2017/1/9 9:42
3780 Albert Petrick	225	1 28.3.18.2	354	46	E	Y	354.46 28.3.18.2	3612	Extra digit in Table 28-44	Change "+3441" to "+344"	2017/1/9 9:42
3781 Albert Petrick	225	1 27.5.2.5	171	41	E	Y	171.41 27.5.2.5	3326	Table number missing for Table 9-XX (Delta TID subfield encoding).	Add Table number 9-18c	2017/1/9 9:42
3782 Albert Petrick	225	1 9.4.2.1	67	20	T	Y	67.20 9.4.2.1	3263	The HE Operation Element clause number is incorrect in Table 9-77 Element IDs.	Change clause number to "9.4.2.219"	2017/1/9 9:42
3783 Albert Petrick	225	1 28.3.14.3	342	12	E	Y	342.12 28.3.14.3	3615	Spelling error with MCS 7	Change "MCS 7" to "MCS7"	2017/1/9 9:42
3784 Albert Petrick	225	1 9.3.1.22	42	7	E	Y	42.07 9.3.1.22	3327	Figure 9-52d Common Info field B20-B21 has a spelling error for "GIAnd LTF Type"	Change "GIAnd" to "GI And"	2017/1/9 9:42
3785 Albert Petrick	225	1 28.1.1	210	58	E	Y	210.58 28.1.1		Period missing at end of sentence	Add period at the of sentence after "PPDUs"	2017/1/9 9:42

3786	Albert Petrick	225	1 28.3.14.3	342	53	T	Y	342.53 28.3.14.3	3359	CCDF not defined	Change "CCDF" to "complementary cumulative distribution function (CCDF)". Add definition for CCDF in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
3787	Albert Petrick	225	1 28.3.14.3	342	10	E	Y	342.10 28.3.14.3	3617	Spelling error with MCS 0	Change "MCS 0" to "MCS0"	2017/1/9 9:42
3788	Albert Petrick	225	1 9.3.1.20	40	1	E	Y	40.01 9.3.1.20	3361	Clause title should not be underlined.	Remove underline; Change to "VHT/HE NDP"	2017/1/9 9:42
3789	Albert Petrick	225	1 28.3.14.3	342	36	E	Y	342.36 28.3.14.3	3619	In Table 28-40 in the Case A column, there is a hyphen character.	Remove hyphen "-" character and leave cell blank	2017/1/9 9:42
3790	Albert Petrick	225	1 9.3.1.23	41	47	E	Y	41.47 9.3.1.23	3363	Parenthesis not needed in Figure 9-52c-Trigger frame	Remove parenthesis - Change "(RA)" to "RA" in Figure 9-52c-Trigger frame	2017/1/9 9:42
3791	Albert Petrick	225	1 9.4.2.218.1	76	2	E	Y	76.02 9.4.2.218.1	3328	Extra period	Remove extra period from the end of sentence.	2017/1/9 9:42
3792	Albert Petrick	225	1 28.1.1	210	64	E	Y	210.64 28.1.1		Period missing at end of sentence	Add period at the of sentence after "20 MHz"	2017/1/9 9:42
3793	Albert Petrick	225	1 28.3.16	344	45	E	Y	344.45 28.3.16	3622	In Figure 28-36 (HE NDP PPDU format) the PE field is the Packet Extension field. The text should reference this field.	Change "Packet Extension" to "Packet Extension (PE)"	2017/1/9 9:42
3794	Albert Petrick	225	1 9.3.1.23	41	59	E	Y	41.59 9.3.1.23	3365	Add space between sentences	Add space at end of sentence after the word "STA."	2017/1/9 9:42
3795	Albert Petrick	225	1 28.1.1	210	64	T	Y	210.64 28.1.1		Bandwidth should be specific to 20 MHz channels	Add the word "channel" before "bandwidth"	2017/1/9 9:42
3796	Albert Petrick	225	1 9.4.2.218.5	89	38	E	Y	89.38 9.4.2.218.5	3329	Extra period	Remove extra period from the end of sentence.	2017/1/9 9:42
3797	Albert Petrick	225	1 28.3.16	344	36	E	Y	344.36 28.3.16	3628	Remove space between sentences	Delete lines 35 and 36. The text should read as follows: NDP is the only HE sounding format. The format of an HE NDP PPDU is shown in Figure 28-36 (HE NDP PPDU format).	2017/1/9 9:42
3798	Albert Petrick	225	1 9.3.1.23	41	61	E	Y	41.61 9.3.1.23	3369	Add space between sentences	Add space at end of sentence after the word "address."	2017/1/9 9:42
3799	Albert Petrick	225	1 9.4.2.218.5	89	13	E	Y	89.13 9.4.2.218.5	3330	Bit positions B0 - Bn not labeled on Figure 9-589cp--PPE Thresholds Info field format	Update Figure 9-589cp with Bit positions B0-Bn for groups of 3 bits per PPET16 and PPET8 subfields.	2017/1/9 9:42
3800	Albert Petrick	225	1 28.1.1	211	5	E	Y	211.05 28.1.1		Period missing at end of sentence	Add period at the of sentence after "20 MHz"	2017/1/9 9:42
3801	Albert Petrick	225	1 28.3.17.4	347	13	E	Y	347.13 28.3.17.4	3631	Extra line space between paragraphs	Remove line 13	2017/1/9 9:42
3802	Albert Petrick	225	1 9.3.3.6	53	36	E	Y	53.36 9.3.3.6	3371	spelling hyphen error in Table 9-30	In Table 9-30 remove hyphen change "pre-sent" to "present"	2017/1/9 9:42
3803	Albert Petrick	225	1 9.3.3.8	54	30	E	Y	54.30 9.3.3.8	3373	spelling hyphen error in Table 9-32	In Table 9-32 remove hyphen change "pre-sent" to "present"	2017/1/9 9:42
3804	Albert Petrick	225	1 10.3.2.8a.1	116	3	E	Y	116.03 10.3.2.8a.1	3331	Extra period	Remove extra period from the end of sentence.	2017/1/9 9:42
3805	Albert Petrick	225	1 9.3.3.11	55	26	E	Y	55.26 9.3.3.11	3374	spelling hyphen error in Table 9-34	In Table 9-34 remove hyphen change "pre-sent" to "present"	2017/1/9 9:42
3806	Albert Petrick	225	1 28.3.17.6.4	349	15	E	Y	349.15 28.3.17.6.4	3636	Paragraph misaligned	Left justify paragraph	2017/1/9 9:42
3807	Albert Petrick	225	1 28.1.1	211	8	E	Y	211.08 28.1.1		Period missing at end of sentence	Add period at the of sentence after "PPDU"	2017/1/9 9:42
3808	Albert Petrick	225	1 9.2.4.1.10	20	5	T	Y	20.05 9.2.4.1.10	3375	"HCT/Order subfield" naming should be consistent when referenced in text. It's referenced as "HTC/Order field"	Change to "HCT/Order subfield" on lines 5 and 7	2017/1/9 9:42
3809	Albert Petrick	225	1 28.5	373	28	E	Y	373.28 28.5	3242	Units "Mbps" in Table 28-47 through Tables 28-102 not consistent with units "Mb/s" in text, tables and figures in IEEE 802.11-2016.	Change "Mbps" to "Mb/s" in Tables 28-47 through Table 28-102. There are 54 tables that need updating!	2017/1/9 9:42
3810	Albert Petrick	225	1 9.2.4.6.4.1	23	37	E	Y	23.37 9.2.4.6.4.1	3377	Reverse Direction Protocol (RDP) in Table 9-18a is missing reference "subclause reference" in the Content of the Control Information subfield.	Add the following clause reference: "See 9.2.4.6.4.8 (Reverse direction protocol (RDP))"	2017/1/9 9:42
3811	Albert Petrick	225	1 27.4.4.5	162	26	E	Y	162.26 27.4.4.5	3332	Extra period	Remove extra period at the end of sentence after the word "context"	2017/1/9 9:42

3812	Albert Petrick	225	1 9.2.4.6.4.1	22	59	T	Y	22.59 9.2.4.6.4.1	3483	In clause A-Control 9.2.6.4 the text needs to clarify the bit length in the Control ID subfields, describe the sequence ordering and state how many Control IDs are defined and reserved. The text should flow with Table 9-15b, and Table 9-18a.	Add the following underlined text (without the underline), and remove the strikethrough text from lines 59 to 65 on page 22 and lines 11 - 12 to read as follows: The A-Control subfield contains a sequence of one or more Control subfields. The format of each Control subfield is defined shown in Figure 9-15b (Control subfield format). The Control subfield with Control ID subfield equal to 0, if present, is the first subfield of the sequence. The Control ID subfield as shown in Figure 9-15b (Control subfield format) is 4-bits in length and indicates the type of information carried in the Control Information subfield. The bit length of the Control Information subfield is fixed for each value of the Control ID subfield that is not reserved. The values of the Control ID subfield and the associated length of the Control	2017/1/9 9:42
3813	Albert Petrick	225	1 28.1.1	211	9	E	Y	211.09 28.1.1		Period missing at end of sentence	Add period at the of sentence after "receive)"	2017/1/9 9:42
3814	Albert Petrick	225	1 28.1.1	209	16	E	Y	209.16 28.1.1	3250	Period missing at end of sentence	Add period at the of sentence after "band"	2017/1/9 9:42
3815	Albert Petrick	225	1 9.2.4.6.4.2	24	20	E	Y	24.20 9.2.4.6.4.2	3380	Editorial formatting error with Target receiver power, TRSSI,	Remove comma "," before TRSSI and change ", TRSSI" to "(TRSSI)"	2017/1/9 9:42
3816	Albert Petrick	225	1 27.5.2.2.1	164	46	E	Y	164.46 27.5.2.2.1	3333	Extra period	Remove extra period at the end of sentence after the word "allocation)"	2017/1/9 9:42
3817	Albert Petrick	225	1 9.2.4.6.4.2	23	59	T	Y	23.59 9.2.4.6.4.2	3381	Provide more clarity: UL PPDU subfield. The text should reference the "5-bits" for UL PPDU Length field in Figure 9-15c.	Insert text "is 5-bits (B0-B4) that" after the word subfield.	2017/1/9 9:42
3818	Albert Petrick	225	1 28.1.1	211	13	E	Y	211.13 28.1.1	3273	Period missing at end of sentence	Add period at the of sentence after "DL OFDMA)"	2017/1/9 9:42
3819	Albert Petrick	225	1 9.2.4.6.4.6	27	39	T	Y	27.39 9.2.4.6.4.6	3382	No reference to the bits in the Reserve subfield In 9.2.4.6.4.6.	Add the following sentence "Bits (B6-B7) are reserved." after the sentence on line 39.	2017/1/9 9:42
3820	Albert Petrick	225	1 28.1.1	209	19	E	Y	209.19 28.1.1	3258	Period missing at end of sentence	Add period at the of sentence after "band"	2017/1/9 9:42
3821	Albert Petrick	225	1 27.5.2.2.1	164	53	E	Y	164.53 27.5.2.2.1	3335	Period missing at end of sentence	Add period at end of sentence after the word "S-MPDUs))"	2017/1/9 9:42
3822	Albert Petrick	225	1 9.2.4.6.4.8	28	60	T	Y	28.60 9.2.4.6.4.8	3384	The bits in Table 9-15i should be called in the text for clarification.	Add the following underlined text. The Control Information 8-bit subfield for the RDP Trigger frame is shown in Figure 9-15i (Control Information subfield format when the Control ID subfield is 6), 6-bits (B2-B7) are reserved. The AC Constraint subfield bit (B0) of the RDP field indicates whether the mapped AC of an RD Data frame is constrained to a single AC, and is defined in Table 9-10 (AC Constraint subfield values), except that if B0 equals a value of 1 indicates that the response from an HE STA contains Data frames from the same AC or higher AC as defined in 10.28.4 (Rules for RD responder). The RDG/More PPDU subfield bit (B1) is defined in Table 9-11 (RDG/More PPDU subfield values).	2017/1/9 9:42
3823	Albert Petrick	225	1 9.3.1.24	41	23	T	Y	41.23 9.3.1.24	3385	CQI acronym not defined in Table 9-25a	Add definition for CQI in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
3824	Albert Petrick	225	1 28.1.1	211	15	E	Y	211.15 28.1.1	3283	Period missing at end of sentence	Add period at the of sentence after "UL OFDMA)"	2017/1/9 9:42
3825	Albert Petrick	225	1 9.4.2.218.3	82	12	E	Y	82.12 9.4.2.218.3	3387	Missing period after sentences in Table 9-262aa	Add "periods" after each sentence in the Definition and Encoding columns in Table 9-262aa	2017/1/9 9:42
3826	Albert Petrick	225	1 28.1.1	209	22	E	Y	209.22 28.1.1	3265	Period missing at end of sentence	Add period at the of sentence after "band"	2017/1/9 9:42
3827	Albert Petrick	225	1 27.5.2.2.1	164	56	E	Y	164.56 27.5.2.2.1	3338	Period missing at end of sentence	Add period at end of sentence after the word "behavior))"	2017/1/9 9:42
3828	Albert Petrick	225	1 9.4.2.218.5	89	36	T	Y	89.36 9.4.2.218.5	3388	PPET, PPET8 and PPET16 acronym not defined	Add definitions for PPET, PPET8 and PPET16 in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
3829	Albert Petrick	225	1 28.1.1	211	18	E	Y	211.18 28.1.1		Period missing at end of sentence	Add period at the of sentence after "streams"	2017/1/9 9:42
3830	Albert Petrick	225	1 9.4.2.221	94	56	T	Y	94.56 9.4.2.221	3244	MUEDCATimer not defined	Add definition for MUEDCATimer in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42

3831	Albert Petrick	225	1 28.1.1	210	6	E	Y	210.06 28.1.1	3663	Period missing at end of sentence	Add period at the of sentence after "bandwidth"	2017/1/9 9:42
3832	Albert Petrick	225	1 27.5.2.2.1	164	59	E	Y	164.59 27.5.2.2.1	3342	Period missing at end of sentence	Add period at end of sentence after the word "TIDs))"	2017/1/9 9:42
3833	Albert Petrick	225	1 27.16.1	204	56	E	Y	204.56 27.16.1	3246	Sentence center justified should be left justified	Left justify sentence; "A STA for which dot11HEOptionImplemented is true shall set dot11VeryHighThroughputOptionImplemented or dot11HighThroughputOptionImplemented to true."	2017/1/9 9:42
3834	Albert Petrick	225	1 28.3.11.5	317	32	T	Y	317.32 28.3.11.5	3251	BCC acronym not defined	Add definition for "BCC = binary convolutional code" in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
3835	Albert Petrick	225	1 28.1.1	211	21	E	Y	211.21 28.1.1		Period missing at end of sentence	Add period at the of sentence after "receive)"	2017/1/9 9:42
3836	Albert Petrick	225	1 28.3.11.5	317	33	T	Y	317.33 28.3.11.5	3252	LDPC acronym not defined	Add definition for "LDPC = low density parity check " in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
3837	Albert Petrick	225	1 28.1.1	210	9	E	Y	210.09 28.1.1	3671	Period missing at end of sentence	Add period at the of sentence after "bandwidth"	2017/1/9 9:42
3838	Albert Petrick	225	1 27.5.2.3	170	15	E	Y	170.15 27.5.2.3	3345	Extra period	Add period at end of sentence after the word "PPDU"	2017/1/9 9:42
3839	Albert Petrick	225	1 9.3.1.23	42	7	E	Y	42.07 9.3.1.23	3255	Space missing between words in GIAnd LTF Type subfield of Figure 9-52	Add character space between the letters "IA" in "GIAnd LTF Type". Should read as "GI And LTF Type"	2017/1/9 9:42
3840	Albert Petrick	225	1 9.4.1.62	56	15	E	Y	56.15 9.4.1.62	3259	Table 9-121a bit positions misaligned	Fix bit alignment with each subfield and resize Figure 9-121a to fit center of page.	2017/1/9 9:42
3841	Albert Petrick	225	1 28.1.1	211	26	E	Y	211.26 28.1.1		Period missing at end of sentence	Add period at the of sentence after "OFDMA)"	2017/1/9 9:42
3842	Albert Petrick	225	1 28.3.3.2	229	31	E	Y	229.31 28.3.3.2	3348	Extra period	Add period at end of sentence after the word "width)"	2017/1/9 9:42
3843	Albert Petrick	225	1 28.1.1	210	13	E	Y	210.13 28.1.1	3677	Period missing at end of sentence	Add period at the of sentence after "MHz"	2017/1/9 9:42
3844	Albert Petrick	225	1 9.4.1.62	56	4	T	Y	56.04 9.4.1.62	3261	The text in Clause 9.4.1.62 HE MIMO Control field) needs clarification. The text should call out number of bits and range of bits for Figure 9-121a.	Add the following underlined text (not underlined text) . The HE MIMO Control field is included in every HE Compressed Beamforming frame (see 9.4.1.63 (HE Compressed Beamforming Report field)). The HE MIMO Control field is 40-bits (B0-B39) and is defined in Figure 9-121a (HE MIMO Control field). The subfields and bit assignments (B0-B39) are defined and described in Table 9-7a (HE MIMO Control field encoding).	2017/1/9 9:42
3845	Albert Petrick	225	1 9.4.2.218.2	77	55	E	Y	77.55 9.4.2.218.2	3349	Table 9-262z misaligned Equation in "Encoding" column. "OfF" misspelled	Fix alignment of Eq Nmax = 2Maximum Number OFF-MPDUs. Change "OfF" to "Off". Increase line spacing between sentences for aligning equation.	2017/1/9 9:42
3846	Albert Petrick	225	1 9.4.1.62	56	30	T	Y	56.30 9.4.1.62	3404	Add clarity. Call out bit positions in Table 9-76a for subfield "Nc Index " corresponding to those bit positions in Figure 9-121a HE MIMO Control field	Add underlined text (without the underline) in "Description" column to read: "Indicates the number of columns, Nc, in the compressed beamforming feed-back matrix minus 1: For 3-bits (B0-B2): Set to 0 for Nc = 1 Set to 1 for Nc = 2 ... Set to 7 for Nc = 8"	2017/1/9 9:42
3847	Albert Petrick	225	1 28.1.1	211	29	E	Y	211.29 28.1.1		Period missing at end of sentence	Add period at the of sentence after "MIMO)"	2017/1/9 9:42
3848	Albert Petrick	225	1 10.13.2	128	42	T	Y	128.42 10.13.2	3241	HE Capabilities Element clause number incorrect	Change clause number to "9.4.2.218"	2017/1/9 9:42
3849	Albert Petrick	225	1 9.4.1.62	56	38	T	Y	56.38 9.4.1.62	3406	Add clarity. Call out bit positions in Table 9-76a for subfield "Nr Index" corresponding to those bit positions in Figure 9-121a HE MIMO Control field	Add underlined text in "Description" column to read: "Indicates the number of rows, Nr, in the compressed beamforming feed-back matrix minus 1: For 3-bits (B3-B5): Set to 0 for Nr = 1 Set to 1 for Nr = 2 ... Set to 7 for Nr = 8"	2017/1/9 9:42
3850	Albert Petrick	225	1 28.1.1	210	15	E	Y	210.15 28.1.1	3685	Period missing at end of sentence	Add period at the of sentence after "subcarriers"	2017/1/9 9:42
3851	Albert Petrick	225	1 9.4.1.62	56	45	T	Y	56.45 9.4.1.62	3408	Add clarity. Call out bit positions in Table 9-76a for subfield "BW" corresponding to those bit positions in Figure 9-121a HE MIMO Control field	Add underlined text (without the underline) in "Description" column to read: "Indicates the channel width used to determine the starting and ending subcarrier indexes when interpreting the RU Start Index and RU End Index subfields. For 2-bits (B6-B7): Set to 0 for 20 MHz Set to 1 for 40 MHz Set to 2 for 80 MHz Set to 3 for 160 MHz and 80+80 MHz"	2017/1/9 9:42

3852	Albert Petrick	225	1 9.4.1.62	56	53	T	Y	56.53 9.4.1.62	3410	Add clarity. Call out bit positions in Table 9-76a for subfield "Grouping" corresponding to the bit positions in Figure 9-121a HE MIMO Control field	Add underlined text (without the underline) in "Description" column to read: "Indicates the subcarrier grouping, Ng, used for the compressed beamforming feedback matrix: Set bit (B8) as follows: Set to 0 for Ng = 4 Set to 1 for Ng = 16"	2017/1/9 9:42
3853	Albert Petrick	225	1 26.6.2	178	63	T	Y	178.63 26.6.2	3249	HE Capabilities Element clause number incorrect	Change clause number to "9.4.2.218"	2017/1/9 9:42
3854	Albert Petrick	225	1 28.1.1	211	32	E	Y	211.32 28.1.1		Period missing at end of sentence	Add period at the of sentence after "OFDMA)"	2017/1/9 9:42
3855	Albert Petrick	225	1 28.1.1	210	17	E	Y	210.17 28.1.1	3691	Period missing at end of sentence	Add period at the of sentence after "4"	2017/1/9 9:42
3856	Albert Petrick	225	1 9.4.1.62	57	4	T	Y	57.04 9.4.1.62	3412	Add clarity. Call out bit positions in Table 9-76a for subfield "Codebook Information" corresponding to the bit positions in Figure 9-121a HE MIMO Control field	Add underlined text (without the underline)in "Description" column to read: "Indicates the size of codebook entries: Set bit B9 for SU and MU Feedback types as follows: If Feedback Type is ....."	2017/1/9 9:42
3857	Albert Petrick	225	1 9.4.1.62	57	14	T	Y	57.14 9.4.1.62	3414	The bit positions in Table 9-76a for subfield "Feedback Type" should correspond to those bit positions in Figure 9-121a HE MIMO Control field	Add underlined text (without the underline) in "Description" column to read: "Indicates the feedback type: For 2-bits (B10-B11) Set to 0 for SU Set to 1 for MU Set to 2 for CQI feedback 3 is reserved"	2017/1/9 9:42
3858	Albert Petrick	225	1 27.15.4.1	203	18	T	Y	203.18 27.15.4.1	3256	HE Capabilities Element clause number incorrect	Change clause number to "9.4.2.218"	2017/1/9 9:42
3859	Albert Petrick	225	1 28.1.1	211	34	E	Y	211.34 28.1.1		Period missing at end of sentence	Add period at the of sentence after "PPDU"	2017/1/9 9:42
3860	Albert Petrick	225	1 9.4.1.62	57	21	T	Y	57.21 9.4.1.62	3416	Add clarity. Call out bit positions in Table 9-76a for subfield "Remaining Feedback Segments" corresponding to those bit positions in Figure 9-121a HE MIMO Control field	Add underlined text (as not underlined text) in "Description" column to read: "Indicates the number of remaining feedback segments for the associated VHT Compressed Beamforming frame: For 3-bits (B12-B14) Set to 0 for the last feedback segment of a segmented report....."	2017/1/9 9:42
3861	Albert Petrick	225	1 28.1.1	210	18	E	Y	210.18 28.1.1	3698	Period missing at end of sentence	Add period at the of sentence after "11"	2017/1/9 9:42
3862	Albert Petrick	225	1 9.4.2.1	67	16	T	Y	67.16 9.4.2.1	3260	HE Capabilities Element clause number incorrect in Table 9-77 Element IDs	Change clause number to "9.4.2.218"	2017/1/9 9:42
3863	Albert Petrick	225	1 9.4.1.62	57	32	T	Y	57.32 9.4.1.62	3418	Add clarity. Call out bit positions in Table 9-76a for subfield "First Feedback Segments" corresponding to the bit positions in Figure 9-121a HE MIMO Control field	Add underlined text (without the underline) in "Description" column to read: "Set bit (B15) as follows: Set to 1 for the first feedback segment of a segmented report or the only feedback segment of an unsegmented report. Set to 0 if not the first feedback segment or if the VHT....."	2017/1/9 9:42
3864	Albert Petrick	225	1 28.1.1	210	18	E	Y	210.18 28.1.1	3701	Referencing "MCS 10" not consistent in text in .11ax D1.0. Should use "MCS10"	Change "MCS 10" to MCS10" Change "11" to "MCS11"	2017/1/9 9:42
3865	Albert Petrick	225	1 9.4.2.1	67	20	T	Y	67.20 9.4.2.1	3263	The HE Operation Element clause number is incorrect in Table 9-77 Element IDs.	Change clause number to "9.4.2.219"	2017/1/9 9:42
3866	Albert Petrick	225	1 9.4.1.62	57	40	T	Y	57.40 9.4.1.62	3419	Add clarity. Call out bit positions in Table 9-76a for subfield "RU Start Index" corresponding to those bit positions in Figure 9-121a HE MIMO Control field	Add underlined text in "Description" column to read: "The starting RU index 7-Bits (B16-B22) indicates the first 26-tone RU for which the HE beamformer is requesting feedback."	2017/1/9 9:42
3867	Albert Petrick	225	1 28.3.14.3	342	53	T	Y	342.53 28.3.14.3	3359	CCDF not defined	Change "CCDF" to "complementary cumulative distribution function (CCDF)". Add definition for CCDF in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
3868	Albert Petrick	225	1 28.1.1	211	38	E	Y	211.38 28.1.1		Period missing at end of sentence	Add period at the of sentence after "receive)"	2017/1/9 9:42
3869	Albert Petrick	225	1 9.4.1.62	57	43	T	Y	57.43 9.4.1.62	3421	Add clarity. Call out bit positions in Table 9-76a for subfield "RU End Index" corresponding to those bit positions in Figure 9-121a HE MIMO Control field.	Add the following underlined text (without the underline) in "Description" column to read: "The ending RU index 7-Bits (B23-B29) indicates the first 26-tone RU for which the HE beamformer is requesting feedback."	2017/1/9 9:42
3870	Albert Petrick	225	1 9.3.1.20	40	1	E	Y	40.01 9.3.1.20	3361	Clause title should not be underlined.	Remove underline; Change to "VHT/HE NDP"	2017/1/9 9:42
3871	Albert Petrick	225	1 28.1.1	210	22	E	Y	210.22 28.1.1	3707	Period missing at end of sentence	Add period at the of sentence after "20 MHz"	2017/1/9 9:42

3872	Albert Petrick	225	1 9.4.1.62	57	46	T	Y	57.46 9.4.1.62	3529	The description of the Sounding Dialog Token Number in Table 9-76a is not correct. This should be similar to the description in Table 9-66.	Add the following underlined text (without the underline) and remove the strikethrough text in "Description" column to read: "The ending RU index indicates the last RU26 for which the HE beamformer is requesting feedback. The sounding dialog token is from the HE NDP Announcement frame soliciting feedback. "	2017/1/9 9:42
3873	Albert Petrick	225	1 9.3.1.23	41	47	E	Y	41.47 9.3.1.23	3363	Parenthesis not needed in Figure 9-52c-Trigger frame	Remove parenthesis - Change "(RA)" to "RA" in Figure 9-52c-Trigger frame	2017/1/9 9:42
3874	Albert Petrick	225	1 9.4.1.62	57	49	T	Y	57.49 9.4.1.62	3423	The "Reserved" subfield and description is missing in Table 9-76a. corresponding to Figure 121a.	At the end of Table 9-76a insert a new row and add the following underlined text (without the underline) "Reserved" in Subfield column, and the following text in Description column. "4-bits (B36-B39) are reserved."	2017/1/9 9:42
3875	Albert Petrick	225	1 28.1.1	211	41	E	Y	211.41 28.1.1		Period missing at end of sentence	Add period at the of sentence after "receive)"	2017/1/9 9:42
3876	Albert Petrick	225	1 9.3.1.23	41	59	E	Y	41.59 9.3.1.23	3365	Add space between sentences	Add space at end of sentence after the word "STA."	2017/1/9 9:42
3877	Albert Petrick	225	1 9.4.1.63	58	28	T	Y	58.28 9.4.1.63	3425	Equation (8-1) missing	Add reference and/or detailed equation (8-1)	2017/1/9 9:42
3878	Albert Petrick	225	1 28.1.1	210	26	E	Y	210.26 28.1.1	3714	Period missing at end of sentence	Add period at the of sentence after "STA"	2017/1/9 9:42
3879	Albert Petrick	225	1 9.4.1.63	59	57	T	Y	59.57 9.4.1.63	3427	In Table 9-76c, "FB" in 20, 40 and 80 MHz (S, E) FB tone labels need to be defined to follow the foregoing text.	Change "FB" to "Feedback" in column label headers: 80 MHz FB tone, 40 MHz FB tone and 20 MHz FB tone.	2017/1/9 9:42
3880	Albert Petrick	225	1 28.1.1	211	42	E	Y	211.42 28.1.1		Period missing at end of sentence	Add period at the of sentence after "puncturing"	2017/1/9 9:42
3881	Albert Petrick	225	1 9.4.1.63	61	57	T	Y	61.57 9.4.1.63	3428	In Table 9-76d, "FB" in 20,40, 80 MHz (S, E) FB tone labels need to be defined to follow the foregoing text.	Change "FB" to "Feedback" in column label headers: 80 MHz FB tone, 40 MHz FB tone and 20 MHz FB tone.	2017/1/9 9:42
3882	Albert Petrick	225	1 9.3.1.23	41	61	E	Y	41.61 9.3.1.23	3369	Add space between sentences	Add space at end of sentence after the word "address."	2017/1/9 9:42
3883	Albert Petrick	225	1 9.4.1.63	59	38	T	Y	59.38 9.4.1.63	3539	The S-tone and E-tone description needs clarification when comparing and referencing tables 9-76c and 9-76d.	Add underlined text (without the underline) and remove strikethrough text from line 38 to 49 as follows: The S-tone and E-tone corresponding to the possible RU indices for 20MHz, 40MHz and 80 MHz channels are listed in Table 9-76c and Table 9-76d. (Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for Ng = 4) for Ng = 4 are shown in Table 9-76c, and for Ng = 16 for in Table 9-76d. (Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for Ng = 16) for Ng = 16. For 160 MHz, to determine the S-tone and E-tone, RUs 37 to 73 occupying the higher 80 MHz use the same entries in Table 9-76c (Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for Ng = 4) and Table 9-76d (Feedback subcarrier indices indicating start 26-tone RU index and end	2017/1/9 9:42
3884	Albert Petrick	225	1 28.1.1	210	30	E	Y	210.30 28.1.1	3722	Period missing at end of sentence	Add period at the of sentence after "STA"	2017/1/9 9:42
3885	Albert Petrick	225	1 9.3.3.6	53	36	E	Y	53.36 9.3.3.6	3371	spelling hyphen error in Table 9-30	In Table 9-30 remove hyphen change "pre-sent" to "present"	2017/1/9 9:42

3886	Albert Petrick	225	1 9.4.1.63	63	21	T	Y	63.21 9.4.1.63	3431	Calculating the AveSNRi needs more clarification.	Add the following underlined text (without the underline) and remove the strikethrough text from lines 21 through 30 as follows: The AvgSNRi in Table 9-71 (Average SNR of Space-Time Stream i subfield) is found determined by computing the SNR per subcarrier in decibels for the subcarriers in 20 MHz channel bandwidth identified in Table 9-76c (Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for Ng = 4) for Ng = 4 , and for Ng = 16 in Table 9-76d. (Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for Ng = 16) for Ng = 16, and then The computing (The arithmetic mean is calculated of for those values. Each SNR value per subcarrier in stream i (before being averaged) corresponds to the SNR associated with the column i of the beamforming feedback matrix V determined	2017/1/9 9:42
3887	Albert Petrick	225	1 9.3.3.8	54	30	E	Y	54.30 9.3.3.8	3373	spelling hyphen error in Table 9-32	In Table 9-32 remove hyphen change "pre-sent" to "present"	2017/1/9 9:42
3888	Albert Petrick	225	1 28.1.1	211	47	E	Y	211.47 28.1.1		Period missing at end of sentence	Add period at the of sentence after "OFDMA)"	2017/1/9 9:42
3889	Albert Petrick	225	1 9.4.1.63	63	4	E	Y	63.04 9.4.1.63	3432	Spelling error "indeces" in Table 9-763	Change "indeces" to "indices"	2017/1/9 9:42
3890	Albert Petrick	225	1 9.3.3.11	55	26	E	Y	55.26 9.3.3.11	3374	spelling hyphen error in Table 9-34	In Table 9-34 remove hyphen change "pre-sent" to "present"	2017/1/9 9:42
3891	Albert Petrick	225	1 28.1.1	210	31	E	Y	210.31 28.1.1	3727	Period missing at end of sentence	Add period at the of sentence after "MSC11"	2017/1/9 9:42
3892	Albert Petrick	225	1 9.4.1.64	64	48	T	Y	64.48 9.4.1.64	3434	Missing number of bits for Delta SNR for k=scidx(Ns-1)	Add number of bits for (Ns-1) for Delta SNR	2017/1/9 9:42
3893	Albert Petrick	225	1 9.2.4.1.10	20	5	T	Y	20.05 9.2.4.1.10	3375	"HCT/Order subfield" naming should be consistent when referenced in text. It's referenced as "HTC/Order field"	Change to "HCT/Order subfield" on lines 5 and 7	2017/1/9 9:42
3894	Albert Petrick	225	1 9.2.4.6.4.1	23	37	E	Y	23.37 9.2.4.6.4.1	3377	Reverse Direction Protocol (RDP) in Table 9-18a is missing reference "subclause reference" in the Content of the Control Information subfield.	Add the following clause reference: "See 9.2.4.6.4.8 (Reverse direction protocol (RDP))"	2017/1/9 9:42
3895	Albert Petrick	225	1 28.1.1	211	50	E	Y	211.50 28.1.1		Period missing at end of sentence	Add period at the of sentence after "OFDMA)"	2017/1/9 9:42
3896	Albert Petrick	225	1 9.2.4.6.4.1	22	59	T	Y	22.59 9.2.4.6.4.1	3483	In clause A-Control 9.2.6.4 the text needs to clarify the bit length in the Control ID subfields, describe the sequence ordering and state how many Control IDs are defined and reserved. The text should flow with Table 9-15b, and Table 9-18a.	Add the following underlined text (without the underline), and remove the strikethrough text from lines 59 to 65 on page 22 and lines 11 - 12 to read as follows: The A-Control subfield contains a sequence of one or more Control subfields. The format of each Control subfield is defined shown in Figure 9-15b (Control subfield format). The Control subfield with Control ID subfield equal to 0, if present, is the first subfield of the sequence. The Control ID subfield as shown in Figure 9-15b (Control subfield format) is 4-bits in length and indicates the type of information carried in the Control Information subfield. The bit length of the Control Information subfield is fixed for each value of the Control ID subfield that is not reserved. The values of the Control ID subfield and the associated length of the Control	2017/1/9 9:42
3897	Albert Petrick	225	1 28.1.1	210	33	E	Y	210.33 28.1.1	3247	Period missing at end of sentence	Add period at the of sentence after "5"	2017/1/9 9:42
3898	Albert Petrick	225	1 9.4.1.64	64	53	T	Y	64.53 9.4.1.64	3436	Missing number of bits for Delta SNR for k=scidx(Ns-1)	Add number of bits for (Ns-1) for Delta SNR	2017/1/9 9:42
3899	Albert Petrick	225	1 9.2.4.6.4.2	24	20	E	Y	24.20 9.2.4.6.4.2	3380	Editorial formatting error with Target receiver power, TRSSI,	Remove comma "," before TRSSI and change ", TRSSI" to "(TRSSI)"	2017/1/9 9:42
3900	Albert Petrick	225	1 9.4.1.64	64	13	E	Y	64.13 9.4.1.64	3437	Remove paragraph indent	Fix paragraph alignment starting at "No padding is present....."	2017/1/9 9:42
3901	Albert Petrick	225	1 28.1.1	211	62	E	Y	211.62 28.1.1	3268	Period missing at end of sentence	Add period at the of sentence after "least 4"	2017/1/9 9:42
3902	Albert Petrick	225	1 9.2.4.6.4.2	23	59	T	Y	23.59 9.2.4.6.4.2	3381	Provide more clarity: UL PPDU subfield. The text should reference the "5-bits" for UL PPDU Length field in Figure 9-15c.	Insert text "is 5-bits (B0-B4) that" after the word subfield.	2017/1/9 9:42

3903	Albert Petrick	225	1 9.4.1.64	64	18	T	Y	64.18 9.4.1.64	3439	Equation (9-2) is referenced in the text and in Table 9-76f HE MU Exclusive Beamforming Report information, and is not linked or referenced to any other documents. Equation (9-2) should be linked and referenced to its location IEEE 802.11-2016 (Rev D8.0) and clarified as a "Note" at the end of Table 9-76f.	Add note for equation 9-2 in text and/or add the following underlined text (without the underline) and reference link in Table 9-76f as a Note: "as defined in Equation (9-2) in clause 9.4.1.51 (MU Exclusive Beamforming Report Field)"	2017/1/9 9:42
3904	Albert Petrick	225	1 28.1.1	210	35	E	Y	210.35 28.1.1	3254	Period missing at end of sentence	Add period at the of sentence after "PPDUs"	2017/1/9 9:42
3905	Albert Petrick	225	1 9.2.4.6.4.6	27	39	T	Y	27.39 9.2.4.6.4.6	3382	No reference to the bits in the Reserve subfield In 9.2.4.6.4.6.	Add the following sentence "Bits (B6-B7) are reserved." after the sentence on line 39.	2017/1/9 9:42
3906	Albert Petrick	225	1 9.4.1.64	64	30	T	Y	64.30 9.4.1.64	3440	Equation (9-2) reference in Table 9-76f calls out subcarrier k=scidx(0) and k=scidx(1). Equation 9-2 in IEEE 802.11-2016 (Rev D8.0) in clause 9.4.1.51 specifies k=sscidx(0) and k=sscidx(1) There appears to be an ambiguity in equation in 9-2 and with k=scidx(_)	Fix references for subcarrier k=scidx(0) and k=scidx(1) in Table 9-76f (lines 30-54) to match assumptions with equation 9-2 in clause 9.4.1.51 in IEEE 802.11-2016 (Rev D8.0)	2017/1/9 9:42
3907	Albert Petrick	225	1 9.2.4.6.4.8	28	60	T	Y	28.60 9.2.4.6.4.8	3384	The bits in Table 9-15i should be called in the text for clarification.	Add the following underlined text. The Control Information 8-bit subfield for the RDP Trigger frame is shown in Figure 9-15i (Control Information subfield format when the Control ID subfield is 6), 6-bits (B2-B7) are reserved. The AC Constraint subfield bit (B0) of the RDP field indicates whether the mapped AC of an RD Data frame is constrained to a single AC, and is defined in Table 9-10 (AC Constraint subfield values), except that if B0 equals a value of 1 indicates that the response from an HE STA contains Data frames from the same AC or higher AC as defined in 10.28.4 (Rules for RD responder). The RDG/More PPDU subfield bit (B1) is defined in Table 9-11 (RDG/More PPDU subfield values).	2017/1/9 9:42
3908	Albert Petrick	225	1 28.4.2	371	36	T	Y	371.36 28.4.2	3441	Clarify "aSignalExtension" referenced from Table 19-25	Add the following underlined text (without the underline): and is aSignalExtension (0us for 5 GHz band, 6us for 2.4 GHz band)	2017/1/9 9:42
3909	Albert Petrick	225	1 28.1.1	212	2	E	Y	212.02 28.1.1	3280	Period missing at end of sentence	Add period at the of sentence after "applicable"	2017/1/9 9:42
3910	Albert Petrick	225	1 9.3.1.24	41	23	T	Y	41.23 9.3.1.24	3385	CQI acronym not defined in Table 9-25a	Add definition for CQI in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
3911	Albert Petrick	225	1 28.1.1	210	38	E	Y	210.38 28.1.1	3264	Period missing at end of sentence	Add period at the of sentence after "receive)"	2017/1/9 9:42
3912	Albert Petrick	225	1 28.4.2	371	39	E	Y	371.39 28.4.2	3443	Missing period	Add period at the end of sentence after "false"	2017/1/9 9:42
3913	Albert Petrick	225	1 9.4.2.218.3	82	12	E	Y	82.12 9.4.2.218.3	3387	Missing period after sentences in Table 9-262aa	Add "periods" after each sentence in the Definition and Encoding columns in Table 9-262aa	2017/1/9 9:42
3914	Albert Petrick	225	1 9.2.5.2	32	1	E	Y	32.01 9.2.5.2	3444	Format error - sentence alignment	Sentence format needs to be left justified.	2017/1/9 9:42
3915	Albert Petrick	225	1 28.1.1	212	2	E	Y	212.02 28.1.1		Period missing at end of sentence	Add period at the of sentence after "receive)"	2017/1/9 9:42
3916	Albert Petrick	225	1 9.4.2.218.5	89	36	T	Y	89.36 9.4.2.218.5	3388	PPET, PPET8 and PPET16 acronym not defined	Add definitions for PPET, PPET8 and PPET16 in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
3917	Albert Petrick	225	1 9.3.1.9.1	34	12	T	Y	34.12 9.3.1.9.1	3446	In Figure 9-33 (BA Control Field) Bit (B5) in the Reserve sub-field is marked as deleted (strikethrough) as shown. The Reserved subfield now shows 7-bits (B6-B11). The text does not describe B5. Define B5 or correct Figure 9-33	Fix as commented	2017/1/9 9:42
3918	Albert Petrick	225	1 28.1.1	210	41	E	Y	210.41 28.1.1	3747	Period missing at end of sentence	Add period at the of sentence after "MIMO)"	2017/1/9 9:42
3919	Albert Petrick	225	1 9.4.2.221	94	56	T	Y	94.56 9.4.2.221	3244	MUEDCATimer not defined	Add definition for MUEDCATimer in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
3920	Albert Petrick	225	1 B.4.27.2	413	45	E	Y	413.45 B.4.27.2	3447	Numbering / letter (5GHz) spacing issue in Table B.4.27.2 HEW PHY features	Change "5GHz" to "5 GHz"	2017/1/9 9:42
3921	Albert Petrick	225	1 27.16.1	204	56	E	Y	204.56 27.16.1	3246	Sentence center justified should be left justified	Left justify sentence; "A STA for which dot11HEOptionImplemented is true shall set dot11VeryHighThroughputOptionImplemented or dot11HighThroughputOptionImplemented to true."	2017/1/9 9:42

3922	Albert Petrick	225	1 9.3.1.23	45	6	E	Y	45.06 9.3.1.23	3449	Number / letter (2.4GHz) spacing issue in Table B.4.27.2 HEW PHY features	Change "2.4GHz" to "2.4 GHz"	2017/1/9 9:42
3923	Albert Petrick	225	1 28.1.1	212	9	E	Y	212.09 28.1.1		Period missing at end of sentence	Add period at the of sentence after "bandwidth"	2017/1/9 9:42
3924	Albert Petrick	225	1 28.3.11.5	317	32	T	Y	317.32 28.3.11.5	3251	BCC acronym not defined	Add definition for "BCC = binary convolutional code" in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
3925	Albert Petrick	225	1 28.1.1	210	44	E	Y	210.44 28.1.1	3754	Period missing at end of sentence	Add period at the of sentence after "receive)"	2017/1/9 9:42
3926	Albert Petrick	225	1 28.3.11.5	317	33	T	Y	317.33 28.3.11.5	3252	LDPC acronym not defined	Add definition for "LDPC = low density parity check " in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
3927	Albert Petrick	225	1 9.4.2.218.2	76	24	E	Y	76.24 9.4.2.218.2	3450	Format error - sentence alignment	Fix paragraph alignment - left justify.	2017/1/9 9:42
3928	Albert Petrick	225	1 9.3.1.23	42	7	E	Y	42.07 9.3.1.23	3255	Space missing between words in GIAnd LTF Type subfield of Figure 9-52	Add character space between the letters "IA" in "GIAnd LTF Type". Should read as "GI And LTF Type"	2017/1/9 9:42
3929	Albert Petrick	225	1 28.1.1	212	14	E	Y	212.14 28.1.1		Period missing at end of sentence	Add period at the of sentence after "supported"	2017/1/9 9:42
3930	Albert Petrick	225	1 9.4.2.218.3	81	35	E	Y	81.35 9.4.2.218.3	3453	In Figure 9-589cl - (HE PHY Capabilities Information field format) subfield NSTA Total For < 80 MHz is labeled as having 2-bits. There are 3-bits (B37 -B39).	Change Bits "2" to "3" for subfield "NSTS Total for < 80 MHz" in Figure 9m-589cl	2017/1/9 9:42
3931	Albert Petrick	225	1 9.4.1.62	56	15	E	Y	56.15 9.4.1.62	3259	Table 9-121a bit positions misaligned	Fix bit alignment with each subfield and resize Figure 9-121a to fit center of page.	2017/1/9 9:42
3932	Albert Petrick	225	1 28.1.1	210	46	E	Y	210.46 28.1.1	3763	Period missing at end of sentence	Add period at the of sentence after "receive)"	2017/1/9 9:42
3933	Albert Petrick	225	1 9.4.2.218.3	81	35	T	Y	81.35 9.4.2.218.3	3455	In Figure 9-589cl - (HE PHY Capabilities Information field format) subfield "Number Of Sounding Dimensions For < 80 MHz" is mark as having 1-bit. There are 3-bits (B46 -B48).	Change Bits "1" to "3" for subfield "NSTS Total for < 80 MHz" in Figure 9-589cl	2017/1/9 9:42
3934	Albert Petrick	225	1 9.4.1.62	56	4	T	Y	56.04 9.4.1.62	3261	The text in Clause 9.4.1.62 HE MIMO Control field) needs clarification. The text should call out number of bits and range of bits for Figure 9-121a.	Add the following underlined text (not underlined text) . The HE MIMO Control field is included in every HE Compressed Beamforming frame (see 9.4.1.63 (HE Compressed Beamforming Report field)). The HE MIMO Control field is 40-bits (B0-B39) and is defined in Figure 9-121a (HE MIMO Control field). The subfields and bit assignments (B0-B39) are defined and described in Table 9-7a (HE MIMO Control field encoding).	2017/1/9 9:42
3935	Albert Petrick	225	1 9.4.2.218.3	81	35	T	Y	81.35 9.4.2.218.3	3270	In Figure 9-589cl - (HE PHY Capabilities Information field format) subfield "Number Of Sounding Dimensions For > 80 MHz" is labeled as 1-bit. There are 3-bits (B49 -B51).	Change Bits "1" to "3" for subfield "NSTS Total for > 80 MHz" in Figure 9-589cl	2017/1/9 9:42
3936	Albert Petrick	225	1 28.1.1	212	17	E	Y	212.17 28.1.1		Period missing at end of sentence	Add period at the of sentence after "capable"	2017/1/9 9:42
3937	Albert Petrick	225	1 9.4.1.62	56	30	T	Y	56.30 9.4.1.62	3404	Add clarity. Call out bit positions in Table 9-76a for subfield "Nc Index " corresponding to those bit positions in Figure 9-121a HE MIMO Control field	Add underlined text (without the underline) in "Description" column to read: "Indicates the number of columns, Nc, in the compressed beamforming feed-back matrix minus 1: For 3-bits (B0-B2): Set to 0 for Nc = 1 Set to 1 for Nc = 2 ... Set to 7 for Nc = 8"	2017/1/9 9:42
3938	Albert Petrick	225	1 9.4.2.218.3	83	6	T	Y	83.06 9.4.2.218.3	3274	Add clarity. Call out bit positions in Table 9-262aa for subfield "Device Class" corresponding to those bit positions in Figure 9-589cl	In "Definition" column: Add "B12:" at the beginning of the sentence." In the "Encoding" column: Before sentence Add "B12:" "Set to 1 to indicate STA is a Class A device." In the "Encoding" column: Before sentence Add "B12:" Set to 0 to indicate STA is a Class B device. Note: This field is reserved when transmitting STA is an AP STA."	2017/1/9 9:42
3939	Albert Petrick	225	1 28.1.1	210	48	E	Y	210.48 28.1.1	3769	Period missing at end of sentence	Add period at the of sentence after "PPDUs"	2017/1/9 9:42
3940	Albert Petrick	225	1 9.4.1.62	56	38	T	Y	56.38 9.4.1.62	3406	Add clarity. Call out bit positions in Table 9-76a for subfield "Nr Index" corresponding to those bit positions in Figure 9-121a HE MIMO Control field	Add underlined text in "Description" column to read: "Indicates the number of rows, Nr, in the compressed beamforming feed-back matrix minus 1: For 3-bits (B3-B5): Set to 0 for Nr = 1 Set to 1 for Nr = 2 ... Set to 7 for Nr = 8"	2017/1/9 9:42

3941	Albert Petrick	225	1 9.4.2.218.3	83	13	T	Y	83.13 9.4.2.218.3	3277	Add clarity and call out bit positions in Table 9-262aa for subfield "LDPC Coding In Payload" corresponding to those bit positions in Figure 9-589cl	Change text in "Definition" column to read: "B13: Indicates support of transmission....." Change text in "Encoding" column to read: "B13: Set to 1 to indicate STA.... B13: Set to 9 otherwise. "	2017/1/9 9:42
3942	Albert Petrick	225	1 9.4.1.62	56	45	T	Y	56.45 9.4.1.62	3408	Add clarity. Call out bit positions in Table 9-76a for subfield "BW" corresponding to those bit positions in Figure 9-121a HE MIMO Control field	Add underlined text (without the underline) in "Description" column to read: "Indicates the channel width used to determine the starting and ending subcarrier indexes when interpreting the RU Start Index and RU End Index subfields. For 2-bits (B6-B7): Set to 0 for 20 MHz Set to 1 for 40 MHz Set to 2 for 80 MHz Set to 3 for 160 MHz and 80+80 MHz"	2017/1/9 9:42
3943	Albert Petrick	225	1 28.1.1	212	19	E	Y	212.19 28.1.1		Period missing at end of sentence	Add period at the of sentence after "capable"	2017/1/9 9:42
3944	Albert Petrick	225	1 9.4.2.218.3	83	16	T	Y	83.16 9.4.2.218.3	3282	Add clarity and call out bit positions in Table 9-262 aa for subfield "HE-LTF And GI For HE PPDUs" corresponding to those bit positions in Figure 9-589cl	Change text in "Encoding column to read: "For B14 and B15: Set to 1 if supported by the STA. Set to 0 otherwise."	2017/1/9 9:42
3945	Albert Petrick	225	1 9.4.1.62	56	53	T	Y	56.53 9.4.1.62	3410	Add clarity. Call out bit positions in Table 9-76a for subfield "Grouping" corresponding to the bit positions in Figure 9-121a HE MIMO Control field	Add underlined text (without the underline) in "Description" column to read: "Indicates the subcarrier grouping, Ng, used for the compressed beamforming feedback matrix: Set bit (B8) as follows: Set to 0 for Ng = 4 Set to 1 for Ng = 16"	2017/1/9 9:42
3946	Albert Petrick	225	1 28.1.1	210	50	E	Y	210.50 28.1.1	3776	Period missing at end of sentence	Add period at the of sentence after "receive)"	2017/1/9 9:42
3947	Albert Petrick	225	1 9.4.2.218.3	82	15	E	Y	82.15 9.4.2.218.3	3286	Table 9-262aa, "Definition column" missing period at end of sentence	Fix. Add period after 2.4 GHz.	2017/1/9 9:42
3948	Albert Petrick	225	1 9.4.1.62	57	4	T	Y	57.04 9.4.1.62	3412	Add clarity. Call out bit positions in Table 9-76a for subfield "Codebook Information" corresponding to the bit positions in Figure 9-121a HE MIMO Control field	Add underlined text (without the underline)in "Description" column to read: "Indicates the size of codebook entries: Set bit B9 for SU and MU Feedback types as follows: If Feedback Type is ....."	2017/1/9 9:42
3949	Albert Petrick	225	1 9.4.1.62	57	14	T	Y	57.14 9.4.1.62	3414	The bit positions in Table 9-76a for subfield "Feedback Type" should correspond to those bit positions in Figure 9-121a HE MIMO Control field	Add underlined text (without the underline) in "Description" column to read: "Indicates the feedback type: For 2-bits (B10-B11) Set to 0 for SU Set to 1 for MU Set to 2 for CQI feedback 3 is reserved"	2017/1/9 9:42
3950	Albert Petrick	225	1 28.1.1	212	22	E	Y	212.22 28.1.1		Period missing at end of sentence	Add period at the of sentence after "capable"	2017/1/9 9:42
3951	Albert Petrick	225	1 28.1.1	210	58	E	Y	210.58 28.1.1	3785	Period missing at end of sentence	Add period at the of sentence after "PPDUs"	2017/1/9 9:42
3952	Albert Petrick	225	1 9.4.1.62	57	21	T	Y	57.21 9.4.1.62	3416	Add clarity. Call out bit positions in Table 9-76a for subfield "Remaining Feedback Segments" corresponding to those bit positions in Figure 9-121a HE MIMO Control field	Add underlined text (as not underlined text) in "Description" column to read: "Indicates the number of remaining feedback segments for the associated VHT Compressed Beamforming frame: For 3-bits (B12-B14) Set to 0 for the last feedback segment of a segmented report....."	2017/1/9 9:42
3953	Albert Petrick	225	1 9.4.2.218.3	82	18	E	Y	82.18 9.4.2.218.3	3465	Table 9-262aa, "Definition column" missing period at end of sentence	Fix. Add period after 5 GHz.	2017/1/9 9:42
3954	Albert Petrick	225	1 9.4.1.62	57	32	T	Y	57.32 9.4.1.62	3418	Add clarity. Call out bit positions in Table 9-76a for subfield "First Feedback Segments" corresponding to the bit positions in Figure 9-121a HE MIMO Control field	Add underlined text (without the underline) in "Description" column to read: "Set bit (B15) as follows: Set to 1 for the first feedback segment of a segmented report or the only feedback segment of an unsegmented report. Set to 0 if not the first feedback segment or if the VHT....."	2017/1/9 9:42
3955	Albert Petrick	225	1 9.4.1.62	57	40	T	Y	57.40 9.4.1.62	3419	Add clarity. Call out bit positions in Table 9-76a for subfield "RU Start Index" corresponding to those bit positions in Figure 9-121a HE MIMO Control field	Add underlined text in "Description" column to read: "The starting RU index 7-Bits (B16-B22) indicates the first 26-tone RU for which the HE beamformer is requesting feedback."	2017/1/9 9:42
3956	Albert Petrick	225	1 28.1.1	212	27	E	Y	212.27 28.1.1		Period missing at end of sentence	Add period at the of sentence after "applicable"	2017/1/9 9:42
3957	Albert Petrick	225	1 28.1.1	210	64	E	Y	210.64 28.1.1	3792	Period missing at end of sentence	Add period at the of sentence after "20 MHz"	2017/1/9 9:42

3958	Albert Petrick	225	1 9.4.2.218.3	82	20	E	Y	82.20 9.4.2.218.3	3468	Table 9-262aa, "Definition column" missing period at end of sentence	Fix. Add period after 5 GHz.	2017/1/9 9:42
3959	Albert Petrick	225	1 9.4.1.62	57	43	T	Y	57.43 9.4.1.62	3421	Add clarity. Call out bit positions in Table 9-76a for subfield "RU End Index" corresponding to those bit positions in Figure 9-121a HE MIMO Control field.	Add the following underlined text (without the underline) in "Description" column to read: "The ending RU index 7-Bits (B23-B29) indicates the first 26-tone RU for which the HE beamformer is requesting feedback."	2017/1/9 9:42
3960	Albert Petrick	225	1 28.1.1	210	64	T	Y	210.64 28.1.1	3795	Bandwidth should be specific to 20 MHz channels	Add the word "channel" before "bandwidth"	2017/1/9 9:42
3961	Albert Petrick	225	1 9.4.1.62	57	46	T	Y	57.46 9.4.1.62	3529	The description of the Sounding Dialog Token Number in Table 9-76a is not correct. This should be similar to the description in Table 9-66.	Add the following underlined text (without the underline) and remove the strikethrough text in "Description" column to read: "The ending RU index indicates the last RU26 for which the HE beamformer is requesting feedback. The sounding dialog token is from the HE NDP Announcement frame soliciting feedback. "	2017/1/9 9:42
3962	Albert Petrick	225	1 28.1.1	212	35	E	Y	212.35 28.1.1		Period missing at end of sentence	Add period at the of sentence after "least 4"	2017/1/9 9:42
3963	Albert Petrick	225	1 9.4.1.62	57	49	T	Y	57.49 9.4.1.62	3423	The "Reserved" subfield and description is missing in Table 9-76a. corresponding to Figure 121a.	At the end of Table 9-76a insert a new row and add the following underlined text (without the underline) "Reserved" in Subfield column, and the following text in Description column. "4-bits (B36-B39) are reserved."	2017/1/9 9:42
3964	Albert Petrick	225	1 9.4.2.218.3	82	23	E	Y	82.23 9.4.2.218.3	3471	Table 9-262aa, "Definition column" missing period at end of sentence	Fix. Add period after 5 GHz.	2017/1/9 9:42
3965	Albert Petrick	225	1 9.4.1.63	58	28	T	Y	58.28 9.4.1.63	3425	Equation (8-1) missing	Add reference and/or detailed equation (8-1)	2017/1/9 9:42
3966	Albert Petrick	225	1 28.1.1	211	5	E	Y	211.05 28.1.1	3800	Period missing at end of sentence	Add period at the of sentence after "20 MHz"	2017/1/9 9:42
3967	Albert Petrick	225	1 9.4.2.218.3	82	18	E	Y	82.18 9.4.2.218.3	3472	Table 9-262aa, "Encoding column" missing period at end of sentence	Fix. Change "Note" to "NOTE" and add colon ":" after "NOTE:"	2017/1/9 9:42
3968	Albert Petrick	225	1 9.4.1.63	59	57	T	Y	59.57 9.4.1.63	3427	In Table 9-76c, "FB" in 20, 40 and 80 MHz (S, E) FB tone labels need to be defined to follow the foregoing text.	Change "FB" to "Feedback" in column label headers: 80 MHz FB tone, 40 MHz FB tone and 20 MHz FB tone.	2017/1/9 9:42
3969	Albert Petrick	225	1 9.4.2.218.3	82	44	T	Y	82.44 9.4.2.218.3	3474	Table 9-262aa, grammar issue	Change "of" to "on"	2017/1/9 9:42
3970	Albert Petrick	225	1 28.1.1	212	39	E	Y	212.39 28.1.1		Period missing at end of sentence	Add period at the of sentence after "supported"	2017/1/9 9:42
3971	Albert Petrick	225	1 9.4.1.63	61	57	T	Y	61.57 9.4.1.63	3428	In Table 9-76d, "FB" in 20,40, 80 MHz (S, E) FB tone labels need to be defined to follow the foregoing text.	Change "FB" to "Feedback" in column label headers: 80 MHz FB tone, 40 MHz FB tone and 20 MHz FB tone.	2017/1/9 9:42
3972	Albert Petrick	225	1 9.4.2.218.3	82	47	E	Y	82.47 9.4.2.218.3	3476	Table 9-262aa, "Definition column" missing period at end of sentence and line between paragraphs	Fix. In the Definition column Add period "." after "punctured." and carriage return before B9, B10, and B11 on lines 47, 51, and 56. On line 60 add period after "is present."	2017/1/9 9:42
3973	Albert Petrick	225	1 28.1.1	211	8	E	Y	211.08 28.1.1	3807	Period missing at end of sentence	Add period at the of sentence after "PPDU"	2017/1/9 9:42
3974	Albert Petrick	225	1 9.4.1.63	59	38	T	Y	59.38 9.4.1.63	3539	The S-tone and E-tone description needs clarification when comparing and referencing tables 9-76c and 9-76d.	Add underlined text (without the underline) and remove strikethrough text from line 38 to 49 as follows: The S-tone and E-tone corresponding to the possible RU indices for 20MHz, 40MHz and 80 MHz channels are listed in Table 9-76c and Table 9-76d. (Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for Ng = 4) for Ng = 4 are shown in Table 9-76c, and for Ng = 16 for in Table 9-76d. (Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for Ng = 16) for Ng = 16. For 160 MHz, to determine the S-tone and E-tone, RUs 37 to 73 occupying the higher 80 MHz use the same entries in Table 9-76c (Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for Ng = 4) and Table 9-76d (Feedback subcarrier indices indicating start 26-tone RU index and end	2017/1/9 9:42
3975	Albert Petrick	225	1 9.4.2.218.3	93	25	E	Y	93.25 9.4.2.218.3	3479	Table 9-262aa, missing period at the end of sentence	Fix. In the "Definition column", Add period "." after the "duration" on lines 25 and 29.	2017/1/9 9:42
3976	Albert Petrick	225	1 28.1.1	212	43	E	Y	212.43 28.1.1		Period missing at end of sentence	Add period at the of sentence after "supported"	2017/1/9 9:42

3977	Albert Petrick	225	1 9.4.1.63	63	21	T	Y	63.21 9.4.1.63	3431	Calculating the AveSNRi needs more clarification.	Add the following underlined text (without the underline) and remove the strikethrough text from lines 21 through 30 as follows: The AvgSNRi in Table 9-71 (Average SNR of Space-Time Stream i subfield) is found determined by computing the SNR per subcarrier in decibels for the subcarriers in 20 MHz channel bandwidth identified in Table 9-76c (Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for Ng = 4) for Ng = 4 , and for Ng = 16 in Table 9-76d. (Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for Ng = 16) for Ng = 16, and then The computing tThe arithmetic mean is calculated of for those values. Each SNR value per subcarrier in stream i (before being averaged) corresponds to the SNR associated with the column i of the beamforming feedback matrix V determined	2017/1/9 9:42
3978	Albert Petrick	225	1 9.4.2.218.3	83	34	E	Y	83.34 9.4.2.218.3	3481	Table 9-262aa, missing period and colon in sentence.	Fix. In the "Definition column, Add period "." after the "stream" on lines 35 and 39. In Encoding column Add ":" after B18 on line 34 and B19 on line 37.	2017/1/9 9:42
3979	Albert Petrick	225	1 28.3.3.2	230	1	E	Y	230.01 28.3.3.2		Missing hyphen	Add hyphen " - " after "484"	2017/1/9 9:42
3980	Albert Petrick	225	1 9.4.1.63	63	4	E	Y	63.04 9.4.1.63	3432	Spelling error "indeces" in Table 9-763	Change "indeces" to "indices"	2017/1/9 9:42
3981	Albert Petrick	225	1 28.1.1	211	9	E	Y	211.09 28.1.1	3813	Period missing at end of sentence	Add period at the of sentence after "receive)"	2017/1/9 9:42
3982	Albert Petrick	225	1 9.4.1.64	64	48	T	Y	64.48 9.4.1.64	3434	Missing number of bits for Delta SNR for k=scidx(Ns-1)	Add number of bits for (Ns-1) for Delta SNR	2017/1/9 9:42
3983	Albert Petrick	225	1 9.4.2.218.3	83	40	E	Y	83.40 9.4.2.218.3	3484	Table 9-262aa, missing period and colon in sentence.	In the Definition column, Add colon ":" after B20 and B21. Add period after "procedure." on lines 41 and 43. In Encoding column Add colon after B20 on line 40 and B21 on line 43. Add extra line space between lines 41 and 42.	2017/1/9 9:42
3984	Albert Petrick	225	1		2	T	Y		3287	.11ax D1.0 makes reference to IEEE P802.11REVmc-D8.0, which is essentially IEEE P802.11-2016 (the new rollup baseline standard) and soon to be published in 2017. Once it is published, P802.11REVmc-D8.0 will be removed from the IEEE 802.11 working group members area on the website and will not be available in public domain on the IEEE 802.11 work group document server for public use. All references in .11ax D1.0 to clauses in the baseline standard should be made to IEEE P802.11-2016 and not to IEEE P802.11REVmc-D8.0.	Remove IEEE P802.11REVmc(TM)/D8.0 and replace with IEEE P802.11-2016	2017/1/9 9:42
3985	Albert Petrick	225	1 9.4.2.218.3	83	58	E	Y	83.58 9.4.2.218.3	3486	Table 9-262aa, missing period at the end of sentence.	Add period after "MU-MIMO" on line 58.	2017/1/9 9:42
3986	Albert Petrick	225	1 28.3.10.5	212	49	E	Y	212.49 28.3.10.5		Period missing at end of sentence	Add period at the of sentence after "false"	2017/1/9 9:42
3987	Albert Petrick	225	1 28.1.1	211	13	E	Y	211.13 28.1.1	3273	Period missing at end of sentence	Add period at the of sentence after "DL OFDMA)"	2017/1/9 9:42
3988	Albert Petrick	225	1			G	Y		3288	The title of the column headers in ALL of the tables need to be formatted; 1) center text in title. 2) lock 1st row of table to continue on next page.	Fix and format ALL tables headers (1st row) and enable 1st row to roll-over on next page when tables don't fit on current page.	2017/1/9 9:42
3989	Albert Petrick	225	1 9.4.1.64	64	53	T	Y	64.53 9.4.1.64	3436	Missing number of bits for Delta SNR for k=scidx(Ns-1)	Add number of bits for (Ns-1) for Delta SNR	2017/1/9 9:42
3990	Albert Petrick	225	1 9.4.2.218.3	82	11	T	Y	82.11 9.4.2.218.3	3488	Add clarity and call out bit position in Table 9-262aa for subfield "Dual Band Support" corresponding to those bit positions in Figure 9-589cl	Add bit B0 in Definition column Change to: "B0 indicates support of both...."	2017/1/9 9:42
3991	Albert Petrick	225	1 28.3.10.7.2	275	21	E	Y	275.21 28.3.10.7.2		Period missing in Table 28-16	Add period after "1"	2017/1/9 9:42
3992	Albert Petrick	225	1			G	Y		3289	Throughout .11ax D1.0 there are references where some bits have hyphens and others do not e.g., 1 bit, and 1-bit . The text, Tables and Figures should be consistent using "hyphens" as used in IEEE 802.11-2016.	Fix. Include hyphens in text, Tables and Figures similar to the format utilized in baseline IEEE 802.11-2016	2017/1/9 9:42
3993	Albert Petrick	225	1 9.4.1.64	64	13	E	Y	64.13 9.4.1.64	3437	Remove paragraph indent	Fix paragraph alignment starting at "No padding is present....."	2017/1/9 9:42

3994	Albert Petrick	225	1 9.4.2.218.3	84	26	T	Y	84.26 9.4.2.218.3	3490	Add clarity and call out bit position in Table 9-262aa for subfield "UL HE MU PPDU Payload Support" corresponding to those bit positions in Figure 9-589cl	Add bit B30 in Definition column Change to: "B30 indicates that the STA supports the reception of....."	2017/1/9 9:42
3995	Albert Petrick	225	1 28.3.1.8.3	289	19	E	Y	289.19 28.3.1.8.3		Missing space between sentences	Add space and the end of the sentence after the period " . "	2017/1/9 9:42
3996	Albert Petrick	225	1 28.1.1	211	15	E	Y	211.15 28.1.1	3283	Period missing at end of sentence	Add period at the of sentence after "UL OFDMA)"	2017/1/9 9:42
3997	Albert Petrick	225	1			G	Y		3290	Throughout .11ax D1.0 cross-reference links in text to tables, figures, equations, clauses and sub-clauses either broken, and non-existent.	Fix cross-reference links in text, tables, figures, equations and external links	2017/1/9 9:42
3998	Albert Petrick	225	1 9.4.1.64	64	18	T	Y	64.18 9.4.1.64	3439	Equation (9-2) is referenced in the text and in Table 9-76f HE MU Exclusive Beamforming Report information, and is not linked or referenced to any other documents. Equation (9-2) should be linked and referenced to its location IEEE 802.11-2016 (Rev D8.0) and clarified as a "Note" at the end of Table 9-76f.	Add note for equation 9-2 in text and/or add the following underlined text (without the underline) and reference link in Table 9-76f as a Note: "as defined in Equation (9-2) in clause 9.4.1.51 (MU Exclusive Beamforming Report Field)"	2017/1/9 9:42
3999	Albert Petrick	225	1 9.4.2.218.3	84	31	T	Y	84.31 9.4.2.218.3	3492	Add clarity and call out bit position in Table 9-262aa for subfield "SU Beamformer" corresponding to those bit positions in Figure 9-589cl	Add bit B31 in Definition column Change to: "B31 indicates support for operation as an SU beamformer."	2017/1/9 9:42
4000	Albert Petrick	225	1 28.3.5	246	33	T	Y	246.33 28.3.5		OFDMA PPDU not clarified with HE	Add underlined text (without the underline) and remove strikethrough text from line 33 to 35 as follows: "This also includes the SU transmission in an RU that is part of a downlink or uplink HE OFDMA PPDU, and a transmission from one STA that is part of an UL MU-MIMO transmission in current RU.	2017/1/9 9:42
4001	Albert Petrick	225	1			G	Y		3291	Throughout .11ax D1.0 the alignment of the terms in equations and spacing between paragraph text and equations need to be centered on the pages.	Fix spacing of terms in equations and space of text between equations.	2017/1/9 9:42
4002	Albert Petrick	225	1 9.4.1.64	64	30	T	Y	64.30 9.4.1.64	3440	Equation (9-2) reference in Table 9-76f calls out subcarrier k=scidx(0) and k=scidx(1). Equation 9-2 in IEEE 802.11-2016 (Rev D8.0) in clause 9.4.1.51 specifies k=sscidx(0) and k=sscidx(1) There appears to be an ambiguity in equation in 9-2 and with k=scidx(_)	Fix references for subcarrier k=scidx(0) and k=scidx(1) in Table 9-76f (lines 30-54) to match assumptions with equation 9-2 in clause 9.4.1.51 in IEEE 802.11-2016 (Rev D8.0)	2017/1/9 9:42
4003	Albert Petrick	225	1 9.4.2.218.3	84	36	T	Y	84.36 9.4.2.218.3	3494	Add clarity and call out bit position in Table 9-262aa for subfield "SU Beamformee" corresponding to those bit positions in Figure 9-589cl	Add bit B32 in Definition column Change to: "B32 indicates support for operation as an SU beamformee."	2017/1/9 9:42
4004	Albert Petrick	225	1 3.4	7	13	E	Y	7.13 3.4	3292	hyphen error -- hyphen between the words frequency and division "Orthogonal frequency-division multiple access" The use of hyphens should be consistent with what is used in IEEE 802.11-2016.	Remove hyphen after "frequency"	2017/1/9 9:42
4005	Albert Petrick	225	1 28.4.2	371	36	T	Y	371.36 28.4.2	3441	Clarify "aSignalExtension" referenced from Table 19-25	Add the following underlined text (without the underline): and is aSignalExtension (0us for 5 GHz band, 6us for 2.4 GHz band)	2017/1/9 9:42
4006	Albert Petrick	225	1 9.4.2.218.3	84	40	T	Y	84.40 9.4.2.218.3	3496	Add clarity and call out bit position in Table 9-262aa for subfield "MU Beamformer" corresponding to those bit positions in Figure 9-589cl	Add bit B33 in Definition column Change to: "B33 indicates support for operation as an MU beamformer."	2017/1/9 9:42
4007	Albert Petrick	225	1 28.1.1	211	18	E	Y	211.18 28.1.1	3829	Period missing at end of sentence	Add period at the of sentence after "streams"	2017/1/9 9:42
4008	Albert Petrick	225	1 28.3.11.2	315	33	E	Y	315.33 28.3.11.2		Paragraph misaligned	Left justify	2017/1/9 9:42
4009	Albert Petrick	225	1 4.3.14a	9	33	T	Y	9.33 4.3.14a	3293	"RU" not defined	Add definition for "RU" in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
4010	Albert Petrick	225	1 28.4.2	371	39	E	Y	371.39 28.4.2	3443	Missing period	Add period at the end of sentence after "false"	2017/1/9 9:42
4011	Albert Petrick	225	1 9.4.2.218.3	84	6	T	Y	84.06 9.4.2.218.3	3267	Add clarity and call out bit positions in Table 9-262aa for subfield "Beamforemee STS For < 80 MHz" corresponding to those bit positions in Figure 9-589cl. Missing period at the end of sentence.	Add bits B34-B36 in Definition column Change to: "B34-B36 indicates the maximum number of space-time streams the STA can receive in an HE NDP."	2017/1/9 9:42
4012	Albert Petrick	225	1 28.3.11.3	317	4	E	Y	317.04 28.3.11.3		Grammar issue	Delete the word "as"	2017/1/9 9:42
4013	Albert Petrick	225	1 6.3.4.2.2	11		E	Y	11.00 6.3.4.2.2	3294	primitive parameter misaligned	Fix alignment	2017/1/9 9:42
4014	Albert Petrick	225	1 9.2.5.2	32	1	E	Y	32.01 9.2.5.2	3444	Format error - sentence alignment	Sentence format needs to be left justified.	2017/1/9 9:42

4015	Albert Petrick	225	1 9.4.2.218.3	84	56	T	Y	84.56 9.4.2.218.3	3272	Add clarity and call out bit positions in Table 9-262aa for subfield "NTST Total For < 80 MHz" corresponding to those bit positions in Figure 9-589cl. Missing period at the end of sentence.	Add bits B37-B39 in Definition column Change to: "B37-B39 indicates the maximum value for.....partial bandwidth."	2017/1/9 9:42
4016	Albert Petrick	225	1 28.3.6.4	250	36	T	Y	250.36 28.3.6.4		Binary convolutional coding and BCC referenced in various subclauses, figures, and tables. This should be defined.	Add definition for "BCC" in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
4017	Albert Petrick	225	1 28.1.1	211	21	E	Y	211.21 28.1.1	3835	Period missing at end of sentence	Add period at the of sentence after "receive)"	2017/1/9 9:42
4018	Albert Petrick	225	1 9.3.1.9.1	34	12	T	Y	34.12 9.3.1.9.1	3446	In Figure 9-33 (BA Control Field) Bit (B5) in the Reserve sub-field is marked as deleted (strikethrough) as shown. The Reserved subfield now shows 7-bits (B6-B11). The text does not describe B5. Define B5 or correct Figure 9-33	Fix as commented	2017/1/9 9:42
4019	Albert Petrick	225	1 9.4.2.218.3	85	6	T	Y	85.06 9.4.2.218.3	3276	Add clarity and call out bit positions in Table 9-262aa for subfield "Beamformee STS for > 80 MHz" corresponding to those bit positions in Figure 9-589cl. Missing period at the end of sentence.	Add bits B40-B42 in Definition column Change to: "B40-B42 indicates the maximum number for.....HE NDP."	2017/1/9 9:42
4020	Albert Petrick	225	1 B.4.27.2	413	45	E	Y	413.45 B.4.27.2	3447	Numbering / letter (5GHz) spacing issue in Table B.4.27.2 HEW PHY features	Change "5GHz" to "5 GHz"	2017/1/9 9:42
4021	Albert Petrick	225	1 9.4.2.218.3	85	13	T	Y	85.13 9.4.2.218.3	3281	Add clarity and call out bit positions in Table 9-262aa for subfield "NSTS Total For > 80 MHz" corresponding to those bit positions in Figure 9-589cl. Missing period at the end of sentence.	Add bits B44-B45 in Definition column Change to: "B43-B45 indicates the maximum value for.....partial bandwidth."	2017/1/9 9:42
4022	Albert Petrick	225	1 6.3.7.4.2	12	25	E	Y	12.25 6.3.7.4.2	3295	primitive parameter misaligned	Fix alignment	2017/1/9 9:42
4023	Albert Petrick	225	1 9.3.1.23	45	6	E	Y	45.06 9.3.1.23	3449	Number / letter (2.4GHz) spacing issue in Table B.4.27.2 HEW PHY features	Change "2.4GHz" to "2.4 GHz"	2017/1/9 9:42
4024	Albert Petrick	225	1 9.4.2.218.3	85	20	T	Y	85.20 9.4.2.218.3	3285	Add clarity and call out bit positions in Table 9-262aa for subfield "Number Of Sounding Dimensions For < 80 MHz" corresponding to those bit positions in Figure 9-589cl. Missing period at the end of sentence.	Add bits B46-B48 in Definition column Change to: "B46-B48 represents the beamformer's capability.....for an HE NDP."	2017/1/9 9:42
4025	Albert Petrick	225	1 27.4.2	158	30	E	Y	158.30 27.4.2	3296	multi-TID not capitalized	change "multi-TID" to "Multi-TID"	2017/1/9 9:42
4026	Albert Petrick	225	1 28.1.1	211	26	E	Y	211.26 28.1.1	3841	Period missing at end of sentence	Add period at the of sentence after "OFDMA)"	2017/1/9 9:42
4027	Albert Petrick	225	1 27.2.1	149	26	E	Y	149.26 27.2.1		Period missing at end of sentence	Add period at the of sentence after "associated"	2017/1/9 9:42
4028	Albert Petrick	225	1 9.4.2.218.3	85	22	E	Y	85.22 9.4.2.218.3	3509	Missing period at end of sentence in Definition column of Table 9-262aa.	Add period at the end of sentence "HE NDP"	2017/1/9 9:42
4029	Albert Petrick	225	1 9.4.2.218.3	85	26	T	Y	85.26 9.4.2.218.3	3511	Add clarity and call out bit positions in Table 9-262aa for subfield "Number Of Sounding Dimensions For > 80 MHz" corresponding to those bit positions in Figure 9-589cl. Missing period at the end of sentence.	Add bits B48-B51 in Definition column Change to: "B49-B51 represents the beamformer's capability.....for an HE NDP."	2017/1/9 9:42
4030	Albert Petrick	225	1 9.4.2.218.2	76	24	E	Y	76.24 9.4.2.218.2	3450	Format error - sentence alignment	Fix paragraph alignment - left justify.	2017/1/9 9:42
4031	Albert Petrick	225	1 27.4.2	158	51	E	Y	158.51 27.4.2	3297	multi-TID not capitalized	change "multi-TID" to "Multi-TID"	2017/1/9 9:42
4032	Albert Petrick	225	1 28.1.1	211	29	E	Y	211.29 28.1.1	3847	Period missing at end of sentence	Add period at the of sentence after "MIMO)"	2017/1/9 9:42
4033	Albert Petrick	225	1 27.2.1	149	28	E	Y	149.28 27.2.1		Period missing at end of sentence	Add period at the of sentence after "associated"	2017/1/9 9:42
4034	Albert Petrick	225	1 9.4.2.218.3	81	35	E	Y	81.35 9.4.2.218.3	3453	In Figure 9-589cl - (HE PHY Capabilities Information field format) subfield NSTA Total For < 80 MHz is labeled as having 2-bits. There are 3-bits (B37 -B39).	Change Bits "2" to "3" for subfield "NSTS Total for < 80 MHz" in Figure 9m-589cl	2017/1/9 9:42
4035	Albert Petrick	225	1 9.4.2.218.3	81	35	T	Y	81.35 9.4.2.218.3	3455	In Figure 9-589cl - (HE PHY Capabilities Information field format) subfield "Number Of Sounding Dimensions For < 80 MHz" is mark as having 1-bit. There are 3-bits (B46 -B48).	Change Bits "1" to "3" for subfield "NSTS Total for < 80 MHz" in Figure 9-589cl	2017/1/9 9:42
4036	Albert Petrick	225	1 9.4.2.218.3	85	28	E	Y	85.28 9.4.2.218.3	3514	Missing period at end of sentence in Definition column of Table 9-262aa.	Fix. Add period at the end of sentence "HE NDP."	2017/1/9 9:42
4037	Albert Petrick	225	1 27.4.4	160	160	E	Y	161.60 27.4.4	3298	multi-TID not capitalized	change "multi-TID" to "Multi-TID"	2017/1/9 9:42
4038	Albert Petrick	225	1 9.4.2.218.3	81	35	T	Y	81.35 9.4.2.218.3	3270	In Figure 9-589cl - (HE PHY Capabilities Information field format) subfield "Number Of Sounding Dimensions For > 80 MHz" is labeled as 1-bit. There are 3-bits (B49 -B51).	Change Bits "1" to "3" for subfield "NSTS Total for > 80 MHz" in Figure 9-589cl	2017/1/9 9:42
4039	Albert Petrick	225	1 9.4.2.218.3	85	29	E	Y	85.29 9.4.2.218.3	3516	Missing period at end of sentence in Encoding column in Table 9-262aa.	Add period at the end of sentence "reserved."	2017/1/9 9:42
4040	Albert Petrick	225	1 28.1.1	211	32	E	Y	211.32 28.1.1	3854	Period missing at end of sentence	Add period at the of sentence after "OFDMA)"	2017/1/9 9:42
4041	Albert Petrick	225	1 27.2.1	149	33	E	Y	149.33 27.2.1		Period missing at end of sentence	Add period at the of sentence after "set"	2017/1/9 9:42

4042	Albert Petrick	225	1 9.4.2.218.3	83	6	T	Y	83.06 9.4.2.218.3	3274	Add clarity. Call out bit positions in Table 9-262aa for subfield "Device Class" corresponding to those bit positions in Figure 9-589cl	In "Definition" column: Add "B12:" at the beginning of the sentence." In the "Encoding" column: Before sentence Add "B12:" "Set to 1 to indicate STA is a Class A device." In the "Encoding" column: Before sentence Add "B12:" Set to 0 to indicate STA is a Class B device. Note: This field is reserved when transmitting STA is an AP STA."	2017/1/9 9:42
4043	Albert Petrick	225	1 9.4.2.218.3	83	13	T	Y	83.13 9.4.2.218.3	3277	Add clarity and call out bit positions in Table 9-262aa for subfield "LDPC Coding In Payload" corresponding to those bit positions in Figure 9-589cl	Change text in "Definition" column to read: "B13: Indicates support of transmission....." Change text in "Encoding" column to read: "B13: Set to 1 to indicate STA.... B13: Set to 9 otherwise. "	2017/1/9 9:42
4044	Albert Petrick	225	1 27.4.4.1	160	45	E	Y	160.45 27.4.4.1	3299	multi-TID not capitalized	change "multi-TID" to "Multi-TID"	2017/1/9 9:42
4045	Albert Petrick	225	1 9.4.2.218.3	85	24	E	Y	85.24 9.4.2.218.3	3520	Missing period at end of sentence in Encoding column in Table 9-262aa.	Add period at the end of sentence "reserved."	2017/1/9 9:42
4046	Albert Petrick	225	1 28.1.1	211	34	E	Y	211.34 28.1.1	3859	Period missing at end of sentence	Add period at the of sentence after "PPDU"	2017/1/9 9:42
4047	Albert Petrick	225	1 9.4.2.218.3	83	16	T	Y	83.16 9.4.2.218.3	3282	Add clarity and call out bit positions in Table 9-262 aa for subfield "HE-LTF And GI For HE PPDUs" corresponding to those bit positions in Figure 9-589cl	Change text in "Encoding column to read: "For B14 and B15: Set to 1 if supported by the STA. Set to 0 otherwise."	2017/1/9 9:42
4048	Albert Petrick	225	1 27.2.1	149	36	E	Y	149.36 27.2.1		Period missing at end of sentence	Add period at the of sentence after "associated"	2017/1/9 9:42
4049	Albert Petrick	225	1 9.4.2.218.3	85	31	T	Y	85.31 9.4.2.218.3	3522	Add clarity and call out bit positions in Table 9-262aa for subfield "Ng = 16 For SU Feedback Support" corresponding to those bit positions in Figure 9-589cl. Missing period at the end of sentence.	Add bit B52 in Definition column Change to: "B52 indicates if the HE beamformee....."	2017/1/9 9:42
4050	Albert Petrick	225	1 9.4.2.218.3	82	15	E	Y	82.15 9.4.2.218.3	3286	Table 9-262aa, "Definition column" missing period at end of sentence	Fix. Add period after 2.4 GHz.	2017/1/9 9:42
4051	Albert Petrick	225	1			E	Y		3300	multi-TID not capitalized	Make global change in .11ax D1.0: change "multi-TID to Multi-TID"	2017/1/9 9:42
4052	Albert Petrick	225	1 9.4.2.218.3	85	35	T	Y	85.35 9.4.2.218.3	3524	Add clarity and call out bit positions in Table 9-262aa for subfield "Ng = 16 For MU Feedback Support" corresponding to those bit positions in Figure 9-589cl. Missing period at the end of sentence.	Add bit B53 in Definition column Change to: "B53 indicates if the HE beamformee....."	2017/1/9 9:42
4053	Albert Petrick	225	1 28.1.1	211	38	E	Y	211.38 28.1.1	3868	Period missing at end of sentence	Add period at the of sentence after "receive)"	2017/1/9 9:42
4054	Albert Petrick	225	1 25.5.2.3	167	69	T	Y	167.69 25.5.2.3	3301	"TBD" is a placeholder and not allowed in drafts in WG letter ballots as per IEEE 802.11 WG policies.	Remove TBD	2017/1/9 9:42
4055	Albert Petrick	225	1 9.4.2.218.3	85	37	E	Y	85.37 9.4.2.218.3	3526	In Table 9-262aa missing period at the end of sentence.	Add period after "MU-type feedback."	2017/1/9 9:42
4056	Albert Petrick	225	1 9.4.2.218.3	82	18	E	Y	82.18 9.4.2.218.3	3465	Table 9-262aa, "Definition column" missing period at end of sentence	Fix. Add period after 5 GHz.	2017/1/9 9:42
4057	Albert Petrick	225	1 27.3.3.4	154	39	T	Y	154.39 27.3.3.4	3302	The "L3 Frag BA Request frame", "L3 Frag BA Response" and "BA Response frame" are not defined and ambiguous. There are no figures, tables, text or timing flow between Requests and Responses.	Define "L3 Frag BA Request frame" and "L3 Frag BA Response", BA Response frames, add figures, tables and describe a procedure for L3 dynamic fragmentation.	2017/1/9 9:42
4058	Albert Petrick	225	1 9.4.2.218.3	85	39	T	Y	85.39 9.4.2.218.3	3528	Add clarity and call out bit positions in Table 9-262aa for subfield "Codebook Size (ñ≥, ñΩ) = {4, 2} For SU Support" corresponding to those bit positions in Figure 9-589cl.	Add bit B54 in Definition column Change to: "B54 indicates if the HE beamformee....."	2017/1/9 9:42
4059	Albert Petrick	225	1 27.2.1	149	49	E	Y	149.49 27.2.1		Period missing at end of sentence	Add period at the of sentence after "associated"	2017/1/9 9:42
4060	Albert Petrick	225	1 27.6.2	177	19	T	Y	177.19 27.6.2	3303	Text in sentence references table "Table YY-1". Table doesn't exist in .11ax D1.0 or in IEEE 802.11-2016	Fix reference and add table or delete sentence referencing table	2017/1/9 9:42
4061	Albert Petrick	225	1 9.4.2.218.3	85	44	T	Y	85.44 9.4.2.218.3	3530	Add clarity and call out bit positions in Table 9-262aa for subfield "Codebook Size (ñ≥, ñΩ) = {7,5} For MU Support" corresponding to those bit positions in Figure 9-589cl.	Add bit B55 in Definition column Change to: "B55 indicates if the HE beamformee....."	2017/1/9 9:42
4062	Albert Petrick	225	1 28.1.1	211	41	E	Y	211.41 28.1.1	3875	Period missing at end of sentence	Add period at the of sentence after "receive)"	2017/1/9 9:42
4063	Albert Petrick	225	1 27.6.2	177	43	T	Y	177.43 27.6.2	3304	Figure 27-3 Example of sounding protocol not correct.	Re-draw diagram. Fix sounding protocol diagram to illustrate alignment of SIFS timing as beamformee from beamformer.	2017/1/9 9:42

4064	Albert Petrick	225	1 9.4.2.218.3	85	50	E	Y	85.50 9.4.2.218.3	3532	In Table 9-262aa, Missing periods and line spacing between sentences.	In the "Definition" column, Add period at the end of sentences e.i., after "feedback." on lines 50, 52, 54, 57, 59 and 61. Add line space carriage return after "feedback on lines 50, 52, 54, 57 and 59. In "Encoding" column, Add line spacing carriage return after "otherwise." on line 55.	2017/1/9 9:42
4065	Albert Petrick	225	1 9.4.2.218.3	82	20	E	Y	82.20 9.4.2.218.3	3468	Table 9-262aa, "Definition column" missing period at end of sentence	Fix. Add period after 5 GHz.	2017/1/9 9:42
4066	Albert Petrick	225	1 27.6.2	178	6	T	Y	178.06 27.6.2	3305	Figure 27-4 Example of sounding protocol not correct.	Re-draw diagram. Fix sounding protocol diagram to illustrate alignment of SIFS timing, identify the beamformee "1 thru n" and spell out the word "TRIG" in UL TRIG PPDU	2017/1/9 9:42
4067	Albert Petrick	225	1 9.4.2.218.3	86	6	T	Y	86.06 9.4.2.218.3	3534	Add clarity and call out bit position in Table 9-262aa for subfield "HE ER SU Payload" corresponding to those bit positions in Figure 9-589cl.	Add bit B59 in Definition column Change to: "B59: indicates the support of transmission....."	2017/1/9 9:42
4068	Albert Petrick	225	1 27.2.1	149	53	E	Y	149.53 27.2.1		Period missing at end of sentence	Add period at the of sentence after "associated"	2017/1/9 9:42
4069	Albert Petrick	225	1 28.1.1	211	42	E	Y	211.42 28.1.1	3880	Period missing at end of sentence	Add period at the of sentence after "puncturing"	2017/1/9 9:42
4070	Albert Petrick	225	1 9.4.2.218.3	86	11	T	Y	86.11 9.4.2.218.3	3536	Add clarity and call out bit position in Table 9-262aa for subfield "DL MU-MIMO on Partial BW" corresponding to those bit positions in Figure 9-589cl.	Add bit B60 in Definition column Change to: "B60: indicates the non-AP STA supports....."	2017/1/9 9:42
4071	Albert Petrick	225	1 27.6.2	178	7	T	Y	178.07 27.6.2	3306	"CSI" in Figure 27-4 is not defined or referenced in text	Expand on the term "CSI" and describe this term in the text with relationship with HE beamformee.	2017/1/9 9:42
4072	Albert Petrick	225	1 9.4.2.218.3	82	23	E	Y	82.23 9.4.2.218.3	3471	Table 9-262aa, "Definition column" missing period at end of sentence	Fix. Add period after 5 GHz.	2017/1/9 9:42
4073	Albert Petrick	225	1		2	T	Y		3287	.11ax D1.0 makes reference to IEEE P802.11REVmc-D8.0, which is essentially IEEE P802.11-2016 (the new rollup baseline standard) and soon to be published in 2017. Once it is published, P802.11REVmc-D8.0 will be removed from the IEEE 802.11 working group members area on the website and will not be available in public domain on the IEEE 802.11 work group document server for public use. All references in .11ax D1.0 to clauses in the baseline standard should be made to IEEE P802.11-2016 and not to IEEE P802.11REVmc-D8.0.	Remove IEEE P802.11REVmc(TM)/D8.0 and replace with IEEE P802.11-2016	2017/1/9 9:42
4074	Albert Petrick	225	1 9.4.2.218.3	86	14	T	Y	86.14 9.4.2.218.3	3538	Add clarity and call out a "Note" reference in Table 9-262aa for subfield "DL MU-MIMO on Partial BW" in the Encoding column.	Add change to read: "Note: This field is reserved for an AP."	2017/1/9 9:42
4075	Albert Petrick	225	1 27.16.1	204	56	E	Y	204.56 27.16.1	3307	Sentence misaligned spacing	Left just "A STA fro which do11HEOptionImplemented....."	2017/1/9 9:42
4076	Albert Petrick	225	1 9.4.2.218.3	82	18	E	Y	82.18 9.4.2.218.3	3472	Table 9-262aa, "Encoding column" missing period at end of sentence	Fix. Change "Note" to "NOTE" and add colon ":" after "NOTE:"	2017/1/9 9:42
4077	Albert Petrick	225	1			G	Y		3288	The title of the column headers in ALL of the tables need to be formatted; 1) center text in title. 2) lock 1st row of table to continue on next page.	Fix and format ALL tables headers (1st row) and enable 1st row to roll-over on next page when tables don't fit on current page.	2017/1/9 9:42
4078	Albert Petrick	225	1 27.2.1	149	61	E	Y	149.61 27.2.1		Period missing at end of sentence	Add period at the of sentence after "Set"	2017/1/9 9:42
4079	Albert Petrick	225	1 9.4.2.218.3	86	16	T	Y	86.16 9.4.2.218.3	3540	Add clarity and call out bit position in Table 9-262aa for subfield "PPE Threshold Present" corresponding to those bit position in Figure 9-589cl.	Add bit B61 in Definition column Change to: "B61: indicates whether or no the PPE....."	2017/1/9 9:42
4080	Albert Petrick	225	1 28.3.14.3	342	47	E	Y	342.47 28.3.14.3	3308	Period missing at end of sentence	Add period at the end of sentence.	2017/1/9 9:42
4081	Albert Petrick	225	1 9.4.2.218.3	82	44	T	Y	82.44 9.4.2.218.3	3474	Table 9-262aa, grammar issue	Change "of" to "on"	2017/1/9 9:42
4082	Albert Petrick	225	1 28.1.1	211	47	E	Y	211.47 28.1.1	3888	Period missing at end of sentence	Add period at the of sentence after "OFDMA)"	2017/1/9 9:42
4083	Albert Petrick	225	1			G	Y		3289	Throughout .11ax D1.0 there are references where some bits have hyphens and others do not e.g., 1 bit, and 1-bit . The text, Tables and Figures should be consistent using "hyphens" as used in IEEE 802.11-2016.	Fix. Include hyphens in text, Tables and Figures similar to the format utilized in baseline IEEE 802.11-2016	2017/1/9 9:42

4084	Albert Petrick	225	1 9.4.2.218.3	86	18	T	Y	86.18 9.4.2.218.3	3542	Add clarity and call out bit position in Table 9-262aa for subfield "SRP-based SR Support" corresponding to those bit position in Figure 9-589cl.	Add bit B62 in Definition column Change to: "B62: indicates that the STA supports SRP-based....."	2017/1/9 9:42
4085	Albert Petrick	225	1 9.4.2.218.3	82	47	E	Y	82.47 9.4.2.218.3	3476	Table 9-262aa, "Definition column" missing period at end of sentence and line between paragraphs	Fix. In the Definition column Add period "." after "punctured." and carriage return before B9, B10, and B11 on lines 47, 51, and 56. On line 60 add period after "is present."	2017/1/9 9:42
4086	Albert Petrick	225	1			G	Y		3290	Throughout .11ax D1.0 cross-reference links in text to tables, figures, equations, clauses and sub-clauses either broken, and non-existent.	Fix cross-reference links in text, tables, figures, equations and external links	2017/1/9 9:42
4087	Albert Petrick	225	1 9.4.2.218.3	86	19	E	Y	86.19 9.4.2.218.3	3544	In Table 9-262aa, missing period after sentence.	Add period "." at the end of sentence after "operation."	2017/1/9 9:42
4088	Albert Petrick	225	1 9.4.2.218.3	93	25	E	Y	93.25 9.4.2.218.3	3479	Table 9-262aa, missing period at the end of sentence	Fix. In the "Definition column", Add period "." after the "duration" on lines 25 and 29.	2017/1/9 9:42
4089	Albert Petrick	225	1 28.3.17.6.4	349	16	E	Y	349.16 28.3.17.6.4	3309	Sentence misaligned spacing	left justify "issue a PHY-CCA.inidication(BUSY, {secondary40}),"	2017/1/9 9:42
4090	Albert Petrick	225	1 27.2.1	150	2	E	Y	150.02 27.2.1		Period missing at end of sentence	Add period at the of sentence after "Set"	2017/1/9 9:42
4091	Albert Petrick	225	1			G	Y		3291	Throughout .11ax D1.0 the alignment of the terms in equations and spacing between paragraph text and equations need to be centered on the pages.	Fix spacing of terms in equations and space of text between equations.	2017/1/9 9:42
4092	Albert Petrick	225	1 9.4.2.218.3	86	21	T	Y	86.21 9.4.2.218.3	3546	Add clarity and call out bit position in Table 9-262aa for subfield "Power Boost Factor +ªr Support" corresponding to those bit position in Figure 9-589cl.	Add bit B63 in Definition column Change to: "B63: indicates that the STA supports....."	2017/1/9 9:42
4093	Albert Petrick	225	1 28.1.1	211	50	E	Y	211.50 28.1.1	3895	Period missing at end of sentence	Add period at the of sentence after "OFDMA)"	2017/1/9 9:42
4094	Albert Petrick	225	1 9.4.2.218.3	83	34	E	Y	83.34 9.4.2.218.3	3481	Table 9-262aa, missing period and colon in sentence.	Fix. In the "Definition column, Add period "." after the "stream" on lines 35 and 39. In Encoding column Add ":" after B18 on line 34 and B19 on line 37.	2017/1/9 9:42
4095	Albert Petrick	225	1 3.4	7	13	E	Y	7.13 3.4	3292	hyphen error -- hyphen between the words frequency and division "Orthogonal frequency-division multiple access" The use of hyphens should be consistent with what is used in IEEE 802.11-2016.	Remove hyphen after "frequency"	2017/1/9 9:42
4096	Albert Petrick	225	1 4.3.14a	9	33	T	Y	9.33 4.3.14a	3293	"RU" not defined	Add definition for "RU" in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
4097	Albert Petrick	225	1 28.3.17.6.4	349	44	E	Y	349.44 28.3.17.6.4	3310	Sentence misaligned spacing	left justify "PHYCCA. Indication(BUSY, {primary}).....and"	2017/1/9 9:42
4098	Albert Petrick	225	1 27.2.2	150	43	E	Y	150.43 27.2.2		Period missing at end of sentence	Add period at the of sentence after "field"	2017/1/9 9:42
4099	Albert Petrick	225	1 9.4.2.218.3	86	22	E	Y	86.22 9.4.2.218.3	3548	In Table 9-262aa, missing period after sentence.	Add period at the end of sentence after "range [0.5, 2]."	2017/1/9 9:42
4100	Albert Petrick	225	1 6.3.4.2.2	11		E	Y	11.00 6.3.4.2.2	3294	primitive parameter misaligned	Fix alignment	2017/1/9 9:42
4101	Albert Petrick	225	1 28.1.1	211	62	E	Y	211.62 28.1.1	3268	Period missing at end of sentence	Add period at the of sentence after "least 4"	2017/1/9 9:42
4102	Albert Petrick	225	1 9.4.2.218.3	83	40	E	Y	83.40 9.4.2.218.3	3484	Table 9-262aa, missing period and colon in sentence.	In the Definition column, Add colon ":" after B20 and B21. Add period after "procedure." on lines 41 and 43. In Encoding column Add colon after B20 on line 40 and B21 on line 43. Add extra line space between lines 41 and 42.	2017/1/9 9:42
4103	Albert Petrick	225	1 9.4.2.218.3	86	24	T	Y	86.24 9.4.2.218.3	3550	Add clarity and call out bit position in Table 9-262aa for subfield "4x HE-LTF And 0.8 us GI Support For HE PPDUs" corresponding to those bit position in Figure 9-589cl.	Add bit B64 in Definition column Change to: "B64: indicates for the reception of 4x LTF....."	2017/1/9 9:42
4104	Albert Petrick	225	1 9.4.2.218.3	83	58	E	Y	83.58 9.4.2.218.3	3486	Table 9-262aa, missing period at the end of sentence.	Add period after "MU-MIMO" on line 58.	2017/1/9 9:42
4105	Albert Petrick	225	1 28.3.17.6.4	349	27	E	Y	349.27 28.3.17.6.4	3311	Sentence misaligned spacing	left justify "present and on of the .....or"	2017/1/9 9:42
4106	Albert Petrick	225	1 9.4.2.218.3	86	28	T	Y	86.28 9.4.2.218.3	3552	Missing "Reserve" Subfield, and text for Definition and Encoding in Table 9-262aa. The Reserve subfield should correspond to the 7 bit positions B65 -B71 in Figure 9-589Cl.	At the end of Table 9-262-aa. Add "Reserved" in Subfield column. Add text (see underlined text) "B65 - B71 (7-bits) are reserved." Encoding column leave blank.	2017/1/9 9:42
4107	Albert Petrick	225	1 27.2.2	150	54	E	Y	150.54 27.2.2		Period missing at end of sentence	Add period at the of sentence after "detection)"	2017/1/9 9:42
4108	Albert Petrick	225	1 9.4.2.218.3	82	11	T	Y	82.11 9.4.2.218.3	3488	Add clarity and call out bit position in Table 9-262aa for subfield "Dual Band Support" corresponding to those bit positions in Figure 9-589cl	Add bit B0 in Definition column Change to: "B0 indicates support of both...."	2017/1/9 9:42

4109	Albert Petrick	225	1 6.3.7.4.2	12	25	E	Y	12.25 6.3.7.4.2	3295	primitive parameter misaligned	Fix alignment	2017/1/9 9:42
4110	Albert Petrick	225	1 28.1.1	212	2	E	Y	212.02 28.1.1	3280	Period missing at end of sentence	Add period at the of sentence after "applicable"	2017/1/9 9:42
4111	Albert Petrick	225	1 9.4.2.218.3	86	31	T	Y	86.31 9.4.2.218.3	3554	Class A STAs are declared "high capability devices" and class B STAs as "low capability devices" This is the only reference in .11axD1.0 to these terms. Class A and class B STAs are defined in sub-clause 28.3.3.14 (Transmit requirements for an HE trigger-based PPDU). Transmit power accuracy and RSSI measurement accuracy are discussed in detail e.g., Table 28-40. To eliminate ambiguities, "low and high capability devices" should be defined and referenced back to clause 28.3.14.	Add definition for "low and high capability" devices in clause 28.3.14, and add text reference back to clause 28.3.14. Add underline text (without the underline) to read: "Class A STAs are high capability devices and class B STAs are low capability devices as described in 28.3.14 (Transmit requirements for an HE trigger-based PPDU).	2017/1/9 9:42
4112	Albert Petrick	225	1 9.4.2.218.3	84	26	T	Y	84.26 9.4.2.218.3	3490	Add clarity and call out bit position in Table 9-262aa for subfield "UL HE MU PPDU Payload Support" corresponding to those bit positions in Figure 9-589cl	Add bit B30 in Definition column Change to: "B30 indicates that the STA supports the reception of....."	2017/1/9 9:42
4113	Albert Petrick	225	1 27.4.2	158	30	E	Y	158.30 27.4.2	3296	multi-TID not capitalized	change "multi-TID" to "Multi-TID"	2017/1/9 9:42
4114	Albert Petrick	225	1 18.2	147	15	T	Y	147.15 18.2	3556	The "Value" column in Table 18-1 (TXVECTOR parameters) is defined for the Parameter. For example, the "Value" for CBW20 or CBW40 are ambiguous. The description of these Values need additional clarification and a reference subclause, similar to those in Table 17-1 in subclause 17.2.2.1 of .11axD1.0, or Table 18-1, 18-3 in IEEE 802.11-2016, and IEEE 802.11-REVmc - D8.0.	Add text to describe what is meant by CBW20 or CBW40, Static or Dynamic in the Value column and provide reference subclauses.	2017/1/9 9:42
4115	Albert Petrick	225	1 28.3.17.6.4	349	46	E	Y	349.46 28.3.17.6.4	3312	Sentence misaligned spacing	Change "BUSY,{secondary40}}" to "BUSY,{secondary40}}"	2017/1/9 9:42
4116	Albert Petrick	225	1 9.4.2.218.3	84	31	T	Y	84.31 9.4.2.218.3	3492	Add clarity and call out bit position in Table 9-262aa for subfield "SU Beamformer" corresponding to those bit positions in Figure 9-589cl	Add bit B31 in Definition column Change to: "B31 indicates support for operation as an SU beamformer."	2017/1/9 9:42
4117	Albert Petrick	225	1 18.2	147	15	T	Y	147.15 18.2	3558	The "Value" column in Table 18-3 (RXVECTOR parameters) is defined for the Parameter. For example, the "Value" for CBW20 or CBW40 are ambiguous. The description of these Values need additional clarification and a reference subclause, similar to those in Table 18-3 in subclause 17.2.2.1 of .11axD1.0, or Tables 18-1, 18-3, in IEEE 802.11-2016, and IEEE 802.11-REVmc - D8.0.	Add text to describe what is meant by CBW20 or CBW40, Static or Dynamic in the Value column and provide reference subclauses.	2017/1/9 9:42
4118	Albert Petrick	225	1 27.2.2	150	56	E	Y	150.56 27.2.2		Period missing at end of sentence	Add period at the of sentence after "value"	2017/1/9 9:42
4119	Albert Petrick	225	1 9.4.2.218.3	84	36	T	Y	84.36 9.4.2.218.3	3494	Add clarity and call out bit position in Table 9-262aa for subfield "SU Beamformee" corresponding to those bit positions in Figure 9-589cl	Add bit B32 in Definition column Change to: "B32 indicates support for operation as an SU beamformee."	2017/1/9 9:42
4120	Albert Petrick	225	1 28.1.1	212	2	E	Y	212.02 28.1.1	3915	Period missing at end of sentence	Add period at the of sentence after "receive)"	2017/1/9 9:42
4121	Albert Petrick	225	1 27.4.2	158	51	E	Y	158.51 27.4.2	3297	multi-TID not capitalized	change "multi-TID" to "Multi-TID"	2017/1/9 9:42
4122	Albert Petrick	225	1 28.3.18.4.4	355	38	T	Y	355.38 28.3.18.4.4	3560	The EVM for MCS7 (-27 dB) is based on the maximum tx power of MCS7. Clarification is needed why it is being used for BPSK...64-QAM as shown in Table 28-45. The EVM value was selected for UL OFDMA PPDUs. This should be noted or expanded in the text in clause 28.3.18.4.4	Add the following underlined text (without the underline) in the "Note" on line 40 in Table 28-45 as follows: "which EVM is test is conducted. "EVM of -27 dB, is used when the Tx Power is less than the maximum power of MCS7, and assists the AP in managing RUs for UL OFDMA PPDU transmissions."	2017/1/9 9:42
4123	Albert Petrick	225	1 9.4.2.218.3	84	40	T	Y	84.40 9.4.2.218.3	3496	Add clarity and call out bit position in Table 9-262aa for subfield "MU Beamformer" corresponding to those bit positions in Figure 9-589cl	Add bit B33 in Definition column Change to: "B33 indicates support for operation as an MU beamformer."	2017/1/9 9:42
4124	Albert Petrick	225	1 28.3.17.6.4	349	21	E	Y	349.21 28.3.17.6.4	3313	Sentence misaligned spacing	Change "max(-72 dBm, OBSS_PD)" to " "max (-72 dBm, OBSS_PD)"	2017/1/9 9:42
4125	Albert Petrick	225	1 9.4.2.218.2	76	47	E	Y	76.47 9.4.2.218.2	3562	In Figure 9-589ck - (HE MAC PHY Capabilities Information field format) subfield "Group Addressed Multi-STA BlockAck In DL MU Support" is mark as having 4-bits. This is not correct. There is 1-bit assigned (B24).	Change Bits "4" to "1" for subfield "Group Addressed Multi-STA BlockAck In DL MU Support" in Figure 9-589ck.	2017/1/9 9:42

4126	Albert Petrick	225	1 9.4.2.218.3	84	6	T	Y	84.06 9.4.2.218.3	3267	Add clarity and call out bit positions in Table 9-262aa for subfield "Beamforemee STS For < 80 MHz" corresponding to those bit positions in Figure 9-589cl. Missing period at the end of sentence.	Add bits B34-B36 in Definition column Change to: "B34-B36 indicates the maximum number of space-time streams the STA can receive in an HE NDP."	2017/1/9 9:42
4127	Albert Petrick	225	1 28.3.18.2	353	62	T	Y	353.62 28.3.18.2	3314	Spectral flatness procedure needs more clarity	Delete the sentence: "Demodulate the HE PPDUs .....procedure:" and place with the following sentence. " The HE PPDUs shall be demodulated using the following (or equivalent) procedure:"	2017/1/9 9:42
4128	Albert Petrick	225	1 27.2.2	150	59	E	Y	150.59 27.2.2		Period missing at end of sentence	Add period at the of sentence after "holder"	2017/1/9 9:42
4129	Albert Petrick	225	1 28.1.1	212	9	E	Y	212.09 28.1.1	3923	Period missing at end of sentence	Add period at the of sentence after "bandwidth"	2017/1/9 9:42
4130	Albert Petrick	225	1 28.3.17.3	345	64	E	Y	345.64 28.3.17.3	3564	Missing Table number reference in clause 28.3.17.3	Change "Table xx-a" to "Table 28-41"	2017/1/9 9:42
4131	Albert Petrick	225	1 27.4.4	160	160	E	Y	161.60 27.4.4	3298	multi-TID not capitalized	change "multi-TID" to "Multi-TID"	2017/1/9 9:42
4132	Albert Petrick	225	1 9.4.2.218.3	84	56	T	Y	84.56 9.4.2.218.3	3272	Add clarity and call out bit positions in Table 9-262aa for subfield "NTST Total For < 80 MHz" corresponding to those bit positions in Figure 9-589cl. Missing period at the end of sentence.	Add bits B37-B39 in Definition column Change to: "B37-B39 indicates the maximum value for.....partial bandwidth."	2017/1/9 9:42
4133	Albert Petrick	225	1 28.4.3	372	48	T	Y	372.48 28.4.3	3315	Table 28-46 - HE PHY characteristics lists the aPSDUMaxLength set to 6,500,631 octets. It's not clear in the table or text what assumptions were made and how the length is calculated.	Add a NOTE at the bottom of Table 28-46 stating the assumptions and the calculation (Eq.) for determining the PSDU maximum. E.g., 1024-QAM 5/6 rate coding rate, LDPC, 160 MHz channel bandwidth, 8 spatial streams, LDPC.	2017/1/9 9:42
4134	Albert Petrick	225	1 27.7.4	186	8	T	Y	186.08 27.7.4	3240	TWT scheduling STA and TWT scheduled STA are described. The text states "Either STA can tear down an established negotiation...." It's not clear if "Either STA" means the scheduling STA and the scheduled STA.	Rewrite sentence for clarity and expand on "Either STA"	2017/1/9 9:42
4135	Albert Petrick	225	1 28.3.17.6.4	349	16	E	Y	349.16 28.3.17.6.4	3567	Paragraph formatting misalignment in clause 28.3.17.6.4	Fix. Left justify paragraph	2017/1/9 9:42
4136	Albert Petrick	225	1 9.4.2.218.3	85	6	T	Y	85.06 9.4.2.218.3	3276	Add clarity and call out bit positions in Table 9-262aa for subfield "Beamformee STS for > 80 MHz" corresponding to those bit positions in Figure 9-589cl. Missing period at the end of sentence.	Add bits B40-B42 in Definition column Change to: "B40-B42 indicates the maximum number for.....HE NDP."	2017/1/9 9:42
4137	Albert Petrick	225	1 28.3.10.7.2	277	58	E	N	277.58 28.3.10.7.2	3316	LDPC misspelled in Table 28-17	Change "LPDC" to "LDPC" in Bandwidth column of Table 28-17	2017/1/9 9:42
4138	Albert Petrick	225	1 9.4.2.218.3	85	13	T	Y	85.13 9.4.2.218.3	3281	Add clarity and call out bit positions in Table 9-262aa for subfield "NSTS Total For > 80 MHz" corresponding to those bit positions in Figure 9-589cl. Missing period at the end of sentence.	Add bits B44-B45 in Definition column Change to: "B43-B45 indicates the maximum value for.....partial bandwidth."	2017/1/9 9:42
4139	Albert Petrick	225	1 28.1.1	212	14	E	Y	212.14 28.1.1	3929	Period missing at end of sentence	Add period at the of sentence after "supported"	2017/1/9 9:42
4140	Albert Petrick	225	1 28.3.6.4	250	43	T	Y	250.43 28.3.6.4	3317	Four extra tones insertion; mapping not correct for Construction of L-SIG.	In f) Change "{-1, -1, -1, 1}" to {-1, -1, 1, 1}"	2017/1/9 9:42
4141	Albert Petrick	225	1 27.4.4.1	160	45	E	Y	160.45 27.4.4.1	3299	multi-TID not capitalized	change "multi-TID" to "Multi-TID"	2017/1/9 9:42
4142	Albert Petrick	225	1 9.4.2.218.3	85	20	T	Y	85.20 9.4.2.218.3	3285	Add clarity and call out bit positions in Table 9-262aa for subfield "Number Of Sounding Dimensions For < 80 MHz" corresponding to those bit positions in Figure 9-589cl. Missing period at the end of sentence.	Add bits B46-B48 in Definition column Change to: "B46-B48 represents the beamformer's capability.....for an HE NDP."	2017/1/9 9:42
4143	Albert Petrick	225	1 27.7.4	187	23	E	Y	187.23 27.7.4	3248	Period missing at end of sentence	Add period at the of sentence after "TWT"	2017/1/9 9:42
4144	Albert Petrick	225	1 28.3.17.6.4	349	44	E	Y	349.44 28.3.17.6.4	3572	Paragraph formatting misalignment in clause 28.3.17.6.4	Fix. Left justify paragraph	2017/1/9 9:42
4145	Albert Petrick	225	1 28.3.6.5	251	11	T	Y	251.11 28.3.6.5	3318	Four extra tones insertion; mapping not correct for Construction of RL-SIG	In f) Change "{-1, -1, -1, 1}" to {-1, -1, 1, 1}"	2017/1/9 9:42
4146	Albert Petrick	225	1 9.4.2.218.3	85	22	E	Y	85.22 9.4.2.218.3	3509	Missing period at end of sentence in Definition column of Table 9-262aa.	Add period at the end of sentence "HE NDP"	2017/1/9 9:42
4147	Albert Petrick	225	1 28.3.18.4.4	357	11	E	Y	357.11 28.3.18.4.4	3575	Sentence formatting misalignment in clause 28.3.17.6.4	Fix. Left justify sentence	2017/1/9 9:42

4148	Albert Petrick	225	1 9.3.1.23	45	11	T	Y	45.11 9.3.1.23	3319	"Doppler subfield indicates a high doppler mode of transmission." Definition, clarification and technical details are not in .11axD1.0 with respect to the range of doppler spread and operating conditions triggering "high doppler mode". In Table 9-262aa pg. 83 "doppler procedure" defines 2-bits and references for "doppler" and makes reference to STAs using a "Doppler Procedure" for HE PPDUs transmissions. Critical technical details on the doppler procedure are lacking in .11axD1.0.	Either remove all references to Doppler in .11axD1.0 (text and in Table 9-262aa) including STA doppler support or add detailed technical content on Doppler Procedure for HE PPDU transmissions in support of clause of 9.3.1.23 and Table 9-262aa.	2017/1/9 9:42
4149	Albert Petrick	225	1			E	Y		3300	multi-TID not capitalized	Make global change in .11ax D1.0: change "multi-TID to Multi-TID"	2017/1/9 9:42
4150	Albert Petrick	225	1 28.1.1	212	17	E	Y	212.17 28.1.1	3936	Period missing at end of sentence	Add period at the of sentence after "capable"	2017/1/9 9:42
4151	Albert Petrick	225	1 9.4.2.218.3	85	26	T	Y	85.26 9.4.2.218.3	3511	Add clarity and call out bit positions in Table 9-262aa for subfield "Number Of Sounding Dimensions For > 80 MHz" corresponding to those bit positions in Figure 9-589cl. Missing period at the end of sentence.	Add bits B48-B51 in Definition column Change to: "B49-B51 represents the beamformer's capability.....for an HE NDP."	2017/1/9 9:42
4152	Albert Petrick	225	1 9.4.2.218.3	83	41	T	Y	83.41 9.4.2.218.3	3320	Table 9-262aa defines HE-PHY Capabilities Information field. Doppler subfield makes reference to Doppler Procedure. There is no text on "Doppler procedure" procedure needs to be defined.	Add technical detail content or remove "Doppler subfield from Table 262aa	2017/1/9 9:42
4153	Albert Petrick	225	1 25.5.2.3	167	69	T	Y	167.69 25.5.2.3	3301	"TBD" is a placeholder and not allowed in drafts in WG letter ballots as per IEEE 802.11 WG policies.	Remove TBD	2017/1/9 9:42
4154	Albert Petrick	225	1 27.7.4	187	26	E	Y	187.26 27.7.4	3257	Period missing at end of sentence	Add period at the of sentence after "is 1"	2017/1/9 9:42
4155	Albert Petrick	225	1 9.3.1.23	45	11	T	Y	45.11 9.3.1.23	3321	Doppler is not defined in clause 3.4 of IEEE 802.11-2016 (802.11 REVmc D8.0)	Add "Doppler" definition in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
4156	Albert Petrick	225	1 28.3.18.4.4	357	14	E	Y	357.14 28.3.18.4.4	3580	Sentence formatting misalignment in clause 28.3.17.6.4	Fix. Left justify sentence	2017/1/9 9:42
4157	Albert Petrick	225	1 27.3.3.4	154	39	T	Y	154.39 27.3.3.4	3302	The "L3 Frag BA Request frame", "L3 Frag BA Response" and "BA Response frame" are not defined and ambiguous. There are no figures, tables, text or timing flow between Requests and Responses.	Define "L3 Frag BA Request frame" and "L3 Frag BA Response", BA Response frames, add figures, tables and describe a procedure for L3 dynamic fragmentation.	2017/1/9 9:42
4158	Albert Petrick	225	1 27.3.3.1	153	19	E	Y	153.19 27.3.3.1	3322	Extra period	Remove extra period from the end of the sentence.	2017/1/9 9:42
4159	Albert Petrick	225	1 9.4.2.218.3	85	28	E	Y	85.28 9.4.2.218.3	3514	Missing period at end of sentence in Definition column of Table 9-262aa.	Fix. Add period at the end of sentence "HE NDP."	2017/1/9 9:42
4160	Albert Petrick	225	1 28.1.1	212	19	E	Y	212.19 28.1.1	3943	Period missing at end of sentence	Add period at the of sentence after "capable"	2017/1/9 9:42
4161	Albert Petrick	225	1 28.3.11.13	331	48	E	Y	331.48 28.3.11.13	3583	Misspelling in PPDU BW in Table 28-31 Pilot indices for 52-tone transmission	Change header "PPD BW" to "PPDU BW" in Table 28-31	2017/1/9 9:42
4162	Albert Petrick	225	1 27.6.2	177	19	T	Y	177.19 27.6.2	3303	Text in sentence references table "Table YY-1". Table doesn't exist in .11ax D1.0 or in IEEE 802.11-2016	Fix reference and add table or delete sentence referencing table	2017/1/9 9:42
4163	Albert Petrick	225	1 27.3.4.1	155	44	E	Y	155.44 27.3.4.1	3323	Paragraph misaligned	left justify paragraph	2017/1/9 9:42
4164	Albert Petrick	225	1 9.4.2.218.3	85	29	E	Y	85.29 9.4.2.218.3	3516	Missing period at end of sentence in Encoding column in Table 9-262aa.	Add period at the end of sentence "reserved."	2017/1/9 9:42
4165	Albert Petrick	225	1 27.7.4	187	31	E	Y	187.31 27.7.4	3266	Period missing at end of sentence	Add period at the of sentence after "TWT"	2017/1/9 9:42
4166	Albert Petrick	225	1 28.3.11.13	332	30	E	Y	332.30 28.3.11.13	3585	Misspelling in PPDU BW in Table 28-33 Pilot indices for 106-tone transmission	Change header "PPD BW" to "PPDU BW" in Table 28-33	2017/1/9 9:42
4167	Albert Petrick	225	1 27.6.2	177	43	T	Y	177.43 27.6.2	3304	Figure 27-3 Example of sounding protocol not correct.	Re-draw diagram. Fix sounding protocol diagram to illustrate alignment of SIFS timing as beamformee from beamformer.	2017/1/9 9:42
4168	Albert Petrick	225	1 27.5.2.5	171	43	E	Y	171.43 27.5.2.5	3324	Extra parenthesis	Remove extra parenthesis at the end of sentence.	2017/1/9 9:42
4169	Albert Petrick	225	1 28.3.11.13	333	11	E	Y	333.11 28.3.11.13	3589	Misspelling in PPDU BW in Table 28-34 Pilot indices for 242-tone transmission	Change header "PPD BW" to "PPDU BW" in Table 28-34	2017/1/9 9:42
4170	Albert Petrick	225	1 27.6.2	178	6	T	Y	178.06 27.6.2	3305	Figure 27-4 Example of sounding protocol not correct.	Re-draw diagram. Fix sounding protocol diagram to illustrate alignment of SIFS timing, identify the beamformee "1 thru n" and spell out the word "TRIG" in UL TRIG PPDU	2017/1/9 9:42
4171	Albert Petrick	225	1 28.1.1	212	22	E	Y	212.22 28.1.1	3950	Period missing at end of sentence	Add period at the of sentence after "capable"	2017/1/9 9:42
4172	Albert Petrick	225	1 27.5.2.5	171	40	T	Y	171.40 27.5.2.5	3325	"ACs (#2190, 2191)" are remaining CID placeholders and not part of draft .11ax D1.0	Remove references to CIDs #2190, and 2191	2017/1/9 9:42

4173	Albert Petrick	225	1 28.3.11.13	333	11	E	Y	333.11 28.3.11.13	3591	Misspelling in PPDU BW in Table 28-36 Pilot indices for 484-tone transmission	Change header "PPD BW" to "PPDU BW" in Table 28-36	2017/1/9 9:42
4174	Albert Petrick	225	1 27.6.2	178	7	T	Y	178.07 27.6.2	3306	"CSI" in Figure 27-4 is not defined or referenced in text	Expand on the term "CSI" and describe this term in the text with relationship with HE beamformee.	2017/1/9 9:42
4175	Albert Petrick	225	1 9.4.2.218.3	85	24	E	Y	85.24 9.4.2.218.3	3520	Missing period at end of sentence in Encoding column in Table 9-262aa.	Add period at the end of sentence "reserved."	2017/1/9 9:42
4176	Albert Petrick	225	1 27.7.4	187	35	E	Y	187.35 27.7.4		Period missing at end of sentence	Add period at the of sentence after "is 0"	2017/1/9 9:42
4177	Albert Petrick	225	1 27.5.2.5	171	41	E	Y	171.41 27.5.2.5	3326	Table number missing for Table 9-XX (Delta TID subfield encoding).	Add Table number 9-18c	2017/1/9 9:42
4178	Albert Petrick	225	1 28.3.11.13	334	43	E	Y	334.43 28.3.11.13	3592	Misspelling in PPDU BW in Table 28-37 Pilot indices for 484-tone transmission	Change header "PPD BW" to "PPDU BW" in Table 28-37	2017/1/9 9:42
4179	Albert Petrick	225	1 27.16.1	204	56	E	Y	204.56 27.16.1	3307	Sentence misaligned spacing	Left just "A STA fro which do11HEOptionImplemented....."	2017/1/9 9:42
4180	Albert Petrick	225	1 9.4.2.218.3	85	31	T	Y	85.31 9.4.2.218.3	3522	Add clarity and call out bit positions in Table 9-262aa for subfield "Ng = 16 For SU Feedback Support" corresponding to those bit positions in Figure 9-589cl. Missing period at the end of sentence.	Add bit B52 in Definition column Change to: "B52 indicates if the HE beamformee....."	2017/1/9 9:42
4181	Albert Petrick	225	1 9.3.1.22	42	7	E	Y	42.07 9.3.1.22	3327	Figure 9-52d Common Info field B20-B21 has a spelling error for "GIAnd LTF Type"	Change "GIAnd" to "GI And"	2017/1/9 9:42
4182	Albert Petrick	225	1 28.3.12	339	3	E	Y	339.03 28.3.12	3594	Grammar error in text referencing Table 28-38 in clause 28.3.12	Add underlined text (without the underline) to read: "The 3-bit Packet Extension field in HE-SIG-A is defined as shown in Table 28-38.....HE-SIG-A)."	2017/1/9 9:42
4183	Albert Petrick	225	1 28.1.1	212	27	E	Y	212.27 28.1.1	3956	Period missing at end of sentence	Add period at the of sentence after "applicable"	2017/1/9 9:42
4184	Albert Petrick	225	1 28.3.14.3	342	47	E	Y	342.47 28.3.14.3	3308	Period missing at end of sentence	Add period at the end of sentence.	2017/1/9 9:42
4185	Albert Petrick	225	1 9.4.2.218.3	85	35	T	Y	85.35 9.4.2.218.3	3524	Add clarity and call out bit positions in Table 9-262aa for subfield "Ng = 16 For MU Feedback Support" corresponding to those bit positions in Figure 9-589cl. Missing period at the end of sentence.	Add bit B53 in Definition column Change to: "B53 indicates if the HE beamformee....."	2017/1/9 9:42
4186	Albert Petrick	225	1 28.3.11.1	314	36	E	Y	314.36 28.3.11.1	3596	Spelling error "non STBC" in several clauses in .11axD1.0. Not consistent with IEEE 802.11-2016.	Global change text "non STBC" to "non-STBC" (add hyphen after non) throughout .11axD1.0, in text, Figures, Tables and subclause headers.	2017/1/9 9:42
4187	Albert Petrick	225	1 27.7.4	187	37	E	Y	187.37 27.7.4		Period missing at end of sentence	Add period at the of sentence after "is 1"	2017/1/9 9:42
4188	Albert Petrick	225	1 9.4.2.218.3	85	37	E	Y	85.37 9.4.2.218.3	3526	In Table 9-262aa missing period at the end of sentence.	Add period after "MU-type feedback."	2017/1/9 9:42
4189	Albert Petrick	225	1 28.3.10.7.2	281		E	Y	281.00 28.3.10.7.2	3598	Missing period in Table 28-18	Add period. Change "is punctured" to "is punctured."	2017/1/9 9:42
4190	Albert Petrick	225	1 9.4.2.218.1	76	2	E	Y	76.02 9.4.2.218.1	3328	Extra period	Remove extra period from the end of sentence.	2017/1/9 9:42
4191	Albert Petrick	225	1 9.4.2.218.3	85	39	T	Y	85.39 9.4.2.218.3	3528	Add clarity and call out bit positions in Table 9-262aa for subfield "Codebook Size (ñ≥, ñΩ) = {4, 2} For SU Support" corresponding to those bit positions in Figure 9-589cl.	Add bit B54 in Definition column Change to: "B54 indicates if the HE beamformee....."	2017/1/9 9:42
4192	Albert Petrick	225	1 28.1.1	212	35	E	Y	212.35 28.1.1	3962	Period missing at end of sentence	Add period at the of sentence after "least 4"	2017/1/9 9:42
4193	Albert Petrick	225	1 28.3.17.6.4	349	16	E	Y	349.16 28.3.17.6.4	3309	Sentence misaligned spacing	left justify "issue a PHY-CCA.indication(BUSY, {secondary40})."	2017/1/9 9:42
4194	Albert Petrick	225	1 28.3.10.7.2	276	44	T	Y	276.44 28.3.10.7.2	3600	Table 28-17 referencing B11-B14 Spatial Reuse suggests the need for more development. This is a place holder e.g., TBD.	Delete note in Table 28-17: NOTE: this part needs further development.	2017/1/9 9:42
4195	Albert Petrick	225	1 9.4.2.218.3	85	44	T	Y	85.44 9.4.2.218.3	3530	Add clarity and call out bit positions in Table 9-262aa for subfield "Codebook Size (ñ≥, ñΩ) = {7,5} For MU Support" corresponding to those bit positions in Figure 9-589cl.	Add bit B55 in Definition column Change to: "B55 indicates if the HE beamformee....."	2017/1/9 9:42
4196	Albert Petrick	225	1 27.7.4	187	43	E	Y	187.43 27.7.4		Period missing at end of sentence	Add period at the of sentence after "session"	2017/1/9 9:42
4197	Albert Petrick	225	1 9.4.2.218.3	85	50	E	Y	85.50 9.4.2.218.3	3532	In Table 9-262aa, Missing periods and line spacing between sentences.	In the "Definition" column, Add period at the end of sentences e.i., after "feedback." on lines 50, 52, 54, 57, 59 and 61. Add line space carriage return after "feedback on lines 50, 52, 54, 57 and 59. In "Encoding" column, Add line spacing carriage return after "otherwise." on line 55.	2017/1/9 9:42
4198	Albert Petrick	225	1 9.4.2.218.5	89	38	E	Y	89.38 9.4.2.218.5	3329	Extra period	Remove extra period from the end of sentence.	2017/1/9 9:42
4199	Albert Petrick	225	1 28.3.17.6.4	349	44	E	Y	349.44 28.3.17.6.4	3310	Sentence misaligned spacing	left justify "PHYCCA. Indication(BUSY, {primary}),.....and"	2017/1/9 9:42

4200	Albert Petrick	225	1 9.4.2.218.3	86	6	T	Y	86.06 9.4.2.218.3	3534	Add clarity and call out bit position in Table 9-262aa for subfield "HE ER SU Payload" corresponding to those bit positions in Figure 9-589cl.	Add bit B59 in Definition column Change to: "B59: indicates the support of transmission....."	2017/1/9 9:42
4201	Albert Petrick	225	1 28.1.1	212	39	E	Y	212.39 28.1.1	3970	Period missing at end of sentence	Add period at the of sentence after "supported"	2017/1/9 9:42
4202	Albert Petrick	225	1 9.4.2.218.5	89	13	E	Y	89.13 9.4.2.218.5	3330	Bit positions B0 - Bn not labeled on Figure 9-589cp--PPE Thresholds Info field format	Update Figure 9-589cp with Bit positions B0-Bn for groups of 3 bits per PPET16 and PPET8 subfields.	2017/1/9 9:42
4203	Albert Petrick	225	1 28.3.14.3	342	47	E	Y	342.47 28.3.14.3	3604	Period missing at end of sentence	Add period at the end of the sentence after "preamble".	2017/1/9 9:42
4204	Albert Petrick	225	1 9.4.2.218.3	86	11	T	Y	86.11 9.4.2.218.3	3536	Add clarity and call out bit position in Table 9-262aa for subfield "DL MU-MIMO on Partial BW" corresponding to those bit positions in Figure 9-589cl.	Add bit B60 in Definition column Change to: "B60: indicates the non-AP STA supports....."	2017/1/9 9:42
4205	Albert Petrick	225	1 27.8.3	189	30	E	Y	189.30 27.8.3		Period missing at end of sentence	Add period at the of sentence after "frames"	2017/1/9 9:42
4206	Albert Petrick	225	1 28.3.14.3	342	45	T	Y	342.45 28.3.14.3	3606	In clause 28.3.14.3 transmit power requirements and RSSI measurement accuracy requirements are defined for signal level ranges in dBm operating in the 2.4 GHz and 5GHz bands. The requirements are defined for nominal (room) temperature conditions. Specifying transmit power measurements and RSSI accuracy measurements over temperature is implementation dependent and could be regulatory dependent. Specifying a specific operation temperature drives an implementation and is out-of-scope of the standard.	Delete sentence: "The requirements are for nominal (room) temperature conditions."	2017/1/9 9:42
4207	Albert Petrick	225	1 9.4.2.218.3	86	14	T	Y	86.14 9.4.2.218.3	3538	Add clarity and call out a "Note" reference in Table 9-262aa for subfield "DL MU-MIMO on Partial BW" in the Encoding column.	Add change to read: "Note: This field is reserved for an AP."	2017/1/9 9:42
4208	Albert Petrick	225	1 28.3.14.3	342	46	T	Y	342.46 28.3.14.3	3609	In clause 28.3.14.3 the RSSI is measured during the "PHY legacy preamble". The RSSI_LEGACY is defined, but the PHY legacy preamble is not. It's not define or referenced in the IEEE 802.11-2016 baseline. This should be defined and referenced back to the IEEE 802.11-2016 baseline standard.	Add definition for PHY legacy preamble in clause 3.4 Definitions, acronyms, and abbreviations with reference back to IEEE 802.11-2016 figures, text or subclause	2017/1/9 9:42
4209	Albert Petrick	225	1 28.3.17.6.4	349	27	E	Y	349.27 28.3.17.6.4	3311	Sentence misaligned spacing	left justify "present and on of the .....or"	2017/1/9 9:42
4210	Albert Petrick	225	1 10.3.2.8a.1	116	3	E	Y	116.03 10.3.2.8a.1	3331	Extra period	Remove extra period from the end of sentence.	2017/1/9 9:42
4211	Albert Petrick	225	1 28.1.1	212	43	E	Y	212.43 28.1.1	3976	Period missing at end of sentence	Add period at the of sentence after "supported"	2017/1/9 9:42
4212	Albert Petrick	225	1 9.4.2.218.3	86	16	T	Y	86.16 9.4.2.218.3	3540	Add clarity and call out bit position in Table 9-262aa for subfield "PPE Threshold Present" corresponding to those bit position in Figure 9-589cl.	Add bit B61 in Definition column Change to: "B61: indicates whether or no the PPE....."	2017/1/9 9:42
4213	Albert Petrick	225	1 28.3.18.2	354	46	E	Y	354.46 28.3.18.2	3612	Extra digit in Table 28-44	Change "+3441" to "+344"	2017/1/9 9:42
4214	Albert Petrick	225	1 28.3.3.2	230	1	E	Y	230.01 28.3.3.2	3979	Missing hyphen	Add hyphen " - " after "484"	2017/1/9 9:42
4215	Albert Petrick	225	1 27.8.3	189	37	E	Y	189.37 27.8.3		Period missing at end of sentence	Add period at the of sentence after "field"	2017/1/9 9:42
4216	Albert Petrick	225	1 9.4.2.218.3	86	18	T	Y	86.18 9.4.2.218.3	3542	Add clarity and call out bit position in Table 9-262aa for subfield "SRP-based SR Support" corresponding to those bit position in Figure 9-589cl.	Add bit B62 in Definition column Change to: "B62: indicates that the STA supports SRP-based....."	2017/1/9 9:42
4217	Albert Petrick	225	1 28.3.14.3	342	12	E	Y	342.12 28.3.14.3	3615	Spelling error with MCS 7	Change "MCS 7" to "MCS7"	2017/1/9 9:42
4218	Albert Petrick	225	1 28.3.17.6.4	349	46	E	Y	349.46 28.3.17.6.4	3312	Sentence misaligned spacing	Change "BUSY,{secondary40}}" to "BUSY,{secondary40}}"	2017/1/9 9:42
4219	Albert Petrick	225	1 9.4.2.218.3	86	19	E	Y	86.19 9.4.2.218.3	3544	In Table 9-262aa, missing period after sentence.	Add period "." at the end of sentence after "operation."	2017/1/9 9:42
4220	Albert Petrick	225	1 27.4.4.5	162	26	E	Y	162.26 27.4.4.5	3332	Extra period	Remove extra period at the end of sentence after the word "context"	2017/1/9 9:42
4221	Albert Petrick	225	1 28.3.14.3	342	10	E	Y	342.10 28.3.14.3	3617	Spelling error with MCS 0	Change "MCS 0" to "MCS0"	2017/1/9 9:42
4222	Albert Petrick	225	1 9.4.2.218.3	86	21	T	Y	86.21 9.4.2.218.3	3546	Add clarity and call out bit position in Table 9-262aa for subfield "Power Boost Factor +thr Support" corresponding to those bit position in Figure 9-589cl.	Add bit B63 in Definition column Change to: "B63: indicates that the STA supports....."	2017/1/9 9:42
4223	Albert Petrick	225	1 28.3.14.3	342	36	E	Y	342.36 28.3.14.3	3619	In Table 28-40 in the Case A column, there is a hyphen character.	Remove hyphen "-" character and leave cell blank	2017/1/9 9:42
4224	Albert Petrick	225	1 28.3.10.5	212	49	E	Y	212.49 28.3.10.5	3986	Period missing at end of sentence	Add period at the of sentence after "false"	2017/1/9 9:42
4225	Albert Petrick	225	1 27.8.3	189	46	E	Y	189.46 27.8.3		Period missing at end of sentence	Add period at the of sentence after "field"	2017/1/9 9:42
4226	Albert Petrick	225	1 28.3.17.6.4	349	21	E	Y	349.21 28.3.17.6.4	3313	Sentence misaligned spacing	Change "max(-72 dBm, OBSS_PD)" to " "max (-72 dBm, OBSS_PD)"	2017/1/9 9:42

4227 Albert Petrick	225	1 28.3.16	344	45	E	Y	344.45 28.3.16	3622	In Figure 28-36 (HE NDP PPDU format) the PE field is the Packet Extension field. The text should reference this field.	Change "Packet Extension" to "Packet Extension (PE)"	2017/1/9 9:42
4228 Albert Petrick	225	1 28.3.10.7.2	275	21	E	Y	275.21 28.3.10.7.2	3991	Period missing in Table 28-16	Add period after "1"	2017/1/9 9:42
4229 Albert Petrick	225	1 27.5.2.2.1	164	46	E	Y	164.46 27.5.2.2.1	3333	Extra period	Remove extra period at the end of sentence after the word "allocation)"	2017/1/9 9:42
4230 Albert Petrick	225	1 28.3.18.2	353	62	T	Y	353.62 28.3.18.2	3314	Spectral flatness procedure needs more clarity	Delete the sentence: "Demodulate the HE PPDUs .....procedure:" and place with the following sentence. " The HE PPDUs shall be demodulated using the following (or equivalent) procedure:"	2017/1/9 9:42
4231 Albert Petrick	225	1 28.3.1.8.3	289	19	E	Y	289.19 28.3.1.8.3	3995	Missing space between sentences	Add space and the end of the sentence after the period " . "	2017/1/9 9:42
4232 Albert Petrick	225	1 9.4.2.218.3	86	22	E	Y	86.22 9.4.2.218.3	3548	In Table 9-262aa, missing period after sentence.	Add period at the end of sentence after "range [0.5, 2]."	2017/1/9 9:42
4233 Albert Petrick	225	1 27.8.3	189	49	E	Y	189.49 27.8.3		Period missing at end of sentence	Add period at the of sentence after "field"	2017/1/9 9:42
4234 Albert Petrick	225	1 28.4.3	372	48	T	Y	372.48 28.4.3	3315	Table 28-46 - HE PHY characteristics lists the aPSDUMaxLength set to 6,500,631 octets. It's not clear in the table or text what assumptions were made and how the length is calculated.	Add a NOTE at the bottom of Table 28-46 stating the assumptions and the calculation (Eq.) for determining the PSDU maximum. E.g., 1024-QAM 5/6 rate coding rate, LDPC, 160 MHz channel bandwidth, 8 spatial streams, LDPC.	2017/1/9 9:42
4235 Albert Petrick	225	1 9.4.2.218.3	86	24	T	Y	86.24 9.4.2.218.3	3550	Add clarity and call out bit position in Table 9-262aa for subfield "4x HE-LTF And 0.8 us GI Support For HE PPDUs" corresponding to those bit position in Figure 9-589cl.	Add bit B64 in Definition column Change to: "B64: indicates for the reception of 4x LTF....."	2017/1/9 9:42
4236 Albert Petrick	225	1 28.3.5	246	33	T	Y	246.33 28.3.5	4000	OFDMA PPDU not clarified with HE	Add underlined text (without the underline) and remove strikethrough text from line 33 to 35 as follows: "This also includes the SU transmission in an RU that is part of a downlink or uplink HE OFDMA PPDU, and a transmission from one STA that is part of an UL MU-MIMO transmission in current RU.	2017/1/9 9:42
4237 Albert Petrick	225	1 28.3.16	344	36	E	Y	344.36 28.3.16	3628	Remove space between sentences	Delete lines 35 and 36. The text should read as follows: NDP is the only HE sounding format. The format of an HE NDP PPDU is shown in Figure 28-36 (HE NDP PPDU format).	2017/1/9 9:42
4238 Albert Petrick	225	1 27.5.2.2.1	164	53	E	Y	164.53 27.5.2.2.1	3335	Period missing at end of sentence	Add period at end of sentence after the word "S-MPDUs))"	2017/1/9 9:42
4239 Albert Petrick	225	1 28.3.10.7.2	277	58	E	N	277.58 28.3.10.7.2	3316	LDPC misspelled in Table 28-17	Change "LPDC" to "LDPC" in Bandwidth column of Table 28-17	2017/1/9 9:42
4240 Albert Petrick	225	1 9.4.2.218.3	86	28	T	Y	86.28 9.4.2.218.3	3552	Missing "Reserve" Subfield, and text for Definition and Encoding in Table 9-262aa. The Reserve subfield should correspond to the 7 bit positions B65 -B71 in Figure 9-589CI.	At the end of Table 9-262-aa. Add "Reserved" in Subfield column. Add text (see underlined text) "B65 - B71 (7-bits) are reserved." Encoding column leave blank.	2017/1/9 9:42
4241 Albert Petrick	225	1 28.3.17.4	347	13	E	Y	347.13 28.3.17.4	3631	Extra line space between paragraphs	Remove line 13	2017/1/9 9:42
4242 Albert Petrick	225	1 28.3.6.4	250	43	T	Y	250.43 28.3.6.4	3317	Four extra tones insertion; mapping not correct for Construction of L-SIG.	In f) Change "{-1, -1, -1, 1}" to {-1, -1, 1, 1}"	2017/1/9 9:42
4243 Albert Petrick	225	1 9.4.2.218.3	86	31	T	Y	86.31 9.4.2.218.3	3554	Class A STAs are declared "high capability devices" and class B STAs as "low capability devices" This is the only reference in .11axD1.0 to these terms. Class A and class B STAs are defined in sub-clause 28.3.14 (Transmit requirements for an HE trigger-based PPDU). Transmit power accuracy and RSSI measurement accuracy are discussed in detail e.g., Table 28-40. To eliminate ambiguities, "low and high capability devices" should be defined and referenced back to clause 28.3.14.	Add definition for "low and high capability" devices in clause 28.3.14, and add text reference back to clause 28.3.14. Add underline text (without the underline) to read: "Class A STAs are high capability devices and class B STAs are low capability devices as described in 28.3.14 (Transmit requirements for an HE trigger-based PPDU).	2017/1/9 9:42
4244 Albert Petrick	225	1 27.8.3	189	53	E	Y	189.53 27.8.3		Period missing at end of sentence	Add period at the of sentence after "Initiator"	2017/1/9 9:42
4245 Albert Petrick	225	1 28.3.11.2	315	33	E	Y	315.33 28.3.11.2	4008	Paragraph misaligned	Left justify	2017/1/9 9:42
4246 Albert Petrick	225	1 28.3.6.5	251	11	T	Y	251.11 28.3.6.5	3318	Four extra tones insertion; mapping not correct for Construction of RL-SIG	In f) Change "{-1, -1, -1, 1}" to {-1, -1, 1, 1}"	2017/1/9 9:42
4247 Albert Petrick	225	1 27.5.2.2.1	164	56	E	Y	164.56 27.5.2.2.1	3338	Period missing at end of sentence	Add period at end of sentence after the word "behavior))"	2017/1/9 9:42

4248	Albert Petrick	225	1 18.2	147	15	T	Y	147.15 18.2	3556	The "Value" column in Table 18-1 (TXVECTOR parameters) is defined for the Parameter. For example, the "Value" for CBW20 or CBW40 are ambiguous. The description of these Values need additional clarification and a reference subclause, similar to those in Table 17-1 in subclause 17.2.2.1 of .11axD1.0, or Table 18-1, 18-3 in IEEE 802.11-2016, and IEEE 802.11-REVmc - D8.0.	Add text to describe what is meant by CBW20 or CBW40, Static or Dynamic in the Value column and provide reference subclauses.	2017/1/9 9:42
4249	Albert Petrick	225	1 28.3.11.3	317	4	E	Y	317.04 28.3.11.3	4012	Grammar issue	Delete the word "as"	2017/1/9 9:42
4250	Albert Petrick	225	1 28.3.17.6.4	349	15	E	Y	349.15 28.3.17.6.4	3636	Paragraph misaligned	Left justify paragraph	2017/1/9 9:42
4251	Albert Petrick	225	1 9.3.1.23	45	11	T	Y	45.11 9.3.1.23	3319	"Doppler subfield indicates a high doppler mode of transmission." Definition, clarification and technical details are not in .11axD1.0 with respect to the range of doppler spread and operating conditions triggering "high doppler mode". In Table 9-262aa pg. 83 "doppler procedure" defines 2-bits and references for "doppler" and makes reference to STAs using a "Doppler Procedure" for HE PPDUs transmissions. Critical technical details on the doppler procedure are lacking in .11axD1.0.	Either remove all references to Doppler in .11axD1.0 (text and in Table 9-262aa) including STA doppler support or add detailed technical content on Doppler Procedure for HE PPDU transmissions in support of clause of 9.3.1.23 and Table 9-262aa.	2017/1/9 9:42
4252	Albert Petrick	225	1 18.2	147	15	T	Y	147.15 18.2	3558	The "Value" column in Table 18-3 (RXVECTOR parameters) is defined for the Parameter. For example, the "Value" for CBW20 or CBW40 are ambiguous. The description of these Values need additional clarification and a reference subclause, similar to those in Table 18-3 in subclause 17.2.2.1 of .11axD1.0, or Tables 18-1, 18-3, in IEEE 802.11-2016, and IEEE 802.11-REVmc - D8.0.	Add text to describe what is meant by CBW20 or CBW40, Static or Dynamic in the Value column and provide reference subclauses.	2017/1/9 9:42
4253	Albert Petrick	225	1 28.3.6.4	250	36	T	Y	250.36 28.3.6.4	4016	Binary convolutional coding and BCC referenced in various subclauses, figures, and tables. This should be defined.	Add definition for "BCC" in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
4254	Albert Petrick	225	1 28.5	373	28	E	Y	373.28 28.5	3242	Units "Mbps" in Table 28-47 through Tables 28-102 not consistent with units "Mb/s" in text, tables and figures in IEEE 802.11-2016.	Change "Mbps" to "Mb/s" in Tables 28-47 through Table 28-102. There are 54 tables that need updating!	2017/1/9 9:42
4255	Albert Petrick	225	1 9.4.2.218.3	83	41	T	Y	83.41 9.4.2.218.3	3320	Table 9-262aa defines HE-PHY Capabilities Information field. Doppler subfield makes reference to Doppler Procedure. There is no text on "Doppler procedure" procedure needs to be defined.	Add technical detail content or remove "Doppler subfield from Table 262aa	2017/1/9 9:42
4256	Albert Petrick	225	1 28.3.18.4.4	355	38	T	Y	355.38 28.3.18.4.4	3560	The EVM for MCS7 (-27 dB) is based on the maximum tx power of MCS7. Clarification is needed why it is being used for BPSK...64-QAM as shown in Table 28-45. The EVM value was selected for UL OFDMA PPDUs. This should be noted or expanded in the text in clause 28.3.18.4.4	Add the following underlined text (without the underline) in the "Note" on line 40 in Table 28-45 as follows: "which EVM is test is conducted. "EVM of -27 dB, is used when the Tx Power is less than the maximum power of MCS7, and assists the AP in managing RUs for UL OFDMA PPDU transmissions."	2017/1/9 9:42
4257	Albert Petrick	225	1 27.8.3	189	57	E	Y	189.57 27.8.3		Period missing at end of sentence	Add period at the of sentence after "Initiator"	2017/1/9 9:42
4258	Albert Petrick	225	1 27.5.2.2.1	164	59	E	Y	164.59 27.5.2.2.1	3342	Period missing at end of sentence	Add period at end of sentence after the word "TIDs))"	2017/1/9 9:42
4259	Albert Petrick	225	1 9.3.1.23	45	11	T	Y	45.11 9.3.1.23	3321	Doppler is not defined in clause 3.4 of IEEE 802.11-2016 (802.11 REVmc D8.0)	Add "Doppler" definition in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
4260	Albert Petrick	225	1 9.4.2.218.2	76	47	E	Y	76.47 9.4.2.218.2	3562	In Figure 9-589ck - (HE MAC PHY Capabilities Information field format) subfield "Group Addressed Multi-STA BlockAck In DL MU Support" is mark as having 4-bits. This is not correct. There is 1-bit assigned (B24).	Change Bits "4" to "1" for subfield "Group Addressed Multi-STA BlockAck In DL MU Support" in Figure 9-589ck.	2017/1/9 9:42
4261	Albert Petrick	225	1 27.9.2.2	192	1	T	Y	192.01 27.9.2.2		The note reference to the antenna connector connection to section 3.1. is ambigous. Clause 3.1 doesn't exist.	Add definition for antenna connector in 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
4262	Albert Petrick	225	1 27.3.3.1	153	19	E	Y	153.19 27.3.3.1	3322	Extra period	Remove extra period from the end of the sentence.	2017/1/9 9:42
4263	Albert Petrick	225	1 28.3.17.3	345	64	E	Y	345.64 28.3.17.3	3564	Missing Table number reference in clause 28.3.17.3	Change "Table xx-a" to "Table 28-41"	2017/1/9 9:42
4264	Albert Petrick	225	1 27.2.1	149	26	E	Y	149.26 27.2.1	4027	Period missing at end of sentence	Add period at the of sentence after "associated"	2017/1/9 9:42
4265	Albert Petrick	225	1 28.1.1	209	16	E	Y	209.16 28.1.1	3250	Period missing at end of sentence	Add period at the of sentence after "band"	2017/1/9 9:42

4266	Albert Petrick	225	1 27.11.2	196	19	T	Y	196.19 27.11.2		(T)DLS peer STA is not defined or linked to IEEE 802.11-2016 or IEEE 802.11ac-2013	Add text clarification and figure to support description	2017/1/9 9:42
4267	Albert Petrick	225	1 27.5.2.3	170	15	E	Y	170.15 27.5.2.3	3345	Extra period	Add period at end of sentence after the word "PPDU"	2017/1/9 9:42
4268	Albert Petrick	225	1 27.3.4.1	155	44	E	Y	155.44 27.3.4.1	3323	Paragraph misaligned	left justify paragraph	2017/1/9 9:42
4269	Albert Petrick	225	1 28.3.17.6.4	349	16	E	Y	349.16 28.3.17.6.4	3567	Paragraph formatting misalignment in clause 28.3.17.6.4	Fix. Left justify paragraph	2017/1/9 9:42
4270	Albert Petrick	225	1 9.4.2.221	94	4	E	Y	94.04 9.4.2.221		MU EDCA not defined, nor in IEEE 802.11-2016	Change text "MU EDCA" to "Multi-user (MU) EDCA"	2017/1/9 9:42
4271	Albert Petrick	225	1 27.5.2.5	171	43	E	Y	171.43 27.5.2.5	3324	Extra parenthesis	Remove extra parenthesis at the end of sentence.	2017/1/9 9:42
4272	Albert Petrick	225	1 28.3.10.8	286	8	E	Y	286.08 28.3.10.8		Figure 28-20 to small to read or print	Redraw figure use larger text font and align across page	2017/1/9 9:42
4273	Albert Petrick	225	1 28.1.1	209	19	E	Y	209.19 28.1.1	3258	Period missing at end of sentence	Add period at the of sentence after "band"	2017/1/9 9:42
4274	Albert Petrick	225	1 27.2.1	149	28	E	Y	149.28 27.2.1	4033	Period missing at end of sentence	Add period at the of sentence after "associated"	2017/1/9 9:42
4275	Albert Petrick	225	1 27.5.2.5	171	40	T	Y	171.40 27.5.2.5	3325	"ACs (#2190, 2191)" are remaining CID placeholders and not part of draft .11ax D1.0	Remove references to CIDs #2190, and 2191	2017/1/9 9:42
4276	Albert Petrick	225	1 28.3.3.2	229	31	E	Y	229.31 28.3.3.2	3348	Extra period	Add period at end of sentence after the word "width)"	2017/1/9 9:42
4277	Albert Petrick	225	1 28.3.10.8	286	43	E	Y	286.43 28.3.10.8		Figure 28-21 to small to read or print	Redraw figure use larger text font and align across page	2017/1/9 9:42
4278	Albert Petrick	225	1 28.3.17.6.4	349	44	E	Y	349.44 28.3.17.6.4	3572	Paragraph formatting misalignment in clause 28.3.17.6.4	Fix. Left justify paragraph	2017/1/9 9:42
4279	Albert Petrick	225	1 27.5.2.5	171	41	E	Y	171.41 27.5.2.5	3326	Table number missing for Table 9-XX (Delta TID subfield encoding).	Add Table number 9-18c	2017/1/9 9:42
4280	Albert Petrick	225	1 9.4.2.218.2	77	55	E	Y	77.55 9.4.2.218.2	3349	Table 9-262z misaligned Equation in "Encoding" column. "OfF" misspelled	Fix alignment of Eq Nmax = 2Maximum Number OFF-MPDUs. Change "OfF" to "Off". Increase line spacing between sentences for aligning equation.	2017/1/9 9:42
4281	Albert Petrick	225	1 28.3.10.8	287	8	E	Y	287.08 28.3.10.8		Figure 28-22 to small to read or print	Redraw figure use larger text font and align across page	2017/1/9 9:42
4282	Albert Petrick	225	1 28.3.18.4.4	357	11	E	Y	357.11 28.3.18.4.4	3575	Sentence formatting misalignment in clause 28.3.17.6.4	Fix. Left justify sentence	2017/1/9 9:42
4283	Albert Petrick	225	1 9.3.1.22	42	7	E	Y	42.07 9.3.1.22	3327	Figure 9-52d Common Info field B20-B21 has a spelling error for "GIAnd LTF Type"	Change "GIAnd" to "GI And"	2017/1/9 9:42
4284	Albert Petrick	225	1 10.13.2	128	42	T	Y	128.42 10.13.2	3241	HE Capabilities Element clause number incorrect	Change clause number to "9.4.2.218"	2017/1/9 9:42
4285	Albert Petrick	225	1 28.1.1	209	22	E	Y	209.22 28.1.1	3265	Period missing at end of sentence	Add period at the of sentence after "band"	2017/1/9 9:42
4286	Albert Petrick	225	1 28.3.10.8	287	51	E	Y	287.51 28.3.10.8		Figure 28-23 to small to read or print	Redraw figure use larger text font and align across page	2017/1/9 9:42
4287	Albert Petrick	225	1 27.2.1	149	33	E	Y	149.33 27.2.1	4041	Period missing at end of sentence	Add period at the of sentence after "set"	2017/1/9 9:42
4288	Albert Petrick	225	1 28.3.10.8	288	20	E	Y	288.20 28.3.10.8		Figure 28-23 to small tor read or print	Redraw figure use larger text font and align across page	2017/1/9 9:42
4289	Albert Petrick	225	1 28.3.18.4.4	357	14	E	Y	357.14 28.3.18.4.4	3580	Sentence formatting misalignment in clause 28.3.17.6.4	Fix. Left justify sentence	2017/1/9 9:42
4290	Albert Petrick	225	1 9.4.2.218.1	76	2	E	Y	76.02 9.4.2.218.1	3328	Extra period	Remove extra period from the end of sentence.	2017/1/9 9:42
4291	Albert Petrick	225	1 28.3.11.2	315	33	E	Y	315.33 28.3.11.2		Misaligned paragragh	Left justify	2017/1/9 9:42
4292	Albert Petrick	225	1 26.6.2	178	63	T	Y	178.63 26.6.2	3249	HE Capabilities Element clause number incorrect	Change clause number to "9.4.2.218"	2017/1/9 9:42
4293	Albert Petrick	225	1 28.1.1	210	6	E	Y	210.06 28.1.1	3663	Period missing at end of sentence	Add period at the of sentence after "bandwidth"	2017/1/9 9:42
4294	Albert Petrick	225	1 28.3.11.13	331	48	E	Y	331.48 28.3.11.13	3583	Misspelling in PPDU BW in Table 28-31 Pilot indices for 52-tone transmission	Change header "PPD BW" to "PPDU BW" in Table 28-31	2017/1/9 9:42
4295	Albert Petrick	225	1 27.2.1	149	36	E	Y	149.36 27.2.1	4048	Period missing at end of sentence	Add period at the of sentence after "associated"	2017/1/9 9:42
4296	Albert Petrick	225	1 28.3.11.2	315	50	E	Y	315.50 28.3.11.2		Equation 28-61 brackets cutoff	vertically center between paragraphs	2017/1/9 9:42
4297	Albert Petrick	225	1 28.3.11.13	332	30	E	Y	332.30 28.3.11.13	3585	Misspelling in PPDU BW in Table 28-33 Pilot indices for 106-tone transmission	Change header "PPD BW" to "PPDU BW" in Table 28-33	2017/1/9 9:42
4298	Albert Petrick	225	1 28.3.11.2	316	61	E	Y	316.61 28.3.11.2		Equation 28-64 brackets cutoff	vertically center between paragraphs	2017/1/9 9:42
4299	Albert Petrick	225	1 9.4.2.218.5	89	38	E	Y	89.38 9.4.2.218.5	3329	Extra period	Remove extra period from the end of sentence.	2017/1/9 9:42
4300	Albert Petrick	225	1 28.3.11.13	333	11	E	Y	333.11 28.3.11.13	3589	Misspelling in PPDU BW in Table 28-34 Pilot indices for 242-tone transmission	Change header "PPD BW" to "PPDU BW" in Table 28-34	2017/1/9 9:42
4301	Albert Petrick	225	1 27.15.4.1	203	18	T	Y	203.18 27.15.4.1	3256	HE Capabilities Element clause number incorrect	Change clause number to "9.4.2.218"	2017/1/9 9:42
4302	Albert Petrick	225	1 28.1.1	210	9	E	Y	210.09 28.1.1	3671	Period missing at end of sentence	Add period at the of sentence after "bandwidth"	2017/1/9 9:42
4303	Albert Petrick	225	1 28.3.11.5.1	318	2	E	Y	318.02 28.3.11.5.1		Equation 28-65 brackets cutoff	vertically center between paragraphs	2017/1/9 9:42
4304	Albert Petrick	225	1 9.4.2.218.5	89	13	E	Y	89.13 9.4.2.218.5	3330	Bit positions B0 - Bn not labeled on Figure 9-589cp--PPE Thresholds Info field format	Update Figure 9-589cp with Bit positions B0-Bn for groups of 3 bits per PPET16 and PPET8 subfields.	2017/1/9 9:42
4305	Albert Petrick	225	1 28.3.11.13	333	11	E	Y	333.11 28.3.11.13	3591	Misspelling in PPDU BW in Table 28-36 Pilot indices for 484-tone transmission	Change header "PPD BW" to "PPDU BW" in Table 28-36	2017/1/9 9:42
4306	Albert Petrick	225	1 9.4.2.1	67	16	T	Y	67.16 9.4.2.1	3260	HE Capabilities Element clause number incorrect in Table 9-77 Element IDs	Change clause number to "9.4.2.218"	2017/1/9 9:42
4307	Albert Petrick	225	1 28.3.11.5.2	318	43	E	Y	318.43 28.3.11.5.2		Equation 28-70 brackets cutoff	vertically center between paragraphs	2017/1/9 9:42
4308	Albert Petrick	225	1 28.3.11.13	334	43	E	Y	334.43 28.3.11.13	3592	Misspelling in PPDU BW in Table 28-37 Pilot indices for 484-tone transmission	Change header "PPD BW" to "PPDU BW" in Table 28-37	2017/1/9 9:42

4309	Albert Petrick	225	1 9.4.2.1	67	20	T	Y	67.20 9.4.2.1	3263	The HE Operation Element clause number is incorrect in Table 9-77 Element IDs.	Change clause number to "9.4.2.219"	2017/1/9 9:42
4310	Albert Petrick	225	1 27.2.1	149	49	E	Y	149.49 27.2.1	4059	Period missing at end of sentence	Add period at the of sentence after "associated"	2017/1/9 9:42
4311	Albert Petrick	225	1 28.3.11.5.4	321	54	E	Y	321.54 28.3.11.5.4		Equation 28-89 brackets cutoff	vertically center between paragraphs	2017/1/9 9:42
4312	Albert Petrick	225	1 28.1.1	210	13	E	Y	210.13 28.1.1	3677	Period missing at end of sentence	Add period at the of sentence after "MHz"	2017/1/9 9:42
4313	Albert Petrick	225	1 28.3.12	339	3	E	Y	339.03 28.3.12	3594	Grammar error in text referencing Table 28-38 in clause 28.3.12	Add underlined text (without the underline) to read: "The 3-bit Packet Extension field in HE-SIG-A is defined as shown in Table 28-38.....HE-SIG-A)."	2017/1/9 9:42
4314	Albert Petrick	225	1 28.3.14.3	342	53	T	Y	342.53 28.3.14.3	3359	CCDF not defined	Change "CCDF" to "complementary cumulative distribution function (CCDF)". Add definition for CCDF in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
4315	Albert Petrick	225	1 10.3.2.8a.1	116	3	E	Y	116.03 10.3.2.8a.1	3331	Extra period	Remove extra period from the end of sentence.	2017/1/9 9:42
4316	Albert Petrick	225	1 28.3.11.6	322	54	E	Y	322.54 28.3.11.6		Equation 28-92 brackets to small	Increase font size of brackets around equation	2017/1/9 9:42
4317	Albert Petrick	225	1 28.3.11.1	314	36	E	Y	314.36 28.3.11.1	3596	Spelling error "non STBC" in several clauses in .11axD1.0. Not consistent with IEEE 802.11-2016.	Global change text "non STBC" to "non-STBC" (add hyphen after non) throughout .11axD1.0, in text, Figures, Tables and subclause headers.	2017/1/9 9:42
4318	Albert Petrick	225	1 9.3.1.20	40	1	E	Y	40.01 9.3.1.20	3361	Clause title should not be underlined.	Remove underline; Change to "VHT/HE NDP"	2017/1/9 9:42
4319	Albert Petrick	225	1 28.3.11.11	329	46	E	Y	329.46 28.3.11.11		LDPC tone mapper note references index I in Error! Reference source not found. and Error! Reference source not found.	Remove Error! And add external reference source.	2017/1/9 9:42
4320	Albert Petrick	225	1 28.3.10.7.2	281		E	Y	281.00 28.3.10.7.2	3598	Missing period in Table 28-18	Add period. Change "is punctured" to "is punctured."	2017/1/9 9:42
4321	Albert Petrick	225	1 9.3.1.23	41	47	E	Y	41.47 9.3.1.23	3363	Parenthesis not needed in Figure 9-52c-Trigger frame	Remove parenthesis - Change "(RA)" to "RA" in Figure 9-52c-Trigger frame	2017/1/9 9:42
4322	Albert Petrick	225	1 27.2.1	149	53	E	Y	149.53 27.2.1	4068	Period missing at end of sentence	Add period at the of sentence after "associated"	2017/1/9 9:42
4323	Albert Petrick	225	1 28.1.1	210	15	E	Y	210.15 28.1.1	3685	Period missing at end of sentence	Add period at the of sentence after "subcarriers"	2017/1/9 9:42
4324	Albert Petrick	225	1 27.4.4.5	162	26	E	Y	162.26 27.4.4.5	3332	Extra period	Remove extra period at the end of sentence after the word "context"	2017/1/9 9:42
4325	Albert Petrick	225	1 28.3.11.15	338	43	E	Y	338.43 28.3.11.15		Figure 28-35 to read or print	Redraw figure use larger text font and align across page	2017/1/9 9:42
4326	Albert Petrick	225	1 28.3.10.7.2	276	44	T	Y	276.44 28.3.10.7.2	3600	Table 28-17 referencing B11-B14 Spatial Reuse suggests the need for more development. This is a place holder e.g., TBD.	Delete note in Table 28-17: NOTE: this part needs further development.	2017/1/9 9:42
4327	Albert Petrick	225	1 9.3.1.23	41	59	E	Y	41.59 9.3.1.23	3365	Add space between sentences	Add space at end of sentence after the word "STA."	2017/1/9 9:42
4328	Albert Petrick	225	1 27.2.1	149	61	E	Y	149.61 27.2.1	4078	Period missing at end of sentence	Add period at the of sentence after "Set"	2017/1/9 9:42
4329	Albert Petrick	225	1 28.1.1	210	17	E	Y	210.17 28.1.1	3691	Period missing at end of sentence	Add period at the of sentence after "4"	2017/1/9 9:42
4330	Albert Petrick	225	1 27.5.2.2.1	164	46	E	Y	164.46 27.5.2.2.1	3333	Extra period	Remove extra period at the end of sentence after the word "allocation)"	2017/1/9 9:42
4331	Albert Petrick	225	1 28.3.12	321	54	E	Y	321.54 28.3.12		Equation 28-89 brackets cutoff	vertically center between paragraphs	2017/1/9 9:42
4332	Albert Petrick	225	1 28.3.14.3	342	47	E	Y	342.47 28.3.14.3	3604	Period missing at end of sentence	Add period at the end of the sentence after "preamble".	2017/1/9 9:42
4333	Albert Petrick	225	1 9.3.1.23	41	61	E	Y	41.61 9.3.1.23	3369	Add space between sentences	Add space at end of sentence after the word "address."	2017/1/9 9:42
4334	Albert Petrick	225	1 28.3.12	339	44	E	Y	339.44 28.3.12		Equation 28-115 brackets cutoff	vertically center between paragraphs	2017/1/9 9:42
4335	Albert Petrick	225	1 28.3.14.3	342	45	T	Y	342.45 28.3.14.3	3606	In clause 28.3.14.3 transmit power requirements and RSSI measurement accuracy requirements are defined for signal level ranges in dBm operating in the 2.4 GHz and 5GHz bands. The requirements are defined for nominal (room) temperature conditions. Specifying transmit power measurements and RSSI accuracy measurements over temperature is implementation dependent and could be regulatory dependent. Specifying a specific operation temperature drives an implementation and is out-of-scope of the standard.	Delete sentence: "The requirements are for nominal (room) temperature conditions."	2017/1/9 9:42
4336	Albert Petrick	225	1 9.3.3.6	53	36	E	Y	53.36 9.3.3.6	3371	spelling hyphen error in Table 9-30	In Table 9-30 remove hyphen change "pre-sent" to "present"	2017/1/9 9:42
4337	Albert Petrick	225	1 28.3.12	339	62	E	Y	339.62 28.3.12		Equation 28-116 brackets cutoff	vertically center between paragraphs	2017/1/9 9:42
4338	Albert Petrick	225	1 27.2.1	150	2	E	Y	150.02 27.2.1	4090	Period missing at end of sentence	Add period at the of sentence after "Set"	2017/1/9 9:42
4339	Albert Petrick	225	1 27.5.2.2.1	164	53	E	Y	164.53 27.5.2.2.1	3335	Period missing at end of sentence	Add period at end of sentence after the word "S-MPDUs))"	2017/1/9 9:42

4340	Albert Petrick	225	1 28.3.14.3	342	46	T	Y	342.46 28.3.14.3	3609	In clause 28.3.14.3 the RSSI is measured during the "PHY legacy preamble". The RSSI_LEGACY is defined, but the PHY legacy preamble is not. It's not define or referenced in the IEEE 802.11-2016 baseline. This should be defined and referenced back to the IEEE 802.11-2016 baseline standard.	Add definition for PHY legacy preamble in clause 3.4 Definitions, acronyms, and abbreviations with reference back to IEEE 802.11-2016 figures, text or subclause	2017/1/9 9:42
4341	Albert Petrick	225	1 28.1.1	210	18	E	Y	210.18 28.1.1	3698	Period missing at end of sentence	Add period at the of sentence after "11"	2017/1/9 9:42
4342	Albert Petrick	225	1 9.3.3.8	54	30	E	Y	54.30 9.3.3.8	3373	spelling hyphen error in Table 9-32	In Table 9-32 remove hyphen change "pre-sent" to "present"	2017/1/9 9:42
4343	Albert Petrick	225	1 28.3.12	340	3	E	Y	340.03 28.3.12		Equation 28-117 brackets cutoff	vertically center between paragraphs	2017/1/9 9:42
4344	Albert Petrick	225	1 28.3.18.2	354	46	E	Y	354.46 28.3.18.2	3612	Extra digit in Table 28-44	Change "+3441" to "+344"	2017/1/9 9:42
4345	Albert Petrick	225	1 28.1.1	210	18	E	Y	210.18 28.1.1	3701	Referencing "MCS 10" not consistent in text in .11ax D1.0. Should use "MCS10"	Change "MCS 10" to MCS10" Change "11" to "MCS11"	2017/1/9 9:42
4346	Albert Petrick	225	1 9.3.3.11	55	26	E	Y	55.26 9.3.3.11	3374	spelling hyphen error in Table 9-34	In Table 9-34 remove hyphen change "pre-sent" to "present"	2017/1/9 9:42
4347	Albert Petrick	225	1 28.3.11.8	323	58	T	Y	323.58 28.3.11.8		BCC interleaver explanation needs further clarification. User "u"is reference once in this clause.	Rewrite first paragraph to read with clarity.	2017/1/9 9:42
4348	Albert Petrick	225	1 28.3.14.3	342	12	E	Y	342.12 28.3.14.3	3615	Spelling error with MCS 7	Change "MCS 7" to "MCS7"	2017/1/9 9:42
4349	Albert Petrick	225	1 9.2.4.1.10	20	5	T	Y	20.05 9.2.4.1.10	3375	"HCT/Order subfield" naming should be consistent when referenced in text. It's referenced as "HTC/Order field"	Change to "HCT/Order subfield" on lines 5 and 7	2017/1/9 9:42
4350	Albert Petrick	225	1 27.5.2.2.1	164	56	E	Y	164.56 27.5.2.2.1	3338	Period missing at end of sentence	Add period at end of sentence after the word "behavior))"	2017/1/9 9:42
4351	Albert Petrick	225	1 27.2.2	150	43	E	Y	150.43 27.2.2	4098	Period missing at end of sentence	Add period at the of sentence after "field"	2017/1/9 9:42
4352	Albert Petrick	225	1 28.3.11.9	327	6	E	Y	327.06 28.3.11.9		Spelling errors	Change text "MCS 1" to "MCS1" Change text "MCS 3" to "MCS3" Change text "MCS 4" to "MCS4"	2017/1/9 9:42
4353	Albert Petrick	225	1 28.3.14.3	342	10	E	Y	342.10 28.3.14.3	3617	Spelling error with MCS 0	Change "MCS 0" to "MCS0"	2017/1/9 9:42
4354	Albert Petrick	225	1 9.2.4.6.4.1	23	37	E	Y	23.37 9.2.4.6.4.1	3377	Reverse Direction Protocol (RDP) in Table 9-18a is missing reference "subclause reference" in the Content of the Control Information subfield.	Add the following clause reference: "See 9.2.4.6.4.8 (Reverse direction protocol (RDP))"	2017/1/9 9:42
4355	Albert Petrick	225	1 28.1.1	210	22	E	Y	210.22 28.1.1	3707	Period missing at end of sentence	Add period at the of sentence after "20 MHz"	2017/1/9 9:42
4356	Albert Petrick	225	1 28.3.14.3	342	36	E	Y	342.36 28.3.14.3	3619	In Table 28-40 in the Case A column, there is a hyphen character.	Remove hyphen "-" character and leave cell blank	2017/1/9 9:42
4357	Albert Petrick	225	1 28.3.11.10	327	58	E	Y	327.58 28.3.11.10		Grammar error	Remove "as"	2017/1/9 9:42
4358	Albert Petrick	225	1 9.2.4.6.4.1	22	59	T	Y	22.59 9.2.4.6.4.1	3483	In clause A-Control 9.2.6.4 the text needs to clarify the bit length in the Control ID subfields, describe the sequence ordering and state how many Control IDs are defined and reserved. The text should flow with Table 9-15b, and Table 9-18a.	Add the following underlined text (without the underline), and remove the strikethrough text from lines 59 to 65 on page 22 and lines 11 - 12 to read as follows: The A-Control subfield contains a sequence of one or more Control subfields. The format of each Control subfield is defined shown in Figure 9-15b (Control subfield format). The Control subfield with Control ID subfield equal to 0, if present, is the first subfield of the sequence. The Control ID subfield as shown in Figure 9-15b (Control subfield format) is 4-bits in length and indicates the type of information carried in the Control Information subfield. The bit length of the Control Information subfield is fixed for each value of the Control ID subfield that is not reserved. The values of the Control ID subfield and the associated length of the Control	2017/1/9 9:42
4359	Albert Petrick	225	1 27.5.2.2.1	164	59	E	Y	164.59 27.5.2.2.1	3342	Period missing at end of sentence	Add period at end of sentence after the word "TIDs))"	2017/1/9 9:42
4360	Albert Petrick	225	1 28.3.16	344	45	E	Y	344.45 28.3.16	3622	In Figure 28-36 (HE NDP PPDU format) the PE field is the Packet Extension field. The text should reference this field.	Change "Packet Extension" to "Packet Extension (PE)"	2017/1/9 9:42
4361	Albert Petrick	225	1 27.2.2	150	54	E	Y	150.54 27.2.2	4107	Period missing at end of sentence	Add period at the of sentence after "detection)"	2017/1/9 9:42
4362	Albert Petrick	225	1 9.2.4.6.4.2	24	20	E	Y	24.20 9.2.4.6.4.2	3380	Editorial formatting error with Target receiver power, TRSSI,	Remove comma "," before TRSSI and change ", TRSSI" to "(TRSSI)"	2017/1/9 9:42
4363	Albert Petrick	225	1 28.3.11.11	328	57	E	Y	328.57 28.3.11.11		Equation 28-96 brackets cutoff	Resize font of brackets and vertically center between paragraphs	2017/1/9 9:42

4364	Albert Petrick	225	1 28.1.1	210	26	E	Y	210.26 28.1.1	3714	Period missing at end of sentence	Add period at the of sentence after "STA"	2017/1/9 9:42
4365	Albert Petrick	225	1 9.2.4.6.4.2	23	59	T	Y	23.59 9.2.4.6.4.2	3381	Provide more clarity: UL PPDU subfield. The text should reference the "5-bits" for UL PPDU Length field in Figure 9-15c.	Insert text "is 5-bits (B0-B4) that" after the word subfield.	2017/1/9 9:42
4366	Albert Petrick	225	1 28.3.11.11	329	30	E	Y	329.30 28.3.11.11		Equation 28-97 brackets cutoff	Resize font of brackets and vertically center between paragraphs	2017/1/9 9:42
4367	Albert Petrick	225	1 27.5.2.3	170	15	E	Y	170.15 27.5.2.3	3345	Extra period	Add period at end of sentence after the word "PPDU"	2017/1/9 9:42
4368	Albert Petrick	225	1 9.2.4.6.4.6	27	39	T	Y	27.39 9.2.4.6.4.6	3382	No reference to the bits in the Reserve subfield In 9.2.4.6.4.6.	Add the following sentence "Bits (B6-B7) are reserved." after the sentence on line 39.	2017/1/9 9:42
4369	Albert Petrick	225	1 28.3.16	344	36	E	Y	344.36 28.3.16	3628	Remove space between sentences	Delete lines 35 and 36. The text should read as follows: NDP is the only HE sounding format. The format of an HE NDP PPDU is shown in Figure 28-36 (HE NDP PPDU format).	2017/1/9 9:42
4370	Albert Petrick	225	1 27.2.2	150	56	E	Y	150.56 27.2.2	4118	Period missing at end of sentence	Add period at the of sentence after "value"	2017/1/9 9:42
4371	Albert Petrick	225	1 9.2.4.6.4.8	28	60	T	Y	28.60 9.2.4.6.4.8	3384	The bits in Table 9-15i should be called in the text for clarification.	Add the following underlined text. The Control Information 8-bit subfield for the RDP Trigger frame is shown in Figure 9-15i (Control Information subfield format when the Control ID subfield is 6), 6-bits (B2-B7) are reserved. The AC Constraint subfield bit (B0) of the RDP field indicates whether the mapped AC of an RD Data frame is constrained to a single AC, and is defined in Table 9-10 (AC Constraint subfield values), except that if B0 equals a value of 1 indicates that the response from an HE STA contains Data frames from the same AC or higher AC as defined in 10.28.4 (Rules for RD responder). The RDG/More PPDU subfield bit (B1) is defined in Table 9-11 (RDG/More PPDU subfield values).	2017/1/9 9:42
4372	Albert Petrick	225	1 28.3.17.4	347	13	E	Y	347.13 28.3.17.4	3631	Extra line space between paragraphs	Remove line 13	2017/1/9 9:42
4373	Albert Petrick	225	1 28.1.1	210	30	E	Y	210.30 28.1.1	3722	Period missing at end of sentence	Add period at the of sentence after "STA"	2017/1/9 9:42
4374	Albert Petrick	225	1 28.3.11.11	329	39	E	Y	329.39 28.3.11.11		Equation 28-97 brackets cutoff	Resize font of brackets and vertically center between paragraphs	2017/1/9 9:42
4375	Albert Petrick	225	1 9.3.1.24	41	23	T	Y	41.23 9.3.1.24	3385	CQI acronym not defined in Table 9-25a	Add definition for CQI in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
4376	Albert Petrick	225	1 28.3.3.2	229	31	E	Y	229.31 28.3.3.2	3348	Extra period	Add period at end of sentence after the word "width)"	2017/1/9 9:42
4377	Albert Petrick	225	1 28.3.12	338	4	E	Y	338.04 28.3.12		Figure 28-35 to small to read or print	Redraw figure use larger text font and align across page	2017/1/9 9:42
4378	Albert Petrick	225	1 9.4.2.218.3	82	12	E	Y	82.12 9.4.2.218.3	3387	Missing period after sentences in Table 9-262aa	Add "periods" after each sentence in the Definition and Encoding columns in Table 9-262aa	2017/1/9 9:42
4379	Albert Petrick	225	1 27.2.2	150	59	E	Y	150.59 27.2.2	4128	Period missing at end of sentence	Add period at the of sentence after "holder"	2017/1/9 9:42
4380	Albert Petrick	225	1 9.4.2.218.2	77	55	E	Y	77.55 9.4.2.218.2	3349	Table 9-262z misaligned Equation in "Encoding" column. "OfF" misspelled	Fix alignment of Eq Nmax = 2Maximum Number OFF-MPDUs. Change "OfF" to "Off". Increase line spacing between sentences for aligning equation.	2017/1/9 9:42
4381	Albert Petrick	225	1 28.3.17.6.4	349	15	E	Y	349.15 28.3.17.6.4	3636	Paragraph misaligned	Left justify paragraph	2017/1/9 9:42
4382	Albert Petrick	225	1 28.1.1	210	31	E	Y	210.31 28.1.1	3727	Period missing at end of sentence	Add period at the of sentence after "MSC11"	2017/1/9 9:42
4383	Albert Petrick	225	1 9.4.2.218.5	89	36	T	Y	89.36 9.4.2.218.5	3388	PPET, PPET8 and PPET16 acronym not defined	Add definitions for PPET, PPET8 and PPET16 in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
4384	Albert Petrick	225	1 9.4.1.62	56	30	T	Y	56.30 9.4.1.62	3404	Add clarity. Call out bit positions in Table 9-76a for subfield "Nc Index" corresponding to those bit positions in Figure 9-121a HE MIMO Control field	Add underlined text (without the underline) in "Description" column to read: "Indicates the number of columns, Nc, in the compressed beamforming feedback matrix minus 1: For 3-bits (B0-B2): Set to 0 for Nc = 1 Set to 1 for Nc = 2 ... Set to 7 for Nc = 8"	2017/1/9 9:42
4385	Albert Petrick	225	1 28.3.14.3	342	53	T	Y	342.53 28.3.14.3	3359	CCDF not defined	Change "CCDF" to "complementary cumulative distribution function (CCDF)". Add definition for CCDF in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42

4386	Albert Petrick	225	1 9.4.1.62	56	38	T	Y	56.38 9.4.1.62	3406	Add clarity. Call out bit positions in Table 9-76a for subfield "Nr Index" corresponding to those bit positions in Figure 9-121a HE MIMO Control field	Add underlined text in "Description" column to read: "Indicates the number of rows, Nr, in the compressed beamforming feed-back matrix minus 1: For 3-bits (B3-B5): Set to 0 for Nr = 1 Set to 1 for Nr = 2 ... Set to 7 for Nr = 8"	2017/1/9 9:42
4387	Albert Petrick	225	1 9.3.1.20	40	1	E	Y	40.01 9.3.1.20	3361	Clause title should not be underlined.	Remove underline; Change to "VHT/HE NDP"	2017/1/9 9:42
4388	Albert Petrick	225	1 28.3.12	338	62	E	Y	338.62 28.3.12		Equation 28-116 brackets cutoff	Resize font of brackets and vertically center between paragraphs	2017/1/9 9:42
4389	Albert Petrick	225	1 28.1.1	210	41	E	Y	210.41 28.1.1	3747	Period missing at end of sentence	Add period at the of sentence after "MIMO)"	2017/1/9 9:42
4390	Albert Petrick	225	1 9.4.1.62	56	45	T	Y	56.45 9.4.1.62	3408	Add clarity. Call out bit positions in Table 9-76a for subfield "BW" corresponding to those bit positions in Figure 9-121a HE MIMO Control field	Add underlined text (without the underline) in "Description" column to read: "Indicates the channel width used to determine the starting and ending subcarrier indexes when interpreting the RU Start Index and RU End Index subfields. For 2-bits (B6-B7): Set to 0 for 20 MHz Set to 1 for 40 MHz Set to 2 for 80 MHz Set to 3 for 160 MHz and 80+80 MHz"	2017/1/9 9:42
4391	Albert Petrick	225	1 9.3.1.23	41	47	E	Y	41.47 9.3.1.23	3363	Parenthesis not needed in Figure 9-52c-Trigger frame	Remove parenthesis - Change "(RA)" to "RA" in Figure 9-52c-Trigger frame	2017/1/9 9:42
4392	Albert Petrick	225	1 28.1.1	210	6	E	Y	210.06 28.1.1	3663	Period missing at end of sentence	Add period at the of sentence after "bandwidth"	2017/1/9 9:42
4393	Albert Petrick	225	1 27.7.4	187	35	E	Y	187.35 27.7.4	4176	Period missing at end of sentence	Add period at the of sentence after "is 0"	2017/1/9 9:42
4394	Albert Petrick	225	1 9.4.1.62	56	53	T	Y	56.53 9.4.1.62	3410	Add clarity. Call out bit positions in Table 9-76a for subfield "Grouping" corresponding to the bit positions in Figure 9-121a HE MIMO Control field	Add underlined text (without the underline) in "Description" column to read: "Indicates the subcarrier grouping, Ng, used for the compressed beamforming feedback matrix: Set bit (B8) as follows: Set to 0 for Ng = 4 Set to 1 for Ng = 16"	2017/1/9 9:42
4395	Albert Petrick	225	1 9.3.1.23	41	59	E	Y	41.59 9.3.1.23	3365	Add space between sentences	Add space at end of sentence after the word "STA."	2017/1/9 9:42
4396	Albert Petrick	225	1 9.4.1.62	57	4	T	Y	57.04 9.4.1.62	3412	Add clarity. Call out bit positions in Table 9-76a for subfield "Codebook Information" corresponding to the bit positions in Figure 9-121a HE MIMO Control field	Add underlined text (without the underline)in "Description" column to read: "Indicates the size of codebook entries: Set bit B9 for SU and MU Feedback types as follows: If Feedback Type is ....."	2017/1/9 9:42
4397	Albert Petrick	225	1 28.3.12	149	53	E	Y	149.53 28.3.12		Period missing at end of sentence	Add period at the of sentence after "false"	2017/1/9 9:42
4398	Albert Petrick	225	1 28.1.1	210	44	E	Y	210.44 28.1.1	3754	Period missing at end of sentence	Add period at the of sentence after "receive)"	2017/1/9 9:42
4399	Albert Petrick	225	1 28.1.1	210	9	E	Y	210.09 28.1.1	3671	Period missing at end of sentence	Add period at the of sentence after "bandwidth"	2017/1/9 9:42
4400	Albert Petrick	225	1 9.4.1.62	57	14	T	Y	57.14 9.4.1.62	3414	The bit positions in Table 9-76a for subfield "Feedback Type" should correspond to those bit positions in Figure 9-121a HE MIMO Control field	Add underlined text (without the underline) in "Description" column to read: "Indicates the feedback type: For 2-bits (B10-B11) Set to 0 for SU Set to 1 for MU Set to 2 for CQI feedback 3 is reserved"	2017/1/9 9:42
4401	Albert Petrick	225	1 27.7.4	187	37	E	Y	187.37 27.7.4	4187	Period missing at end of sentence	Add period at the of sentence after "is 1"	2017/1/9 9:42
4402	Albert Petrick	225	1 9.3.1.23	41	61	E	Y	41.61 9.3.1.23	3369	Add space between sentences	Add space at end of sentence after the word "address."	2017/1/9 9:42
4403	Albert Petrick	225	1 9.4.1.62	57	21	T	Y	57.21 9.4.1.62	3416	Add clarity. Call out bit positions in Table 9-76a for subfield "Remaining Feedback Segments" corresponding to those bit positions in Figure 9-121a HE MIMO Control field	Add underlined text (as not underlined text) in "Description" column to read: "Indicates the number of remaining feedback segments for the associated VHT Compressed Beamforming frame: For 3-bits (B12-B14) Set to 0 for the last feedback segment of a segmented report....."	2017/1/9 9:42
4404	Albert Petrick	225	1 9.3.3.6	53	36	E	Y	53.36 9.3.3.6	3371	spelling hyphen error in Table 9-30	In Table 9-30 remove hyphen change "pre-sent" to "present"	2017/1/9 9:42
4405	Albert Petrick	225	1 28.3.12	340	3	E	Y	340.03 28.3.12		Equation 28-117 brackets cutoff	Resize font of brackets and vertically center between paragraphs	2017/1/9 9:42
4406	Albert Petrick	225	1 28.1.1	210	46	E	Y	210.46 28.1.1	3763	Period missing at end of sentence	Add period at the of sentence after "receive)"	2017/1/9 9:42

4407 Albert Petrick	225	1 9.4.1.62	57	32	T	Y	57.32 9.4.1.62	3418	Add clarity. Call out bit positions in Table 9-76a for subfield "First Feedback Segments" corresponding to the bit positions in Figure 9-121a HE MIMO Control field	Add underlined text (without the underline) in "Description" column to read: "Set bit (B15) as follows: Set to 1 for the first feedback segment of a segmented report or the only feedback segment of an unsegmented report. Set to 0 if not the first feedback segment or if the VHT....."	2017/1/9 9:42
4408 Albert Petrick	225	1 28.1.1	210	13	E	Y	210.13 28.1.1	3677	Period missing at end of sentence	Add period at the of sentence after "MHz"	2017/1/9 9:42
4409 Albert Petrick	225	1 9.3.3.8	54	30	E	Y	54.30 9.3.3.8	3373	spelling hyphen error in Table 9-32	In Table 9-32 remove hyphen change "pre-sent" to "present"	2017/1/9 9:42
4410 Albert Petrick	225	1 27.7.4	187	43	E	Y	187.43 27.7.4	4196	Period missing at end of sentence	Add period at the of sentence after "session"	2017/1/9 9:42
4411 Albert Petrick	225	1 28.3.13	340	38	E	Y	340.38 28.3.13		Misaligned paragraph	Left justify	2017/1/9 9:42
4412 Albert Petrick	225	1 9.4.1.62	57	40	T	Y	57.40 9.4.1.62	3419	Add clarity. Call out bit positions in Table 9-76a for subfield "RU Start Index" corresponding to those bit positions in Figure 9-121a HE MIMO Control field	Add underlined text in "Description" column to read: "The starting RU index 7-Bits (B16-B22) indicates the first 26-tone RU for which the HE beamformer is requesting feedback."	2017/1/9 9:42
4413 Albert Petrick	225	1 9.3.3.11	55	26	E	Y	55.26 9.3.3.11	3374	spelling hyphen error in Table 9-34	In Table 9-34 remove hyphen change "pre-sent" to "present"	2017/1/9 9:42
4414 Albert Petrick	225	1 9.3.1.23	47	56	E	Y	47.56 9.3.1.23		Equation 9-ax1 brackets cutoff	Resize font of brackets and vertically center between paragraphs	2017/1/9 9:42
4415 Albert Petrick	225	1 9.4.1.62	57	43	T	Y	57.43 9.4.1.62	3421	Add clarity. Call out bit positions in Table 9-76a for subfield "RU End Index" corresponding to those bit positions in Figure 9-121a HE MIMO Control field.	Add the following underlined text (without the underline) in "Description" column to read: "The ending RU index 7-Bits (B23-B29) indicates the first 26-tone RU for which the HE beamformer is requesting feedback."	2017/1/9 9:42
4416 Albert Petrick	225	1 28.1.1	210	48	E	Y	210.48 28.1.1	3769	Period missing at end of sentence	Add period at the of sentence after "PPDUs"	2017/1/9 9:42
4417 Albert Petrick	225	1 9.2.4.1.10	20	5	T	Y	20.05 9.2.4.1.10	3375	"HCT/Order subfield" naming should be consistent when referenced in text. It's referenced as "HTC/Order field"	Change to "HCT/Order subfield" on lines 5 and 7	2017/1/9 9:42
4418 Albert Petrick	225	1 9.3.1.23	47	5	E	Y	47.05 9.3.1.23		Equation 9-ax2 brackets cutoff	Resize font of brackets and vertically center between paragraphs	2017/1/9 9:42
4419 Albert Petrick	225	1 28.1.1	210	15	E	Y	210.15 28.1.1	3685	Period missing at end of sentence	Add period at the of sentence after "subcarriers"	2017/1/9 9:42
4420 Albert Petrick	225	1 9.4.1.62	57	46	T	Y	57.46 9.4.1.62	3529	The description of the Sounding Dialog Token Number in Table 9-76a is not correct. This should be similar to the description in Table 9-66.	Add the following underlined text (without the underline) and remove the strikethrough text in "Description" column to read: "The ending RU index indicates the last RU26 for which the HE beamformer is requesting feedback. The sounding dialog token is from the HE NDP Announcement frame soliciting feedback. "	2017/1/9 9:42
4421 Albert Petrick	225	1 27.8.3	189	30	E	Y	189.30 27.8.3	4205	Period missing at end of sentence	Add period at the of sentence after "frames"	2017/1/9 9:42
4422 Albert Petrick	225	1 9.2.4.6.4.1	23	37	E	Y	23.37 9.2.4.6.4.1	3377	Reverse Direction Protocol (RDP) in Table 9-18a is missing reference "subclause reference" in the Content of the Control Information subfield.	Add the following clause reference: "See 9.2.4.6.4.8 (Reverse direction protocol (RDP))"	2017/1/9 9:42
4423 Albert Petrick	225	1 9.4.1.63	58	9	E	Y	58.09 9.4.1.63		Extra paragraph line space	Remove line space between paragraph	2017/1/9 9:42
4424 Albert Petrick	225	1 9.4.1.62	57	49	T	Y	57.49 9.4.1.62	3423	The "Reserved" subfield and description is missing in Table 9-76a. corresponding to Figure 121a.	At the end of Table 9-76a insert a new row and add the following underlined text (without the underline) "Reserved" in Subfield column, and the following text in Description column. "4-bits (B36-B39) are reserved."	2017/1/9 9:42

4425	Albert Petrick	225	1 9.2.4.6.4.1	22	59	T	Y	22.59 9.2.4.6.4.1	3483	In clause A-Control 9.2.6.4 the text needs to clarify the bit length in the Control ID subfields, describe the sequence ordering and state how many Control IDs are defined and reserved. The text should flow with Table 9-15b, and Table 9-18a.	Add the following underlined text (without the underline), and remove the strikethrough text from lines 59 to 65 on page 22 and lines 11 - 12 to read as follows: The A-Control subfield contains a sequence of one or more Control subfields. The format of each Control subfield is defined shown in Figure 9-15b (Control subfield format). The Control subfield with Control ID subfield equal to 0, if present, is the first subfield of the sequence. The Control ID subfield as shown in Figure 9-15b (Control subfield format) is 4-bits in length and indicates the type of information carried in the Control Information subfield. The bit length of the Control Information subfield is fixed for each value of the Control ID subfield that is not reserved. The values of the Control ID subfield and the associated length of the Control	2017/1/9 9:42
4426	Albert Petrick	225	1 28.1.1	210	50	E	Y	210.50 28.1.1	3776	Period missing at end of sentence	Add period at the of sentence after "receive)"	2017/1/9 9:42
4427	Albert Petrick	225	1 9.4.1.63	58	28	T	Y	58.28 9.4.1.63	3425	Equation (8-1) missing	Add reference and/or detailed equation (8-1)	2017/1/9 9:42
4428	Albert Petrick	225	1 28.1.1	210	17	E	Y	210.17 28.1.1	3691	Period missing at end of sentence	Add period at the of sentence after "4"	2017/1/9 9:42
4429	Albert Petrick	225	1 9.2.4.6.4.2	24	20	E	Y	24.20 9.2.4.6.4.2	3380	Editorial formatting error with Target receiver power, TRSSI,	Remove comma "," before TRSSI and change ", TRSSI" to "(TRSSI)"	2017/1/9 9:42
4430	Albert Petrick	225	1 27.8.3	189	37	E	Y	189.37 27.8.3	4215	Period missing at end of sentence	Add period at the of sentence after "field"	2017/1/9 9:42
4431	Albert Petrick	225	1 9.4.1.63	59	57	T	Y	59.57 9.4.1.63	3427	In Table 9-76c, "FB" in 20, 40 and 80 MHz (S, E) FB tone labels need to be defined to follow the foregoing text.	Change "FB" to "Feedback" in column label headers: 80 MHz FB tone, 40 MHz FB tone and 20 MHz FB tone.	2017/1/9 9:42
4432	Albert Petrick	225	1 9.4.1.63	58	22	E	Y	58.22 9.4.1.63		Extra paragraph line space	Remove line space between paragraph	2017/1/9 9:42
4433	Albert Petrick	225	1 9.2.4.6.4.2	23	59	T	Y	23.59 9.2.4.6.4.2	3381	Provide more clarity: UL PPDU subfield. The text should reference the "5-bits" for UL PPDU Length field in Figure 9-15c.	Insert text "is 5-bits (B0-B4) that" after the word subfield.	2017/1/9 9:42
4434	Albert Petrick	225	1 9.4.1.63	61	57	T	Y	61.57 9.4.1.63	3428	In Table 9-76d, "FB" in 20,40, 80 MHz (S, E) FB tone labels need to be defined to follow the foregoing text.	Change "FB" to "Feedback" in column label headers: 80 MHz FB tone, 40 MHz FB tone and 20 MHz FB tone.	2017/1/9 9:42
4435	Albert Petrick	225	1 28.1.1	210	58	E	Y	210.58 28.1.1	3785	Period missing at end of sentence	Add period at the of sentence after "PPDUs"	2017/1/9 9:42
4436	Albert Petrick	225	1 9.2.4.6.4.6	27	39	T	Y	27.39 9.2.4.6.4.6	3382	No reference to the bits in the Reserve subfield In 9.2.4.6.4.6.	Add the following sentence "Bits (B6-B7) are reserved." after the sentence on line 39.	2017/1/9 9:42
4437	Albert Petrick	225	1 28.1.1	210	18	E	Y	210.18 28.1.1	3698	Period missing at end of sentence	Add period at the of sentence after "11"	2017/1/9 9:42
4438	Albert Petrick	225	1 9.4.1.63	59	38	T	Y	59.38 9.4.1.63	3539	The S-tone and E-tone description needs clarification when comparing and referencing tables 9-76c and 9-76d.	Add underlined text (without the underline) and remove strikethrough text from line 38 to 49 as follows: The S-tone and E-tone corresponding to the possible RU indices for 20MHz, 40MHz and 80 MHz channels are listed in Table 9-76c and Table 9-76d. (Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for Ng = 4) for Ng = 4 are shown in Table 9-76c, and for Ng = 16 for in Table 9-76d. (Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for Ng = 16) for Ng = 16. For 160 MHz, to determine the S-tone and E-tone, RUs 37 to 73 occupying the higher 80 MHz use the same entries in Table 9-76c (Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for Ng = 4) and Table 9-76d (Feedback subcarrier indices indicating start 26-tone RU index and end	2017/1/9 9:42

4439	Albert Petrick	225	1 9.2.4.6.4.8	28	60	T	Y	28.60 9.2.4.6.4.8	3384	The bits in Table 9-15i should be called in the text for clarification.	Add the following underlined text. The Control Information 8-bit subfield for the RDP Trigger frame is shown in Figure 9-15i (Control Information subfield format when the Control ID subfield is 6), 6-bits (B2-B7) are reserved. The AC Constraint subfield bit (B0) of the RDP field indicates whether the mapped AC of an RD Data frame is constrained to a single AC, and is defined in Table 9-10 (AC Constraint subfield values), except that if B0 equals a value of 1 indicates that the response from an HE STA contains Data frames from the same AC or higher AC as defined in 10.28.4 (Rules for RD responder). The RDG/More PPDU subfield bit (B1) is defined in Table 9-11 (RDG/More PPDU subfield values).	2017/1/9 9:42
4440	Albert Petrick	225	1 27.8.3	189	46	E	Y	189.46 27.8.3	4225	Period missing at end of sentence	Add period at the of sentence after "field"	2017/1/9 9:42
4441	Albert Petrick	225	1 28.1.1	210	18	E	Y	210.18 28.1.1	3701	Referencing "MCS 10" not consistent in text in .11ax D1.0. Should use "MCS10"	Change "MCS 10" to MCS10" Change "11" to "MCS11"	2017/1/9 9:42
4442	Albert Petrick	225	1 9.4.1.63	58	30	E	Y	58.30 9.4.1.63		Extra paragraph line space	Remove line space between paragraph	2017/1/9 9:42
4443	Albert Petrick	225	1 9.4.1.63	63	21	T	Y	63.21 9.4.1.63	3431	Calculating the AveSNRi needs more clarification.	Add the following underlined text (without the underline) and remove the strikethrough text from lines 21 through 30 as follows: The AvgSNRi in Table 9-71 (Average SNR of Space-Time Stream i subfield) is found determined by computing the SNR per subcarrier in decibels for the subcarriers in 20 MHz channel bandwidth identified in Table 9-76c (Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for Ng = 4) for Ng = 4 , and for Ng = 16 in Table 9-76d. (Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for Ng = 16) for Ng = 16, and then The computing tThe arithmetic mean is calculated of for those values. Each SNR value per subcarrier in stream i (before being averaged) corresponds to the SNR associated with the column i of the beamforming feedback matrix V determined	2017/1/9 9:42
4444	Albert Petrick	225	1 9.3.1.24	41	23	T	Y	41.23 9.3.1.24	3385	CQI acronym not defined in Table 9-25a	Add definition for CQI in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
4445	Albert Petrick	225	1 28.1.1	210	64	E	Y	210.64 28.1.1	3792	Period missing at end of sentence	Add period at the of sentence after "20 MHz"	2017/1/9 9:42
4446	Albert Petrick	225	1 9.4.1.63	63	4	E	Y	63.04 9.4.1.63	3432	Spelling error "indeces" in Table 9-763	Change "indeces" to "indices"	2017/1/9 9:42
4447	Albert Petrick	225	1 9.4.2.218.3	82	12	E	Y	82.12 9.4.2.218.3	3387	Missing period after sentences in Table 9-262aa	Add "periods" after each sentence in the Definition and Encoding columns in Table 9-262aa	2017/1/9 9:42
4448	Albert Petrick	225	1 28.1.1	210	64	T	Y	210.64 28.1.1	3795	Bandwidth should be specific to 20 MHz channels	Add the word "channel" before "bandwidth"	2017/1/9 9:42
4449	Albert Petrick	225	1 9.4.1.64	64	48	T	Y	64.48 9.4.1.64	3434	Missing number of bits for Delta SNR for k=scidx(Ns-1)	Add number of bits for (Ns-1) for Delta SNR	2017/1/9 9:42
4450	Albert Petrick	225	1 28.1.1	210	22	E	Y	210.22 28.1.1	3707	Period missing at end of sentence	Add period at the of sentence after "20 MHz"	2017/1/9 9:42
4451	Albert Petrick	225	1 27.8.3	189	49	E	Y	189.49 27.8.3	4233	Period missing at end of sentence	Add period at the of sentence after "field"	2017/1/9 9:42
4452	Albert Petrick	225	1 9.4.2.6	68	60	E	Y	68.60 9.4.2.6		Period missing at end of sentence	Add period at the of sentence after "reserved"	2017/1/9 9:42
4453	Albert Petrick	225	1 9.4.2.218.5	89	36	T	Y	89.36 9.4.2.218.5	3388	PPET, PPET8 and PPET16 acronym not defined	Add definitions for PPET, PPET8 and PPET16 in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
4454	Albert Petrick	225	1 9.4.2.221	94	56	T	Y	94.56 9.4.2.221	3244	MUEDCATimer not defined	Add definition for MUEDCATimer in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
4455	Albert Petrick	225	1 28.1.1	211	5	E	Y	211.05 28.1.1	3800	Period missing at end of sentence	Add period at the of sentence after "20 MHz"	2017/1/9 9:42
4456	Albert Petrick	225	1 9.4.1.64	64	53	T	Y	64.53 9.4.1.64	3436	Missing number of bits for Delta SNR for k=scidx(Ns-1)	Add number of bits for (Ns-1) for Delta SNR	2017/1/9 9:42
4457	Albert Petrick	225	1 27.16.1	204	56	E	Y	204.56 27.16.1	3246	Sentence center justified should be left justified	Left justify sentence; "A STA for which dot11HEOptionImplemented is true shall set dot11VeryHighThroughputOptionImplemented or dot11HighThroughputOptionImplemented to true."	2017/1/9 9:42
4458	Albert Petrick	225	1 28.1.1	210	26	E	Y	210.26 28.1.1	3714	Period missing at end of sentence	Add period at the of sentence after "STA"	2017/1/9 9:42

4459	Albert Petrick	225	1 27.8.3	189	53	E	Y	189.53 27.8.3	4244	Period missing at end of sentence	Add period at the of sentence after "Initiator"	2017/1/9 9:42
4460	Albert Petrick	225	1 9.4.2.6	68	62	E	Y	68.62 9.4.2.6		Period missing at end of sentence	Add period at the of sentence after "reserved"	2017/1/9 9:42
4461	Albert Petrick	225	1 28.3.11.5	317	32	T	Y	317.32 28.3.11.5	3251	BCC acronym not defined	Add definition for "BCC = binary convolutional code" in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
4462	Albert Petrick	225	1 9.4.1.64	64	13	E	Y	64.13 9.4.1.64	3437	Remove paragraph indent	Fix paragraph alignment starting at "No padding is present....."	2017/1/9 9:42
4463	Albert Petrick	225	1 9.4.2.200	69	32	E	Y	69.32 9.4.2.200		Figure 9-589av misaligned	Align figure to fit on page	2017/1/9 9:42
4464	Albert Petrick	225	1 28.3.11.5	317	33	T	Y	317.33 28.3.11.5	3252	LDPC acronym not defined	Add definition for "LDPC = low density parity check " in clause 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
4465	Albert Petrick	225	1 9.4.1.64	64	18	T	Y	64.18 9.4.1.64	3439	Equation (9-2) is referenced in the text and in Table 9-76f HE MU Exclusive Beamforming Report information, and is not linked or referenced to any other documents. Equation (9-2) should be linked and referenced to its location IEEE 802.11-2016 (Rev D8.0) and clarified as a "Note" at the end of Table 9-76f.	Add note for equation 9-2 in text and/or add the following underlined text (without the underline) and reference link in Table 9-76f as a Note: "as defined in Equation (9-2) in clause 9.4.1.51 (MU Exclusive Beamforming Report Field)"	2017/1/9 9:42
4466	Albert Petrick	225	1 28.1.1	211	8	E	Y	211.08 28.1.1	3807	Period missing at end of sentence	Add period at the of sentence after "PPDU"	2017/1/9 9:42
4467	Albert Petrick	225	1 9.4.2.218.2	76	40	E	Y	76.40 9.4.2.218.2		Figure 9-589av subfield "Group Addressed Multi-STA Block Ack in DL MU Support" is marked as having 5 Bits. Only 1-bit B24 is assigned to the subfield.	Change "4" to "1" in Figure 9-589av	2017/1/9 9:42
4468	Albert Petrick	225	1 28.1.1	210	30	E	Y	210.30 28.1.1	3722	Period missing at end of sentence	Add period at the of sentence after "STA"	2017/1/9 9:42
4469	Albert Petrick	225	1 9.3.1.23	42	7	E	Y	42.07 9.3.1.23	3255	Space missing between words in GIAnd LTF Type subfield of Figure 9-52	Add character space between the letters "IA" in "GIAnd LTF Type". Should read as "GI And LTF Type"	2017/1/9 9:42
4470	Albert Petrick	225	1 9.4.1.64	64	30	T	Y	64.30 9.4.1.64	3440	Equation (9-2) reference in Table 9-76f calls out subcarrier k=scidx(0) and k=scidx(1). Equation 9-2 in IEEE 802.11-2016 (Rev D8.0) in clause 9.4.1.51 specifies k=sscidx(0) and k=sscidx(1) There appears to be an ambiguity in equation in 9-2 and with k=scidx(_)	Fix references for subcarrier k=scidx(0) and k=scidx(1) in Table 9-76f (lines 30-54) to match assumptions with equation 9-2 in clause 9.4.1.51 in IEEE 802.11-2016 (Rev D8.0)	2017/1/9 9:42
4471	Albert Petrick	225	1 27.8.3	189	57	E	Y	189.57 27.8.3	4257	Period missing at end of sentence	Add period at the of sentence after "initiator"	2017/1/9 9:42
4472	Albert Petrick	225	1 9.4.2.225	97	16	T	Y	97.16 9.4.2.225		Element ID Extension subfield shown in Figure 9-589db (Quiet Time Period Response element) is not defined in the text following the figure.	Define subfields "Element ID Extension"	2017/1/9 9:42
4473	Albert Petrick	225	1 9.4.1.62	56	15	E	Y	56.15 9.4.1.62	3259	Table 9-121a bit positions misaligned	Fix bit alignment with each subfield and resize Figure 9-121a to fit center of page.	2017/1/9 9:42
4474	Albert Petrick	225	1 28.4.2	371	36	T	Y	371.36 28.4.2	3441	Clarify "aSignalExtension" referenced from Table 19-25	Add the following underlined text (without the underline): and is aSignalExtension (0us for 5 GHz band, 6us for 2.4 GHz band)	2017/1/9 9:42
4475	Albert Petrick	225	1 27.9.2.2	192	1	T	Y	192.01 27.9.2.2	4261	The note reference to the antenna connector connection to section 3.1. is ambigous. Clause 3.1 doesn't exist.	Add definition for antenna connector in 3.4 Definitions, acronyms, and abbreviations	2017/1/9 9:42
4476	Albert Petrick	225	1 28.1.1	211	9	E	Y	211.09 28.1.1	3813	Period missing at end of sentence	Add period at the of sentence after "receive)"	2017/1/9 9:42
4477	Albert Petrick	225	1 9.4.1.62	56	4	T	Y	56.04 9.4.1.62	3261	The text in Clause 9.4.1.62 HE MIMO Control field) needs clarification. The text should call out number of bits and range of bits for Figure 9-121a.	Add the following underlined text (not underlined text) . The HE MIMO Control field is included in every HE Compressed Beamforming frame (see 9.4.1.63 (HE Compressed Beamforming Report field)). The HE MIMO Control field is 40-bits (B0-B39) and is defined in Figure 9-121a (HE MIMO Control field). The subfields and bit assignments (B0-B39) are defined and described in Table 9-7a (HE MIMO Control field encoding).	2017/1/9 9:42
4478	Albert Petrick	225	1 28.4.2	371	39	E	Y	371.39 28.4.2	3443	Missing period	Add period at the end of sentence after "false"	2017/1/9 9:42
4479	Albert Petrick	225	1 27.11.2	196	19	T	Y	196.19 27.11.2	4266	(T)DLS peer STA is not defined or linked to IEEE 802.11-2016 or IEEE 802.11ac-2013	Add text clarification and figure to support description	2017/1/9 9:42
4480	Albert Petrick	225	1 28.1.1	210	31	E	Y	210.31 28.1.1	3727	Period missing at end of sentence	Add period at the of sentence after "MSC11"	2017/1/9 9:42
4481	Albert Petrick	225	1 9.2.5.2	32	1	E	Y	32.01 9.2.5.2	3444	Format error - sentence alignment	Sentence format needs to be left justified.	2017/1/9 9:42

4482	Albert Petrick	225	1 9.4.1.62	56	30	T	Y	56.30 9.4.1.62	3404	Add clarity. Call out bit positions in Table 9-76a for subfield "Nc Index " corresponding to those bit positions in Figure 9-121a HE MIMO Control field	Add underlined text (without the underline) in "Description" column to read: "Indicates the number of columns, Nc, in the compressed beamforming feed-back matrix minus 1: For 3-bits (B0-B2): Set to 0 for Nc = 1 Set to 1 for Nc = 2 ... Set to 7 for Nc = 8"	2017/1/9 9:42
4483	Albert Petrick	225	1 9.4.2.221	94	4	E	Y	94.04 9.4.2.221	4270	MU EDCA not defined, nor in IEEE 802.11-2016	Change text "MU EDCA" to "Multi-user (MU) EDCA"	2017/1/9 9:42
4484	Albert Petrick	225	1 9.6.28.3	104	2	E	Y	104.02 9.6.28.3		Extra paragraph line space	Remove line space between paragraph	2017/1/9 9:42
4485	Albert Petrick	225	1 9.4.1.62	56	38	T	Y	56.38 9.4.1.62	3406	Add clarity. Call out bit positions in Table 9-76a for subfield "Nr Index" corresponding to those bit positions in Figure 9-121a HE MIMO Control field	Add underlined text in "Description" column to read: "Indicates the number of rows, Nr, in the compressed beamforming feed-back matrix minus 1: For 3-bits (B3-B5): Set to 0 for Nr = 1 Set to 1 for Nr = 2 ... Set to 7 for Nr = 8"	2017/1/9 9:42
4486	Albert Petrick	225	1 9.3.1.9.1	34	12	T	Y	34.12 9.3.1.9.1	3446	In Figure 9-33 (BA Control Field) Bit (B5) in the Reserve sub-field is marked as deleted (strikethrough) as shown. The Reserved subfield now shows 7-bits (B6-B11). The text does not describe B5. Define B5 or correct Figure 9-33	Fix as commented	2017/1/9 9:42
4487	Albert Petrick	225	1 28.3.10.8	286	8	E	Y	286.08 28.3.10.8	4272	Figure 28-20 to small to read or print	Redraw figure use larger text font and align across page	2017/1/9 9:42
4488	Albert Petrick	225	1 28.1.1	211	13	E	Y	211.13 28.1.1	3273	Period missing at end of sentence	Add period at the of sentence after "DL OFDMA)"	2017/1/9 9:42
4489	Albert Petrick	225	1 28.1.1	210	33	E	Y	210.33 28.1.1	3247	Period missing at end of sentence	Add period at the of sentence after "5"	2017/1/9 9:42
4490	Albert Petrick	225	1 9.4.1.62	56	45	T	Y	56.45 9.4.1.62	3408	Add clarity. Call out bit positions in Table 9-76a for subfield "BW" corresponding to those bit positions in Figure 9-121a HE MIMO Control field	Add underlined text (without the underline) in "Description" column to read: "Indicates the channel width used to determine the starting and ending subcarrier indexes when interpreting the RU Start Index and RU End Index subfields. For 2-bits (B6-B7): Set to 0 for 20 MHz Set to 1 for 40 MHz Set to 2 for 80 MHz Set to 3 for 160 MHz and 80+80 MHz"	2017/1/9 9:42
4491	Albert Petrick	225	1 B.4.27.2	413	45	E	Y	413.45 B.4.27.2	3447	Numbering / letter (5GHz) spacing issue in Table B.4.27.2 HEW PHY features	Change "5GHz" to "5 GHz"	2017/1/9 9:42
4492	Albert Petrick	225	1 28.3.10.8	286	43	E	Y	286.43 28.3.10.8	4277	Figure 28-21 to small to read or print	Redraw figure use larger text font and align across page	2017/1/9 9:42
4493	Albert Petrick	225	1 9.6.28.3	104	5	E	Y	104.05 9.6.28.3		Extra paragraph line space	Remove line space between paragraph	2017/1/9 9:42
4494	Albert Petrick	225	1 9.4.1.62	56	53	T	Y	56.53 9.4.1.62	3410	Add clarity. Call out bit positions in Table 9-76a for subfield "Grouping" corresponding to the bit positions in Figure 9-121a HE MIMO Control field	Add underlined text (without the underline) in "Description" column to read: "Indicates the subcarrier grouping, Ng, used for the compressed beamforming feedback matrix: Set bit (B8) as follows: Set to 0 for Ng = 4 Set to 1 for Ng = 16"	2017/1/9 9:42
4495	Albert Petrick	225	1 9.3.1.23	45	6	E	Y	45.06 9.3.1.23	3449	Number / letter (2.4GHz) spacing issue in Table B.4.27.2 HEW PHY features	Change "2.4GHz" to "2.4 GHz"	2017/1/9 9:42
4496	Albert Petrick	225	1 28.3.10.8	287	8	E	Y	287.08 28.3.10.8	4281	Figure 28-22 to small to read or print	Redraw figure use larger text font and align across page	2017/1/9 9:42
4497	Albert Petrick	225	1 28.1.1	211	15	E	Y	211.15 28.1.1	3283	Period missing at end of sentence	Add period at the of sentence after "UL OFDMA)"	2017/1/9 9:42
4498	Albert Petrick	225	1 9.4.1.62	57	4	T	Y	57.04 9.4.1.62	3412	Add clarity. Call out bit positions in Table 9-76a for subfield "Codebook Information" corresponding to the bit positions in Figure 9-121a HE MIMO Control field	Add underlined text (without the underline)in "Description" column to read: "Indicates the size of codebook entries: Set bit B9 for SU and MU Feedback types as follows: If Feedback Type is ....."	2017/1/9 9:42
4499	Albert Petrick	225	1 28.1.1	210	35	E	Y	210.35 28.1.1	3254	Period missing at end of sentence	Add period at the of sentence after "PPDUs"	2017/1/9 9:42
4500	Albert Petrick	225	1 28.3.10.8	287	51	E	Y	287.51 28.3.10.8	4286	Figure 28-23 to small to read or print	Redraw figure use larger text font and align across page	2017/1/9 9:42
4501	Albert Petrick	225	1 9.4.1.62	57	14	T	Y	57.14 9.4.1.62	3414	The bit positions in Table 9-76a for subfield "Feedback Type" should correspond to those bit positions in Figure 9-121a HE MIMO Control field	Add underlined text (without the underline) in "Description" column to read: "Indicates the feedback type: For 2-bits (B10-B11) Set to 0 for SU Set to 1 for MU Set to 2 for CQI feedback 3 is reserved"	2017/1/9 9:42
4502	Albert Petrick	225	1 28.3.10.8	288	20	E	Y	288.20 28.3.10.8	4288	Figure 28-23 to small tor read or print	Redraw figure use larger text font and align across page	2017/1/9 9:42
4503	Albert Petrick	225	1 9.6.28.3	104	9	E	Y	104.09 9.6.28.3		Extra paragraph line space	Remove line space between paragraph	2017/1/9 9:42
4504	Albert Petrick	225	1 9.4.2.218.2	76	24	E	Y	76.24 9.4.2.218.2	3450	Format error - sentence alignment	Fix paragraph alignment - left justify.	2017/1/9 9:42

4505	Albert Petrick	225	1 9.4.1.62	57	21	T	Y	57.21 9.4.1.62	3416	Add clarity. Call out bit positions in Table 9-76a for subfield "Remaining Feedback Segments" corresponding to those bit positions in Figure 9-121a HE MIMO Control field	Add underlined text (as not underlined text) in "Description" column to read: "Indicates the number of remaining feedback segments for the associated VHT Compressed Beamforming frame: For 3-bits (B12-B14) Set to 0 for the last feedback segment of a segmented report....."	2017/1/9 9:42
4506	Albert Petrick	225	1 28.1.1	211	18	E	Y	211.18 28.1.1	3829	Period missing at end of sentence	Add period at the of sentence after "streams"	2017/1/9 9:42
4507	Albert Petrick	225	1 28.3.11.2	315	33	E	Y	315.33 28.3.11.2	4291	Misaligned paragragh	Left justify	2017/1/9 9:42
4508	Albert Petrick	225	1 9.6.29.2	104	50	E	Y	104.50 9.6.29.2		Spelling error	Change "TTable" to "Table"	2017/1/9 9:42
4509	Albert Petrick	225	1 9.4.2.218.3	81	35	E	Y	81.35 9.4.2.218.3	3453	In Figure 9-589cl - (HE PHY Capabilities Information field format) subfield NSTA Total For < 80 MHz is labeled as having 2-bits. There are 3-bits (B37 -B39).	Change Bits "2" to "3" for subfield "NSTS Total for < 80 MHz" in Figure 9m-589cl	2017/1/9 9:42
4510	Albert Petrick	225	1 28.1.1	210	38	E	Y	210.38 28.1.1	3264	Period missing at end of sentence	Add period at the of sentence after "receive)"	2017/1/9 9:42
4511	Albert Petrick	225	1 9.4.1.62	57	32	T	Y	57.32 9.4.1.62	3418	Add clarity. Call out bit positions in Table 9-76a for subfield "First Feedback Segments" corresponding to the bit positions in Figure 9-121a HE MIMO Control field	Add underlined text (without the underline) in "Description" column to read: "Set bit (B15) as follows: Set to 1 for the first feedback segment of a segmented report or the only feedback segment of an unsegmented report. Set to 0 if not the first feedback segment or if the VHT....."	2017/1/9 9:42
4512	Albert Petrick	225	1 28.3.11.2	315	50	E	Y	315.50 28.3.11.2	4296	Equation 28-61 brackets cutoff	vertically center between paragraphs	2017/1/9 9:42
4513	Albert Petrick	225	1 9.7.3	108	64	E	Y	108.64 9.7.3		Spelling error in Note of Table 9-424	Change "block ack" to "Block Ack"	2017/1/9 9:42
4514	Albert Petrick	225	1 9.4.2.218.3	81	35	T	Y	81.35 9.4.2.218.3	3455	In Figure 9-589cl - (HE PHY Capabilities Information field format) subfield "Number Of Sounding Dimensions For < 80 MHz" is mark as having 1-bit. There are 3-bits (B46 -B48).	Change Bits "1" to "3" for subfield "NSTS Total for < 80 MHz" in Figure 9-589cl	2017/1/9 9:42
4515	Albert Petrick	225	1 9.4.1.62	57	40	T	Y	57.40 9.4.1.62	3419	Add clarity. Call out bit positions in Table 9-76a for subfield "RU Start Index" corresponding to those bit positions in Figure 9-121a HE MIMO Control field	Add underlined text in "Description" column to read: "The starting RU index 7-Bits (B16-B22) indicates the first 26-tone RU for which the HE beamformer is requesting feedback."	2017/1/9 9:42
4516	Albert Petrick	225	1 28.3.11.2	316	61	E	Y	316.61 28.3.11.2	4298	Equation 28-64 brackets cutoff	vertically center between paragraphs	2017/1/9 9:42
4517	Albert Petrick	225	1 9.7.3	110	69	E	Y	110.69 9.7.3		Period missing at end of sentence in Note 2 of Table 9-425	Add period at the of sentence after "MPDU"	2017/1/9 9:42
4518	Albert Petrick	225	1 9.4.2.218.3	81	35	T	Y	81.35 9.4.2.218.3	3270	In Figure 9-589cl - (HE PHY Capabilities Information field format) subfield "Number Of Sounding Dimensions For > 80 MHz" is labeled as 1-bit. There are 3-bits (B49 -B51).	Change Bits "1" to "3" for subfield "NSTS Total for > 80 MHz" in Figure 9-589cl	2017/1/9 9:42
4519	Albert Petrick	225	1 28.1.1	211	21	E	Y	211.21 28.1.1	3835	Period missing at end of sentence	Add period at the of sentence after "receive)"	2017/1/9 9:42
4520	Albert Petrick	225	1 28.1.1	210	41	E	Y	210.41 28.1.1	3747	Period missing at end of sentence	Add period at the of sentence after "MIMO)"	2017/1/9 9:42
4521	Albert Petrick	225	1 9.4.1.62	57	43	T	Y	57.43 9.4.1.62	3421	Add clarity. Call out bit positions in Table 9-76a for subfield "RU End Index" corresponding to those bit positions in Figure 9-121a HE MIMO Control field.	Add the following underlined text (without the underline) in "Description" column to read: "The ending RU index 7-Bits (B23-B29) indicates the first 26-tone RU for which the HE beamformer is requesting feedback."	2017/1/9 9:42
4522	Albert Petrick	225	1 28.3.11.5.1	318	2	E	Y	318.02 28.3.11.5.1	4303	Equation 28-65 brackets cutoff	vertically center between paragraphs	2017/1/9 9:42
4523	Albert Petrick	225	1 9.4.2.218.3	83	6	T	Y	83.06 9.4.2.218.3	3274	Add clarity. Call out bit positions in Table 9-262aa for subfield "Device Class" corresponding to those bit positions in Figure 9-589cl	In "Definition" column: Add "B12:" at the beginning of the sentence." In the "Encoding" column: Before sentence Add "B12:" "Set to 1 to indicate STA is a Class A device." In the "Encoding" column: Before sentence Add "B12:" Set to 0 to indicate STA is a Class B device. Note: This field is reserved when transmitting STA is an AP STA."	2017/1/9 9:42
4524	Albert Petrick	225	1 9.4.1.62	57	46	T	Y	57.46 9.4.1.62	3529	The description of the Sounding Dialog Token Number in Table 9-76a is not correct. This should be similar to the description in Table 9-66.	Add the following underlined text (without the underline) and remove the strikethrough text in "Description" column to read: "The ending RU index indicates the last RU26 for which the HE beamformer is requesting feedback. The sounding dialog token is from the HE NDP Announcement frame soliciting feedback. "	2017/1/9 9:42

4525	Albert Petrick	225	1 28.3.11.5.2	318	43	E	Y	318.43 28.3.11.5.2	4307	Equation 28-70 brackets cutoff	vertically center between paragraphs	2017/1/9 9:42
4526	Albert Petrick	225	1 9.4.2.218.3	83	13	T	Y	83.13 9.4.2.218.3	3277	Add clarity and call out bit positions in Table 9-262aa for subfield "LDPC Coding In Payload" corresponding to those bit positions in Figure 9-589cl	Change text in "Definition" column to read: "B13: Indicates support of transmission....." Change text in "Encoding" column to read: "B13: Set to 1 to indicate STA… B13: Set to 9 otherwise. "	2017/1/9 9:42
4527	Albert Petrick	225	1 9.4.1.62	57	49	T	Y	57.49 9.4.1.62	3423	The "Reserved" subfield and description is missing in Table 9-76a. corresponding to Figure 121a.	At the end of Table 9-76a insert a new row and add the following underlined text (without the underline) "Reserved" in Subfield column, and the following text in Description column. "4-bits (B36-B39) are reserved."	2017/1/9 9:42
4528	Albert Petrick	225	1 10.22.2.7	131	61	E	Y	131.61 10.22.2.7		Period missing at end of sentence	Add period at the of sentence after "frames"	2017/1/9 9:42
4529	Albert Petrick	225	1 28.1.1	211	26	E	Y	211.26 28.1.1	3841	Period missing at end of sentence	Add period at the of sentence after "OFDMA)"	2017/1/9 9:42
4530	Albert Petrick	225	1 28.3.11.5.4	321	54	E	Y	321.54 28.3.11.5.4	4311	Equation 28-89 brackets cutoff	vertically center between paragraphs	2017/1/9 9:42
4531	Albert Petrick	225	1 28.1.1	210	44	E	Y	210.44 28.1.1	3754	Period missing at end of sentence	Add period at the of sentence after "receive)"	2017/1/9 9:42
4532	Albert Petrick	225	1 9.4.2.218.3	83	16	T	Y	83.16 9.4.2.218.3	3282	Add clarity and call out bit positions in Table 9-262 aa for subfield "HE-LTF And GI For HE PPDUs" corresponding to those bit positions in Figure 9-589cl	Change text in "Encoding column to read: "For B14 and B15: Set to 1 if supported by the STA. Set to 0 otherwise."	2017/1/9 9:42
4533	Albert Petrick	225	1 9.4.1.63	58	28	T	Y	58.28 9.4.1.63	3425	Equation (8-1) missing	Add reference and/or detailed equation (8-1)	2017/1/9 9:42
4534	Albert Petrick	225	1 28.3.11.6	322	54	E	Y	322.54 28.3.11.6	4316	Equation 28-92 brackets to small	Increase font size of brackets around equation	2017/1/9 9:42
4535	Albert Petrick	225	1 9.4.2.218.3	82	15	E	Y	82.15 9.4.2.218.3	3286	Table 9-262aa, "Definition column" missing period at end of sentence	Fix. Add period after 2.4 GHz.	2017/1/9 9:42
4536	Albert Petrick	225	1 9.4.1.63	59	57	T	Y	59.57 9.4.1.63	3427	In Table 9-76c, "FB" in 20, 40 and 80 MHz (S, E) FB tone labels need to be defined to follow the foregoing text.	Change "FB" to "Feedback" in column label headers: 80 MHz FB tone, 40 MHz FB tone and 20 MHz FB tone.	2017/1/9 9:42
4537	Albert Petrick	225	1 28.3.11.11	329	46	E	Y	329.46 28.3.11.11	4319	LDPC tone mapper note references index I in Error! Reference source not found. and Error! Reference source not found.	Remove Error! And add external reference source.	2017/1/9 9:42
4538	Albert Petrick	225	1 10.22.2.7	131	65	E	Y	131.65 10.22.2.7		Period missing at end of sentence	Add period at the of sentence after "frames"	2017/1/9 9:42
4539	Albert Petrick	225	1 28.1.1	211	29	E	Y	211.29 28.1.1	3847	Period missing at end of sentence	Add period at the of sentence after "MIMO)"	2017/1/9 9:42
4540	Albert Petrick	225	1 9.4.1.63	61	57	T	Y	61.57 9.4.1.63	3428	In Table 9-76d, "FB" in 20,40, 80 MHz (S, E) FB tone labels need to be defined to follow the foregoing text.	Change "FB" to "Feedback" in column label headers: 80 MHz FB tone, 40 MHz FB tone and 20 MHz FB tone.	2017/1/9 9:42
4541	Albert Petrick	225	1 28.1.1	210	46	E	Y	210.46 28.1.1	3763	Period missing at end of sentence	Add period at the of sentence after "receive)"	2017/1/9 9:42
4542	Albert Petrick	225	1 28.3.11.15	338	43	E	Y	338.43 28.3.11.15	4325	Figure 28-35 to read or print	Redraw figure use larger text font and align across page	2017/1/9 9:42
4543	Albert Petrick	225	1 9.4.2.218.3	82	18	E	Y	82.18 9.4.2.218.3	3465	Table 9-262aa, "Definition column" missing period at end of sentence	Fix. Add period after 5 GHz.	2017/1/9 9:42
4544	Albert Petrick	225	1 9.4.1.63	59	38	T	Y	59.38 9.4.1.63	3539	The S-tone and E-tone description needs clarification when comparing and referencing tables 9-76c and 9-76d.	Add underlined text (without the underline) and remove strikethrough text from line 38 to 49 as follows: The S-tone and E-tone corresponding to the possible RU indices for 20MHz, 40MHz and 80 MHz channels are listed in Table 9-76c and Table 9-76d. (Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for Ng = 4) for Ng = 4 are shown in Table 9-76c, and for Ng = 16 for in Table 9-76d. (Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for Ng = 16) for Ng = 16. For 160 MHz, to determine the S-tone and E-tone, RUs 37 to 73 occupying the higher 80 MHz use the same entries in Table 9-76c (Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for Ng = 4) and Table 9-76d (Feedback subcarrier indices indicating start 26-tone RU index and end	2017/1/9 9:42

4545	Albert Petrick	225	1 9.4.1.63	63	21	T	Y	63.21 9.4.1.63	3431	Calculating the AveSNRi needs more clarification.	Add the following underlined text (without the underline) and remove the strikethrough text from lines 21 through 30 as follows: The AvgSNRi in Table 9-71 (Average SNR of Space-Time Stream i subfield) is found determined by computing the SNR per subcarrier in decibels for the subcarriers in 20 MHz channel bandwidth identified in Table 9-76c (Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for Ng = 4) for Ng = 4 , and for Ng = 16 in Table 9-76d. (Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for Ng = 16) for Ng = 16, and then The computing tThe arithmetic mean is calculated of for those values. Each SNR value per subcarrier in stream i (before being averaged) corresponds to the SNR associated with the column i of the beamforming feedback matrix V determined	2017/1/9 9:42
4546	Albert Petrick	225	1 28.1.1	211	32	E	Y	211.32 28.1.1	3854	Period missing at end of sentence	Add period at the of sentence after "OFDMA)"	2017/1/9 9:42
4547	Albert Petrick	225	1 10.22.2.7	132	9	E	Y	132.09 10.22.2.7		Period missing at end of sentence	Add period at the of sentence after "frames"	2017/1/9 9:42
4548	Albert Petrick	225	1 28.1.1	210	48	E	Y	210.48 28.1.1	3769	Period missing at end of sentence	Add period at the of sentence after "PPDUs"	2017/1/9 9:42
4549	Albert Petrick	225	1 28.3.12	321	54	E	Y	321.54 28.3.12	4331	Equation 28-89 brackets cutoff	vertically center between paragraphs	2017/1/9 9:42
4550	Albert Petrick	225	1 9.4.1.63	63	4	E	Y	63.04 9.4.1.63	3432	Spelling error "indeces" in Table 9-763	Change "indeces" to "indices"	2017/1/9 9:42
4551	Albert Petrick	225	1 9.4.2.218.3	82	20	E	Y	82.20 9.4.2.218.3	3468	Table 9-262aa, "Definition column" missing period at end of sentence	Fix. Add period after 5 GHz.	2017/1/9 9:42
4552	Albert Petrick	225	1 9.4.1.64	64	48	T	Y	64.48 9.4.1.64	3434	Missing number of bits for Delta SNR for k=scidx(Ns-1)	Add number of bits for (Ns-1) for Delta SNR	2017/1/9 9:42
4553	Albert Petrick	225	1 28.3.12	339	44	E	Y	339.44 28.3.12	4334	Equation 28-115 brackets cutoff	vertically center between paragraphs	2017/1/9 9:42
4554	Albert Petrick	225	1 28.3.12	339	62	E	Y	339.62 28.3.12	4337	Equation 28-116 brackets cutoff	vertically center between paragraphs	2017/1/9 9:42
4555	Albert Petrick	225	1 28.1.1	211	34	E	Y	211.34 28.1.1	3859	Period missing at end of sentence	Add period at the of sentence after "PPDU"	2017/1/9 9:42
4556	Albert Petrick	225	1 28.1.1	210	50	E	Y	210.50 28.1.1	3776	Period missing at end of sentence	Add period at the of sentence after "receive)"	2017/1/9 9:42
4557	Albert Petrick	225	1 10.22.2.7	132	65	E	Y	132.65 10.22.2.7		Period missing at end of sentence	Add period at the of sentence after "A-MPDU"	2017/1/9 9:42
4558	Albert Petrick	225	1 9.4.2.218.3	82	23	E	Y	82.23 9.4.2.218.3	3471	Table 9-262aa, "Definition column" missing period at end of sentence	Fix. Add period after 5 GHz.	2017/1/9 9:42
4559	Albert Petrick	225	1 28.3.12	340	3	E	Y	340.03 28.3.12	4343	Equation 28-117 brackets cutoff	vertically center between paragraphs	2017/1/9 9:42
4560	Albert Petrick	225	1 9.4.2.218.2	77	21	T	Y	77.21 9.4.2.218.2		Add clarity and call out bit position in Table 9-262z for subfield "HTC-HE Support" corresponding to those bit positions in Figure 9-589ck.	Add bit "B0:" in Definition column before the word "Indicates" Add bit "B0:" in Encoding column before the word "Set"	2017/1/9 9:42
4561	Albert Petrick	225	1 9.4.1.64	64	53	T	Y	64.53 9.4.1.64	3436	Missing number of bits for Delta SNR for k=scidx(Ns-1)	Add number of bits for (Ns-1) for Delta SNR	2017/1/9 9:42
4562	Albert Petrick	225	1 9.4.2.218.3	82	18	E	Y	82.18 9.4.2.218.3	3472	Table 9-262aa, "Encoding column" missing period at end of sentence	Fix. Change "Note" to "NOTE" and add colon ":" after "NOTE:"	2017/1/9 9:42
4563	Albert Petrick	225	1 28.3.11.8	323	58	T	Y	323.58 28.3.11.8	4347	BCC interleaver explanation needs further clarification. User "u"is reference once in this clause.	Rewrite first paragraph to read with clarity.	2017/1/9 9:42
4564	Albert Petrick	225	1 9.4.2.218.2	77	27	T	Y	77.27 9.4.2.218.2		Add clarity and call out bit position in Table 9-262z for subfield "TWT Requester Support" corresponding to those bit positions in Figure 9-589ck.	Add bit "B1:" in Definition column before the word "Indicates" Add bit "B1:" in Encoding column before the word "Set"	2017/1/9 9:42
4565	Albert Petrick	225	1 9.4.1.64	64	13	E	Y	64.13 9.4.1.64	3437	Remove paragraph indent	Fix paragraph alignment starting at "No padding is present....."	2017/1/9 9:42
4566	Albert Petrick	225	1 28.1.1	210	58	E	Y	210.58 28.1.1	3785	Period missing at end of sentence	Add period at the of sentence after "PPDUs"	2017/1/9 9:42
4567	Albert Petrick	225	1 9.4.2.218.3	82	44	T	Y	82.44 9.4.2.218.3	3474	Table 9-262aa, grammar issue	Change "of" to "on"	2017/1/9 9:42
4568	Albert Petrick	225	1 28.1.1	211	38	E	Y	211.38 28.1.1	3868	Period missing at end of sentence	Add period at the of sentence after "receive)"	2017/1/9 9:42
4569	Albert Petrick	225	1 28.3.11.9	327	6	E	Y	327.06 28.3.11.9	4352	Spelling errors	Change text "MCS 1" to "MCS1" Change text "MCS 3" to "MCS3" Change text "MCS 4" to "MCS4"	2017/1/9 9:42

4570	Albert Petrick	225	1 9.4.1.64	64	18	T	Y	64.18 9.4.1.64	3439	Equation (9-2) is referenced in the text and in Table 9-76f HE MU Exclusive Beamforming Report information, and is not linked or referenced to any other documents. Equation (9-2) should be linked and referenced to its location IEEE 802.11-2016 (Rev D8.0) and clarified as a "Note" at the end of Table 9-76f.	Add note for equation 9-2 in text and/or add the following underlined text (without the underline) and reference link in Table 9-76f as a Note: "as defined in Equation (9-2) in clause 9.4.1.51 (MU Exclusive Beamforming Report Field)"	2017/1/9 9:42
4571	Albert Petrick	225	1 9.4.2.218.2	77	33	T	Y	77.33 9.4.2.218.2		Add clarity and call out bit position in Table 9-262z for subfield "TWT Responder Support" corresponding to those bit positions in Figure 9-589ck.	Add bit "B2:" in Definition column before the word "Indicates" Add bit "B2:" in Encoding column before the word "Set"	2017/1/9 9:42
4572	Albert Petrick	225	1 9.4.2.218.3	82	47	E	Y	82.47 9.4.2.218.3	3476	Table 9-262aa, "Definition column" missing period at end of sentence and line between paragraphs	Fix. In the Definition column Add period "." after "punctured." and carriage return before B9, B10, and B11 on lines 47, 51, and 56. On line 60 add period after "is present."	2017/1/9 9:42
4573	Albert Petrick	225	1 28.3.11.10	327	58	E	Y	327.58 28.3.11.10	4357	Grammar error	Remove "as"	2017/1/9 9:42
4574	Albert Petrick	225	1 9.4.1.64	64	30	T	Y	64.30 9.4.1.64	3440	Equation (9-2) reference in Table 9-76f calls out subcarrier k=scidx(0) and k=scidx(1). Equation 9-2 in IEEE 802.11-2016 (Rev D8.0) in clause 9.4.1.51 specifies k=sscidx(0) and k=sscidx(1) There appears to be an ambiguity in equation in 9-2 and with k=scidx(_)	Fix references for subcarrier k=scidx(0) and k=scidx(1) in Table 9-76f (lines 30-54) to match assumptions with equation 9-2 in clause 9.4.1.51 in IEEE 802.11-2016 (Rev D8.0)	2017/1/9 9:42
4575	Albert Petrick	225	1 9.4.2.218.2	77	38	T	Y	77.38 9.4.2.218.2		Add clarity and call out bit position in Table 9-262z for subfield "Fragmentation Support" corresponding to those bit positions in Figure 9-589ck.	Add bits "B3-B4:" in Definition column before the word "Indicates" Add bits "B3-B4:" in Encoding column before the word "Set"	2017/1/9 9:42
4576	Albert Petrick	225	1 9.4.2.218.3	93	25	E	Y	93.25 9.4.2.218.3	3479	Table 9-262aa, missing period at the end of sentence	Fix. In the "Definition column", Add period "." after the "duration" on lines 25 and 29.	2017/1/9 9:42
4577	Albert Petrick	225	1 28.3.11.11	328	57	E	Y	328.57 28.3.11.11	4363	Equation 28-96 brackets cutoff	Resize font of brackets and vertically center between paragraphs	2017/1/9 9:42
4578	Albert Petrick	225	1 28.1.1	210	64	E	Y	210.64 28.1.1	3792	Period missing at end of sentence	Add period at the of sentence after "20 MHz"	2017/1/9 9:42
4579	Albert Petrick	225	1 28.1.1	211	41	E	Y	211.41 28.1.1	3875	Period missing at end of sentence	Add period at the of sentence after "receive)"	2017/1/9 9:42
4580	Albert Petrick	225	1 28.4.2	371	36	T	Y	371.36 28.4.2	3441	Clarify "aSignalExtension" referenced from Table 19-25	Add the following underlined text (without the underline): and is aSignalExtension (0us for 5 GHz band, 6us for 2.4 GHz band)	2017/1/9 9:42
4581	Albert Petrick	225	1 9.4.2.218.2	77	54	T	Y	77.54 9.4.2.218.2		Add clarity and call out bit position in Table 9-262z for subfield "Maximum number of Fragmented MSDUs" corresponding to those bit positions in Figure 9-589ck.	Add bits "B5-B7:" in Definition column before the word "Indicates" Add bits "B5-B7:" in Encoding column before the word "The"	2017/1/9 9:42
4582	Albert Petrick	225	1 9.4.2.218.3	83	34	E	Y	83.34 9.4.2.218.3	3481	Table 9-262aa, missing period and colon in sentence.	Fix. In the "Definition column, Add period "." after the "stream" on lines 35 and 39. In Encoding column Add ":" after B18 on line 34 and B19 on line 37.	2017/1/9 9:42
4583	Albert Petrick	225	1 28.3.11.11	329	30	E	Y	329.30 28.3.11.11	4366	Equation 28-97 brackets cutoff	Resize font of brackets and vertically center between paragraphs	2017/1/9 9:42
4584	Albert Petrick	225	1 28.1.1	210	64	T	Y	210.64 28.1.1	3795	Bandwidth should be specific to 20 MHz channels	Add the word "channel" before "bandwidth"	2017/1/9 9:42
4585	Albert Petrick	225	1 28.4.2	371	39	E	Y	371.39 28.4.2	3443	Missing period	Add period at the end of sentence after "false"	2017/1/9 9:42
4586	Albert Petrick	225	1 9.4.2.218.2	78	54	T	Y	78.54 9.4.2.218.2		Add clarity and call out bit position in Table 9-262z for subfield "Minimum Fragment Size" corresponding to those bit positions in Figure 9-589ck.	Add bits "B8-B9:" in Definition column before the word "Indicates" Add bits "B8-B9:" in Encoding column before the word "Set"	2017/1/9 9:42
4587	Albert Petrick	225	1 9.2.5.2	32	1	E	Y	32.01 9.2.5.2	3444	Format error - sentence alignment	Sentence format needs to be left justified.	2017/1/9 9:42
4588	Albert Petrick	225	1 9.4.2.218.2	78	13	T	Y	78.13 9.4.2.218.2		Add clarity and call out bit position in Table 9-262z for subfield "Trigger Frame MAC Padding Duration" corresponding to those bit positions in Figure 9-589ck.	Add bits "B10-B11:" in Definition column before the word "Indicates" Add bits "B10-B11:" in Encoding column before the word "Set"	2017/1/9 9:42
4589	Albert Petrick	225	1 28.1.1	211	42	E	Y	211.42 28.1.1	3880	Period missing at end of sentence	Add period at the of sentence after "puncturing"	2017/1/9 9:42
4590	Albert Petrick	225	1 9.4.2.218.3	83	40	E	Y	83.40 9.4.2.218.3	3484	Table 9-262aa, missing period and colon in sentence.	In the Definition column, Add colon ":" after B20 and B21. Add period after "procedure." on lines 41 and 43. In Encoding column Add colon after B20 on line 40 and B21 on line 43. Add extra line space between lines 41 and 42.	2017/1/9 9:42

4591	Albert Petrick	225	1 9.3.1.9.1	34	12	T	Y	34.12 9.3.1.9.1	3446	In Figure 9-33 (BA Control Field) Bit (B5) in the Reserve sub-field is marked as deleted (strikethrough) as shown. The Reserved subfield now shows 7-bits (B6-B11). The text does not describe B5. Define B5 or correct Figure 9-33	Fix as commented	2017/1/9 9:42
4592	Albert Petrick	225	1 28.3.11.11	329	39	E	Y	329.39 28.3.11.11	4374	Equation 28-97 brackets cutoff	Resize font of brackets and vertically center between paragraphs	2017/1/9 9:42
4593	Albert Petrick	225	1 9.4.2.218.2	78	20	T	Y	78.20 9.4.2.218.2		Add clarity and call out bit position in Table 9-262z for subfield "Multi-TID Aggregation Support" corresponding to those bit positions in Figure 9-589ck.	Add bits "B12-B14:" in Definition column before the word "Indicates" Add bits "B12-B14:" in Encoding column before the word "Set"	2017/1/9 9:42
4594	Albert Petrick	225	1 28.1.1	211	5	E	Y	211.05 28.1.1	3800	Period missing at end of sentence	Add period at the of sentence after "20 MHz"	2017/1/9 9:42
4595	Albert Petrick	225	1 9.4.2.218.3	83	58	E	Y	83.58 9.4.2.218.3	3486	Table 9-262aa, missing period at the end of sentence.	Add period after "MU-MIMO" on line 58.	2017/1/9 9:42
4596	Albert Petrick	225	1 B.4.27.2	413	45	E	Y	413.45 B.4.27.2	3447	Numbering / letter (5GHz) spacing issue in Table B.4.27.2 HEW PHY features	Change "5GHz" to "5 GHz"	2017/1/9 9:42
4597	Albert Petrick	225	1 28.3.12	338	4	E	Y	338.04 28.3.12	4377	Figure 28-35 to small to read or print	Redraw figure use larger text font and align across page	2017/1/9 9:42
4598	Albert Petrick	225	1 9.4.2.218.2	78	27	T	Y	78.27 9.4.2.218.2		Add clarity and call out bit position in Table 9-262z for subfield "HE Link Adaptation" corresponding to those bit positions in Figure 9-589ck.	Add bits "B15-B16:" in Definition column before the word "Indicates" Add bits "B15-B16:" in Encoding column before the word "If"	2017/1/9 9:42
4599	Albert Petrick	225	1 9.4.2.218.3	82	11	T	Y	82.11 9.4.2.218.3	3488	Add clarity and call out bit position in Table 9-262aa for subfield "Dual Band Support" corresponding to those bit positions in Figure 9-589cl	Add bit B0 in Definition column Change to: "B0 indicates support of both...."	2017/1/9 9:42
4600	Albert Petrick	225	1 9.3.1.23	45	6	E	Y	45.06 9.3.1.23	3449	Number / letter (2.4GHz) spacing issue in Table B.4.27.2 HEW PHY features	Change "2.4GHz" to "2.4 GHz"	2017/1/9 9:42
4601	Albert Petrick	225	1 28.1.1	211	47	E	Y	211.47 28.1.1	3888	Period missing at end of sentence	Add period at the of sentence after "OFDMA)"	2017/1/9 9:42
4602	Albert Petrick	225	1 9.4.2.218.2	78	38	T	Y	78.38 9.4.2.218.2		Add clarity and call out bit position in Table 9-262z for subfield "All Ack Support" corresponding to those bit positions in Figure 9-589ck.	Add bit "B17:" in Definition column before the word "Indicates" Add bits "B17:" in Encoding column before the word "Set"	2017/1/9 9:42
4603	Albert Petrick	225	1 9.4.2.218.3	84	26	T	Y	84.26 9.4.2.218.3	3490	Add clarity and call out bit position in Table 9-262aa for subfield "UL HE MU PPDU Payload Support" corresponding to those bit positions in Figure 9-589cl	Add bit B30 in Definition column Change to: "B30 indicates that the STA supports the reception of....."	2017/1/9 9:42
4604	Albert Petrick	225	1 28.1.1	211	8	E	Y	211.08 28.1.1	3807	Period missing at end of sentence	Add period at the of sentence after "PPDU"	2017/1/9 9:42
4605	Albert Petrick	225	1 9.4.2.218.2	78	43	T	Y	78.43 9.4.2.218.2		Add clarity and call out bit position in Table 9-262z for subfield "UL MU Response Scheduling Support" corresponding to those bit positions in Figure 9-589ck.	Add bit "B18:" in Definition column before the word "Indicates" Add bits "B18:" in Encoding column before the word "If"	2017/1/9 9:42
4606	Albert Petrick	225	1 9.4.2.218.3	84	31	T	Y	84.31 9.4.2.218.3	3492	Add clarity and call out bit position in Table 9-262aa for subfield "SU Beamformer" corresponding to those bit positions in Figure 9-589cl	Add bit B31 in Definition column Change to: "B31 indicates support for operation as an SU beamformer."	2017/1/9 9:42
4607	Albert Petrick	225	1 28.3.12	338	43	E	Y	338.43 28.3.12	3243	Figure 28-35 to small to read or print	Redraw figure use larger text font and align across page	2017/1/9 9:42
4608	Albert Petrick	225	1 9.4.2.218.2	76	24	E	Y	76.24 9.4.2.218.2	3450	Format error - sentence alignment	Fix paragraph alignment - left justify.	2017/1/9 9:42
4609	Albert Petrick	225	1 9.4.2.218.2	78	49	T	Y	78.49 9.4.2.218.2		Add clarity and call out bit position in Table 9-262z for subfield "A-BSR Support" corresponding to those bit positions in Figure 9-589ck.	Add bit "B19:" in Definition column before the word "Indicates" Add bits "B19:" in Encoding column before the word "If"	2017/1/9 9:42
4610	Albert Petrick	225	1 28.1.1	211	50	E	Y	211.50 28.1.1	3895	Period missing at end of sentence	Add period at the of sentence after "OFDMA)"	2017/1/9 9:42
4611	Albert Petrick	225	1 28.3.12	338	50	E	Y	338.50 28.3.12	3245	Equation 28-114 brackets cutoff	Resize font of brackets and vertically center between paragraphs	2017/1/9 9:42
4612	Albert Petrick	225	1 9.4.2.218.3	84	36	T	Y	84.36 9.4.2.218.3	3494	Add clarity and call out bit position in Table 9-262aa for subfield "SU Beamformee" corresponding to those bit positions in Figure 9-589cl	Add bit B32 in Definition column Change to: "B32 indicates support for operation as an SU beamformee."	2017/1/9 9:42
4613	Albert Petrick	225	1 9.4.2.218.3	81	35	E	Y	81.35 9.4.2.218.3	3453	In Figure 9-589cl - (HE PHY Capabilities Information field format) subfield NSTA Total For < 80 MHz is labeled as having 2-bits. There are 3-bits (B37 -B39).	Change Bits "2" to "3" for subfield "NSTS Total for < 80 MHz" in Figure 9m-589cl	2017/1/9 9:42
4614	Albert Petrick	225	1 9.4.2.218.2	78	58	T	Y	78.58 9.4.2.218.2		Add clarity and call out bit position in Table 9-262z for subfield "Broadcast TWT Support" corresponding to those bit positions in Figure 9-589ck.	Add bit "B20:" in Definition column before the word "Indicates" Add bits "B20:" in Encoding column before the word "Set"	2017/1/9 9:42
4615	Albert Petrick	225	1 28.1.1	211	9	E	Y	211.09 28.1.1	3813	Period missing at end of sentence	Add period at the of sentence after "receive)"	2017/1/9 9:42
4616	Albert Petrick	225	1 9.4.2.218.3	84	40	T	Y	84.40 9.4.2.218.3	3496	Add clarity and call out bit position in Table 9-262aa for subfield "MU Beamformer" corresponding to those bit positions in Figure 9-589cl	Add bit B33 in Definition column Change to: "B33 indicates support for operation as an MU beamformer."	2017/1/9 9:42

4617	Albert Petrick	225	1 9.4.2.218.3	81	35	T	Y	81.35 9.4.2.218.3	3455	In Figure 9-589cl - (HE PHY Capabilities Information field format) subfield "Number Of Sounding Dimensions For < 80 MHz" is mark as having 1-bit. There are 3-bits (B46 -B48).	Change Bits "1" to "3" for subfield "NSTS Total for < 80 MHz" in Figure 9-589cl	2017/1/9 9:42
4618	Albert Petrick	225	1 9.4.2.218.2	79	4	T	Y	79.04 9.4.2.218.2		Add clarity and call out bit position in Table 9-262z for subfield "32-bit BA Bitmap Support" corresponding to those bit positions in Figure 9-589ck.	Add bit "B21:" in Definition column before the word "Indicates" Add bits "B21:" in Encoding column before the word "Set"	2017/1/9 9:42
4619	Albert Petrick	225	1 9.4.2.218.2	79	34	T	Y	79.34 9.4.2.218.2		Add clarity and call out bit position in Table 9-262z for subfield "OFDMA RA Support" corresponding to those bit positions in Figure 9-589ck.	Add bit "B26:" in Definition column before the word "Indicates" Add bits "B26:" in Encoding column before the word "Set"	2017/1/9 9:42
4620	Albert Petrick	225	1 9.4.2.218.3	85	22	E	Y	85.22 9.4.2.218.3	3509	Missing period at end of sentence in Definition column of Table 9-262aa.	Add period at the end of sentence "HE NDP"	2017/1/9 9:42
4621	Albert Petrick	225	1 28.3.12	338	62	E	Y	338.62 28.3.12	4388	Equation 28-116 brackets cutoff	Resize font of brackets and vertically center between paragraphs	2017/1/9 9:42
4622	Albert Petrick	225	1 28.1.1	212	2	E	Y	212.02 28.1.1	3915	Period missing at end of sentence	Add period at the of sentence after "receive)"	2017/1/9 9:42
4623	Albert Petrick	225	1 9.4.2.218.2	79	42	T	Y	79.42 9.4.2.218.2		Add clarity and call out bit position in Table 9-262z for subfield "Maximum A-MPDU Length Exponent" corresponding to those bit positions in Figure 9-589ck.	Add bits "B27-B28:" in Definition column Add bits "B27-B28:" in Encoding column	2017/1/9 9:42
4624	Albert Petrick	225	1 9.4.2.218.3	85	26	T	Y	85.26 9.4.2.218.3	3511	Add clarity and call out bit positions in Table 9-262aa for subfield "Number Of Sounding Dimensions For > 80 MHz" corresponding to those bit positions in Figure 9-589cl. Missing period at the end of sentence.	Add bits B48-B51 in Definition column Change to: "B49-B51 represents the beamformer's capability.....for an HE NDP."	2017/1/9 9:42
4625	Albert Petrick	225	1 28.1.1	211	18	E	Y	211.18 28.1.1	3829	Period missing at end of sentence	Add period at the of sentence after "streams"	2017/1/9 9:42
4626	Albert Petrick	225	1 9.4.2.218.3	82	18	E	Y	82.18 9.4.2.218.3	3465	Table 9-262aa, "Definition column" missing period at end of sentence	Fix. Add period after 5 GHz.	2017/1/9 9:42
4627	Albert Petrick	225	1 9.4.2.218.2	79	42	T	Y	79.42 9.4.2.218.2		Table 9-262z subfield "Maximum A-MPDU Length Exponent" not defined in Definition and Encoding columns of Table 9-262z	Add definition and Definition and Encoding columns	2017/1/9 9:42
4628	Albert Petrick	225	1 9.4.2.218.2	79	47	T	Y	79.47 9.4.2.218.2		Add clarity and call out bit position in Table 9-262z for subfield "A-MSDU Fragmentation Support" corresponding to those bit positions in Figure 9-589ck.	Add bit "B29:" in Definition column before the word "The" Add bits "B29:" in Encoding column before the word "Set"	2017/1/9 9:42
4629	Albert Petrick	225	1 28.3.12	149	53	E	Y	149.53 28.3.12	4397	Period missing at end of sentence	Add period at the of sentence after "false"	2017/1/9 9:42
4630	Albert Petrick	225	1 28.1.1	212	9	E	Y	212.09 28.1.1	3923	Period missing at end of sentence	Add period at the of sentence after "bandwidth"	2017/1/9 9:42
4631	Albert Petrick	225	1 9.4.2.218.3	85	28	E	Y	85.28 9.4.2.218.3	3514	Missing period at end of sentence in Definition column of Table 9-262aa.	Fix. Add period at the end of sentence "HE NDP."	2017/1/9 9:42
4632	Albert Petrick	225	1 28.1.1	211	21	E	Y	211.21 28.1.1	3835	Period missing at end of sentence	Add period at the of sentence after "receive)"	2017/1/9 9:42
4633	Albert Petrick	225	1 9.4.2.218.2	79	52	T	Y	79.52 9.4.2.218.2		Add clarity and call out bit position in Table 9-262z for subfield "Flexible TWT Schedule Support" corresponding to those bit positions in Figure 9-589ck.	Add bit "B30:" in Definition column before the word "Indicates" Add bits "B30:" in Encoding column before the word "Set"	2017/1/9 9:42
4634	Albert Petrick	225	1 9.4.2.218.3	82	20	E	Y	82.20 9.4.2.218.3	3468	Table 9-262aa, "Definition column" missing period at end of sentence	Fix. Add period after 5 GHz.	2017/1/9 9:42
4635	Albert Petrick	225	1 9.4.2.218.3	85	29	E	Y	85.29 9.4.2.218.3	3516	Missing period at end of sentence in Encoding column in Table 9-262aa.	Add period at the end of sentence "reserved."	2017/1/9 9:42
4636	Albert Petrick	225	1 9.4.2.218.2	79	57	T	Y	79.57 9.4.2.218.2		Add clarity and call out bit position in Table 9-262z for subfield "Rx Control Frame to MultiBss" corresponding to those bit positions in Figure 9-589ck.	Add bit "B31:" in Definition column before the word "Indicates" Add bits "B31:" in Encoding column before the word "Set"	2017/1/9 9:42
4637	Albert Petrick	225	1 28.3.12	340	3	E	Y	340.03 28.3.12	4405	Equation 28-117 brackets cutoff	Resize font of brackets and vertically center between paragraphs	2017/1/9 9:42
4638	Albert Petrick	225	1 28.1.1	212	14	E	Y	212.14 28.1.1	3929	Period missing at end of sentence	Add period at the of sentence after "supported"	2017/1/9 9:42
4639	Albert Petrick	225	1 9.4.2.218.2	80	4	T	Y	80.04 9.4.2.218.2		Add clarity and call out bit position in Table 9-262z for subfield "BSRP A-MPDU Aggregation" corresponding to those bit positions in Figure 9-589ck.	Add bit "B32:" in Definition column before the word "Indicates" Add bits "B32:" in Encoding column before the word "Set"	2017/1/9 9:42
4640	Albert Petrick	225	1 28.1.1	211	26	E	Y	211.26 28.1.1	3841	Period missing at end of sentence	Add period at the of sentence after "OFDMA)"	2017/1/9 9:42
4641	Albert Petrick	225	1 28.3.13	340	38	E	Y	340.38 28.3.13	4411	Misaligned paragraph	Left justify	2017/1/9 9:42
4642	Albert Petrick	225	1 9.4.2.218.3	82	23	E	Y	82.23 9.4.2.218.3	3471	Table 9-262aa, "Definition column" missing period at end of sentence	Fix. Add period after 5 GHz.	2017/1/9 9:42
4643	Albert Petrick	225	1 9.4.2.218.3	85	24	E	Y	85.24 9.4.2.218.3	3520	Missing period at end of sentence in Encoding column in Table 9-262aa.	Add period at the end of sentence "reserved."	2017/1/9 9:42

4644	Albert Petrick	225	1 9.4.2.218.2	80	10	T	Y	80.10 9.4.2.218.2		Add clarity and call out bit position in Table 9-262z for subfield "QTP Support" corresponding to those bit positions in Figure 9-589ck.	Add bit "B33:" in Definition column before the word "The" Add bits "B33:" in Encoding column before the word "If"	2017/1/9 9:42
4645	Albert Petrick	225	1 9.3.1.23	47	56	E	Y	47.56 9.3.1.23	4414	Equation 9-ax1 brackets cutoff	Resize font of brackets and vertically center between paragraphs	2017/1/9 9:42
4646	Albert Petrick	225	1 9.4.2.218.3	82	18	E	Y	82.18 9.4.2.218.3	3472	Table 9-262aa, "Encoding column" missing period at end of sentence	Fix. Change "Note" to "NOTE" and add colon ":" after "NOTE:"	2017/1/9 9:42
4647	Albert Petrick	225	1 9.4.2.218.3	85	31	T	Y	85.31 9.4.2.218.3	3522	Add clarity and call out bit positions in Table 9-262aa for subfield "Ng = 16 For SU Feedback Support" corresponding to those bit positions in Figure 9-589cl. Missing period at the end of sentence.	Add bit B52 in Definition column Change to: "B52 indicates if the HE beamformee....."	2017/1/9 9:42
4648	Albert Petrick	225	1 9.4.2.218.2	80	16	T	Y	80.16 9.4.2.218.2		Add clarity and call out bit position in Table 9-262z for subfield "A-BQR Support" corresponding to those bit positions in Figure 9-589ck.	Add bit "B34:" in Definition column before the word "Indicates" Add bits "B34:" in Encoding column before the word "If"	2017/1/9 9:42
4649	Albert Petrick	225	1 28.1.1	212	17	E	Y	212.17 28.1.1	3936	Period missing at end of sentence	Add period at the of sentence after "capable"	2017/1/9 9:42
4650	Albert Petrick	225	1 9.3.1.23	47	5	E	Y	47.05 9.3.1.23	4418	Equation 9-ax2 brackets cutoff	Resize font of brackets and vertically center between paragraphs	2017/1/9 9:42
4651	Albert Petrick	225	1 9.4.2.218.3	82	44	T	Y	82.44 9.4.2.218.3	3474	Table 9-262aa, grammar issue	Change "of" to "on"	2017/1/9 9:42
4652	Albert Petrick	225	1 9.4.2.218.3	85	35	T	Y	85.35 9.4.2.218.3	3524	Add clarity and call out bit positions in Table 9-262aa for subfield "Ng = 16 For MU Feedback Support" corresponding to those bit positions in Figure 9-589cl. Missing period at the end of sentence.	Add bit B53 in Definition column Change to: "B53 indicates if the HE beamformee....."	2017/1/9 9:42
4653	Albert Petrick	225	1 28.1.1	211	29	E	Y	211.29 28.1.1	3847	Period missing at end of sentence	Add period at the of sentence after "MIMO)"	2017/1/9 9:42
4654	Albert Petrick	225	1 9.4.2.218.2	80	24	T	Y	80.24 9.4.2.218.2		Add clarity and call out bit position in Table 9-262z for subfield "Reserved" corresponding to those bit positions in Figure 9-589ck.	Add bit "B35-B39: are Reserved" in Definition column Add bits "B35-B39: are Reserved" in Encoding column.	2017/1/9 9:42
4655	Albert Petrick	225	1 9.4.1.63	58	9	E	Y	58.09 9.4.1.63	4423	Extra paragraph line space	Remove line space between paragraph	2017/1/9 9:42
4656	Albert Petrick	225	1 9.4.2.218.3	82	47	E	Y	82.47 9.4.2.218.3	3476	Table 9-262aa, "Definition column" missing period at end of sentence and line between paragraphs	Fix. In the Definition column Add period "." after "punctured." and carriage return before B9, B10, and B11 on lines 47, 51, and 56. On line 60 add period after "is present."	2017/1/9 9:42
4657	Albert Petrick	225	1 9.4.2.218.3	85	37	E	Y	85.37 9.4.2.218.3	3526	In Table 9-262aa missing period at the end of sentence.	Add period after "MU-type feedback."	2017/1/9 9:42
4658	Albert Petrick	225	1 9.4.2.218.2	80	24	T	Y	80.24 9.4.2.218.2		Missing row for Reserved subfield in Table 9-262z	Add row for "Reserved" subfield	2017/1/9 9:42
4659	Albert Petrick	225	1 28.1.1	212	19	E	Y	212.19 28.1.1	3943	Period missing at end of sentence	Add period at the of sentence after "capable"	2017/1/9 9:42
4660	Albert Petrick	225	1 9.4.2.218.3	85	39	T	Y	85.39 9.4.2.218.3	3528	Add clarity and call out bit positions in Table 9-262aa for subfield "Codebook Size (ñ≥, ñΩ) = {4, 2} For SU Support" corresponding to those bit positions in Figure 9-589cl.	Add bit B54 in Definition column Change to: "B54 indicates if the HE beamformee....."	2017/1/9 9:42
4661	Albert Petrick	225	1 9.4.2.218.3	93	25	E	Y	93.25 9.4.2.218.3	3479	Table 9-262aa, missing period at the end of sentence	Fix. In the "Definition column", Add period "." after the "duration" on lines 25 and 29.	2017/1/9 9:42
4662	Albert Petrick	225	1 CAdocument	1		E	Y	1.00 CAdocument		In "Abstract" abbreviation missing for "coexistence assurance"	In "Abstract" clause, Add underlined text (without the underline) in the following sentence. "This serves as the coexistence assurance (CA) document for TGax in meeting the requirement of the CSD."	2017/1/9 9:42
4663	Albert Petrick	225	1 28.1.1	211	32	E	Y	211.32 28.1.1	3854	Period missing at end of sentence	Add period at the of sentence after "OFDMA)"	2017/1/9 9:42
4664	Albert Petrick	225	1 9.4.2.218.3	85	44	T	Y	85.44 9.4.2.218.3	3530	Add clarity and call out bit positions in Table 9-262aa for subfield "Codebook Size (ñ≥, ñΩ) = {7,5} For MU Support" corresponding to those bit positions in Figure 9-589cl.	Add bit B55 in Definition column Change to: "B55 indicates if the HE beamformee....."	2017/1/9 9:42
4665	Albert Petrick	225	1 9.4.2.218.3	83	34	E	Y	83.34 9.4.2.218.3	3481	Table 9-262aa, missing period and colon in sentence.	Fix. In the "Definition column, Add period "." after the "stream" on lines 35 and 39. In Encoding column Add ":" after B18 on line 34 and B19 on line 37.	2017/1/9 9:42
4666	Albert Petrick	225	1 9.4.1.63	58	22	E	Y	58.22 9.4.1.63	4432	Extra paragraph line space	Remove line space between paragraph	2017/1/9 9:42
4667	Albert Petrick	225	1 CAdocument	2		E	Y	2.00 CAdocument		Period missing at end of sentence in clause "1 Introduction"	In clause "1 Introduction" under the sub-bullet "CSD", add period " . " at the end of sentence.	2017/1/9 9:42

4668	Albert Petrick	225	1 9.4.2.218.3	85	50	E	Y	85.50 9.4.2.218.3	3532	In Table 9-262aa, Missing periods and line spacing between sentences.	In the "Definition" column, Add period at the end of sentences e.i., after "feedback." on lines 50, 52, 54, 57, 59 and 61. Add line space carriage return after "feedback on lines 50, 52, 54, 57 and 59. In "Encoding" column, Add line spacing carriage return after "otherwise." on line 55.	2017/1/9 9:42
4669	Albert Petrick	225	1 28.1.1	212	22	E	Y	212.22 28.1.1	3950	Period missing at end of sentence	Add period at the of sentence after "capable"	2017/1/9 9:42
4670	Albert Petrick	225	1 CAdocument	2		T	Y	2.00 CAdocument		In clause "3 Coexistence with non-802.11 systems" Reference to contiguous and noncontiguous channel bandwidths should be added before secondary channel discussion.	In clause "3 Coexistence with non-802.11 systems" before the sentence starting with "According to 802.11ac 22.3.20.5 [4]....." Add the following sentence: "802.11ac and 802.11ax provides support for 20MHz, 40 MHz, 80 MHz and 160 MHz contiguous channel bandwidths and for 80+80 MHz noncontiguous channel bandwidths."	2017/1/9 9:42
4671	Albert Petrick	225	1 9.4.2.218.3	86	6	T	Y	86.06 9.4.2.218.3	3534	Add clarity and call out bit position in Table 9-262aa for subfield "HE ER SU Payload" corresponding to those bit positions in Figure 9-589cl.	Add bit B59 in Definition column Change to: "B59: indicates the support of transmission....."	2017/1/9 9:42
4672	Albert Petrick	225	1 28.1.1	211	34	E	Y	211.34 28.1.1	3859	Period missing at end of sentence	Add period at the of sentence after "PPDU"	2017/1/9 9:42
4673	Albert Petrick	225	1 9.4.2.218.3	83	40	E	Y	83.40 9.4.2.218.3	3484	Table 9-262aa, missing period and colon in sentence.	In the Definition column, Add colon ":" after B20 and B21. Add period after "procedure." on lines 41 and 43. In Encoding column Add colon after B20 on line 40 and B21 on line 43. Add extra line space between lines 41 and 42.	2017/1/9 9:42
4674	Albert Petrick	225	1 CAdocument	2		T	Y	2.00 CAdocument		In clause "3 Coexistence with non-802.11 systems" a reference if made to sub-clause 22.3.30.5 [4] IEEE Std 802.11ac-2013. There is no such sub-clause in 802.11ac-2013.	In the following sentence, "According to 802.11ac 22.3.20.5 [4], a PHY must set its CCA indication to busy as follows:" add the correct sub-clause reference and include the subclause title	2017/1/9 9:42
4675	Albert Petrick	225	1 9.4.1.63	58	30	E	Y	58.30 9.4.1.63	4442	Extra paragraph line space	Remove line space between paragraph	2017/1/9 9:42
4676	Albert Petrick	225	1 9.4.2.218.3	86	11	T	Y	86.11 9.4.2.218.3	3536	Add clarity and call out bit position in Table 9-262aa for subfield "DL MU-MIMO on Partial BW" corresponding to those bit positions in Figure 9-589cl.	Add bit B60 in Definition column Change to: "B60: indicates the non-AP STA supports....."	2017/1/9 9:42
4677	Albert Petrick	225	1 9.4.2.218.3	83	58	E	Y	83.58 9.4.2.218.3	3486	Table 9-262aa, missing period at the end of sentence.	Add period after "MU-MIMO" on line 58.	2017/1/9 9:42
4678	Albert Petrick	225	1 CAdocument	3		T	Y	3.00 CAdocument		In clause "5.2 Spatial Reuse", has a grammar issue and reference to 20 MHz and 40 MHz should reference "channel bandwidths for more clarity.	In clause "3 Coexistence with non-802.11 systems" Add underlined text (without the underline) and remove strikethrough text in the last sentence of the this clause as follows: "For 2.4 GHz, we refer to 20.3.21.4 [5] (which corresponds to 802.11n), which corresponds to the same rules for 20 and 40 MHz channel bandwidths described in the paragraph above."	2017/1/9 9:42
4679	Albert Petrick	225	1 9.4.2.218.3	86	14	T	Y	86.14 9.4.2.218.3	3538	Add clarity and call out a "Note" reference in Table 9-262aa for subfield "DL MU-MIMO on Partial BW" in the Encoding column.	Add change to read: "Note: This field is reserved for an AP."	2017/1/9 9:42
4680	Albert Petrick	225	1 28.1.1	212	27	E	Y	212.27 28.1.1	3956	Period missing at end of sentence	Add period at the of sentence after "applicable"	2017/1/9 9:42
4681	Albert Petrick	225	1 9.4.2.218.3	82	11	T	Y	82.11 9.4.2.218.3	3488	Add clarity and call out bit position in Table 9-262aa for subfield "Dual Band Support" corresponding to those bit positions in Figure 9-589cl	Add bit B0 in Definition column Change to: "B0 indicates support of both...."	2017/1/9 9:42
4682	Albert Petrick	225	1 28.1.1	211	38	E	Y	211.38 28.1.1	3868	Period missing at end of sentence	Add period at the of sentence after "receive)"	2017/1/9 9:42
4683	Albert Petrick	225	1 CAdocument	3		T	Y	3.00 CAdocument		Clause "5.2 Spatial Reuse": coexistence with this mode of operation needs to be consistent with technical draft .11axD1.0 clause 27.9 (Spatial reuse operation) In .11axD1.0, Table 28-17 makes reference to Spatial Reuse section needing more development.	Update as commented	2017/1/9 9:42
4684	Albert Petrick	225	1 9.4.2.218.3	86	16	T	Y	86.16 9.4.2.218.3	3540	Add clarity and call out bit position in Table 9-262aa for subfield "PPE Threshold Present" corresponding to those bit position in Figure 9-589cl.	Add bit B61 in Definition column Change to: "B61: indicates whether or no the PPE....."	2017/1/9 9:42

4685	Albert Petrick	225	1 9.4.2.218.3	84	26	T	Y	84.26 9.4.2.218.3	3490	Add clarity and call out bit position in Table 9-262aa for subfield "UL HE MU PPDU Payload Support" corresponding to those bit positions in Figure 9-589cl	Add bit B30 in Definition column Change to: "B30 indicates that the STA supports the reception of....."	2017/1/9 9:42
4686	Albert Petrick	225	1 9.4.2.6	68	60	E	Y	68.60 9.4.2.6	4452	Period missing at end of sentence	Add period at the of sentence after "reserved"	2017/1/9 9:42
4687	Albert Petrick	225	1 CAdocument	3		E	Y	3.00 CAdocument		Grammar issues in clause "5.4 New OFDM Waveform Design"	In clause "5.4 New OFDM Waveform Design": Add underlined text (without the underline) and remove strikethrough text from paragraph as follows: "In 802.11n (in 2.4 GHz) and 802.11n/ac (in 5 GHz) the 20 MHz channelization uses a 64pt FFT with edge tones at +/-28. In 802.11ax (in both 2.4 and 5 GHz) the 20 MHz channelization uses a 256pt FFT with edge tones at +/-122. More spectrum is occupied within the channel bandwidth with the new 802.11ax OFDM waveform design. That said, due Due to the narrower subcarrier spacing (312.5 kHz for 802.11n/ac vs 78.125 kHz for 802.11ax), the spectral rolloff for 802.11ax will be sharper and will result is yield less out-of-band emissions beyond +/- 11 MHz as shown in (see the figure below).	2017/1/9 9:42
4688	Albert Petrick	225	1 9.4.2.218.3	86	18	T	Y	86.18 9.4.2.218.3	3542	Add clarity and call out bit position in Table 9-262aa for subfield "SRP-based SR Support" corresponding to those bit position in Figure 9-589cl.	Add bit B62 in Definition column Change to: "B62: indicates that the STA supports SRP-based....."	2017/1/9 9:42
4689	Albert Petrick	225	1 9.4.2.218.3	84	31	T	Y	84.31 9.4.2.218.3	3492	Add clarity and call out bit position in Table 9-262aa for subfield "SU Beamformer" corresponding to those bit positions in Figure 9-589cl	Add bit B31 in Definition column Change to: "B31 indicates support for operation as an SU beamformer."	2017/1/9 9:42
4690	Albert Petrick	225	1 28.1.1	212	35	E	Y	212.35 28.1.1	3962	Period missing at end of sentence	Add period at the of sentence after "least 4"	2017/1/9 9:42
4691	Albert Petrick	225	1 CAdocument	4		T	Y	4.00 CAdocument		In clause "5.4 New OFDM Waveform Design": Reference is made spectral rolloff between .11a/g, .11n /ac and .11ax for 20 MHz channel bandwidth. There is no reference or discussion where figure and plot (s) originated e.i., 802.11 documents, drafts, simulations etc.	Add reference to documents where plots originated and text (short description of plots).	2017/1/9 9:42
4692	Albert Petrick	225	1 9.4.2.218.3	86	19	E	Y	86.19 9.4.2.218.3	3544	In Table 9-262aa, missing period after sentence.	Add period "." at the end of sentence after "operation."	2017/1/9 9:42
4693	Albert Petrick	225	1 28.1.1	211	41	E	Y	211.41 28.1.1	3875	Period missing at end of sentence	Add period at the of sentence after "receive)"	2017/1/9 9:42
4694	Albert Petrick	225	1 9.4.2.218.3	84	36	T	Y	84.36 9.4.2.218.3	3494	Add clarity and call out bit position in Table 9-262aa for subfield "SU Beamformee" corresponding to those bit positions in Figure 9-589cl	Add bit B32 in Definition column Change to: "B32 indicates support for operation as an SU beamformee."	2017/1/9 9:42
4695	Albert Petrick	225	1 CAdocument	3		E	Y	3.00 CAdocument		In clause "6 Definitions": There are missing periods at the end of the sentences	Add period " . " at the end of the sentences after the word "next" and after the word "protection"	2017/1/9 9:42
4696	Albert Petrick	225	1 9.4.2.218.3	86	21	T	Y	86.21 9.4.2.218.3	3546	Add clarity and call out bit position in Table 9-262aa for subfield "Power Boost Factor +^r Support" corresponding to those bit position in Figure 9-589cl.	Add bit B63 in Definition column Change to: "B63: indicates that the STA supports....."	2017/1/9 9:42
4697	Albert Petrick	225	1 9.4.2.6	68	62	E	Y	68.62 9.4.2.6	4460	Period missing at end of sentence	Add period at the of sentence after "reserved"	2017/1/9 9:42
4698	Albert Petrick	225	1 9.4.2.218.3	84	40	T	Y	84.40 9.4.2.218.3	3496	Add clarity and call out bit position in Table 9-262aa for subfield "MU Beamformer" corresponding to those bit positions in Figure 9-589cl	Add bit B33 in Definition column Change to: "B33 indicates support for operation as an MU beamformer."	2017/1/9 9:42
4699	Albert Petrick	225	1 CAdocument	4		T	Y	4.00 CAdocument		In clause "7 References", reference [1] Draft P802.11axD1.0 has no cross-reference in the body of the text. References [4] IEEE Std 802.11ac-2013 and [5] IEEE 802.11REVmcD8.0 should reference to the IEEE P802.11-2016. In the near future, IEEE 802.11REVmcD8.0 will be removed from the IEEE 802.11 members area of the website. IEEE 802.11REVmcD8.0 is IEEE P802.11-2016.	Site references [4] and [5] to IEEE P802.11-2016. Add a note to reference [1] Draft P802.11axD1.0 (general content reference.)	2017/1/9 9:42
4700	Albert Petrick	225	1 28.1.1	212	39	E	Y	212.39 28.1.1	3970	Period missing at end of sentence	Add period at the of sentence after "supported"	2017/1/9 9:42
4701	Albert Petrick	225	1 9.4.2.200	69	32	E	Y	69.32 9.4.2.200	4463	Figure 9-589av misaligned	Align figure to fit on page	2017/1/9 9:42

4702	Albert Petrick	225	1 9.4.2.218.3	84	6	T	Y	84.06 9.4.2.218.3	3267	Add clarity and call out bit positions in Table 9-262aa for subfield "Beamforemee STS For < 80 MHz" corresponding to those bit positions in Figure 9-589cl. Missing period at the end of sentence.	Add bits B34-B36 in Definition column Change to: "B34-B36 indicates the maximum number of space-time streams the STA can receive in an HE NDP."	2017/1/9 9:42
4703	Albert Petrick	225	1 28.1.1	211	42	E	Y	211.42 28.1.1	3880	Period missing at end of sentence	Add period at the of sentence after "puncturing"	2017/1/9 9:42
4704	Albert Petrick	225	1 9.4.2.218.3	86	22	E	Y	86.22 9.4.2.218.3	3548	In Table 9-262aa, missing period after sentence.	Add period at the end of sentence after "range [0.5, 2]."	2017/1/9 9:42
4705	Alfred Asterjadhi	225	1 3.2	4	26	E	Y	4.26 3.2		Underline is missing	Add underline to the paragraph of item j)	2017/1/9 9:42
4706	Alfred Asterjadhi	225	1 3.2	6	22	E	Y	6.22 3.2		VHT is already defined in the first sentence of this definition, so "very high throughput" is redundant here. There are a couple of places where this occurs throughout the subclause as indicated in the proposed change.	In page/lines 6/22, 6/26, remove "very high throughput", "non-high throughput", and the enclosing parenthesis of the subsequent word "VHT", "non-HT", respectively.	2017/1/9 9:42
4707	Alfred Asterjadhi	225	1 3.2	6	45	E	Y	6.45 3.2		This definition applies to both HE and VHT. Remove VHT from VHT STA.	As in comment.	2017/1/9 9:42
4708	Alfred Asterjadhi	225	1 3.2	6	50	T	Y	6.50 3.2		Some issues with this definition: 1) Replace first occurrence of "BSS" with "basic service set (BSS)", replace "PHY modes", with "physical layer (PHY) protocol data unit (PPDU)", replace "efficient" with "efficiency", replace "HE extended range PHY" with "HE extended range single user (ER SU) PPDU", replace "HE_EXT_SU PHY format" with "HE ER SU PPDU", and replace "non-HE" with "non-HT". Also "in the whole BSS coverage" is arguable. Even when the AP does not use ER SU PPDUs for Beacons the legacy beacon covers the "whole BSS". It is a matter of perspective. Perhaps better to say, expanding the BSS coverage or something like that.	As in comment.	2017/1/9 9:42
4709	Alfred Asterjadhi	225	1 3.2	6	55	E	Y	6.55 3.2		Replace "HE" with "high efficiency (HE)".	As in comment.	2017/1/9 9:42
4710	Alfred Asterjadhi	225	1 3.4	7	11	T	Y	7.11 3.4		OBO is not OFDMA backoff, but OFDMA random access backoff, Find a fancy acronym that reflects it. Same observation with OCW. Apply it throughout.	As in comment.	2017/1/9 9:42
4711	Alfred Asterjadhi	225	1 3.4	7	18	E	Y	7.18 3.4		Only MU RTS is listed in the list of acronyms. Either of the two options is fine: Either remove MU RTS, or keep it and add the other trigger variants.	As in comment.	2017/1/9 9:42
4712	Alfred Asterjadhi	225	1 4.3.14a	9	20	E	Y	9.20 4.3.14a		These two items can be merged into one: "An HE non-AP STA is also a VHT non-AP STA except when the STA supports only 20 MHz channel width. Also in P9L26 the second item is not needed as an HT non-AP STA can be a 20 Mhz so it is covered by the first item.	As in comment.	2017/1/9 9:42
4713	Alfred Asterjadhi	225	1 4.3.14a	9		T	Y	9.00 4.3.14a		These items whether are main or not is subjective at this point and maybe not correct. E.g., dynamic fragmentation level 0 is actually no fragmentation (highly a new MAC feature).	As in comment.	2017/1/9 9:42
4714	Alfred Asterjadhi	225	1 4.3.14a	9	60	T	Y	9.60 4.3.14a		This paragraph is very partial. Depending on the purpose of it, either expand it to cover the case being discussed correctly or remove it.	As in comment.	2017/1/9 9:42
4715	Alfred Asterjadhi	225	1 8.3.5.2.2	15	35	T	Y	15.35 8.3.5.2.2		There are two cases HE DL MU PPDU and HE UL MU PPDU. This statement applies to the DL MU PPDU, while for the UL MU PPDU it is the transmitter identifier. Also it is not really an index of the user (well actually yes) but for consistency specify it as the AID of the user (and add a reference to 27.11.1 (STA_ID_LIST). Similar observation for the next subclause 8.3.5.3.2.	As in comment.	2017/1/9 9:42

4716	Alfred Asterjadhi	225	1 8.3.5.3.2	15	56	T	Y	15.56 8.3.5.3.2	"request" should be "indication". Also need to keep consistency on how we call this PPDU. Maybe define an acronym HE Trigger Based PPDU (HE TB PPDU) and stick with it throughout the draft.	As in comment.	2017/1/9 9:42
4717	Alfred Asterjadhi	225	1 8.3.5.10.3	16	1	T	Y	16.01 8.3.5.10.3	This additional generation is applicable to HE STAs. Also refer to the general spatial reuse subclause rather than to the OBSS-PD pased subclause only.	Replace paragraph with: "This primitive can additionally be generated by the MAC sublayer for the local HE PHY entity when the spatial reuse conditions defined in 27.9 (Spatial Reuse) are met.	2017/1/9 9:42
4718	Alfred Asterjadhi	225	1 8.3.5.12.2	16	15	T	Y	16.15 8.3.5.12.2	The conditions in this table are becoming too cumbersome. Find a hierarchical way to categorize an HT STA that is not a VHT STA, an HE STA that is not a VHT STA and so on. And itemize the list so that it is clear which STA follows which CCA sections. Also since an HE STA can also be a VHT STA or an HT STA then it needs to be clear which rules are followed and when.	As in comment.	2017/1/9 9:42
4719	Alfred Asterjadhi	225	1 8	15	1	T	Y	15.01 8	There are new features in 11ax that need additional updates to these clause's rules. Namely spatial reuse, preamble puncturig, UL MU, DL MU transmissions, etc.	Ensure that the clause is properly amended so that all the appropriate exceptions for a decent 11ax operatoin are added.	2017/1/9 9:42
4720	Alfred Asterjadhi	225	1 9.2.4.1.3	19	25	T	Y	19.25 9.2.4.1.3	I am aware that ANA is going to determine the assigned subtype value for this field once the LB approval has reached 75%. But the table has the value 0011 striked out, which logically means that the value 0011 would be the one assigned for this purpose. Ask ANA to allocate 0011 for the Subtype value or if ANA does not know yet then find a way that it is clear that the number is not assigned yet. Also we already have the term Trigger defined in REVmc so it would be good to have a unique name that would avoid confusion. It could be as simple as UL Trigger.	As in comment.	2017/1/9 9:42
4721	Alfred Asterjadhi	225	1 9.2.4.1.8	19	35	T	Y	19.35 9.2.4.1.8	There is a bunch of elements that have the QoS Info field, namely QoS Capabilities, EDCA Parameter Set, MU EDCA parameter elements. Add a note so that it is clear where this field is contained, so that it is known what "frames" contain it. Also B7 of the QoS Info field when transmitted by AP is currently reserved. Need to add the exception that for an HE AP that bit is actually the same as the non-AP STA case (More Data Ack).	As in comment.	2017/1/9 9:42
4722	Alfred Asterjadhi	225	1 9.2.4.1.10	19	57	E	Y	19.57 9.2.4.1.10	I see more than "two purposes" below. This sentence was actually modified in 11ah. So please ensure consistency across amendments.	As in comment.	2017/1/9 9:42
4723	Alfred Asterjadhi	225	1 9.2.4.5.4	20	27	T	Y	20.27 9.2.4.5.4	MU Ack name is not completely correct due to the fact that the PPDU is actually called Trigger-based ppdu. So I would suggest to change it TBP Ack or something like that, reflecting the correct intention.	As in comment.	2017/1/9 9:42
4724	Alfred Asterjadhi	225	1 9.2.4.5.4	20	45	T	Y	20.45 9.2.4.5.4	This paragraph can be written better. Rephrase this paragraph as suggested in the proposed change.	"When the frame is carried in a HE DL MU PPDU: The addressed recipient returns an Ack, BlockAck, or Multi-STA BlockAck frame carried in HE TB PPDU, after SIFS, (see 10.3.2.11.2 (Acknowledgement procedure for HE MU PPDU in MU format) and 27.4.4.3 (DL MU PPDU soliciting an HE trigger-based PPDU response)."	2017/1/9 9:42
4725	Alfred Asterjadhi	225	1 9.2.4.6.1	21	60	T	Y	21.60 9.2.4.6.1	Table 9-9a already shows what this paragraph is defining as such it is redundant.	Remove the paragraph in P21L60-65.	2017/1/9 9:42
4726	Alfred Asterjadhi	225	1 9.2.4.6.4.1	22	48	E	Y	22.48 9.2.4.6.4.1	Already defined A-Control in L43. So no need to call it below. Replace "Aggregate Control" with "A-Control" in L48, and in L55.	As in comment.	2017/1/9 9:42

4727	Alfred Asterjadhi	225	1 9.2.4.6.4.1	23	24	T	Y	23.24 9.2.4.6.4.1	Add acronyms for each of these Control fields so that it is easy to refer to them. 1) "UL MU Response Scheduling" => T"rigger-based Response Scheduling (TRS)", 2) Operating Mode (OM)", "HE Link Adaptation" => Link Adaptation (LA), 3) UL Power Headroom (UPH)". Use these acronyms, followed by "A-Control" throughout once defined here.	As in comment.	2017/1/9 9:42
4728	Alfred Asterjadhi	225	1 9.2.4.6.4.1	23	34	E	Y	23.34 9.2.4.6.4.1	Link to BQR is not alive and for RDP is missing. Fix link for BQR and add the one for RDP in the 4th column of the Table.	As in comment.	2017/1/9 9:42
4729	Alfred Asterjadhi	225	1 9.2.4.6.4.2	23	59	E	Y	23.59 9.2.4.6.4.2	Since the PPDU is a Trigger-based PPDU I suggest we call this field TB PPDU Length.	Replace "UL PPDU Length" with "TB PPDU Length" throughout.	2017/1/9 9:42
4730	Alfred Asterjadhi	225	1 9.2.4.6.4.2	23	60	E	Y	23.60 9.2.4.6.4.2	"and is set to the number of OFDM symbols the Data field of the HE trigger-based PPDU minus 1" => "and is set to N_sym minus 1, where N_sym is the number of OFDM symbols of the Data field of the HE TB PPDU".	As in comment.	2017/1/9 9:42
4731	Alfred Asterjadhi	225	1 9.2.4.6.4.2	24	21	E	Y	24.21 9.2.4.6.4.2	"TRSSI" => "T_RSSI", and "F_VAL, except for the value 31..." => F_VAL, where F_VAL is the value of the UL Target RSSI subfield, except for the value 31..."	As in comment.	2017/1/9 9:42
4732	Alfred Asterjadhi	225	1 9.2.4.6.4.3	24	63	T	Y	24.63 9.2.4.6.4.3	Similar observation here. Saying UL MU is misleading. The operation refers to the generation of TB PPDUs. Maybe call the field "TB UL MU Disable"?	As in comment.	2017/1/9 9:42
4733	Alfred Asterjadhi	225	1 9.2.4.6.4.3	24	55	T	Y	24.55 9.2.4.6.4.3	N_ss is called twice in the same subclause to identify tx and rx ss. To avoid confusion specify the variables as N_rx, ss, and N_tx, ss.	As in comment.	2017/1/9 9:42
4734	Alfred Asterjadhi	225	1 9.2.4.6.4.2	24	27	T	Y	24.27 9.2.4.6.4.2	"The UL MCS subfield indicates the MCS, from MCS0 to MCS3, to be used by the receiving STA for the HE trigger-based PPDU (see 28.5 (Parameters for HE-MCSs))." needs to specify the encoding of the field	Add prior to "(see 28.5 (Parameters for HE-MCSs))." the following: ". The UL MCS subfield contains the 2 LSBs of the HE MCS Index field, and 2 MSBs of the MCS is set to 0".	2017/1/9 9:42
4735	Alfred Asterjadhi	225	1 9.2.4.6.4.5	27	12	E	Y	27.12 9.2.4.6.4.5	Wrong reference. Replace "10.9 (HT operation)" with "10.13.1 (A-MPDU contents)"	As in comment.	2017/1/9 9:42
4736	Alfred Asterjadhi	225	1 9.2.4.6.4.6	27	34	E	Y	27.34 9.2.4.6.4.6	Some editorial changes to the paragraph are proposed to remove redundancy.	Replace the paragraph with "The 5 LSBs (B0-B4) of the UL Power Headroom subfield indicate the available power headroom in units of one dB, for the current MCS. The UL Power Headroom subfield contains a value from 0 to 31 that maps to power headroom values from 0 dB to 31 dB. B5 of the UL Power Headroom subfield is set to 1 to indicate that the minimum transmit power for the current MCS is reached by the STA and is set to 0 otherwise."	2017/1/9 9:42
4737	Alfred Asterjadhi	225	1 9.2.4.6.4.7	28	45	E	Y	28.45 9.2.4.6.4.7	Suggested changes to remove redundancies. Replace first paragraph with "The Control Information subfield, when the Control ID subfield is 5, contains the Bandwidth Query Report (BQR) used for BQR delivery that can assist HE DL MU operation (see 27.5.1.3 (HE bandwidth query report operation for DL MU))." And remove the paragraph in P27L64-65.	As in comment.	2017/1/9 9:42
4738	Alfred Asterjadhi	225	1 9.2.4.6.4.7	28	6	T	Y	28.06 9.2.4.6.4.7	Having the mapping as a table didn't actually help in removing the redundancy and providiing a concise definition of this field. Perhaps better to specify the bit locations settings as a function of the operating channel width. In any case think of finding a way to put this in a more concise way. Also remove the "may" in the note as normative verbs cannot be placed in clause 9. Also remove "section", and add full subclause, and figure titles to the references in the note.	As in comment.	2017/1/9 9:42

4739	Alfred Asterjadhi	225	1 9.2.4.7.1	29	26	E	Y	29.26 9.2.4.7.1	All these parenthesis in the cells make this table very long. For a cleaner table move references in the Note rows. Also I don't dare to ask adding non-HE to the first row second column... Shouldn't it be for simplicity non-HT PPDU and Non-HT duplicate PPDU?	As in comment	2017/1/9 9:42
4740	Alfred Asterjadhi	225	1 9.2.4.6.4.8	28	60	T	Y	28.60 9.2.4.6.4.8	Suggest to rephase the first two paragraphs of this subclause as follows: "The Control Information subfield, when the Control ID subfield is 6, contains reverse direction information used by HE STAs for RDP operation (see 10.28 (Reverse direction protocol)). The AC Constraint subfield is defined in Table 9-10 (AC Constraint subfield values), except that a value of 1 indicates to an HE STA that the response can contain RD Data frames from the same or higher AC(s), as defined in 10.28.4 (Rules for RD responder).	As in comment.	2017/1/9 9:42
4741	Alfred Asterjadhi	225	1 9.4.2.1	67	10	T	Y	67.10 9.4.2.1	There are a couple of elements missing in this list: BSS Color Change Announcement, Quiet Time Period Setup element, its request and its response (which by the way is it needed to have 3 elements for the same procedure? Why not simply have a bit or smth in one element that makes this differentiation> See my other comment in the same logic.	Add the missing rows for those elements that are defined.	2017/1/9 9:42
4742	Alfred Asterjadhi	225	1 9.4.2.221	94	27	T	Y	94.27 9.4.2.221	Only UL MU Capable STAs update their MIBs. And they do so when certain conditions occure as defined in10.2.4.2. Change to something like this: The most recent MU EDCA Parameter Set element is used by an "UL MU Capable STA" to update the appropriate MIB variables, "as defined in 10.2.4.2 (HCF contention based channel access (EDCA))."	Add quoted text as in comment.	2017/1/9 9:42
4743	Alfred Asterjadhi	225	1 10.2.4.2	113	20	T	Y	113.20 10.2.4.2	There needs to be a statement, similar to the baseline, regarding the interval during which the new values are taken into consideration for MU ECA Parameters as well, when a parameter change occurs. Also the MIB variables are missing for the MU EDCA case.	Add the following :An UL MU Capable STA shall update its MIB attributes that correspond to fields in an MU EDCA Parameter Set element within an interval of time equal to one beacon interval after receiving an updated MU EDCA parameter set." Also define the MIB variables for MU EDCA parameter and explicitly call out that the same baseline update procedure is used by AP and STA to update the MU MIBs.	2017/1/9 9:42
4744	Alfred Asterjadhi	225	1 9.4.2.221	94	63	T	Y	94.63 9.4.2.221	This sentence is unclear. Rephrase it so that it is clear that this is the time during which the STA is supposed to use the MU EDCA parames.	Replace with "The MU EDCA Timer field indicates the duration of time, in units of 8 TUs, during which the HE STA uses the provided MU EDCA parameters for the corresponding AC, as defined in 27.2.3 (Obtaining an EDCA TXOP for UL MU capable STAs).	2017/1/9 9:42
4745	Alfred Asterjadhi	225	1 10.2.4.2	113	113	T	Y	114.13 10.2.4.2	What is the expectation when the AP wants to not use MU EDCA Parameters anymore? Does it decide to not include the MU EDCA Parameter Set in the Beacon, or does it continue including it and always specify the same values in the MU and normal EDCA Parameter Set elements? Clarify (noting that the second option requires to keep 16 redundant octets in the Beacon).	As in comment.	2017/1/9 9:42
4746	Alfred Asterjadhi	225	1 10.2.1	1258	1258	T	Y	1270.58 10.2.1	Need to update the MAC architecture (Figure 10-1) and respective definitions to host the enhancements for HE (UL MU, etc).	As in comment.	2017/1/9 9:42

4747	Alfred Asterjadhi	225	1 27.2.3	152	17	T	Y	152.17 27.2.3	Time references when to update these state variables are missing, especially for the timer.	Add the following at the end of the paragraph: "The backoff counter maintenance corresponding to the updated state variables shall follow the rules in 10.22.2.2 (EDCA backoff procedure), and the updated HEMUEDCATimer[AC] shall start at the end of the immediate response (if any is sent by the AP).	2017/1/9 9:42
4748	Alfred Asterjadhi	225	1 27.2.3	152	18	T	Y	152.18 27.2.3	Perhaps it is already clear but better to add a note that only the Basic Trigger frame causes a switch to the MU EDCA parameters, and only when QoS Data are sent.	Add the following note: "The non-AP STA is not required to update its state variables to the values contained in the MU EDCA Parameter Set element if it the Trigger frame addressed to it is not a Basic Trigger frame or if it transmits frames that are not QoS Data frames in the HE TB PPDU response."	2017/1/9 9:42
4749	Alfred Asterjadhi	225	1 10.9	126	46	E	Y	126.46 10.9	Not all 10.9 is present in the draft, so this instruction is not correct. Also there is some part that is underlined but actually is baseline (P127L38-42). Also this subclause need to be modified to be inline with the new amendment style.	As in comment.	2017/1/9 9:42
4750	Alfred Asterjadhi	225	1 10.9	126	63	T	Y	126.63 10.9	There are 7 control fields defined and only 3 MIB variables here. There has to be one MIB for each of the 7. Add the remaining 4 MIB variables to the list.	As in comment.	2017/1/9 9:42
4751	Alfred Asterjadhi	225	1 10.9	127	14	E	Y	127.14 10.9	Some editorial fixes in this paragraph: in the HE Capabilities Information field" => "in the HE MAC Capabilities Information field", "receive operating mode" => "operating mode", 10.31.4 => 27.13, add at the end of the items: "A value of 6 in the Control ID subfield when the transmitting STA follows the reverse direction procedure, as described in 10.29 (Reverse direction protocol)"	As in comment.	2017/1/9 9:42
4752	Alfred Asterjadhi	225	1 10.12	128	10	E	Y	128.10 10.12	Redundant sentence that can be avoided by adding a reference where this behavior is defined. Add "as defined in 27.3 (Fragmentation)" at the end of the second sentence and remove the third sentence.	As in comment.	2017/1/9 9:42
4753	Alfred Asterjadhi	225	1 10.13.2	128	36	T	Y	128.36 10.13.2	The maximum length of the A-MPDU per-EOF that an HE STA can receive is actually signaled by a combination of the values of the MALE (Maximum A-MPDU Length Exponent) fields in the HT, VHT, and HE Capabilities element. As such this statement is not correct. Fix the inconsistency inline with the definition of these fields in the HE Capabilities, and VHT, HT Caps (similarly in P129L5). Also the term "padding in this sentence is ambiguous. At first read i thought that this applies to padding, but actually refers to the A-MPDU max length, or does it? Remove "padding" or somehow clarify that it relates to the A-MPDU length, e.g., adding a reference to 9.7.1 (A-MPDU format). Also in the VHT case.	As in comment.	2017/1/9 9:42
4754	Alfred Asterjadhi	225	1 10.13.2	107	1	T	Y	107.01 10.13.2	The MPDU length for HE follows the same rules as the one for VHT. Replace "VHT PPDU" with "VHT or HE PPDU" in this equation.	As in comment.	2017/1/9 9:42
4755	Alfred Asterjadhi	225	1 10.7.6.5.2	123	34	T	Y	123.34 10.7.6.5.2	Move these two paragraphs to subclause 27.15.3 (MCS, NSS, BW and DCM selection) after ensuring that there is no redundancy in the provided normative behavior.	As in comment.	2017/1/9 9:42
4756	Alfred Asterjadhi	225	1 10.7.10	126	1	T	Y	126.01 10.7.10	Is DCM considered an MCS? If yes (which I think it should) then specify what is the non-HT refence rate for the conversion in this table, or somewhere else.	As in comment.	2017/1/9 9:42
4757	Alfred Asterjadhi	225	1 9.7.3	107	65	T	Y	107.65 9.7.3	This sentence is confusing "The further restrictions of A-MPDU content are defined in the conditions of various contexts."	Replace it with "The content of an A-MPDU depends on the context at which it is transmitted as defined in the tables below."	2017/1/9 9:42

4758	Alfred Asterjadhi	225	1 9.7.3	108	7	T	Y	108.07 9.7.3	I don't think this sentence is needed because both cases are allowed for an HE MU PPDU, and both of them are defined in clause 10. So remove this sentence as it brings no new informaiton. If necessary modify it to say that an HE DL MU PPDU can carry more than one A_MPDU that ... as defined somewhere in clause 10 (where acknowledgment procedures are defined).	As in comment.		2017/1/9 9:42
4759	Alfred Asterjadhi	225	1 9.7.3	108	50	T	Y	108.50 9.7.3	What is so special about the A-MPDU transmitted by an AP in an HE BSS that needs the addition of it in the Control response context? If there is nothing special then remove the following part "or the A-MPDU is transmitted by AP in an HE BSS".	As in comment.		2017/1/9 9:42
4760	Alfred Asterjadhi	225	1 9.7.3	111	48	T	Y	111.48 9.7.3	The case of an AP sending a multi-STA BlockAck frame as a response to TB PPDUs from multi STAs is missing in the control response context. Also it is good to explicitly call out the two cases: when the M-BA contains Ack and when it contains BlockAck so that it is clear that the M-BA is not neccessarily tied to the HT_Immediate agreement.	As in comment. Also referring in one case (third column) to not HE BSS and in another to HE STAs is confusing. Make this an itemized list specifying the condition on a per receiving STA basis. Same observations for the third column of the other two preceding Tables (Data no immediate resp, and Data immediate resp) and for the conditions on the multi-STA BlockAck frame.		2017/1/9 9:42
4761	Alfred Asterjadhi	225	1 9.7.3	111	32	T	Y	111.32 9.7.3	This note has nothing to do with this context because delayed BA is deprecated, and Trigger plue BlockAck can be added only in the Data enabled immediate response context. Remove this note (eventually add it to the immediate response context).	As in comment.		2017/1/9 9:42
4762	Alfred Asterjadhi	225	1 9.7.3	110	36	T	Y	110.36 9.7.3	There is only one of the following cases. So no need to organize this way the second column. Also it is not technically correct because it would mean that a BAR and a Multi-TID BAR can be present (but that is not the case). Add the following sentence as the first sentence of the second column: "In a single TID A-MPDU context:" Replace the newly added paragraph in the second column with the following sentence: " In a multi-TID A-MPDU context: At most one Multi-TID BlockAckReq frame with one or more TIDs that correspond to established HT-immediate block ack agreements. It is not present if a BlockAckReq frame is present. This is the last MPDU in the A-MPDU."	As in comment.		2017/1/9 9:42
4763	Alfred Asterjadhi	225	1 9.7.3	110	7	T	Y	110.07 9.7.3	These items (third column) are confusing as certain frames presence has nothing to do with the others. See proposed change for a possible organization as part of the single TID A-MPDU context, and multi-TID A-MPDU context.	Define a single TID A-MPDU context that applies to non-DMG STAs (to HE STAs as well [first round of conditions in this colum falls in this category]). And specify that Data frames without HT-immediate block agreement, and Action frames are not allowed in this context. Define a multi-TID A-MPDU context that applies to HE STAs only which specifies that: "Of these, at most one of the following is present: - QoS Data frames from more than one TID, each TID corresponding to an HT-immediate blockack agreement if the recepient supports multi-TID A-MPDU aggregation. - A BAR frame or a Multi-TID BAR frame with TID(s) that correspond to HT-immediate blockack agreement(s) for which QoS Data frames are not present in the A-MPDU. If the recipient supports ack-enabled multi-TID A-MPDU one or more of the following is		2017/1/9 9:42

4764	Alfred Asterjadhi	225	1 9.7.3	110	51	T	Y	110.51 9.7.3	This row has nothing in common with the above ones. Also MU BAR cannot be aggregated along with other Data (if can be as a self contained frame in the S_MPDU context)	Place the row that contains the Trigger as an independent row, which second column contains the following "Zero or more Basic or BSRP Trigger frames if the A-MPDU is transmitted by an AP. The BSRP Trigger frame can be present only when the receiving STA indicates support of its reception in the A-MPDU context (see 27.5.2.5 (HE buffer status feedback operation for UL MU))." Also there is no need for a third column for this case so remove it. Also make the same change for the Trigger row in Table 9-426.	2017/1/9 9:42
4765	Alfred Asterjadhi	225	1 9.4.2.200	69	32	T	Y	69.32 9.4.2.200	There are some issues in this Figure. First some parts are missing (TWR field is 8, 2, or 0 in length, Broadcast TWT ID needs to be underlined). Also in order to avoid confusion between a normal TWT element and a broadcast TWT element I suggest having two Figures, one for TWT element (with one TWT parameter set, as in baseline), and another one for broadcast TWT element (with one or more TWT parameter sets, this to be tied to the value broadcast = 1 and wake TBTT interval value 0).	As in comment.	2017/1/9 9:42
4766	Alfred Asterjadhi	225	1 9.4.2.200	69	55	T	Y	69.55 9.4.2.200	The Broadcast TWT ID is present when the Broadcast field is 1, however the functionality of the Broadcast TWT ID depends on the value of the Wake TBTT interval value. If the value is 0 then this is a broadcast TWT element. If the value is 1 then this is a TWT request/response that is negotiating the broadcast TWT IDs of that (those) particular value(s).	As in comment. Impacts also the paragraph that describes the definition of Wake TBTT Negotiation in the next paragraph (which as is refers only to when the Broacast is 0 and need to add the case when broadcast is 1). Also to generalize call this field something else (as Wake TBTT is restrictive now). Also please make these changes to all those fields that depend on these settings in the remaining paragraphs of this subclause.	2017/1/9 9:42
4767	Alfred Asterjadhi	225	1 9.4.2.200	70	21	T	Y	70.21 9.4.2.200	Couple or more things: There is another table that performs a similar function in 10.43.smth. Maybe just keep that one and undo the changes to this table. This table also contains some inconsistencies (compared to (27.7.3.4 Negotiation of wake TBTT and listen interval) some values are not right), compared to 10.43.1 (TWT overview) it does not contain the listing in dependency of the broadcast field values.)	As in comment (my preference is to have one Table, and that contains all possible combos in one place).	2017/1/9 9:42
4768	Alfred Asterjadhi	225	1 9.4.2.218	76	18	T	Y	76.18 9.4.2.218	Somebody has to do some work here to ensure that each capability bit here: - Has a corresponding normative setting somewhere in >9 clauses. - Uses consistent terminology (support/supported/capable). - Has a reference to the subclause where the normatvie behavior is defined (perhaps in the definition cell (for all of them). - Has an explicit indication of the setting if its values depend on other caps (e.g., Minimum Fragment Size is reserved if Fragmentation Support is 0 and so on) - Maximum A-MPDU Lenght Support's cells are empty because the text is outside the table. Need to add it here.	As in comment.	2017/1/9 9:42
4769	Alfred Asterjadhi	225	1 9.4.2.218.4	86	48	T	Y	86.48 9.4.2.218.4	m and n are not defined. Define them and on what values combos they depend on.	As in comment.	2017/1/9 9:42
4770	Alfred Asterjadhi	225	1 9.4.2.218.4	88	34	T	Y	88.34 9.4.2.218.4	How do you indicate support for NSS = 8 with this encoding?	If the NSS indicates the number of NSS as an unsigned integer then there is no value for NSS =8. Please clarify.	2017/1/9 9:42

4771	Alfred Asterjadhi	225	1 9.4.2.219	91	4	T	Y	91.04 9.4.2.219	The operation of HE STAs is not controlled by the presence of the VHT Operation element because the HE Operation IE has the VHT Operation Information field. Remove the occurrence of VHT Operation element from this sentence.Also specify the meaning of the VHT Operation Information field when sent in 2.4Gigs.	As in comment.	2017/1/9 9:42
4772	Alfred Asterjadhi	225	1 9.4.2.219	91	39	T	Y	91.39 9.4.2.219	Duplicated (conflicting) definition of the BSS Color field. Remove the first occurrence.	As in comment.	2017/1/9 9:42
4773	Alfred Asterjadhi	225	1 9.4.2.219	91	60	T	Y	91.60 9.4.2.219	HE Duration Based does not say much. Replace it with something that gives the idea of a TXOP based duration threshold. Also provide a reference to the subclause where the normative behavior for setting this field is defined. And most importantly where the STA that receives this information updates its MIB variable that controls RTS enablement.	As in comment.	2017/1/9 9:42
4774	Alfred Asterjadhi	225	1 9.4.2.219	92	7	T	Y	92.07 9.4.2.219	This paragraph is not very clear in defining the setting of the Max BSSID Indicator and Tx BSSID Indicator field. Please rephrase it to make the definition clearer. And add a reference to the normative describing subclause	As in comment.	2017/1/9 9:42
4775	Alfred Asterjadhi	225	1 9.4.2.219	92	28	T	Y	92.28 9.4.2.219	This paragraph describes normatvie behavior related to the non-AP STA and cannot be located in this subclause. Move the paragraph somewhere in subclause 27 (e.g., 27.11.4(BSS COLoR).	As in comment.	2017/1/9 9:42
4776	Alfred Asterjadhi	225	1 9.4.2.219	92	40	T	Y	92.40 9.4.2.219	In one PHY format = in non-HT format.	As in comment.	2017/1/9 9:42
4777	Alfred Asterjadhi	225	1 10.43.1	137	43	T	Y	137.43 10.43.1	The Reject TWT case is missing in the description. Please add for completeness. Also it would be beneficial to provide a list of what types of individual TWTs, and broadcast TWTs can be negotiated, depending on the setting of the Broadcast, Wake TBTT Interval Negotiation, since they govern TWT Setup for Individual TWTs, Broadcast TWTs, and TBTTs.	As in comment.	2017/1/9 9:42
4778	Alfred Asterjadhi	225	1 10.43.1	138	7	T	Y	138.07 10.43.1	Broadcast field value is missing in some of these entries. Need to be added and clarify in the third column the dependency of the Wake TBTT, Bcast fields settings and the type fo TWT agreement that is setup. Also instead of using "Don't care" use "Any". Actually since the broadcast TWT cases are valid for HE STAs only I suggest this table only covers the case of individual TWT (with Wake TBTT = 0 and Broadcast = 0) and then another table is added in clause 27 that covers the other combinations (citing as much as possible from the basic table).	As in comment. And editorial: this table is a new insertion so no need for underlines and strikesthoughs.	2017/1/9 9:42
4779	Alfred Asterjadhi	225	1 10.43.1	138	18	T	Y	138.18 10.43.1	Instead of putting the combinations that are not allowed, it would be best to put those that are allowed and specify in the last row: other combinations are not allowed. Also some of these rows are not correct (e.g., page 139L52, there is unsolicited TWT responses that are allowed).	As in comment.	2017/1/9 9:42
4780	Alfred Asterjadhi	225	1 11	141	1	T	Y	141.01 11	Move as much text from clause 11 to clause 27 as possible, under the new editorial style guide.	As in commnet.	2017/1/9 9:42
4781	Alfred Asterjadhi	225	1 11.23	143	53	T	Y	143.53 11.23	Amendments to enable TDLS for HE STAs are partial. Review baseline and add HE qualifiers wherever necessary. Or create a subclasue in 27 that cotnains these amendments.	As in comment.	2017/1/9 9:42

4782	Alfred Asterjadhi	225	1 11.49.1	144	32	T	Y	144.32 11.49.1	The case of Partial BSS Color is 0 is missing. Specify that when that bit is 0 then the AP uses the AID assignment rules of baseline.	As in comment.	2017/1/9 9:42
4783	Alfred Asterjadhi	225	1 27.81	188	29	T	Y	188.29 27.81	This paragraph does not provide the full picture for the OMI optionality at the STA, and mandatroy at the AP. Please rephrase such that it is clear that OMI A-Control field can be sent to a STA that has declared support of its reception (tie to HE Caps), and specify that an HE STA may set the HE Caps to 1 while the HE AP shall set it to 1.	As in comment.	2017/1/9 9:42
4784	Alfred Asterjadhi	225	1 27.8.2	189	5	T	Y	189.05 27.8.2	"Rx Channel Width" => "Channel Width". "To sent PPDUs" => "as transmit parameters for sending PPDUs"	As in comment.	2017/1/9 9:42
4785	Alfred Asterjadhi	225	1 27.8.2	189	8	E	Y	189.08 27.8.2	This paragraph is awkward. Please replace with: "The OMI responder may transmit subsequent SU PPDUs or MU PPDUs that are addressed to the OMI initiator after sending the immediate response for the frame containing the OMI A-Control field.	As in comment. Also there is no ROM Initiator. Please replace it with OMI Initiator (initiator actually throughout).	2017/1/9 9:42
4786	Alfred Asterjadhi	225	1 27.13	198	61	T	Y	198.61 27.13	This subclause seeems incomplete. Please complete it in terms of expected norm behavior at RX, at TX, etc.	As in comment	2017/1/9 9:42
4787	Alfred Asterjadhi	225	1 27.14.2	200		T	Y	200.00 27.14.2	Some of this text applies to the Cascade Indication setting for the Trigger frame from the AP side, which would be more appropriate to be in the TWT subclause. It is appropriate to clarify that the reception of this Trigger frame for random access is classified as an early termination period.	Please organize the subclause such that the normative behavior from AP side is contained in one subclause and the normatvie behavior from STA side is contained in one subclause (in terms of early termination events). If necessary add declarative statements to indicate where such a behavior is defined. Similar considerations for power save in congested environment.	2017/1/9 9:42
4788	Alfred Asterjadhi	225	1 27.14.2	200	30	T	Y	200.30 27.14.2	The other condition is missing. Specify that when the OBO counter is 0 the STA transmits a Trigger-based PPDu in the selected resource (and provide a subclause reference where the norm behavior is defined.	As in comment.	2017/1/9 9:42
4789	Alfred Asterjadhi	225	1 27.15.2	201	37	T	Y	201.37 27.15.2	This capability has nothing to do with the reception of the HE trigger-based PPDU. It has to do with the reception of the UL MU PPDU as provided by motioned comment resolution 11/16/1419r0. Also keep consistency of the capability field name, in the HE Caps, and here.	As in comment.	2017/1/9 9:42
4790	Alfred Asterjadhi	225	1 27.10.2	192	41	T	Y	192.41 27.10.2	There is an exception here for A-MPDUs that are contained in HE PPDUs, that is multi-TID A-MPDU. Please add a reference to the subclause that defines Multi-TID A-MPDU here and in the next subclause.	As in comment.	2017/1/9 9:42
4791	Alfred Asterjadhi	225	1 27.10.3	192	63	T	Y	192.63 27.10.3	The MPDU start spacing requirements for the Trigger-based PPDU also depends on the MU Minimum Start Spacing field of the Trigger frame.	Specify that the minimum start spacing also depends on the value of the MU Start Spacing(?) field of the User Info field of that STA in the Trigger frame.	2017/1/9 9:42
4792	Alfred Asterjadhi	225	1 27.10.3	193	19	T	Y	193.19 27.10.3	This is not true anymore when the A-MPDU si an Ack-enabled multi-TID A-MPDU AMT A-MPDU, where an EOF eq 0 can follow an EOF eq 1.	As in comment.	2017/1/9 9:42
4793	Alfred Asterjadhi	225	1 27.10.4	193	34	T	Y	193.34 27.10.4	A multi-TID A-MPDU can also contain QoS Data frames of one TID and one Action frame and still be called MT A-MPDU. Ensure this definition is consistent. Also there is a certain independence between multi-TID A-MPDU that contains contiguous valued EOFs and multi-TID A-MPDU that contains non-contiguous EOFs. Please use two different terms for these cases so that it is clear that they are not the same, and as such tx, rx and operation for these MPDUs.	As in comment.	2017/1/9 9:42

4794	Alfred Asterjadhi	225	1 27.10.4	194	35	T	Y	194.35 27.10.4	The UL MU PPDU case carrying the MT A-MPDU is missing. Add UL MU PPDU to the list	As in comment.	2017/1/9 9:42
4795	Alfred Asterjadhi	225	1 27.10.4	194	51	T	Y	194.51 27.10.4	Is the presence of an Action frame in the MT A-MPDU contained in the TB PPDU subject to the multi-TID aggregation limit? Seems not but just in case please clarify. Also please check that normative behaviors are not redundantly listed in different subclauses. From a quick check there is normatvie behavior that is redundant in different subclauses.	As in comment.	2017/1/9 9:42
4796	Alfred Asterjadhi	225	1 9.7.3	110	53	T	Y	110.53 9.7.3	The presence of the MU BAR in the second column is inconsistent with trigger frame types listed in the third column and with the normative behaviors described in clause 27.	Remove MU-BAR from the second column.	2017/1/9 9:42
4797	Alfred Asterjadhi	225	1 27.5.1.1	162	44	T	Y	162.44 27.5.1.1	This sentence is not clear "An AP shall not transmit to a STA an HE MU PPDU with the HE-SIG-B allocating spatial streams to more than one recipient STA, unless the STA sets the Downlink MU-MIMO On Partial Bandwidth Rx subfield of the HE Capabilities element to 1.". Please clarify what the intention is.	As in comment	2017/1/9 9:42
4798	Alfred Asterjadhi	225	1 27.5.1.1	162	49	T	Y	162.49 27.5.1.1	It is not the transmission that is padded but the PSDU in each RU. PLease rephrase.	As in commnet.	2017/1/9 9:42
4799	Alfred Asterjadhi	225	1 27.5.1.1	162	56	T	Y	162.56 27.5.1.1	Unicast is not defined. Define it prior to its use.	As in comment.	2017/1/9 9:42
4800	Alfred Asterjadhi	225	1 27.5.1.2	163	8	T	Y	163.08 27.5.1.2	Some more details are needed here for completeness. I sugges to itemize what possible values the AID can have in the SIG-B (and potentlially have a reference to 27.11). For example: AID 0 is broadcast, AID 1 to n can be broadcast for the multi BSSID case, AID 2046 is this AID to indicate unallocated RU, 2047 is the broadcast AID for all BSSs of the multiBSS and so on.	As in comment.	2017/1/9 9:42
4801	Alfred Asterjadhi	225	1 27.5.1.2	163	13	T	Y	163.13 27.5.1.2	This is not enough. It has to be clear what the MPDU that is sent in the broadcast RU contains. E.g., can it be a broadcast MPDU that was sent in legacy PPDU? If yes then what is the STA receiving both expected to do?	As in comment.	2017/1/9 9:42
4802	Alfred Asterjadhi	225	1 27.5.1.3	163	37	T	Y	163.37 27.5.1.3	It seems BQR Trigger frame is not allowed in the A-MPDU content (See 9.7.3). I don't think it is the case. Please amend to fix the inconsistency.	As in comment.	2017/1/9 9:42
4803	Alfred Asterjadhi	225	1 27.5.1.3	163	36	T	Y	163.36 27.5.1.3	This is a weird way to say that reception of the BQR Trigger frames is optional. Find a less weird way to say the same.	As in comment.	2017/1/9 9:42
4804	Alfred Asterjadhi	225	1 27.5.1.3	163	46	T	Y	163.46 27.5.1.3	QoS Data cannot be added because the BQR variant Trigger frame does not have TID AGG limit and MU Minimum Start Spacing indications, etc. Please remove QoS Data from the sentence. Also no need to indicate that "when the AP has indicated its support in the A-BQR Support... because the AP sends the BQR variant Trigger frame only if it supports Rx of the info.	As in comment.	2017/1/9 9:42
4805	Alfred Asterjadhi	225	1 27.5.2.7	174	24	T	Y	174.24 27.5.2.7	There is many details that are not defined in this feature. Either define the missing details or remove it. Also what is a very high number of STAs?	As in comment.	2017/1/9 9:42
4806	Alfred Asterjadhi	225	1 17.5.3	175	33	T	Y	175.33 17.5.3	It seems that the cascading sequence as defined here does not cover all possible combinations. For example an SU PPDU that has this content can still be called part of a cascading sequence. Unless it is not allowed.	As in comment.	2017/1/9 9:42

4807	Alfred Asterjadhi	225	1 17.5.3	175	41	T	Y	175.41 17.5.3	Cascading sequence and cascading indication have nothing to do with each other. Please find alternate names for one of them to avoid confusion.	As in comment.	2017/1/9 9:42
4808	Alfred Asterjadhi	225	1 27.15.2	201	26	T	Y	201.26 27.15.2	The 242-tone ER SU PPDU can be transmitted to another STA if the other STA supports either DCM or 106tone RU. Otherwise what is the benefit? Please clarify the conditional reception (inlien with filosophy of P202L51).	As in comment.	2017/1/9 9:42
4809	Alfred Asterjadhi	225	1 27.5.2.1	163	60	T	Y	163.60 27.5.2.1	"in either UL OFDMA, UL MU-MIMO, or both," is redundant since the trigger-based PPDU already defines the allowed modes	remove "in either UL OFDMA, UL MU-MIMO, or both,"	2017/1/9 9:42
4810	Alfred Asterjadhi	225	1 27.5.2.1	164	3	T	Y	164.03 27.5.2.1	use field name instad of bit number. Same in other lines	as in comment	2017/1/9 9:42
4811	Alfred Asterjadhi	225	1 27.5.2.1	164	14	T	Y	164.14 27.5.2.1	This para is reduntant with the next one	Remove this para and keep the next one starting at line19	2017/1/9 9:42
4812	Alfred Asterjadhi	225	1 27.5.2.1	164	24	T	Y	164.24 27.5.2.1	UL OFDMA PPDU is not defined. Is it meant to be triger-based PPDU with no more than one SS per user?	Define UL OFDMA PPDU or contextualy add more details to define the intended type of PPDU	2017/1/9 9:42
4813	Alfred Asterjadhi	225	1 27.5.2.2.1	164	58	T	Y	164.58 27.5.2.2.1	what else can the AP send, or in which frames? These bullets define only may conditions, but no restrictions	add a reference to A-MPDU context and other restrictions where a trigger frame may not be included	2017/1/9 9:42
4814	Alfred Asterjadhi	225	1 27.5.2.2.1	165	13	T	Y	165.13 27.5.2.2.1	the Ack, This rule is ambiguous, especially on the second part of the sentence. "BlockAck or Multi-STA BlockAck frame shall be the first MPDU in the A-MPDU and a Trigger frame shall follow the Ack, BlockAck or Multi-STA BlockAck frame"	Clarify indicating that "at least one" of Ack/MA/M-BA shall be the first, and tha the trigger shall follow the first frame. Also verify these rules are consistent with the A-MPDU context rules	2017/1/9 9:42
4815	Alfred Asterjadhi	225	1 27.5.2.2.1	165	27	T	Y	165.27 27.5.2.2.1	"The AP shall apply the Trigger Frame MAC Padding field with duration corresponding to the longest value among all STAs that have requested extra MinTrigProcTime through Trigger Frame MAC Padding Duration capability." Which are "all the STAs"? even STAs that are not allocated by this trigger frame?	Clarify that the statement refers to only the STAs are allocated by this trigger frame	2017/1/9 9:42
4816	Alfred Asterjadhi	225	1 27.5.2.2.1	165	31	T	Y	165.31 27.5.2.2.1	This para is reduntant. The previous one is sufficient	Remove this para	2017/1/9 9:42
4817	Alfred Asterjadhi	225	1 27.5.2.2.2	165	60	T	Y	165.60 27.5.2.2.2	confusing construction of the sentence "If an HE AP does not receive an HE Capabilities element with the Rx Control Frame To MultiBSS field equal to 1 from a STA, the HE AP shall not send a Trigger frame whose destination STAs associate with more than one APs to the STA."	Reword the sentence	2017/1/9 9:42
4818	Alfred Asterjadhi	225	1 27.5.2.2.3	167	38	T	Y	167.38 27.5.2.2.3	this para is redundant. Concepts are better explained at the previous para	Remove this paragraph	2017/1/9 9:42
4819	Alfred Asterjadhi	225	1 27.5.2.3	167	57	T	Y	167.57 27.5.2.3	If the STA is not associated with the AP, TBD.	Define the TBD. If the STA is not associated with the AP, a value of 0 indicates the allocation of a random access RU which can be used also by non-associated STAs	2017/1/9 9:42
4820	Alfred Asterjadhi	225	1 27.5.2.3	168	46	T	Y	168.46 27.5.2.3	repeated "shall be set"	remove	2017/1/9 9:42
4821	Alfred Asterjadhi	225	1 27.5.2.3	168	27	T	Y	168.27 27.5.2.3	typo on CH_BANDWITHW	remove the final W	2017/1/9 9:42
4822	Alfred Asterjadhi	225	1 27.5.2.3	168	52	T	Y	168.52 27.5.2.3	repeated "shall be set"	remove duplication	2017/1/9 9:42
4823	Alfred Asterjadhi	225	1 27.5.2.3	169	7	T	Y	169.07 27.5.2.3	UL_TARGET_RSSI, DL_TX_POWER are not defined vectors	Remove. These are not paramters that go into the trigger-based PPDU	2017/1/9 9:42
4824	Alfred Asterjadhi	225	1 27.5.2.3	169	15	T	Y	169.15 27.5.2.3	MU_MIMO_LTF_MODE is not a tx/rx vector paramter. LDPC_EXTRA is actually LTPC_EXTRA_SYMBOL; CODING_TYPE is not defined; SS_ALOCATION is not defined	Refer to the correct paramters or remove them.	2017/1/9 9:42
4825	Alfred Asterjadhi	225	1 27.5.2.3	169	26	T	Y	169.26 27.5.2.3	CP_LTF_TYPE paramter does not exist	Refer to the correct paramter	2017/1/9 9:42
4826	Alfred Asterjadhi	225	1 27.5.2.3	169	30	T	Y	169.30 27.5.2.3	Is UL OFDMA PPDU format defined?	Define UL OFDMA format or contextualy add more details to define the intended type of PPDU.	2017/1/9 9:42
4827	Alfred Asterjadhi	225	1 27.5.2.3	169	43	T	Y	169.43 27.5.2.3	doesn't the presence of the UL MU Response Scheduling imply there is an immediate response?	Clarify what an immediate response means.	2017/1/9 9:42
4828	Alfred Asterjadhi	225	1 27.5.2.3	170	15	T	Y	170.15 27.5.2.3	double period		2017/1/9 9:42
4829	Alfred Asterjadhi	225	1 27.5.2.4	170	23	T	Y	170.23 27.5.2.4	from "ED-based .." to the end of he paragraph. These concepts are more precisely described in the paragraph starting at line 40	Remove the quotes sentences	2017/1/9 9:42

4830	Alfred Asterjadhi	225	1 27.5.2.4	170	37	T	Y	170.37 27.5.2.4	"If one or both of the NAVs are considered and the considered NAV's counter is not zero." which NAVs? Explicitly state. Also, what are the cases where one or the other or both NAV are considered?	Please clarify.	2017/1/9 9:42
4831	Alfred Asterjadhi	225	1 27.5.2.4	170	61	T	Y	170.61 27.5.2.4	By followng this rule then the behavior described at line 29 will never be used. Simply say that the STA considers the ED and NAV if CS Required is 1 and does not if the CS Required is 0.	either keep line 29 or keep this one	2017/1/9 9:42
4832	Alfred Asterjadhi	225	1 10.22.2.4	130	38	T	Y	130.38 10.22.2.4	"During an EDCA TXOP, Address 2 field excluding the Individual/Group bit of all control frames sent by a TXOP holder shall be set to the same address value." change to baseline?	Clarify what the intention is.	2017/1/9 9:42
4833	Alfred Asterjadhi	225	1 10.22.2.7	132	33	T	Y	132.33 10.22.2.7	i) it is not clear what "the RU Allocation subfields of the MU-RTS frame for all intended receiver are equal to the BW subfield in the Common Info field of the MU-RTS frame" means. The two fields that are compared are encoded in quite different ways. ii) in the 'otherwise' case, the 'preceding PPDU' may be an MU-RTS, but the previous bullet that is supposed to describe the MU-RTS case does not cover all the MU-RTS cases, pointing to the 'otherwise', hence there is a loop and something missing.	Make sure there is a defiend behavior for all the cases	2017/1/9 9:42
4834	Alfred Asterjadhi	225	1 10.3.1	113	50	T	Y	113.50 10.3.1	"When HE duration-based RTS is enabled". No mention of where that is indicated. Is it referring to a MIB or to a field somewhere? dot11DurationRTSThreshold: can it be configured through a management message? (I found no such possibility) If not, this mechanism is not enforcing anything.	Specify that this dotBLAH shall be set to the most recent value of the HE Duration Based field of the HE Operation element transmitted by the AP to which it is associated.	2017/1/9 9:42
4835	Alfred Asterjadhi	225	1 10.3.2.8a.3	117	36	T	Y	117.36 10.3.2.8a.3	SCRAMBLER_INITIAL_STATE is not a defined RX/TX vector	define the tx/rx vector parameter	2017/1/9 9:42
4836	Alfred Asterjadhi	225	1 10.3.2.10.1	118	47	T	Y	118.47 10.3.2.10.1	This statement may not be true for HE, since there are new BA formats, fragmentation and new rules.	Remove the reference to HE in this statement	2017/1/9 9:42
4837	Alfred Asterjadhi	225	1 10.3.2.10.1	118	55	T	Y	118.55 10.3.2.10.1	"Responses to A-MPDUs within a VHT MU PPDU or an HE MU PPDU for DL transmissionthat are not immediate responses to the VHT MU PPDU or the HE MU PPDU for DL transmission are transmitted in response to explicit BlockAckReq frames by the AP" This is an option, but not the only one	BARs can also be sent in response to an implicit block ack request in one of the following PPDUs	2017/1/9 9:42
4838	Alfred Asterjadhi	225	1 10.3.2.10.1	118	48	T	Y	118.48 10.3.2.10.1	"MU PPDU for DL transmission" is not defined.	change to MU PPDU sent by an AP STA	2017/1/9 9:42
4839	Alfred Asterjadhi	225	1 27.7.2	181	33	T	Y	181.33 27.7.2	The UL MU Response Scheduling A-Control field can be considered as a Trigger frame if at least it allocates resources for the STA to deliver BSRs.	Clarify the specified condition.	2017/1/9 9:42
4840	Alfred Asterjadhi	225	1 27.7.2	181	55	T	Y	181.55 27.7.2	What does the fact that the STA follows APSD have to do with TWT? Please clarify. Also ensure that these conditions are the same for both individual and broadcast TWT for consistency.	As in comment	2017/1/9 9:42
4841	Alfred Asterjadhi	225	1 27.7.2	182	8	T	Y	182.08 27.7.2	These are the conditions for individually negotiated TWTs, not for TFs with random access. Please remove the condition on random access allocation. Also the term Cascade Indication is confusing as it is also use fro MU Cascade operation.	Clarify as suggested in the comment.	2017/1/9 9:42
4842	Alfred Asterjadhi	225	1 27.7.2	182	10	T	Y	182.10 27.7.2	These are exclusive conditions (based on EOSP setting of the soliciting frame) on whether the soliciting frame does or does not solicit an acknowledgment. Ensure that this consistency is clear.	As in comment.	2017/1/9 9:42

4843	Alfred Asterjadhi	225	1 27.7.3.1	182	44	T	Y	182.44 27.7.3.1	The STA can also negotiate the Broadcast ID. This needs to be stated here for completeness. Also please add references to the normative behaviors for the different features, from TWT scheduled STA perspective (TFRs, power save for congested nets and so on.)	As in comment.	2017/1/9 9:42
4844	Alfred Asterjadhi	225	1 27.7.3.1	183	28	T	Y	183.28 27.7.3.1	It needs to be clear that these TWT elements in this perspective are "TWT Setup" frames rather than broadcast TWT. Also to avoid confusion please clarify setup in a clear way for both wake TBTT and broadcast IDs in one place so that it is easier to interpret.	As in comment.	2017/1/9 9:42
4845	Alfred Asterjadhi	225	1 27.7.3.2	183	51	T	Y	183.51 27.7.3.2	need to specify the value of the Wake TBTT Negotiation field. Also the STA "may" have membership in Broadcast TWT IDs as a result fo the negotiation of broadcast IDs..	As in comment.	2017/1/9 9:42
4846	Alfred Asterjadhi	225	1 27.7.3.2	183	60	T	Y	183.60 27.7.3.2	PLease list the possible values of this fields (Wake TBTT and broadcast, and their interpretation) when they are part of the TWT setup prceudre	As in comment. For both these paragraphs.	2017/1/9 9:42
4847	Alfred Asterjadhi	225	1 27.7.4.3	184	2	T	Y	184.02 27.7.4.3	Too limited. The AP should not include the AID of the STA in the Trigger frame in certain cases, but in other cases it could, e.g., the STA is in AM mode, etc.	As in comment.	2017/1/9 9:42
4848	Alfred Asterjadhi	225	1 27.7.3.2	184	23	T	Y	184.23 27.7.3.2	Outside of a trigger-enabled TWT. Same as the case of individual TWT descriptions.	As in comment	2017/1/9 9:42
4849	Alfred Asterjadhi	225	1 27.7.3.2	184	30	T	Y	184.30 27.7.3.2	As mentioned in the previous comment. the UL MU Response Schedulign can be considered a Trigger frame if it allows the STA to also send BSRs.	As in comment.	2017/1/9 9:42
4850	Alfred Asterjadhi	225	1 27.7.3.2	184	36	T	Y	184.36 27.7.3.2	"The TWT scheduling STA should schedule delivery of DL BUs during unannounced TWT SPs." is too vague. Cant the AP schedule DL BUs delivery when the STA has declared to be in awake state?	As in comment.	2017/1/9 9:42
4851	Alfred Asterjadhi	225	1 27.7.3.2	185	18	T	Y	185.18 27.7.3.2	Make sure that these rules are consistent with those of the individual TWT agreement case. Also not clear the context of the AM mode in this condition. Seems out of place.	As in comment.	2017/1/9 9:42
4852	Alfred Asterjadhi	225	1 9.3.1.8	33	65	T	Y	33.65 9.3.1.8	The BlockACKReq includes the BAR Control which also has the encoding of the BlockAckReq frame variant, and for different variants there can be a different length. Similar observation for the M-BA, that can have different lengths. Clarify that the lenghts that are defined as of now (11ax) are also applicable for future amendments to ensure forward compatibility.	Presentation to be provided	2017/1/9 9:42
4853	Allert Van Zelst	225	1 Contents		36	E	N	Contents	Page number 253 in index line not properly lined out	Line out page number 253 on the right	2017/1/9 9:42
4854	Allert Van Zelst	225	1 28.1.1	210	35	T	N	210.35 28.1.1	replace HE_TRIG PPDU by HE trigger-based PPDU	See comment	2017/1/9 9:42
4855	Allert Van Zelst	225	1 28.1.1	212	40	T	N	212.40 28.1.1	replace HE_TRIG PPDU by HE trigger-based PPDU	See comment	2017/1/9 9:42
4856	Allert Van Zelst	225	1 28.1.1	210	47	T	N	210.47 28.1.1	replace HE_EXT_SU by HE extended range SU	See comment	2017/1/9 9:42
4857	Allert Van Zelst	225	1 28.2.2	216	12	T	N	216.12 28.2.2	It looks like N_TX is not present for the HE formats	please change "Indicates the number of transmit chains." to "Not present" in the value column	2017/1/9 9:42
4858	Allert Van Zelst	225	1 28.2.2	216	48	T	N	216.48 28.2.2	Condition column seems to be in error	Change "FORMAT is HE_SU, HE_MU, HE_EXT_SU or HE_TRIG" to "FORMAT is HE_SU and PSDU_LENGTH is 0"	2017/1/9 9:42
4859	Allert Van Zelst	225	1 28.2.2	219	55	T	N	219.55 28.2.2	There is no DCM entry in Table 21-1	Change "See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters)." to "Not present."	2017/1/9 9:42
4860	Allert Van Zelst	225	1 28.2.2	219	41	T	N	219.41 28.2.2	Is DCM only present in the TXVECTOR and RXVECTOR in case of MU?	I'd say, like STBC, it is present always? Definitely for the TXVECTOR, because the rate decision comes from a higher layer. Is it needed for the RXVECTOR?	2017/1/9 9:42

4861	Allert Van Zelst	225	1 28.2.2	218	12	T	N	218.12 28.2.2	Is FEC_CODING only present in the TXVECTOR and RXVECTOR in case of MU?	I'd say, like STBC, it is present always? Definitely for the TXVECTOR, because the rate decision comes from a higher layer. Is it needed for the RXVECTOR?	2017/1/9 9:42
4862	Allert Van Zelst	225	1 28.2.2	219	34	T	N	219.34 28.2.2	Is MCS only present in the TXVECTOR and RXVECTOR in case of MU?	I'd say, like STBC, it is present always? Definitely for the TXVECTOR, because the rate decision comes from a higher layer. Is it needed for the RXVECTOR?	2017/1/9 9:42
4863	Allert Van Zelst	225	1 28.3.3.1	228	16	T	N	228.16 28.3.3.1	Wrong reference in "The difference between OFDM and OFDMA is illustrated in Table 28-15 (CH_BANDWIDTH and for pre-HE modulated fields)."	Refer to Figure 28-1 instead	2017/1/9 9:42
4864	Bin Tian	225	1 28.3.9	264	49	E	Y	264.49 28.3.9	Remove "a STA" in "may support alpha_r in the grange "‥	as in comment	2017/1/9 9:42
4865	Bin Tian	225	1 28.3.9	265	6	E	Y	265.06 28.3.9	Change to "HE trigger-based PPDU HE modulated fileds". The word "modulated" is missing	as in comment	2017/1/9 9:42
4866	Bin Tian	225	1 28.3.9	265	17	T	Y	265.17 28.3.9	The sentence " cardinality of the set of subcarriers modulated with data within Kr" may lead to confusion that only data subcarrier are counted. Change to "cardinality of the set of modulated subcarriers modulated within Kr"	as in comment	2017/1/9 9:42
4867	Bin Tian	225	1 28.3.9	265	35	T	Y	265.35 28.3.9	The cpation of table 28-14 needs to be reviese. This table doesn't directly provide Tone scaling factor. May change to Occupied subcarrier number for each field of HE PPDU	as in comment	2017/1/9 9:42
4868	Bin Tian	225	1 28.3.9	266	53	T	Y	266.53 28.3.9	Remove the sentence " Note that the mulitiplication matrices Ak_HE-LT ..." and the next one "when the TXVECTOR ...". The matix Ak_HE-LTF is not introduced here and carries the next level of details of how to generate HE-LTF, which is not needed here.	as in comment	2017/1/9 9:42
4869	Bin Tian	225	1 28.3.9	263	56	E	Y	263.56 28.3.9	Change to "In Equation (28-3) and (28-4), "	as in comment	2017/1/9 9:42
4870	Bin Tian	225	1 28.3.10.3	269	14	T	Y	269.14 28.3.10.3	Matrix A_HE_LTF only needs to be applied to HE -LTF and L-LTF when beamchange=0. It is not related to L-STF. Remove the A_HE-LTF from equation 28-8 and the explanation in line 29 .	as in comment	2017/1/9 9:42
4871	Bin Tian	225	1 28.3.11.4	336	55	E	Y	336.55 28.3.11.4	Move the explanation on Q_k_(iseg) below Eq 28-109 instead of Eq 29-110 since the variable first appears there.	as in comment	2017/1/9 9:42
4872	Bin Tian	225	1 28.3.17.3	345	64	E	Y	345.64 28.3.17.3	"specified in Table xx-a" . Should be Table 28-41	as in comment	2017/1/9 9:42
4873	Bin Tian	225	1 28.3.17.6.2	348	17	T	Y	348.17 28.3.17.6.2	Should update the note. Change all the references on clause 21 VHT to the caluse 28 HE receiver	as in comment	2017/1/9 9:42
4874	Bin Tian	225	1 28.4.3	372	45	E	N	372.45 28.4.3	Typo. Change to aCCAMidTime.	as in comment	2017/1/9 9:42
4875	Bin Tian	225	1 28.17.6.4	349	21	T	Y	349.21 28.17.6.4	One variable, OBSS_PD is used in the equation to compuate the CCA threshold for sec20, sec40 and sec80. Need to clarify that this OBSS_PD variable have differnt values in different BW.	as in comment	2017/1/9 9:42
4876	Bin Tian	225	1 28.3.18	350	1	E	N	350.01 28.3.18	Move the transmit specification subclause ahead of the receiver specification to be aligned with other amendments	as in comment	2017/1/9 9:42
4877	Bin Tian	225	1 28.3.1.18.4.4	356	8	T	Y	356.08 28.3.1.18.4.4	Change "Relative constellation error in an HE trigger-based PPDU (dB)" to " Relative constellation error in an HE trigger-based PPDU when transmit power is larger than the maximum power of MCS7 (dB)	as in comment	2017/1/9 9:42
4878	Bin Tian	225	1 28.3.1.18.4.4	357	31	T	Y	357.31 28.3.1.18.4.4	Change to "the i_s OFDMA symbol of frame i_f" in both line 31 and 34	as in comment	2017/1/9 9:42
4879	Bin Tian	225	1 28.3.1.18.4.4.	359	20	T	Y	359.20 28.3.1.18.4.4.	Remove the step h). The limit of unused tone EVE already defined in the step g).	as in comment	2017/1/9 9:42

4880	Bin Tian	225	1 28.3.12	338	61	T	Y	338.61 28.3.12	The variable name T_HE-PERAMBLE defined in line 61 and used in Equation 28-114 has a different meaning from that in equation 26-117 (P340 line 10). Suggest update the equation 28-114 and use the consistent definition of T_PREABMBLE as in Equation 26-117.	as in comment	2017/1/9 9:42
4881	Bin Tian	225	1 28.3.11.5.4	320	40	E	Y	320.40 28.3.11.5.4	Typo. Should be N_abits,u	as in comment	2017/1/9 9:42
4882	Bin Tian	225	1 28.3.14.1	340	53	E	Y	340.53 28.3.14.1	Change to "by the participating STAs to mitigate the synchronization and interference related issues at the AP." since power precorrection has nothing to do with synchronizatin issue	as in comment	2017/1/9 9:42
4883	Bin Tian	225	1 28.3.11.6	323	8	T	Y	323.08 28.3.11.6	In the equation, it shoud be k over upper-case S instead of lower-case s.	as in comment	2017/1/9 9:42
4884	Bin Tian	225	1 28.3.11.9	327	11	T	Y	327.11 28.3.11.9	Need to fix the sentences between line 11 and 15. Some words are missing	as in comment	2017/1/9 9:42
4885	Bin Tian	225	1 28.3.9	264	37	E	Y	264.37 28.3.9	Clean up the text on the conditiosns that power boosting factor = sqrt(2) and remove the redudanat "and 1 otherwise".	as in comment	2017/1/9 9:42
4886	Bin Tian	225	1 28.3.11.9	327	45	E	Y	327.45 28.3.11.9	Typo: The Nsd here refers to..	as in comment	2017/1/9 9:42
4887	Bin Tian	225	1 28.3.10.5	271	4	E	Y	271.04 28.3.10.5	Change "tones" to "subcarriers" and update the text to "The 4 extra subcarriers with indices [-28, -27,27 28] of L-SIG	as in comment	2017/1/9 9:42
4888	Bin Tian	225	1 28.3.10.5	271	49	E	Y	271.49 28.3.10.5	Should be p0 instead of P0	as in comment	2017/1/9 9:42
4889	Bin Tian	225	1 28.3.10.7.3	282	51	T	Y	282.51 28.3.10.7.3	HE SIG-B user specifi code block may content one or two user information so the the value of L should be 20 or 41.	as in comment	2017/1/9 9:42
4890	Bin Tian	225	1 28.3.10.8.4	290	39	T	Y	290.39 28.3.10.8.4	It states that the center 26RU indication in the HE-SIGB only presents for full bandwidth 80MHz, 160MHz and 80+80MHz, which is not correct. Center RU26 still needs to be indicated even in some of the preamble puncturing cases like only the 4th 20MHz channel puncture in 80MHz case. Remove the "full bandwidth" in the description. Make the samilar changes to the line 16 and line 17 in P291.	as in comment	2017/1/9 9:42
4891	Bin Tian	225	1 28.3.10.8.4	293	8	T	Y	293.08 28.3.10.8.4	Can clean up the description. No need to introduce another set of the parameters y[3]y[2]y[1]. Can write a formula to directly map y2y1y0 to the number of STAs multiplexed. May the samilar changes to the notes on other fields like z2z1z0, y1y0, z1z0,etc.	as in comment	2017/1/9 9:42
4892	Bin Tian	225	1 28.3.10.10	302	4	T	Y	302.04 28.3.10.10	1x LTF and 1.6us CI support for UL MU-MIMIO (trigger-based PPDU) is listed as optional, which should be conditional mandatory.	Move the line 4 P302 to Line 62 P301.	2017/1/9 9:42
4893	Bin Tian	225	1 28.3.10.10	311	11	T	Y	311.11 28.3.10.10	Change "In an UL MU-MIMO transmission not using single stream pilots" to "In a full bandwidth UL MU-MIMO transmission not using 1x LTF or not using signal stream pilots in in HE-LTF"	as in comment	2017/1/9 9:42
4894	Bin Tian	225	1 28.3.3.10.5	240	41	E	Y	240.41 28.3.3.10.5	Change "UL MU-MIMO PPDUs" to "UL OFDMA/MU-MIMO PPDUs"	as in comment	2017/1/9 9:42
4895	Bin Tian	225	1 28.3.3.`9.5	240	47	T	Y	240.47 28.3.3.`9.5	When 1x LTF used in UL MU MIMO, no pilot is HE LTF. Add "or no pilots if 1x LTF is used" after "orthogonal code". Also add "for non 1x LTF" after "full bandwidth UL MU-MIMO transmission" in line 50	as in comment	2017/1/9 9:42
4896	Bin Tian	225	1 4.3.14a	9	46	T	Y	9.46 4.3.14a	Then sentences on Optional support of 1024QAM and HE-MCSs 10 and 11 are duplicated. Should be combined into one. Add optional support of UL MU MIMO	as in comment	2017/1/9 9:42
4897	Bin Tian	225	1 28.3.5	242	62	T	Y	242.62 28.3.5	"Spatial and frequency mapping(PHY Motion #172)" was introduced, but there is no spatial mapping happens other than old spatial mapping block.	change to "Frequency mapping"	2017/1/9 9:42
4898	Bin Tian	225	1 28.3.10.6	272	31	T	Y	272.31 28.3.10.6	It is better to write Eq (28-14) and (28-15) for RL-SIG in a same way as Eq (28-12) and (28-13) for L-SIG, to avoid any confusion	as in comment	2017/1/9 9:42

4899 Bin Tian	225	1 28.3.11.13	330	45	E	Y	330.45 28.3.11.13	both 28.3.3.4 (Pilot subcarriers) and 28.3.11.13 (Pilot subcarriers) have same title.	suggest to change the subclause title of 28.3.11.13 to Pilot mapping	2017/1/9 9:42
4900 Bo Sun	225	1 28.1.1	209	15	E	Y	209.15 28.1.1	The description for an HE STA operating in the 5 GHz band is confusing. The pre-requisite is for a common HE STA in line 11 without specific BW capability	Change to " - Clause 19 (High Throughput (HT) PHY specification) and Clause 21 (Very High Throughput (VHT) PHY specification) when the HE STA is of greater than or equal to 80MHz capability and is operating in the 5 GHz band. - Clause 19 (High Throughput (HT) PHY specification) when the HE STA is of 20 MHz only non-AP capability and is operating in the 5 GHz band. - Clause 19...."	2017/1/9 9:42
4901 Bo Sun	225	1 28.1.1	209	36	E	Y	209.36 28.1.1	The statement for downlink and uplink MU-MIMO transmissions is confusing	Change to "Both downlink and uplink MU-MIMO transmissions are supported on portions of the PPDU bandwidth (on resource units greater than or equal to 106 tones) and in an MU-MIMO resource unit with, there is support for up to eight users with up to four space-time streams per user iwth the total number of space-time streams not exceeding eight."	2017/1/9 9:42
4902 Bo Sun	225	1 28.1.1	209	41	T	Y	209.41 28.1.1	The HE PHY provides support of functions not depending on the frequency band and capability. The dependency to the frequency band and device's capability makes sense in an implementation.	Change to "..., depending on the frequency band and capability."	2017/1/9 9:42
4903 Bo Sun	225	1 28.1.1	209	44	T	Y	209.44 28.1.1	The channel puncturing transmisison brief is confusing. Especially, the "zero out" operation is not clear.	Change to "For channel widths greater than or equal to 80 MHz, the HE PHY supports channel puncturing transmissions where one or more of the non-primary 20 MHz channels in an HE MU PPDU with more than one RU is zeroed outare punctured.	2017/1/9 9:42
4904 Bo Sun	225	1 28.2.2	214	22	T	Y	214.22 28.2.2	RXVECTOR is also used in PHY-RXEND.indication primitive	Change to "...list in the PHY-RXSTART.indication primitive and PHY-RXEND.indication primitive."	2017/1/9 9:42
4905 Bo Sun	225	1 28.2	227	28	T	Y	227.28 28.2	Similar to VHT PHY part, the support to Non-HT, HT and VHT need to be described in the spec	Add a section to describe the support to Non-HT, HT and VHT	2017/1/9 9:42
4906 Bo Yu	225	1 28.3.10.10	313	23	T	Y	313.23 28.3.10.10	TGI in equations (28-58) and (28-59) should be replaced by TGI,HE-LTF. TGI is not defined.	as in comment	2017/1/9 9:42
4907 Bo Yu	225	1 28.3.10.4	270	14	T	Y	270.14 28.3.10.4	TGI,LegacyPreamble in equations (28-10) should be replaced by TGI,L-LTF.	as in comment	2017/1/9 9:42
4908 Brian Hart	225	1 27.16.2	206	22	T	Y	206.22 27.16.2	BSS color is defective with highly overlapped BSSs yet different colors. With mobile APs, ensuring highly overlapped BSSs always have the same color is infeasible	Define that non-fixed APs use BSS color = 0 (no color). This is a repeat of a D0.1 comment but was misunderstood during that CR. Being mroe specific, consider AP1 very near to AP2 and two STAs which are on either side of the APs: STA1 ---> AP1, AP2 <--- STA2. STA1 and STA2 want to transmit to AP1 and AP2 respectively. AP1 is a fixed AP, with a BSS color. AP2 is a mobile AP with an initially well-chosen (and different) BSS color who has now wandered very close to AP1. STA1 and STA2 hear each other at say -77 or -72 or -67 dBm. Roughly speaking, under the proportional rule, because STA1 and STA2 have different colors, they can both transmit as long as they drop their TX power by 5 or 10 or 15 dB, respectively. And if they do transmit, then their transmissions collide at AP1 and AP2 - badness. This mitigated by RTS/CTS, but no STA has ever had to transmit an RTS because the	2017/1/9 9:42
4909 Brian Hart	225	1 27.16.2	206	22	T	Y	206.22 27.16.2	Unless every associated STA guarantees to awaken and read the BSS Color Change Announcement element in the Beacon at some minimum interval, the AP has no safe way to set the Color Switch Countdown field in this element so all STAS receive it in time. Without this, a color change will create more problems than it solves.	This BSS Color feature is grossly under-engineered for mobile devices and real-world issues. Re-analyze considering what can go wrong instead of what can go right. Fix the various instabilities arising from BSS Color, especially with mobile APs	2017/1/9 9:42

4910 Brian Hart	225	1 27.16.2	206	22	T	Y	206.22 27.16.2	Since clients might sleep for say 2 sec between beacon reading times, then a color change may take multiples of that before it can happen, which is uselessly slow for a mobile AP, such as one mounted on a bus.	This BSS Color feature is grossly under-engineered for mobile devices and real-world issues. Re-analyze considering what can go wrong instead of what can go right. Fix the various instabilities arising from BSS Color, especially with mobile APs. BTW, a looming change in BSS Color doesn't even change the Check Beacon field in the TIM frame, which shows how little thought has been put into this feature	2017/1/9 9:42
4911 Brian Hart	225	1 27.16.2	206	22	T	Y	206.22 27.16.2	Due to the dangerous power of a BSS Color change frame in the hands of a script kiddie, there should (must!) be protected dual of this frame	This BSS Color feature is grossly under-engineered for mobile devices and real-world issues. Re-analyze considering what can go wrong instead of what can go right. Fix the various instabilities arising from BSS Color, especially with mobile APs	2017/1/9 9:42
4912 Brian Hart	225	1 28.3.10.7.2	280	6	T	Y	280.06 28.3.10.7.2	NOTE 1 looks pretty darn normative to me	Rewrite ot avoid a note. Perhaps add a section elsewhere and a xref to it from here	2017/1/9 9:42
4913 Brian Hart	225	1 28.3.10.7.2	281	27	T	Y	281.27 28.3.10.7.2	40M .. other 2 fields indicate identical values ... is ambiguous. Assume we have ab for P40 and cd need ot be defined . Is c=a, d=b,? OR c=b, d=a, or what?	Define what is identical to what	2017/1/9 9:42
4914 Brian Hart	225	1 28.3.10.7.2	282	39	E	N	282.39 28.3.10.7.2	"below <" is redundant	Delete <	2017/1/9 9:42
4915 Brian Hart	225	1 28.3.10.7.4	283	18	T	Y	283.18 28.3.10.7.4	"each containing 26 bits" is not true due to the memory of a BCC encoder. The first bits smear into the second symbol	Don't bother with A1 and A2. Just have HE-SIG-A with 52 bits. Affects several places. Ditto for HE Extended which I have ot guess should be perceived as 52+52 bits .. because here actually the distinction becomes really important. Are "A1 and A3" BCC encoded as a unit (with the state from A1 initializing the BCC encoder for A3", then "A2 and A4" are encoded as a unit? The para at P284L32 is GROSSLY unclear / misleading on this vital question	2017/1/9 9:42
4916 Brian Hart	225	1 28.3.10.7.4	284	46	E	Y	284.46 28.3.10.7.4	Data	data	2017/1/9 9:42
4917 Brian Hart	225	1 28.3.10.8.2	286	34	T	Y	286.34 28.3.10.8.2	Organization of HESIGB is mixed up. Start with data contents (28.3.10.8.1) and continued details 28.3.10.8.4 and 28.3.10.8.5, then work down to encoding / modulaiton / frequency mapping!	Reorganize: start with fields, and meaning of fields, then encoding then modulation then freq-domain mapping [Editor can take care of this but this MUST be done to convert me into a yes voter]	2017/1/9 9:42
4918 Brian Hart	225	1 28.3.10.8.1	286	7	T	Y	286.07 28.3.10.8.1	Figure is too small to read	Increase size of figure and text. Ditto figures on P286-288. Also, the curved arrows are quite unclear and seem to hide each other. What are they doing? Many seem to be missing - add	2017/1/9 9:42
4919 Brian Hart	225	1 28.3.10.8.1	287	15	E	N	287.15 28.3.10.8.1	Para is rather big to chew on	Break into 3 paras, at L22 and L37	2017/1/9 9:42
4920 Brian Hart	225	1 28.3.10.8.1	287	23	T	Y	287.23 28.3.10.8.1	It is very hard to discern if a STA with an RU within one 20M subchannle is guaranteed to get its PER STA Info field on that 20 M channel, or if it has to look at both 20M subchannels	Add an explicit statement here or somewhere underwhat circumstances "load balancing" of PER STA Info is allowed and when it is not. There is a para at P288L44 - but this only for Compression = 0. LB is referred to at P297L20 but this is for larger Rus only. This is all just too vague	2017/1/9 9:42
4921 Brian Hart	225	1 28.3.10.8.1	288	44	T	Y	288.44 28.3.10.8.1	"when SIGB Compression field ... is set to 0" - what happens when it is set to 1? Is that the content earlier in this section? If so be explicit	"when SIGB Compression field ... is set to 0" - what happens when it is set to 1? Is that the content earlier in this section? If so be explicit	2017/1/9 9:42
4922 Brian Hart	225	1 28.3.10.8.4	290	40	T	Y	290.40 28.3.10.8.4	"full bandwidth 80" is only use here (i.e. is undefined). And a naive reading would look at the last row of fig 28-4 (996 subcarriers) But there is no 26 RU there	Define "full bandwidth 80". I assume it must have a center tone 26?	2017/1/9 9:42
4923 Brian Hart	225	1 28.3.10.8.4	290	44	T	Y	290.44 28.3.10.8.4	"allocated ... with the same value" doesn't make sense	"and the contents of both allocations are the same" / "signal the same allocation" etc	2017/1/9 9:42
4924 Brian Hart	225	1 28.3.10.8.4	290	51	T	Y	290.51 28.3.10.8.4	"160 ... the center 26-tone RU" but aren't there two center 26 tone RUs in this case? Also I cannot make sense of the 160/80+80M text	Rewrite for greater clarity. Also, define the "otherwise" at L45 and L51, since this would help the explanation of this field	2017/1/9 9:42

4925	Brian Hart	225	1 27.15.4.3	203	54	T	Y	203.54 27.15.4.3	From deep practical experience, these rules are the workhorse and pot of gold for high density networks (during 11a, and 11n days, and continuing into VHT days). However D1.0 continues with the "should" logic that was a weak VHT compromise given the pre-ratification product being developed. However, given how early we are in 11ax, there is no technical or practical reason why this "should" shouldn't be upgraded to a "shall".	Replace "should" by "shall" in section 27.15.4.3 (2x)	2017/1/9 9:42
4926	Brian Hart	225	1 27.9.2.1	190	21	T	Y	190.21 27.9.2.1	This CCARESET is trying to say "don't let this PPDU cause CCA to report busy to the MAC". And a reset stops the reporting it cold. But if the PHY is oding mid PPDU detrection (e..g cyclic extension autocorr) then the PPDU can still be detected after the CCARESET	Add a new parameter to CCARESET. Call it "isResetDueToInterBssPpdu" or similar. This will signify: 1) if the PHY does intra PPDU detection, (say cyclic extension autocorrelation or DSSS spreading sequence xcorr), then don't retrigger on something with the same characteristics after a CCARESET until the end of the PPDU. And 2) the parameter will also indicate that CCA issues an IDLE indication immediately after a CCARESET primitive if isResetDueToInterBssPpdu is included and true.	2017/1/9 9:42
4927	Brian Hart	225	1 9.4.2.219	91	39	T	Y	91.39 9.4.2.219	"The BSS Color field is an unsigned integer whose value is the BSS color of the BSS corresponding to the AP which transmitted this element, except that a value of 0 in this field indicates that there is no BSS color for this BSS." - BSS Color is also needed for IBSSs otherwise they get priority over infra BSSs	Actually this para looks like an inferior version of the para at P91L44. So delete lines 39-42. Also generalize "AP" as appropriate at P92L19/28 para, P149L40, P150L10, P197L1-28, etc	2017/1/9 9:42
4928	Brian Hart	225	1 27.2.1	149	16	T	Y	149.16 27.2.1	OBSS interference should be minimized with NDP PPDUs in order that MU works reliably.	Therefore the proportional CCA rule should be disabled during NDP PPDUs (and, related concern, PPDUs containing FTM frames). Changes at P190L30	2017/1/9 9:42
4929	Brian Hart	225	1 28.1.1	209	15	E	N	209.15 28.1.1	Unclear language	Insert commas etc. "STA with greater than or equal ot 80M capability is" => "STA, with greater than or equal ot 80M capability, is" or "STA, that has greater than or equal ot 80M capability, is"	2017/1/9 9:42
4930	Brian Hart	225	1 28.1.1	210	25	T	Y	210.25 28.1.1	If a STA supports more than 4SS, it's not a low complexity / low cost device. N oreason for it not to support LDPC	Ditto P210L29. Strike out "except when the STA is ... 20 MHz only non-AP STA". Need to update P210L60 et passim also	2017/1/9 9:42
4931	Brian Hart	225	1 28.1.1	210	31	T	Y	210.31 28.1.1	"LDPC when declaring support for MCS10 and MCS11"	Is this for TX or RX or both? And all supported PPDU types, RU sizes etc? Be specific	2017/1/9 9:42
4932	Brian Hart	225	1 9.4.2.218.4	71	29	T	Y	71.29 9.4.2.218.4	Maximum thruput per area is achieved at a middling MCS - not too low (sets NAV too far away) and not too high (area that must be suppressed in order to achieve an adequate SINR for MCS10/11 is inefficiently high). But the HE Operation/HE Capability signalling does not permit 64QAM MCSs to be deleted	Use the Reserved values to lower the max MCS to 4/5/6 as an AP's policy choice for the BSS for high density deployments	2017/1/9 9:42
4933	Brian Hart	225	1 28.1.1	210	37	E	N	210.37 28.1.1	Two bullets when 1 suffices	Combine bullets at L37 and 42 "0.8 and 1.6us ..."	2017/1/9 9:42
4934	Brian Hart	225	1 28.1.1	210	49	T	Y	210.49 28.1.1	"applicable" in "all RU sizes and locations applicable to the 20 MHz channel width" is vague	Provide a rigorous definition: e.g. via a cross reference to a table.	2017/1/9 9:42
4935	Brian Hart	225	1 28.1.1	211	7	T	Y	211.07 28.1.1	If 11n taught us anything, long range modes should be mandatory or deleted from the draft. The status quo involves too many MAC work-arounds and/or little likelihood of adoption	Make this mandaotry or remove this mode	2017/1/9 9:42
4936	Brian Hart	225	1 28.1.1	211	54	T	Y	211.54 28.1.1	Maximum number of SSs per user, at 4, is too low	AP antenna counts will only increase: min value should be 8 for practically important client antenna counts. See also P212L32	2017/1/9 9:42
4937	Brian Hart	225	1 28.1.1	211	62	T	Y	211.62 28.1.1	Maximum number of SSs for explicit feedback, at 4, is too low	AP antenna counts will only increase: min value should be 8 for practically important client antenna counts. See als P12L35	2017/1/9 9:42

4938	Brian Hart	225	1 28.1.1	212	2	E	N	212.02 28.1.1	So many missing articles!	in the 5G band. P212L5. "in the 5 G band"; P218L43 "in the case of an HE-MU PPDU". P237L19 - this para needs about 11 articles to be added. P238L13 - this para needs a lot of articles to be added. P238L62 "the RUs in the current". P238L60 "the SIGB". P240L40 - this para needs a lot of articles to be added. P240L54 "the Trigger frame". P245L32, add two articles. P260L10/30/40 "at the rth". P282L39. "The same ... both".P287L23 "and a User Specific field"	2017/1/9 9:42
4939	Brian Hart	225	1 28.1.1	212	36	E	N	212.36 28.1.1	Consistency for HE_TRIG	HE trigger-based PPDU" at L36 but "HE_TRIG" at line 40. Use HE_TRIG PPDU" everywhere in PHY section	2017/1/9 9:42
4940	Brian Hart	225	1 28.2.2	216	12	T	Y	216.12 28.2.2	N_TX is incorrectly reported as not needed for 11ax	Replace by "Y N" N_TX is needed since there is CSD per TX chain in the preamble, which depends on the number of TX chains	2017/1/9 9:42
4941	Brian Hart	225	1 28.2.2	217	30	T	Y	217.30 28.2.2	RCPI should be per RU in OFDMA	RCPI should be per RU in OFDMA	2017/1/9 9:42
4942	Brian Hart	225	1 28.2.2	217	37	E	N	217.37 28.2.2	"For and"	"For an"	2017/1/9 9:42
4943	Brian Hart	225	1 28.2.2	217	38	T	Y	217.38 28.2.2	"for each SS" but should be RU-aware also	For the STA recipient, this should be for the STA's RU. "of the user" partly captures this, but not precisely enough. Ditto P217L43	2017/1/9 9:42
4944	Brian Hart	225	1 28.2.2	218	4	T	Y	218.04 28.2.2	NO_SIG_EXTN is marked at NN but needed for 2.4G - see P270L47	Add for 2.4G	2017/1/9 9:42
4945	Brian Hart	225	1 28.2.2	218	14	T	Y	218.14 28.2.2	Named constants BCC_CODING/LDPC_CODING are defined but then all-but-never used later in this section	Use named constants in the PHY clause instead of loose language like "This figure also applies to the data field with LDPC encoding in an HE trigger-based PPDU." Or remove the named constants ...	2017/1/9 9:42
4946	Brian Hart	225	1 28.2.2	218	35	T	Y	218.35 28.2.2	"Payload" is loose	Replace by "Data field". 4x in this cell. Also check elsewhere	2017/1/9 9:42
4947	Brian Hart	225	1 28.2.2	218	43	T	Y	218.43 28.2.2	Loose language	Should be "STBC is not applied to an RU in a HE MU PPDU if the RU is assigned to more than 1 user. Also move after "HE MU PPDU" language ending at L37.	2017/1/9 9:42
4948	Brian Hart	225	1 28.2.2	218	36	E	N	218.36 28.2.2	Poor language	"all RUs are not " => "no RU is"	2017/1/9 9:42
4949	Brian Hart	225	1 28.2.2	218	44	T	Y	218.44 28.2.2	Rogue language	"STBC is set ot 0 to indicate ... payload" Unclear what this sentence is doing. IS it clarification? Is it conflicting/overloading other defintions here? What PPDU format(s) does it apply to? Clarify	2017/1/9 9:42
4950	Brian Hart	225	1 28.2.2	219	60	T	Y	219.60 28.2.2	Loose language	Does integer 0 mean MCS0 and integer 5 mean MCS5? OR something else? Be specific	2017/1/9 9:42
4951	Brian Hart	225	1 28.2.2	221	33	T	Y	221.33 28.2.2	Note is unsupported	Add a xref to the stmt that "CH_BANDWIDTH does not represent" ... e.g .ensure it is clear what does represent the chanel width	2017/1/9 9:42
4952	Brian Hart	225	1 28.2.2	223	41	E	N	223.41 28.2.2	"One to 4 values" ... i.e. a vector	Rewrite, defining this to be a vector parameter of length 1 to 4	2017/1/9 9:42
4953	Brian Hart	225	1 28.2.2	223	51	T	Y	223.51 28.2.2	Missing detail	I've searched the spec for the impact of this parameter and nowhere can I find it defined. "B20 indicates transmitting STA supports transmitting HE PPDUs with Doppler procedure" and "The Doppler subfield indicates a high doppler mode of transmission." are uselessly vague. Add detail. Write exactly what does the TX PHY do differently when this parameter is true	2017/1/9 9:42
4954	Brian Hart	225	1 28.2.2	224	15	T	Y	224.15 28.2.2	Cannot parse this description "Each 8 bit per 20MHz PPDU BW for singlaling | The RU assignment ....."	Clarify	2017/1/9 9:42
4955	Brian Hart	225	1 28.2.2	224	49	T	Y	224.49 28.2.2	Allowed values of HE_LTF_MODE are unspcified. True/false, or other?	Define allows values, then use them in rest of section. Also P224L51, does the "it" refer to HE_LTF_MODE or "a mask on each SS". Basically, replace the "it"	2017/1/9 9:42
4956	Brian Hart	225	1 28.2.2	224	57	E	N	224.57 28.2.2	"HE-LTF symbols" is loose language	"Number of OFDM symbols in the HE LTF field"	2017/1/9 9:42
4957	Brian Hart	225	1 28.2.2	225	4	T	Y	225.04 28.2.2	"Reserved" is the wrong name for a field that is not set to 0 on TX according to 27.5.2.3.	Rename the PLCP bit from "HE-SIG-A Reserved", and probably rename this parameter - too e.g. HE_SIGA_COPIED_FIELD or something	2017/1/9 9:42

4958	Brian Hart	225	1 28.2.2	225	15	T	Y	225.15 28.2.2	"global space time streams" is used in this one place and never defined	Define what this means, or reword using standard/used/defined words.	2017/1/9 9:42
4959	Brian Hart	225	1 28.2.2	226	15	T	Y	226.15 28.2.2	"mapped differently" is vague.	Needs additional detail (e.g. in the same way as the pre-VHT portion of a VHT PPDU) or a xref	2017/1/9 9:42
4960	Brian Hart	225	1 28.2.2	226	37	T	Y	226.37 28.2.2	Is this still a list on RX? And by saying "MU" under TX, isn't this entry a single STA ID; and the list comes form tnhe "MU" semantics?	Change to "one STA ID that is an intended recipient of the HE MU PPDU ..."	2017/1/9 9:42
4961	Brian Hart	225	1 28.3.2.1	227	48	E	N	227.48 28.3.2.1	"MU transmissions" is confusing since MU PPDUs are DL only and often we use "Transmission as a synonym for PPD"	Replace by "HE supports both DL MU and UL MU ..."	2017/1/9 9:42
4962	Brian Hart	225	1 28.3.3.1	228	17	E	N	228.17 28.3.3.1	28-15 is wrong xref	28-1	2017/1/9 9:42
4963	Brian Hart	225	1 28.3.3.1	228	17	T	Y	228.17 28.3.3.1	Not clear what is in and out of scope of std	Insert "The allocation of users to subchannels and powers to users is out of scope of this standard"	2017/1/9 9:42
4964	Brian Hart	225	1 28.3.3.1	228	59	T	Y	228.59 28.3.3.1	AFAIK, always more than 1 DC subcarrier	DC subcarrier => DC subcarriers	2017/1/9 9:42
4965	Brian Hart	225	1 28.3.3.2	229	4	E	N	229.04 28.3.3.2	and ... and	Change to 484 tone RU, 996 tone RU and ...	2017/1/9 9:42
4966	Brian Hart	225	1 28.3.3.2	229	4	T	Y	229.04 28.3.3.2	"DFS channel" is undefined .. and practically time-varying	Reference Operating Classes with a defined BehaviorLimit associated with DFS from Annex D/E	2017/1/9 9:42
4967	Brian Hart	225	1 28.3.3.2	229	10	T	Y	229.10 28.3.3.2	Friendly legacy APs tolerant of narrow PPDUs have no way to upgrade their SW to declare they can tolerate narrow Rus	Add a Extended Capability bit for legacy APs to be able to declare "Even if I'm here, don't block usage of narrow RUS on my account"	2017/1/9 9:42
4968	Brian Hart	225	1 28.3.3.2	229	30	E	N	229.30 28.3.3.2	MHZ	MHz	2017/1/9 9:42
4969	Brian Hart	225	1 28.3.3.2	230	11	T	Y	230.11 28.3.3.2	I like the notation but AFAIK it is not defined in the std.	Every table where we use Matlab notation, define it in a footnote. Including "," as a concatenation operator, e.g.: "[-16:-4, 4:16]" which is otherwise especially opaque	2017/1/9 9:42
4970	Brian Hart	225	1 28.3.3.2	233	8	T	Y	233.08 28.3.3.2	RUs are not labelled. Helpful especially for 20M only STAs	Also P234L7, P232L16. Add "RU0, RU1 ..." above each RU matching tables 28-3..-5	2017/1/9 9:42
4971	Brian Hart	225	1 28.3.3.4	236	34	T	Y	236.34 28.3.3.4	"If pilot subcarriers are present in the HE-LTF field" is vague	Specify which formats this applies to and provide a cross-ref	2017/1/9 9:42
4972	Brian Hart	225	1 28.3.3.4	236	34	T	Y	236.34 28.3.3.4	Table 28-7 is misleading / confusing for PPDUs with different RU widths. E.g., as written, a 20 MHz PPDU can only be a mix of 26 or 52 RUs, or a mix of 106/242 Rus. But what about PPDUs that is a mix of 26, 52 and 106 RUs?	Need an extra level of indirection: e.g. if an RU is a 26 or 52 tone RU with a range of subcarreirs defined in table xxx, and a tone number listed in the RHS column falls within that range, then that RHS tone number is a pilot tone. Add clarifying language	2017/1/9 9:42
4973	Brian Hart	225	1 28.3.3.5	237	22	E	N	237.22 28.3.3.5	"DL-OFDMA" is a modifier for a noun but the noun is missing	DL-OFDMA PPDU. Ditto UL-OFDMA PPDU	2017/1/9 9:42
4974	Brian Hart	225	1 28.3.3.5	237	31	T	Y	237.31 28.3.3.5	20 MHz STAs as defined here are catstrophically inefficient (limited RU usage, unbalanced user density on P20, all leading to inefficient scheduling choices for AP) and therefore are out of scope of the 11ax PAR	Signifincat improvements by a) AP allocates a 20M to a 20M only STA, and/or b) a 20M STA has wide enough RX BW (e.g. 40M) that it can receive any RU within 20M, and/or c) AP can prohibit a STA from operating in 20M only mode and/or d) change the RU plan so there is always a single 26RU that spans the 20M boundaries, or add such a plan. Basically strike out P237 L30-52 and replace with something permitted by the PAR. Or move this to a new amendment with a PAR that permits such inefficient operation	2017/1/9 9:42
4975	Brian Hart	225	1 28.3.3.7	238	21	E	N	238.21 28.3.3.7	Why both 28.3.3.7 and 28.3.3.8	Merge into 28.3.3.8	2017/1/9 9:42
4976	Brian Hart	225	1 28.3.3.8.2	238	51	T	Y	238.51 28.3.3.8.2	Para is improperly introduced	Why have this para is it is the same ... just generalize the above para's! Well, because this feature is optional. So then need to start with that constraint, for clarity ... or just dup the content with the new rider that it its for MU-MIMO+DL-OFDMA. BUT, cleaner is probably to define what PPDUs are possible, then define what STAs have to support and may support ... i.e. rewrite for clarity. Finally, "Aforementioned" ... where does the "fore" stop? Need to define (add "in this sub-section")	2017/1/9 9:42
4977	Brian Hart	225	1 28.3.3.8.3	238	64	E	N	238.64 28.3.3.8.3	Missing paired comma for vocative	",NUSer" => ", Nuserr,"	2017/1/9 9:42
4978	Brian Hart	225	1 28.3.3.10.2	240	3	T	Y	240.03 28.3.3.10.2	"A STA capable of" is vague - refer to specific transmitted field in capability element	"A STA capable of" is vague - refer to specific transmitted field in capability element. Ditto P240L11 and P240L14	2017/1/9 9:42

4979 Brian Hart	225	1 28.3.3.10.3	240	11	T	Y	240.11 28.3.3.10.3	"single stream pilot" and "masking LTF sequence of each SS by a distrinct orth code" are really verbiage used for specific terms.	Create defined terms for these, with initial caps. E.g. "HE Single Stream Pilots" versus "HE Masked Pilots". Put definition in this section or section 3 as appropriate	2017/1/9 9:42
4980 Brian Hart	225	1 28.3.3.10.5	240	40	E	N	240.40 28.3.3.10.5	"about when is loose	"the ... about when" => "to the ...when"	2017/1/9 9:42
4981 Brian Hart	225	1 28.3.3.10.5	240	55	T	Y	240.55 28.3.3.10.5	"will not" is not IEEE language	"shall not"	2017/1/9 9:42
4982 Brian Hart	225	1 28.3.5	246	1	E	N	246.01 28.3.5	data field	Data field	2017/1/9 9:42
4983 Brian Hart	225	1 28.3.8	257	25	T	Y	257.25 28.3.8	Too vague	Prepend "OFDM". Append " of the Data field"	2017/1/9 9:42
4984 Brian Hart	225	1 28.3.8	257	61	E	Y	257.61 28.3.8	Bad caps	sum => Sum	2017/1/9 9:42
4985 Brian Hart	225	1 28.3.8	260	57	T	Y	260.57 28.3.8	Kr definition is not clear	This is the set of used/non-zero subcarrier indices. Add "used" / "non-zero"	2017/1/9 9:42
4986 Brian Hart	225	1 28.3.8	261	10	T	Y	261.10 28.3.8	u,u should be u,u'	u,u should be u,u'	2017/1/9 9:42
4987 Brian Hart	225	1 28.3.8	261	10	T	Y	261.10 28.3.8	Mr,n is not diven an English meaning	Add something like "The number of stace time streams of users prior to user r in RU u"	2017/1/9 9:42
4988 Brian Hart	225	1 9.3.1.23	42	17	T	Y	42.17 9.3.1.23	Packets are generally L3 entities. Replace "Packet extension" by "PPDU Extension" throughout the draft	Packets are generally L3 entities. Replace "Packet extension" by "PPDU Extension" throughout the draft (61x)	2017/1/9 9:42
4989 Brian Hart	225	1 28.3.8	260	55	T	Y	260.55 28.3.8	No formula for N_HE_SIGB	Add a formula for N_HE_SIGB (or a least min value of N_HE_SIGB given the number of users, the PPDU BW and the SIGB MCS), and xref it from here	2017/1/9 9:42
4990 Brian Hart	225	1 28.3.9	263	52	T	Y	263.52 28.3.9	"Total power should not exceed ..." ... this flexilibty is OK if BEAM_CHANGE=1, but this flexiblity should be prohibitied (same power before and after) if BEAM_CHANGE=0	"Total power should not exceed ..." ... this flexilibty is OK if BEAM_CHANGE=1, but this flexiblity should be prohibitied (same power before and after) if BEAM_CHANGE=0	2017/1/9 9:42
4991 Brian Hart	225	1 28.3.9	264	39	E	N	264.39 28.3.9	Missing "for"	sqrt(2) for all	2017/1/9 9:42
4992 Brian Hart	225	1 28.3.9	264	45	E	N	264.45 28.3.9	"and 1 otherwise" is too weak given it is "otherwise" to 2 earlier conditions but 1 condition is in a separate sentence	Add semicolon after LSTF..HE-LTF sentence as per "ext range SU PPDU; for the LSIG ...; and 1 otherwise	2017/1/9 9:42
4993 Brian Hart	225	1 28.3.9	264	50	T	Y	264.50 28.3.9	Signalling for this optional mode is unclear	Add a xref to Power Boost Factor +^{6}r Support in HE Cap. And when that is advertised as true hten the STA *shall* support [0.5;2]	2017/1/9 9:42
4994 Brian Hart	225	1 28.3.9	266	51	T	Y	266.51 28.3.9	"Note that ..." ... need a reference to a normative stmt to make this note trustworthy	Add xref	2017/1/9 9:42
4995 Brian Hart	225	1 28.3.10.2.1	267	61	T	Y	267.61 28.3.10.2.1	"transmit chain index of each STA" but what if STA has more than 1 chain?	"transmit chain indices of the transmit chains of each STA"	2017/1/9 9:42
4996 Brian Hart	225	1 28.3.10.7.2	273	54	T	Y	273.54 28.3.10.7.2	DCM/STBC field descriptions are inconsistent with GI+LTF Size field	"Set to 1 to indicate that DCM is applied" but DCM=1 & STBC=1 means 4x HE-LTF from P274L36. Correct descriptions of DCM and STBC at P275L17 accounting forf this exceptional encoding	2017/1/9 9:42
4997 Brian Hart	225	1 28.3.10.7.2	274	10	T	Y	274.10 28.3.10.7.2	"This part needs further development"	This is a trivial rewording of "TBD" and so this draft should not have been submitted for LB. Continue to refine the draft to remove all TBDs and rewordings of TBD	2017/1/9 9:42
4998 Brian Hart	225	1 28.3.10.7.2	274	25	E	N	274.25 28.3.10.7.2	"right 106-tone RU"	Right => upper	2017/1/9 9:42
4999 Carol Ansley	225	1 4.3.14a	9	2127	E	Y	30.27 4.3.14a	lines are repetitive with the previous bullets. What purpose do they serve?	remove these lines	2017/1/9 9:42
5000 Carol Ansley	225	1 9.2.4.6.4.5	26		E	Y	26.00 9.2.4.6.4.5	sentence is confusing - "..indicate that the buffer status of the AC, which ACI is identified by the location of the bit in the ACI Bitmap subfield, is reported and set to 0 otherwise.'	Reword to clarify meaning. Suggested wording: "... indicate that the buffer status of the corresponding AC is reported and set to 0 otherwise."	2017/1/9 9:42
5001 Carol Ansley	225	1 9.2.5.7	32		E	Y	32.00 9.2.5.7	awkward wording: ".. The rule of setting Duration/ID field is described..."	Reword to "... the rules for setting the Duration/ID field are described..."	2017/1/9 9:42
5002 Carol Ansley	225	1 9.3.1.9.7	37	60	E	Y	37.60 9.3.1.9.7	mising "the": "When Multi-STA BlockAck variant is intended..."	Reword to "When the Multi-STA BlockAck variant is intended..."	2017/1/9 9:42
5003 Carol Ansley	225	1 9.3.1.9.7	38	17	E	Y	38.17 9.3.1.9.7	poor grammar: "the presence of each optional subfields"	Reword to: :"the presence of each optional subfield"	2017/1/9 9:42
5004 Carol Ansley	225	1 9.3.1.20	41	1	E	Y	41.01 9.3.1.20	missing space: "inTable" and no period at end of sentence	Add space: "in Table", and period at end of sentence	2017/1/9 9:42
5005 Carol Ansley	225	1 9.3.1.20	41	28	E	Y	41.28 9.3.1.20	poor grammar: " determining it's AID"	Reword: "determining its AID"	2017/1/9 9:42
5006 Carol Ansley	225	1 9.3.1.23	44		E	Y	44.00 9.3.1.23	poor grammar: "The LDPC Extra Symbol Segment subfield of the Common Info field indicates the status of LDPC extra symbol segment. It is set to 1 when LDPC extra symbol segment is present and set to 0 otherwise."	Reword: "The LDPC Extra Symbol Segment subfield of the Common Info field indicates the status of the LDPC extra symbol segment. It is set to 1 when a LDPC extra symbol segment is present and set to 0 otherwise."	2017/1/9 9:42
5007 Carol Ansley	225	1 9.3.1.23	45	6	E	Y	45.06 9.3.1.23	poor grammar: "When operating 40 MHz in 2.4GHz band, two SR fields, SR field 1 and SR field 2, are set to same values."	Reword: "When operating 40 MHz in the 2.4GHz band, SR field 1 and SR field 2 are set to same value."	2017/1/9 9:42

5008	Carol Ansley	225	1 9.3.1.23	45	14	E	Y	45.14	9.3.1.23	poor grammar: "The HE-SIG-A Reserved subfield indicate the values..."	Reword: "The HE-SIG-A Reserved subfield indicates the values..."	2017/1/9 9:42
5009	Carol Ansley	225	1 9.3.1.23	46		E	Y	46.00	9.3.1.23	Confusing wording for bit map descriptions. Example: "B19-B13 are 0000000 indicates 26-tone RU1 [-121: -96],"	Suggest to reword the paragraphs removing the "B19-B13 are" fragments repeated across the 3 paragraphs.	2017/1/9 9:42
5010	Carol Ansley	225	1 9.3.1.23	47		E	Y	47.00	9.3.1.23	Confusing Wording: "The Padding field of the Trigger frame, if present, is an integer number of octets >= 2: Padding field starts with special STAID[11:0] as 0xFFF and the rest bits of the Padding field are all set to one. 0xFFF is reserved as the special value to indicate the start of the MAC padding.	Suggest: "The Padding field of the Trigger frame, if present, is an integer number of octets >= 2. The Padding field may start with special STAID[11:0] = 0xFFF and the other bits of the Padding field are set to one to indicate the start of the MAC padding." I'm not sure if this is what was meant by the original text.	2017/1/9 9:42
5011	Carol Ansley	225	1			G	Y			I am concerned that the current draft has not been shown to provide the level of performance improvement specified in the PAR. While a lot of work has gone into this draft, it seems premature to stop work on the technical aspects if there are any other improvements that could be added to help this amendment reach its avowed goal.		2017/1/9 9:42
5012	Chao Chun Wang	225	1 9.3.1.23	47	24	T	N	47.24	9.3.1.23	For "target RSSI" in Trigger frame's per-user info, HT mentioned this value is normalized by 20 MHz bandwidth. However, D1.0 never mentioned this part in Table 9-25g.	Spec should add this statement about normalization unit to prevent interop issue	2017/1/9 9:42
5013	Chao Chun Wang	225	1 9.2.4.6.4.5			T	N		9.2.4.6.4.5	For BSR, trigger frame can using the type of BSRP to query the necessary information by AP itself. However, there is no trigger type for "UL power headroom"	Spec should define a new type for "UL power headroom". With this type, AP can decide when to query A-Control with this value by itself, rather than event-driven report by STA.	2017/1/9 9:42
5014	Chao Chun Wang	225	1 9.2.4.6.4.7			T	N		9.2.4.6.4.7	For BQR, trigger frame can using the type of BQRP to query the necessary information by AP itself. However, there is no trigger type for "UL power headroom" 1) Spec should define a new type for "UL power headroom". With this type, AP can decide when to query A-Control with this value by itself, rather than event-driven report by STA.	Spec should define a new type for "UL power headroom". With this type, AP can decide when to query A-Control with this value by itself, rather than event-driven report by STA.	2017/1/9 9:42
5015	Chao Chun Wang	225	1 9.4..2.221	94	64	E	N	94.64	9.4..2.221	The term, Basic variant Trigger frame, in " ... after reception of a Basic variant Trigger frame ..." is different from the definition in 9.3.1.23.1. In 9.3.1.23.1 Basic Trigger variant clause, trigger frame is described as, "If the Trigger frame is a Basic Trigger variant, ...". The "Basic variant Trigger frame" appears three times and "Basic Trigger variant" appear 14 times in the specification.	Revising the inconsistency of the usage of the terminology	2017/1/9 9:42
5016	Chao Chun Wang	225	1 27.5.2.1	164		E	N	164.00	27.5.2.1	The following two paragraphs are hard to read and have errors that make it very confusing. (1) "A STA shall not transmit a Trigger frame assigning an MU-MIMO RU in an UL OFDMA PPDU when the RU does not span that entire PPDU bandwidth to a STA from which it has not received an HE Capabilities element with B23 of the UL MU subfield of the HE PHY Capabilities Information field set to 1." and (2) "A STA shall not transmit a Trigger frame soliciting a full bandwidth UL MU-MIMO HE trigger-based PPDU from a STA from which it has not received an HE Capabilities element with B22 of the UL MU subfield of the HE PHY Capabilities Information field set to 1."	Revising the sentences as follows: (1) An AP shall not transmit a trigger frame assigning an MU-MIMO RU, which does not span the entire PPDU bandwidth, to a STA from which it has not received an HE Capabilities element with B23 of the UL MU subfield of the HE PHY Capabilities Information field set to 1 and (2) An AP shall not transmit a Trigger frame soliciting a full bandwidth UL MU-MIMO HE trigger-based PPDU from a STA from which it has not received an HE Capabilities element with B22 of the UL MU subfield of the HE PHY Capabilities Information field set to 1.	2017/1/9 9:42

5017	Chao Chun Wang	225	1 27.5.2.1.1	165	T	N	165.00 27.5.2.1.1	Clauses 27.5.2.2 Rules for soliciting UL MU frames has the following statement, "A non-AP STA shall not send a Trigger frame or an MPDU carrying an UL MU Response Scheduling A-Control field." To more efficiently support peer-to-peer operations in HE BSS, a non-AP STA that is capable of managing operation with basic trigger variant frame should be allowed to send trigger frame for soliciting OFMDA frames from multiple STAs. It is beneficial for HE STAs and BSS.	Adding text to support MU OFDMA-capable non-AP STA to manage basic trigger variant frame operation in peer-to-peer mode. commentator will submit text.		2017/1/9 9:42
5018	Chao Chun Wang	225	1 27.5.2.6	172	T	N	172.00 27.5.2.6	The following cells are all part of the one comment. The clauses describing the UL OFDMA RA is very confusing and problematic. List of issues are below.	Revising the clauses to (1) Reduce the number of combinations of type of access an AP can schedule in one trigger frame. For example, associated STA only or associated STA for data frame only, unassociated STA only or unassociated STA for management frame and e.t.c. (2) Disallow a trigger frame to allocate both scheduled and random access RUs. A trigger frame shall either have all RA RUs or all scheduled RUs. The commentator volunteer to re-write the clauses.		2017/1/9 9:42
5019	Chao Chun Wang	225	1		T	N		(1) Is UL OFDMA RA for associated or unassociated STA? It seems UL OFDMA RA can not be accessed by un-associated STAs, since an STA must announce its support of UL OFDMA RA in HE capabilities element. It is stated in clause ... "A STA shall set the UL OFDMA RA Support subfield in the HE Capabilities element to 1 if it supports UL OFDMA-based random access and set it 0, otherwise." But on clause ...., the specification also stat that AP will indicate whether an un-associated STA can access the RU slots as stated in clause ...			2017/1/9 9:42
5020	Chao Chun Wang	225	1		T	N		... if the value of the AID12 subfield of the User Info field is equal to the AID of the STA or to 0 (indicating a random access allocation). A value of 0 also indicates that nonassociated STAs can transmit on the allocated resource using the random access procedure as described in 27.5.2.6 (UL OFDMA-based random access).			2017/1/9 9:42
5021	Chao Chun Wang	225	1		T	N		The option to support UL OFMA RA for un-associated STAs is also problematic. If an AP does not know whether there are un-associated STAs waiting for UL OFDMA RA opportunities and whether the un-associated STAs are capable of supporting UL OFDMA RA, how an AP would schedule RA RU for un-associated STAs. There is also no evidence that including the option will benefit HE BSS			2017/1/9 9:42

5022	Chao Chun Wang	225	1			T	N		(2) The rules (or lack of it) about how UL OFDMA RA should be used create a huge challenge for chip design. The D 1.0 specification allows AP to allocated UL OFDMA RA opportunities in one trigger frame for associated and un-associated STAs, and for management and date frames with no restriction on the size of the frames. The D 1.0 specification also allows AP to allocated UL OFDMA RA RU with UL OFDMA scheduled RU. The number of combinations and varieties of receiving frame types, scheduled and random accessed, associated and unassociated, data and management frames; posing a huge challenge for the design of receiver while the option provides little benefit.		2017/1/9 9:42
5023	Chao Chun Wang	225	1			T	N		There are a couple of issues with the unrestricted use of UL OFMA RA in trigger-access opportunity. (a) Un-associated STA can't send data frame while associated STA may send both data and management frames. (b) The management functions for associated, and un-associated STA are different and the size of frames may be very different. (c) It is unclear why an AP would schedule RUs for un-associated STAs and not using all available RUs for associated STAs to send UL data. (d) Mixing UL OFMA RA opportunities in one triggered-access duration for associated and un-associated STAs makes little sense. There are many parameters need to consider by AP in order to decide the suitable duration for the UL transmission slot. Any remedy to address the duration issue tends to increase the complexity of the feature.		2017/1/9 9:42
5024	Chittabrata Ghosh	225	1 27.2.2	5	42	E	N	5.42 27.2.2	Page 5, Line 42: Please replace the sentence "Note 1 - If a PS-Poll is received carried in a received HE SU PPDU, ..." with "Note 1 - If a PS-Poll is carried in a received HE SU PPDU, ..."	As in comment	2017/1/9 9:42
5025	Chittabrata Ghosh	225	1 9.2.4.6.4.1	25	18	T	N	25.18 9.2.4.6.4.1	Table 9-18a, Page 25, Line 18: Control ID value for RDP A-Control and corresponding content for control information is missing	Please add a Control ID for RDP A-Control	2017/1/9 9:42
5026	Chittabrata Ghosh	225	1 9.6.29.2	105	50	E	N	105.50 9.6.29.2	Typo in the word "Table"	Please replace the word "TTable 9-421ad ..." with "Table 9-421ad ..."	2017/1/9 9:42
5027	Chittabrata Ghosh	225	1 17.3.9.10	145	61	E	N	145.61 17.3.9.10	Replace "an non-HT ..." with "a non-HT ..."	As in comment	2017/1/9 9:42
5028	Chittabrata Ghosh	225	1 11.1.3.8	141	23	E	N	141.23 11.1.3.8	Replace "shall decodes the Beacon frame ...." to "shall decode the Beacon frame ..."	As in comment	2017/1/9 9:42
5029	Chittabrata Ghosh	225	1 9.4.2.219	93	49	E	N	93.49 9.4.2.219	replace the word "Nontransmitted BSSID or a transmitted BSSID ...." to "nontransmitted BSSID or a transmitted BSSID ..."	As in comment by replacing the word "Nontransmitted" to "nontransmitted"	2017/1/9 9:42
5030	Chittabrata Ghosh	225	1 28.1.1	64	27	E	N	64.27 28.1.1	Replace "an" with "a" as follows: "... when the STA is an 20MHz only non-AP STA" with "... when the STA is a 20MHz only non-AP STA."	As in comment	2017/1/9 9:42
5031	Chittabrata Ghosh	225	1 28.1.1	64	31	E	N	64.31 28.1.1	Replace "an" with "a" as follows: "... when the STA is an 20MHz only non-AP STA" with "... when the STA is a 20MHz only non-AP STA"	As in comment	2017/1/9 9:42
5032	Chittabrata Ghosh	225	1 27.2.3	6	18	T	N	6.18 27.2.3	It is specified that a STA that receives a Basic Trigger frame with its AID in Per User Info field shall update MU EDCA parameters. However, there is no STA behavior mentioned with respect to MU EDCA parameter update when a STA accesses a random access RU with AID 0 assigned in Basic Trigger frame;	Suggest to provide STA behavior when a STA accesses an RU assigned for random access indicated by AID 0 in Basic Trigger frame;	2017/1/9 9:42

5033	Chittabrata Ghosh	225	1 27.7.2	34	37	T	N	34.37 27.7.2		Individual TWT agreements discuss about UL MU operation either in Trigger-enabled TWT SP or in unannounced TWT SP; however, STA should be allowed to transmit SU PPDU within a TWT SP; explicit channel access behavior should be described to allow SU PPDU;	Suggest to mention about channel access for SU PPDU transmission within TWT SP using individual TWT agreements	2017/1/9 9:42
5034	Chittabrata Ghosh	225	1 9.4.2.200	69	51	T	N	69.51 9.4.2.200		It is mentioned that there are one or multiple TWT Parameter sets within a TWT element when Broadcast field is 1; for efficient parsing, it is beneficial to add an indication of the number of the TWT Parameter sets included within the TWT element	Please include signaling of the number of TWT Parameter sets in a TWT element	2017/1/9 9:42
5035	Chittabrata Ghosh	225	1 27.5.2.3	22	19	T	N	22.19 27.5.2.3		"If the STA is not associated with the AP, TBD"	Suggest to define an AID assigned by an AP for a STA that is not associated with the AP; one option is that the AP defines an AID for generic unassociated STA and then define a specific value for a specific unassociated STA; the other option is that the AP assigns an AID for a specific unassociated STA;	2017/1/9 9:42
5036	Chittabrata Ghosh	225	1 27.5.2.6.2	28	15	T	N	28.15 27.5.2.6.2		It is mentioned that the acknowledgement procedure for random access is as defined in 10.3.2.10.3; however, for an unassociated STA, due to its absence of an AID, may not be acknowledged as similar to an associated STA;	Suggest to define an MU acknowledgement procedure for unassociated STAs using UL OFDMA-based random access, following a definition of an AID for the TBD in Subclause 27.5.2.3.	2017/1/9 9:42
5037	Chittabrata Ghosh	225	1 27.4.4.5	16	34	T	N	16.34 27.4.4.5		There is a TBD in the sentence; define TBD	As in comment	2017/1/9 9:42
5038	Christopher Hansen	225	1 3.2	6	56	E	N	6.56 3.2		RU is not defined	Add a definition to Section 3.4	2017/1/9 9:42
5039	Christopher Hansen	225	1 4.3.14a	9	21	T	Y	9.21 4.3.14a		The text "An HE non-AP STA shall support operation in 20 MHz channel bandwidth only" seems to imply that 40 MHz and wider bandwidths are not allowed.	I assume that 20 MHz is mandatory but wider bandwiths are optional. Suggest using this language (or similar) instead.	2017/1/9 9:42
5040	Christopher Hansen	225	1 28.3.2.1	227	53	T	Y	227.53 28.3.2.1		The text "The DL MU transmission allows an AP to simultaneously transmit frames to more than one non-AP STAs." restricts transmission from one AP to another. This is un-necessary.	Remove "non-AP"	2017/1/9 9:42
5041	Christopher Hansen	225	1 28.3.11.5.1	318	27	T	Y	318.27 28.3.11.5.1		It is almost 2017 and we are defining a PHY with a binary convolutional code from the 1950s. This is backwards. Let's move on and use LDPC codes exclusively.	Remove this entire sub-clause.	2017/1/9 9:42
5042	Christopher Hansen	225	1 28.3.11.5.2	318	27	T	Y	318.27 28.3.11.5.2		The LDPC codes and encoding method (shortening and puncturing) developed in 802.11n are poor performing and obsolete. Remove this reference and allow new codes to be used for 802.11ax.	We need to form an 802.11ax subcomittee for LDPC codes and take new submissions.	2017/1/9 9:42
5043	Chunyu Hu	225	1 27.9	190	1	T	Y	190.01 27.9	8094	The MAC operation of the SRP mechanism is not described.	Provide a description of the MAC protocol for the SRP spatial reuse parameter. Expect a submission detailing a set of proposed changes.	2017/1/9 9:42
5044	Chunyu Hu	225	1 10.3.2.8a.2	117	5	T	Y	117.05 10.3.2.8a.2	8095	There might be more than one recipient of an MU-RTS.	Change "sent by the receipient of the MU-RTS frame" to "sent by any recipient of the MU-RTS frame"	2017/1/9 9:42
5045	Chunyu Hu	225	1 10.3.2.8a.2	117	10	T	Y	117.10 10.3.2.8a.2	8096	Why is the MU-RTS not allowed to be sent in an HE PPDU? There is no sense to having such a restriction.	Remove the cited line which disallows MU-RTS from being sent using an HE PPDU format.	2017/1/9 9:42
5046	Chunyu Hu	225	1 10.7.6	123	29	T	Y	123.29 10.7.6	8099	Due to power differences and other considerations, a situation can arise when the transmitter of a response frame using the standard required response MCS value is employing an MCS that will not work for the link because of the asymmetry, e.g. tx power asymmetry. Allow a STA to dictate the response PPDU MCS to avoid this problem.	Allow the transmitter of a response eliciting MPDU to include an indication of an appropriate MCS for the response MPDU. Expect a submission detailing some changes.	2017/1/9 9:42

5047	Chunyu Hu	225	1 9.3.1.9.7	38	35	T	Y	38.35 9.3.1.9.7	There is no explicit language anywhere stating what the allowed responses to single VHT are - I assume, without any explicit language, that both ACK and MBA are allowed	Clarify - even if the comment is correct, at least add a note pointing this out to avoid the possibility that an AP responds with ACK and a non-AP STA refuses it.	2017/1/9 9:42
5048	Chunyu Hu	225	1			T	Y		Size of the MBA response bitmap can be chosen by the MBA transmitter without constraint, so the STA that elicits the MBA cannot predict the duration of MBA - this is probably only a problem for SU PPDU eliciting frame because the MU PPDU includes a trigger for response which includes a duration value		2017/1/9 9:42
5049	Chunyu Hu	225	1 27.10.4	193	54	E	Y	193.54 27.10.4	A multi-TID A-MPDU may contain multiple noncontiguous nonzero length MPDU delimiters with EOF subfield equal to 1, one for each TID that solicits Ack and/or multiple noncontiguous nonzero length MPDU delimiters with EOF subfield equal to 0, one for each TID that solicits BlockAck.	Need to break setence after "one for each TID that solicit ACK" as the remaining statement is in parallel to "may contain multiple noncontiguous ...". Suggest to add ';' or ':'. Current way is confusing/misleading.	2017/1/9 9:42
5050	Chunyu Hu	225	1 10.13			T	Y	10.13	In IEEE 802.11-2016 publication, 10.13.3, page 1368, it's stated that QoS Null frame transmitted by DMG STA are not subject to this spacing, i.e., no MPDU delimiters with zero length need to be inserted after the MPDU immediately preceding the QoS Null frame in an A-MPDU. 11ax allows certain control and management frames to be aggregated with DATA frames. BAR/ACK/BA/MBA/Action/Trigger frame in A-MPDU doesn't need to comply the minimum MPDU spacing time following this QoS-Null example.	Shuold be ammended to 10.13	2017/1/9 9:42
5051	Chunyu Hu	225	1 9.2.4.6.4.2	50		T	Y	50.00 9.2.4.6.4.2	When AP uses a-control field (control ID = 0) to request UL OFDMA response, AP specifies only specifies MCS and RU allocation info. It's assumed that BCC will be used. However, as stated in 28.3.11.5, LDPC is the only encoding schemem for RU 484/996/2x996. This implies that the AP cannot solicit UL-OFDMA response using a-control/RSP field when the RU allocated to the non-AP exceeds RU484.	Should amend state clearly the limitation of using UL MU response scheduling; or amend to allow using MCS0-3/BCC for RU484/996/2x996 size to make this schedule flexible. Prefer the latter.	2017/1/9 9:42
5052	David Kloper	225	1 9.2.4.6.4.3	24	54	T	Y	24.54 9.2.4.6.4.3	Is this limiting SS that can be allocated to a User, or aggregate number of SS in an MU-MIMO transmission?	Please add clarification.	2017/1/9 9:42
5053	David Kloper	225	1 9.2.4.6.4.3	24	62	T	Y	24.62 9.2.4.6.4.3	This should only limit UL MU for sending of buffered data, and not prohibit UL MU allocation for immediate Block Acknowledments. Otherwise it would prohibit DL MU.	Please add clarification.	2017/1/9 9:42
5054	David Kloper	225	1 9.2.4.6.4.5	27	3	T	Y	27.03 9.2.4.6.4.5	This legacy definition does not have sufficient information to enable the correct UL MU allocation. The size should include MPDU headers, and AMPDU delimiters or it will often underestimate the allocation.	Please update definition to include all MAC layer overhead required to transfer the MSDU.	2017/1/9 9:42
5055	David Kloper	225	1 9.2.4.6.4.5	27	12	T	Y	27.12 9.2.4.6.4.5	Since this field is intended to allow UL MU allocation, it must only include MSDU that are available for sending in immediate response to a Trigger frame. Inclusion of buffered traffic that the MAC is not prepared to deliver would result in overallocation.	Please add clarification.	2017/1/9 9:42
5056	David Kloper	225	1 9.2.4.6.4.5	27	12	T	N	27.12 9.2.4.6.4.5	Since we can now carry MMPDU and MPDU in the same AMPDU, should these sizes include MMPDU as well as MSDU?	Please add clarification.	2017/1/9 9:42

5057	David Kloper	225	1 9.3.1.9.3	37	15	T	Y	37.15 9.3.1.9.3	The A-MSDU aggregation is often performed at a different layer than A-MPDU aggregation. As such we should allow fragmentation of A-MSDU. There are multiple references to prohibiting this, and we appear to allow reception of fragmented A-MSDU to be optional. See AMSDU Fragmentation support, p 76.	Update all references.	2017/1/9 9:42
5058	David Kloper	225	1 9.3.1.9.7	38	6	T	Y	38.06 9.3.1.9.7	What is the procedure to identify that all MPDU in an AMPDU were received successfully? An MPDU with a good/bad FCS is easy, but what about delimiters being bad causing an MPDU to be lost. A detailed proceedure is required in order to enable this.	A procedure should be defined that is not error prone.	2017/1/9 9:42
5059	David Kloper	225	1 9.3.1.23	47	34	T	Y	47.34 9.3.1.23	The range of values does not match range of dBm targets.	Adjust ranges to match	2017/1/9 9:42
5060	David Kloper	225	1 3.4	7	19	E	N	7.19 3.4	Add S-MPDU into the acronym list	Several refernces, but not listed in acronyms	2017/1/9 9:42
5061	Dengyu Qiao	225	1 10.43.1	138	7	T	Y	138.07 10.43.1	Please clarify the meaning of "Wake TBTT Negotiation subfield = don't care"	as in comment	2017/1/9 9:42
5062	Dengyu Qiao	225	1 10.43.1	139	9	T	Y	139.09 10.43.1	Some rows are missing. For example, there is no description for the case that Initiating frame is Request TWT with Wake TBTT Negotiation subfield =1, and Response frame is Accept TWT with Wake TBTT Negotiation subfield =1 and Broadcast subfield =1	Even if it is not allowed, it still should be included	2017/1/9 9:42
5063	Dengyu Qiao	225	1 10.9	127	26	E	Y	127.26 10.9	10.31.4 does not exist in Draft1.0	10.31.4 should be revised as 27.13	2017/1/9 9:42
5064	Dengyu Qiao	225	1 10.43.1	139		T	Y	139.00 10.43.1	Broadcast TWT ID is introduced. For Broadcast TWT, TWT scheduled STA cannot provide any resource requirement in TWT element during negotiation of wake TBTT. How does TWT scheduling STA determine to accept or reject the TWT request from TWT scheduled STA.	please clarify	2017/1/9 9:42
5065	Dengyu Qiao	225	1 27.7.3.1	183	9	T	Y	183.09 27.7.3.1	In Figure 27-5, AP uses M-BA to acknowledge multiple PS-Poll frames. The current M-BA mechanism cannot support it.	please correct it	2017/1/9 9:42
5066	Dengyu Qiao	225	1 9.3.1.23	45	36	T	Y	45.36 9.3.1.23	In TWT SP, if AP want to use random access RU to collect buffer status information from TWT scheduled STAs, AP can send a Trigger frame to indicate an RU with AID12=0. But a STA that has no TWT capability also can use the RU to do OFDMA random access. This is inefficient way.	Define a mechanism to solve this issue.	2017/1/9 9:42
5067	Dengyu Qiao	225	1 9.3.1.9.7	37	64	T	Y	37.64 9.3.1.9.7	Regarding multi-TID A-MPDU, the current M-BA mechanism needs to include multiple Per STA Info subfields to acknowledge to one STA.	Define a mechanism to use only one Per STA Info subfield to acknowledge multi-TID MPDUs transmitted by a same STA	2017/1/9 9:42
5068	Dengyu Qiao	225	1 27.16.3.3	208	24	T	Y	208.24 27.16.3.3	How to set Duration field in MAC header? Is it same as Duration field of QTP setup IE?	please clarify	2017/1/9 9:42
5069	Dengyu Qiao	225	1 9.4.2.223	96	22	T	Y	96.22 9.4.2.223	QTP setup frame only contains Vendor Specific Service Identifier, in order to distinguish different types of STA2STA operation, such as NAN, DLS, and etc. In dense environment, if many DLS links try to contend for channel in QTP period, they may collide or interferece with each other.	as in comment	2017/1/9 9:42
5070	Der-Zheng Liu	225	1 28.3.18.1	350	25	G	Y	350.25 28.3.18.1	To add limitation of -53dBm/MHz at frequency offset greater than 9.75 MHz for 20MHz	The transmit spectrum shall not exceed the maximum of the interim transmit spectral mask and -53 dBm/MHz at any frequency offset greater than 9.75 MHz.	2017/1/9 9:42
5071	Der-Zheng Liu	225	1 28.3.18.1	351	36	G	Y	351.36 28.3.18.1	To add limitation of -59dBm/MHz at frequency offset greater than 39.5 MHz for 80MHz	The transmit spectrum shall not exceed the maximum of the interim transmit spectrum mask and -59 dBm/MHz at any frequency offset greater than 39.5 MHz.	2017/1/9 9:42
5072	Der-Zheng Liu	225	1 28.3.18.1	352	7	G	Y	352.07 28.3.18.1	To add limitation of -62dBm/MHz at frequency offset greater than 79.5 MHz for 160MHz	The transmit spectrum shall not exceed the maximum of the interim transmit spectrum mask and -62 dBm/MHz at any frequency offset greater than 79.5 MHz.	2017/1/9 9:42

5073	Der-Zheng Liu	225	1 28.3.18.1	352	8	G	Y	352.08 28.3.18.1	To change to be -62dBm/MHz for 160MHz	Figure 28-40 (Example transmit spectral mask for a 160 MHz mask PPDU) shows an example of the resulting overall spectral mask when the -40 dBr spectrum level is above -62 dBm/MHz.	2017/1/9 9:42
5074	Der-Zheng Liu	225	1 28.3.18.1	352	49	G	Y	352.49 28.3.18.1	To add limitation of -59dBm/MHz at frequency offset greater than 39.5 MHz for 80+80MHz	The transmit spectrum shall not exceed the maximum of the interim transmit spectrum mask and -59 dBm/MHz at any frequency offset greater than 39.5 MHz.	2017/1/9 9:42
5075	Der-Zheng Liu	225	1 10.3.2.8a	117	42	T	Y	117.42 10.3.2.8a	For the example of Figure 10-9a, if only one of STA1 and STA2 respones a valid CTS frame, AP should recognite as successful respone. But if STA1 is busy, AP would still sent DL MU PPDU, and STA1 would be not protected by this MU-RTS/CTS procedure.	The MU-RTS/CTS procedure allows an AP to protect an MU transmission. An HE AP may transmit an MU-RTS frame to solicit simultaneous CTS responses from one or more HE STAs. Need to find out a better solution for some hidden node issue caused by the simultaneous CTS responses.	2017/1/9 9:42
5076	Der-Zheng Liu	225	1 10.3.2.8a	117	42	T	Y	117.42 10.3.2.8a	For the example of Figure 10-9c, STA1 should sent a CTS frame response on primary 20MHz channel indicated by MU-RTS, if the primary 20MHz is idle. However, if there is a hidden node for AP and STA2, which interferes STA1 on secondary 20 MHz channel, STA1 still would sent the CTS frame response. Right? In this case, AP sent a DL MU PPDU to STA1 and STA2, STA1 may be collided by this hidden node for AP.	A CTS frame sent in response to an MU-RTS frame shall be transmitted on the 20 MHz channels indicated in the RU Allocation subfield of the User Info field of the MU-RTS frame when the indicated 20 MHz channels are all idle. If any 20 MHz channel indicated in the RU Allocation subfield of the User Info field is busy, the CTS frame response shall not be transmitted. 1. Need to find out a better solution for some hidden node issue caused by the CTS frame response on a smaller BW channel indicated by MU-RTS. 2. Why not to limit the CTS frame response with the same full bandwith?	2017/1/9 9:42
5077	Der-Zheng Liu	225	1 9.4.2.218.1	76	2	E	Y	76.02 9.4.2.218.1	To remove one of double dots.	The HE Capabilities element is defined in Figure 9-589cj (HE Capabilities element format).	2017/1/9 9:42
5078	Der-Zheng Liu	225	1 9.4.2.218.5	89	38	E	Y	89.38 9.4.2.218.5	To remove one of double dots.	Each PPET8 for NSSn for RUb subfield and PPET16 for NSSn for RUb subfield contains an integer that corresponds to a constellation index value related to the transmission constellation of an HE PPDU as defined in Table 9-262ac (Constellation index).	2017/1/9 9:42
5079	Der-Zheng Liu	225	1 10.3.2.8a.1	116	3	E	Y	116.03 10.3.2.8a.1	To remove one of double dots.	Figure 10-9a (Example of MU-RTS/CTS/DL MU PPDU/Acknowledgement Response and NAV setting) shows an example of the exchange of MU-RTS and simultaneous CTS responses to protect DL MU PPDU and acknowledgement responses.	2017/1/9 9:42
5080	Der-Zheng Liu	225	1 27.3.3.1	152	20	E	Y	152.20 27.3.3.1	To remove one of double dots.	An originator STA transmitting an MPDU or A-MPDU that contains one or more dynamic fragments shall solicit an immediate response from the recipient STA for each of the fragments contained in the MPDU or A-MPDU, except when the fragments are sent under level 3 dynamic fragmentation (see 27.3.3.4 (Level 3 dynamic fragmentation)).	2017/1/9 9:42
5081	Der-Zheng Liu	225	1 27.4.4.5	162	25	E	Y	162.25 27.4.4.5	To remove one of double dots.	The Ack Type field shall be set according to the acknowledgement context.	2017/1/9 9:42
5082	Der-Zheng Liu	225	1 27.5.2.2.1	164	45	E	Y	164.45 27.5.2.2.1	To remove one of double dots.	For recipient STAs that are associated with the AP, the User Info field is addressed to a recipient STA if the value of the AID12 subfield of the User Info field is equal to the AID of the STA or to 0 (indicating a random access allocation).	2017/1/9 9:42
5083	Der-Zheng Liu	225	1 27.5.2.3	170	16	E	Y	170.16 27.5.2.3	To remove one of double dots.	NOTE 2--The frame type of MPDUs may be different across A-MPDUs within a same HE trigger-based PPDU.	2017/1/9 9:42
5084	Der-Zheng Liu	225	1 27.7.3.2	185	16	E	Y	185.16 27.7.3.2	To remove one of double dots.	An unannounced TWT SP, without following the rules in 11.2.2.2.6 (AP operation during the CP)	2017/1/9 9:42

5085	Der-Zheng Liu	225	1 28.3.3.2	229	31	E	Y	229.31 28.3.3.2	To remove one of double dots.	The maximum number of RUs in the 20 MHz, 40 MHz, 80 MHz, 160 MHZ and 80+80 MHz HE PPDU formats are defined in Table 28-2 (Maximum number of RUs for each channel width).	2017/1/9 9:42
5086	Der-Zheng Liu	225	1 28.3.8	256	42	E	Y	256.42 28.3.8	To remove one of double dots.	Table 28-9 (Timing-related constants) defines the timing-related parameters for HE PPDU formats.	2017/1/9 9:42
5087	Der-Zheng Liu	225	1 28.3.10.8.5	296	43	E	Y	296.43 28.3.10.8.5	To replace double DOT by one COMMA	Set to n for MCSn, where n = 0, 1, 2, ..., 11	2017/1/9 9:42
5088	Dmitry Cherniavsky	225	1 27.9	190	1	T	Y	190.01 27.9	The section: "27.9 Spatial reuse operation" does not take antenna and beam-forming in consideration, which is an overlook in my opinion.	There should be a constraint put in place on antenna configuration and beam-forming for spatial reuse. In the most conservative case the same antenna configuration used for reception should be used for Tx. If beam-forming or non-omni antenna is used, the maximum power needs to be scaled down by antenna gain.	2017/1/9 9:42
5089	Dmitry Cherniavsky	225	1 9.3.1.23	45	11	T	Y	45.11 9.3.1.23	Doppler mode is sufficiently defined	I can't propose a change, I can not figure out from the draft, what "Doppler mode" means.	2017/1/9 9:42
5090	Dmitry Cherniavsky	225	1 9.3.1.23	45	11	E	Y	45.11 9.3.1.23	Doppler refer to a last name of famous scientist and must be written with capital letter in the sentence: "The Doppler subfield indicates a high doppler mode of transmission." Also a mode can not be high. I think, the intention is to indicate a possible presence of high Doppler effect.	One possibility is: The Doppler subfield indicates a mode of transmission accounting for a high Doppler effect. As my another comment states, the Doppler mode is not sufficiently defined and here is the place where it could be elaborated.	2017/1/9 9:42
5091	Donald Eastlake 3rd	225	1 4.3.14a	9	18	T	Y	9.18 4.3.14a	Why talk about 40MHz, 80MHz, etc., if an HE non-AP STA can only support 20MHz as stated in line 21?	Make consistant.	2017/1/9 9:42
5092	Donald Eastlake 3rd	225	1 9.2.4.5.6	21	2	E	N	21.02 9.2.4.5.6	It says "non-AP HE STA" but on page 9 in lines 18 and 21 it says "HE non-AP STA".	Make consistent throughout document. I suggest the "HE non-AP STA" ordering.	2017/1/9 9:42
5093	Donald Eastlake 3rd	225	1 9.3.1.8.1	33	43	E	N	33.43 9.3.1.8.1	Editorial instruction not in bold italic.	Make gold italic.	2017/1/9 9:42
5094	Donald Eastlake 3rd	225	1 27.5.2.3	167	59	T	Y	167.59 27.5.2.3	Incomplete Draft.	Fill in for "tbd".	2017/1/9 9:42
5095	Dong Guk Lim	225	1 28.3.6.4	250	38	G	Y	250.38 28.3.6.4	In legacy part, we don't use the concept of RU described in 28.3.11.8. So, for the clarification, the reference should be changed with 17.3.5.7	Change the reference 28.3.11.8 (BCC interleavers) to 17.3.5.7 (Data interleaving).	2017/1/9 9:42
5096	Dong Guk Lim	225	1 28.3.6.5	251	7	G	Y	251.07 28.3.6.5	In legacy part, we don't use the concept of RU described in 28.3.11.8. So, for the clarification, the reference should be changed with 17.3.5.7	Change the reference 28.3.11.8 (BCC interleavers) to 17.3.5.7 (Data interleaving).	2017/1/9 9:42
5097	Dong Guk Lim	225	1 28.3.6.8	253	7	T	Y	253.07 28.3.6.8	We have agreed that the phase rotation is not applied on HE-STF and beyond. Please rerfer the PHY Motion 82, November 2015. So, the phase rotation is not needed.	Change the sentence of clause b) with "Phase rotation: Apply 1 for all subcarrier irrespective bandwidth as described in 28.3.9 (Mathematical description of signals)."	2017/1/9 9:42
5098	Dong Guk Lim	225	1 28.3.6.9	253	32	T	Y	253.32 28.3.6.9	We have agreed that the phase rotation is not applied on HE-STF and beyond. Please rerfer the PHY Motion 82, November 2015. So, the phase rotation is not needed.	Change the sentence of clause b) with "Phase rotation: Apply 1 for all subcarrier irrespective bandwidth as described in 28.3.9 (Mathematical description of signals)."	2017/1/9 9:42
5099	Dong Guk Lim	225	1 28.3.6.9	253	16	T	Y	253.16 28.3.6.9	In time domain, the HE-STF symbol just consists of five-repeated time seqeunce as described in table 28-9. And, it does not inculde the GI in a symbol. So insertion of GI at STF symbol is wrong.	Change the sentence of cluase f) with "Apply windowing as described in 28.3.9 (Mathematical description of signals). "	2017/1/9 9:42
5100	Dong Guk Lim	225	1 28.3.6.9	253	36	T	Y	253.36 28.3.6.9	In an UL MU-MIMO transmission not using the single stream pilot, the LTF sequense is generated by masking with P matrix as defined in Equation (28-53). And in this case, A matrix mapping is not used additionally, since this sequence is directly used. So, this sentence should be revised for clarification.	Chage the sentence of clause c) with "Apply the PHE-LTF matrix to the data tones of the HE-LTF sequence and apply the RHE-LTF matrix to pilot tones except the ULMU-MIMO transmission not using single stream pilot as described in 28.3.10.10 (HE-LTF)."	2017/1/9 9:42
5101	Dong Guk Lim	225	1 28.3.6.10.1	254	24	T	Y	254.24 28.3.6.10.1	We have agreed that the phase rotation is not applied on HE-STF and beyond. Please rerfer the PHY Motion 82, November 2015. So, the phase rotation is not needed.	Chage the sentence of cluase b) with " Phase rotation: Apply 1 for all subcarrier irrespective bandwidth as described in 28.3.9 (Mathematical description of signals) ."	2017/1/9 9:42

5102	Dong Guk Lim	225	1 28.3.6.10.2	255	12	T	Y	255.12 28.3.6.10.2	We have agreed that the phase rotation is not applied on HE-STF and beyond. Please rerfer the PHY Motion 82, November 2015. So, the phase rotation is not needed.	Chage the sentence of cluase b) with " Phase rotation: Apply 1 for all subcarrier irrespective bandwidth as described in 28.3.9 (Mathematical description of signals) ."	2017/1/9 9:42
5103	Dong Guk Lim	225	1 28.3.6.11.4	255	55	T	Y	255.55 28.3.6.11.4	Accroding to PHY motion 82, phase rotaion is not applied at data field of HE-PPDU, so it is not needed.	chage the sentence of cluase b) with " Phase rotation: Apply 1 for all subcarrier irrespective bandwidth as described in 28.3.9 (Mathematical description of signals) ."	2017/1/9 9:42
5104	Dong Guk Lim	225	1 28.3.10.1	267	44	T	Y	267.44 28.3.10.1	As indicated in figure 28-18, L-STF and L-LTF are included in pre-HE modulated fields. Fort the clarification, add the L-STF, L-LTF and L-SIG in the sentence for various HE PPDU formats	Insert the L-STF, L-LTF and L-SIG to each sentence from line 44 to line 48.	2017/1/9 9:42
5105	Dong Guk Lim	225	1 28.3.10.5	270	45	T	Y	270.45 28.3.10.5	Definition of m is wrong, accroding to PHY motion 69, m =1 means SU PPDU format and triger based PPDU, m=2 means either MU PPDU or Exended range SU PPDU format. Thus, this sentence shoud be corrected.	Change the following sentence "m is 1 for an HE MU PPDU and HE extended range SU PPDU, and 2 otherwise " to "m is 1 for HE SU PPDU and HE trigger-based PPDU and 2 for an HE MU PPDU and HE extended range SU PPDU "	2017/1/9 9:42
5106	Dong Guk Lim	225	1 28.3.10.7.4	284	43	T	Y	284.43 28.3.10.7.4	Accroding to PHY motion 69, m =2 means HE MU PPDU and HE extended range SU PPDU so, it should be correted.	Change m =1 to m =2.	2017/1/9 9:42
5107	Dong Guk Lim	225	1 28.3.10.10	301	37	T	Y	301.37 28.3.10.10	Table 28-12 (Frequently used parameters) does not provide any function related with NHE-LTF, so the function of number of HE-LTF symbol would need to be clarified by considering the total number of space time stream.	Provide the function of relation between number of LTF symbol and total number of space time stream like as table 21-13 in 802.11-2016.	2017/1/9 9:42
5108	Dong Guk Lim	225	1 28.3.10.10	301	43	T	Y	301.43 28.3.10.10	In an HE MU PPDU and HE trigger-based PPDU, NHE-LTF is indicated to STA by using the fields of HE-SIG-A and available number of LTF symbol is 1,2,4,6,8 described in 28.3.10.7.2. and this value can be determined by the Nsts,total. So, we need the obvious function like as table 21-13.	Chage the reference Table 28-12 (Frequently used parameters) with Table 21-13.	2017/1/9 9:42
5109	Dong Guk Lim	225	1 9.3.1.23	44	23	E	N	44.23 9.3.1.23	A wrong table is referred, so correct the table reference.	Change Table 22-13 with Table 21-13.	2017/1/9 9:42
5110	Dong Guk Lim	225	1 27.6.4	179	14	E	N	179.14 27.6.4	Reference is wrong. Correct it .	Change 26.1.4 (PPDU formats) with 28.3.4 HE PPDU formats	2017/1/9 9:42
5111	Dong Guk Lim	225	1 27.15.4.1	203	10	E	N	203.10 27.15.4.1	Reference is wrong. Correct it .	Change the reference 26.5 with 28.5	2017/1/9 9:42
5112	Dorothy Stanley	225	1 3	3	1	T	Y	3.01 3	Resource Unit and RU is a major new concept and terminology for 802.11. Need to and a definition in 3.2 and add RU to acronym list in 3.4. (For example, does RU apply to MU in general for both MU-MIMO and OFDMA, or just OFDMA?)	As in comment	2017/1/9 9:42
5113	Dorothy Stanley	225	1 3	3	1	T	Y	3.01 3	Define DL HE MU PPDU	As in comment	2017/1/9 9:42
5114	Dorothy Stanley	225	1 3	3	1	T	Y	3.01 3	Define UL HE MU PPDU	As in comment	2017/1/9 9:42
5115	Dorothy Stanley	225	1 3	3	1	T	Y	3.01 3	Define DL MU PPDU	As in comment	2017/1/9 9:42
5116	Dorothy Stanley	225	1 4.3.14a	9	18	T	Y	9.18 4.3.14a	Regarding, "An HE non-AP STA supporting 20 MHz, 40 MHz, 80 MHz, 160 MHz and 80+80 MHz is also a VHT non-AP STA", an HE non-AP STA supporting 20 MHz, 40 MHz and 80 MHz should also be an VHT non-AP STA	correct the statement	2017/1/9 9:42
5117	Dorothy Stanley	225	1 4.3.14a	9	21	T	Y	9.21 4.3.14a	Regarding, "An HE non-AP STA shall support operation in 20 MHz channel bandwidth only", am I interpreting this correctly that an HE non-AP STA will only operate in 20 MHz? I'm guessing that tne intent is we want all HE non-AP STAs to support 20 MHz-only operation. If so, change the sentence to "An HE non-AP STA shall support 20 MHz-only operation"	As in comment	2017/1/9 9:42

5118	Dorothy Stanley	225	1 4.3.14a	9	27	T	Y	9.27 4.3.14a	Regarding, "An HE non-AP STA shall support operation in 20 MHz channel bandwidth only", am I interpreting this correctly that an HE non-AP STA will only operate in 20 MHz? I'm guessing that tne intent is we want all HE non-AP STAs to support 20 MHz-only operation. If so, change the sentence to "An HE non-AP STA shall support 20 MHz-only operation"	As in comment	2017/1/9 9:42
5119	Dorothy Stanley	225	1 4.3.14a	9	29	T	Y	9.29 4.3.14a	UL MU-MIMO a main PHY feature, and needs to be added to this list.	As in comment	2017/1/9 9:42
5120	Dorothy Stanley	225	1 4.3.14a	9	49	T	Y	9.49 4.3.14a	There is entire MAC section called UL MU. This needs to be added to the list	As in comment	2017/1/9 9:42
5121	Dorothy Stanley	225	1 4.3.14a	9	49	T	Y	9.49 4.3.14a	There is entire MAC section called Spatial Reuse. This needs to be added to the list	As in comment	2017/1/9 9:42
5122	Dorothy Stanley	225	1 9.2.4.6.4.2	24	11	T	Y	24.11 9.2.4.6.4.2	Is DL TX Power conducted power or EIRP? Please clarify.	As in comment	2017/1/9 9:42
5123	Dorothy Stanley	225	1 9.2.4.6.4.2	24	27	T	Y	24.27 9.2.4.6.4.2	Why is UL MCS limited to MCS 0-3? In dense deployments, we will want higher MCS's. Please clarify.	As in comment	2017/1/9 9:42
5124	Dorothy Stanley	225	1 9.2.4.6.4.3	24	59	T	Y	24.59 9.2.4.6.4.3	What does a station that supports 160 MHz but not 80+80 MHz set Channel Width to? Please clarify.	As in comment	2017/1/9 9:42
5125	Dorothy Stanley	225	1 9.2.4.6.4.3	24	63	T	Y	24.63 9.2.4.6.4.3	UL MU is a critical feature in order to achieve the goal of high efficiency. Why are we allowing devices to disable UL MU operation? If this is for power save, then perhaps only allow devices to not support UL MU if their uplink duty cycle is very, very low.	As in comment	2017/1/9 9:42
5126	Dorothy Stanley	225	1 9.2.4.6.4.5	25	32	T	Y	25.32 9.2.4.6.4.5	While queue size is definitely important to the AP in order to schedule UL MU, there are other metrics that are important as well. For example, knowing that the client is experiencing excessive jitter and latency on the uplink or has low battery life will be useful.	Modify BSR accordingly	2017/1/9 9:42
5127	Dorothy Stanley	225	1 9.2.4.6.4.7	27	47	T	Y	27.47 9.2.4.6.4.7	Regarding "Bandwidth Query report operation to assist HE DL HE MU transmission", why is this report for DL only? When the AP schedules RUs to clients in uplink, wouldn't it be important to know uplink 20 MHz sub-channel availability around the client?	Modify BQR accordingly	2017/1/9 9:42
5128	Dorothy Stanley	225	1 9.3.1.9.1	34	10	T	Y	34.10 9.3.1.9.1	The start of reserved was changed from B5 to B6 in Figure 9-33. But there is no new label for B5.	Add label for B5	2017/1/9 9:42
5129	Dorothy Stanley	225	1 9.3.1.23	44	37	T	Y	44.37 9.3.1.23	Is AP Tx Power conducted or EIRP? Please clarify.	As in comment	2017/1/9 9:42
5130	Dorothy Stanley	225	1 9.3.1.23	44	13	T	Y	44.13 9.3.1.23	Its rediculous to have two LTF types for just the UL MU-MIMO PPDU. Save a bit in Trigger frame and PHY implementation complexity by just selecting single stream pilots which we used in 11ac and removing Mask LTF.	As in comment	2017/1/9 9:42
5131	Dorothy Stanley	225	1 9.3.1.23	45	11	T	Y	45.11 9.3.1.23	I don't see anywhere a definition for "high doppler mode of transmission". Please define or delete this field throughout the spec.	As in comment	2017/1/9 9:42
5132	Dorothy Stanley	225	1 9.3.1.23.6	51	30	T	Y	51.30 9.3.1.23.6	Regarding, "9.3.1.23.6 GCR MU-BAR variant", while we're modifying GCR and multicast, we need to address the issue that multicast only uses legacy rates.	expand the rate set available for multicast	2017/1/9 9:42
5133	Dorothy Stanley	225	1 9.3.3.1	52	43	E	Y	52.43 9.3.3.1	change pre-sent to present	As in comment	2017/1/9 9:42
5134	Dorothy Stanley	225	1 9.4.2.218.2	77	54	T	Y	77.54 9.4.2.218.2	What is Maximum Number of Fragmented MSDU's set to if Fragmentation Support is 0? Please clarify.	As in comment	2017/1/9 9:42
5135	Dorothy Stanley	225	1 9.4.2.218.2	78	4	T	Y	78.04 9.4.2.218.2	What is Minimum Fragment Size set to if Fragmentation Support is 0? Please clarify.	As in comment	2017/1/9 9:42
5136	Dorothy Stanley	225	1 9.4.2.218.2	78	14	T	Y	78.14 9.4.2.218.2	What does an HE AP STA set this field to? Please clarify.	As in comment	2017/1/9 9:42
5137	Dorothy Stanley	225	1 9.4.2.218.2	79	42	T	Y	79.42 9.4.2.218.2	The information is blank in Table 9-262z for "Maximum AMPDU Length Exponent"	Add information	2017/1/9 9:42
5138	Dorothy Stanley	225	1 9.4.2.218.2	79	57	T	Y	79.57 9.4.2.218.2	What does an HE AP STA set this field to? Please clarify.	As in comment	2017/1/9 9:42

5139 Dorothy Stanley	225	1 9.4.2.218.3	82	26	T	Y	82.26 9.4.2.218.3	Regarding B5, if an AP establishes a 40 MHz BSS, and the non-AP STA sets B5 0, then the AP can never assign an RU to the non-AP STA? Or in other words, the non-AP STA will never participate in OFDMA? If this is the case, it is a bad idea and will greatly reduce efficiency. We should at least make the 20 MHz non-AP STAs participate in OFDMA in the primary channel.	As in comment	2017/1/9 9:42
5140 Dorothy Stanley	225	1 9.4.2.218.3	82	30	T	Y	82.30 9.4.2.218.3	Regarding B6, if an AP establishes a 40 MHz or 80 MHz BSS, and the non-AP STA sets B6 0, then the AP can never assign an RU to the non-AP STA? Or in other words, the non-AP STA will never participate in OFDMA? If this is the case, it is a bad idea and will greatly reduce efficiency. We should at least make the 20 MHz non-AP STAs participate in OFDMA in the primary channel.	As in comment	2017/1/9 9:42
5141 Dorothy Stanley	225	1 9.4.2.218.3	83	46	T	Y	83.46 9.4.2.218.3	I couldn't find "Doppler procedure" defined anywhere. Either define the procedure or delete the field.	As in comment	2017/1/9 9:42
5142 Dorothy Stanley	225	1 9.4.2.218.3	83	46	T	Y	83.46 9.4.2.218.3	Regarding the field "UL MU", this field is much more specific as to whether the STA supports UL MU-MIMO	Change name of the field to "UL MU-MIMO"	2017/1/9 9:42
5143 Dorothy Stanley	225	1 9.4.2.218.3	84	26	T	Y	84.26 9.4.2.218.3	Regarding the field UL HE MU PPDU Payload Support", please clarify. It is reserved for non-AP STA, so does that mean that non-AP STAs are disallowed to support or mandatory to support? Does this really indicate behavior for all STA type, or is it really for just for HE AP? I can't find the use of the field anywhere in the draft. Why is the capability element needed? In fact, there doesn't even appear to be a definition for UL HE MU PPDU, so add one.	as in comment	2017/1/9 9:42
5144 Dorothy Stanley	225	1 9.4.2.218.3	84	30	T	Y	84.30 9.4.2.218.3	Regarding "SU Beamformer", what does "Set to 1 if sent by an HE AP with support for 4 or more spatial streams." mean? Does is mean that a AP STA always sets it to 1 if it supports 4+ SS and that being an SU beamformer is then mandatory? Please clarify.	as in comment	2017/1/9 9:42
5145 Dorothy Stanley	225	1 9.4.2.218.3	84	36	T	Y	84.36 9.4.2.218.3	Regarding "SU Beamformee", what does "Set to 1 if sent by a non-AP STA." mean? Does is mean that a non-AP STA always sets it to 1 and that being an SU beamformee is mandatory? Please clarify.	as in comment	2017/1/9 9:42
5146 Dorothy Stanley	225	1 9.4.2.218.3	84	40	T	Y	84.40 9.4.2.218.3	Regarding "MU Beamformer", what does "Set to 1 if sent by an AP." mean? Does is mean that an AP always sets it to 1 and that being an MU beamformee is mandatory? Please clarify. what does "Set to 0 if sent by a non-AP STA." mean? Does is mean that a non-AP STA always sets it to 0 and that being an MU beamformer is prohibited? Please clarify. if the above is true, then why do we need this capability bit? AP is mandatory, non-AP is disallowed - don't need a capability bit for this, just a shall statement somewhere.	as in comment	2017/1/9 9:42
5147 Dorothy Stanley	225	1 9.4.2.218.3	84	40	T	Y	84.40 9.4.2.218.3	I don't see MU Beamforee capability bit. Does that mean its mandatory for AP and non-AP? Please clarify.	as in comment	2017/1/9 9:42
5148 Dorothy Stanley	225	1 9.4.2.218.3	84	49	T	Y	84.49 9.4.2.218.3	Regarding "Beamformee STS", what are the settings for MU beamformee? Please clarify.	as in comment	2017/1/9 9:42
5149 Dorothy Stanley	225	1 9.4.2.218.3	84	49	T	Y	84.49 9.4.2.218.3	Regarding "NSTS Total...", Please clarify whether this is for DL MU-MIMO Beamformee or SU Beamformee or both.	as in comment	2017/1/9 9:42

5150 Dorothy Stanley	225	1 9.4.2.218.3	85	6	T	Y	85.06 9.4.2.218.3	Regarding "Beamformee STS...", what are the settings for MU beamformee? Please clarify.	as in comment	2017/1/9 9:42
5151 Dorothy Stanley	225	1 9.4.2.218.3	85	13	T	Y	85.13 9.4.2.218.3	Regarding "NSTS Total...", Please clarify whether this is for DL MU-MIMO Beamformee or SU Beamformee or both.	as in comment	2017/1/9 9:42
5152 Dorothy Stanley	225	1 9.4.2.218.3	85	20	T	Y	85.20 9.4.2.218.3	Regarding "Number Of Sounding Dimensions...", what are the settings for MU beamformer? Please clarify.	as in comment	2017/1/9 9:42
5153 Dorothy Stanley	225	1 9.4.2.218.3	85	26	T	Y	85.26 9.4.2.218.3	Regarding "Number Of Sounding Dimensions...", what are the settings for MU beamformer? Please clarify.	as in comment	2017/1/9 9:42
5154 Dorothy Stanley	225	1 9.4.2.218.3	86	11	T	Y	86.11 9.4.2.218.3	Regaring, "DL MU-MIMO on Partial BW". Does this imply that reception by a non-AP STA of DL MU-MIMO on full BW is mandatory? Please clarity and indicate where the shall statement is for this.	as in comment	2017/1/9 9:42
5155 Dorothy Stanley	225	1 9.4.2.218.3	86	18	T	Y	86.18 9.4.2.218.3	Define SRP	as in comment	2017/1/9 9:42
5156 Dorothy Stanley	225	1 9.4.2.218.3	86	18	T	Y	86.18 9.4.2.218.3	I can't find the use of "SRP-based SR Support" field anywhere in the draft. Why is the capability element needed?	as in comment	2017/1/9 9:42
5157 Dorothy Stanley	225	1 9.4.2.218.3	86	30	T	Y	86.30 9.4.2.218.3	Regarding "A STA that declares support for HE trigger-based PPDUs", how does a STA declare support? i.e. what field is set?	as in comment	2017/1/9 9:42
5158 Dorothy Stanley	225	1 9.4.2.219	91	50	T	Y	91.50 9.4.2.219	What is PE? Please define.	As in comment	2017/1/9 9:42
5159 Dorothy Stanley	225	1 10.3.1	113	45	T	Y	113.45 10.3.1	"HE duration-based RTS" sounds like a name of a function/feature. But I don't see any definition for it.	Define the protocol for establishing "HE duration-based RTS". Perhaps turn 10.3.2.4a into something useful.	2017/1/9 9:42
5160 Dorothy Stanley	225	1 10.3.2.4	114	62	T	Y	114.62 10.3.2.4	Regarding, "A STA shall update the NAV...", this seems pretty broad. Would legacy STAs now be required to update NAV based on new HE information? Or are we counting on the fact that legacy STAs would not be able to decode this PHY format? Perhaps limit this to HE STA?	as in comment	2017/1/9 9:42
5161 Dorothy Stanley	225	1 10.3.2.4	115	38	T	Y	115.38 10.3.2.4	How is the "HE duration-based RTS threshold" used by the non-AP HE STAs?	Define the protocol and provide normative language for how the non-AP HE STAs behaves upon receipt of this threshold. Perhaps turn 10.3.2.4a into something useful.	2017/1/9 9:42
5162 Dorothy Stanley	225	1 10.3.2.4	115	38	T	Y	115.38 10.3.2.4	Clarify that "HE duration-based RTS threshold" is in the HE Operation Parameters field	as in comment	2017/1/9 9:42
5163 Dorothy Stanley	225	1 10.3.2.4a	115	46	T	Y	115.46 10.3.2.4a	Regarding "10.3.2.4a Duration-based RTS/CTS. In dense environments, managing RTS usage by an AP can help the overall interference situation since the AP may have better view of the network situation.", while this a good start in adding control by the AP over non-AP STAs other aspects of client management need to addressed. In an large, dense, managed ESS, the network has much better visibility into the best selection of AP and band that the client should initially associate with and then subsequently select during roaming. The network also needs to be able to control usage of probe request and probe response in an ESS in improve network efficiency.	Add tighter management by the network of client association and roaming	2017/1/9 9:42
5164 Dorothy Stanley	225	1 10.28	136	19	T	Y	136.19 10.28	Regarding, "10.28 Reverse direction protocol", this was added in 11n to address TCP ACK delivery, but was hardly (or not at all) implemented in any devices. Rather than continue to modify RDP, introduce TCP ACK Proxy. And while we're crossing layer boundaries, mechanisms to limit traffic at layer 2 due to higher layer discovery would also improve network efficiency.	define such protocols	2017/1/9 9:42

5165	Dorothy Stanley	225	1 11.1.3.10	141	36	T	Y	141.36 11.1.3.10	We had dual-beacon in 11n with STBC. Noone implemented it. Why are we introducing yet another dual-beacon? Delete this to reduce complexity in the spec.	as in comment	2017/1/9 9:42
5166	Dorothy Stanley	225	1 27.1	149	10	T	Y	149.10 27.1	is "are banned" normative?	change sentence to a "shall not"	2017/1/9 9:42
5167	Dorothy Stanley	225	1 27.2.1	149	19	T	Y	149.19 27.2.1	How does "received frame" equate to the HE receive procedure? To elaborate, in Figure 28-51 PHY receive state machine, BSS color filtering occurs after CRC OK check of HE-SIG-A. However, that doesn't mean the frame can be received. The most obvious example is mismatch in PHY modes (e.g. 2-SS PPDU trying to be received by 1-SS receiver) With respect to "or MAC address", then yes then entire frame needs to be properly received.	With respect to RXVECTOR parameters located in the HE-SIG-A, "received frame" should probably be changed to "valid CRC of HE-SIG-A or valid CRC of VHT-SIG-A".	2017/1/9 9:42
5168	Dorothy Stanley	225	1 27.2.1	149	25	T	Y	149.25 27.2.1	If the BSS_COLOR is zero in the PPDU, and the BSS color of the AP is zero, is the frame still classified as intra-BSS?	as in comment	2017/1/9 9:42
5169	Dorothy Stanley	225	1 27.2.2	151	32	T	Y	151.32 27.2.2	Regarding "A STA shall update the basic NAV with the duration information indicated by the RXVECTOR parameter TXOP_DURATION if and only if all the following conditions are met:" and "The STA does not receive a frame with the duration information indicated by a Duration field in the PSDU of the PPDU carrying the RXVECTOR parameter TXOP_DURATION", aren't these contradicatory statements? Please clarify intent.	as in comment	2017/1/9 9:42
5170	Dorothy Stanley	225	1 27.2.2	151	56	T	Y	151.56 27.2.2	The language "Maintaining two NAV is beneficial in dense deployment scenarios where a STA requires protection from frames transmitted by STAs within its BSS, i.e., intra-BSS, and avoid interference from frames transmitted by STAs in neighboring BSS, i.e., inter-BSS." doesn't seem to match the rules. Consider the situation where an HT STA and HE STA are both associated to the same AP in the same BSS. The HT STA transmits a 2-SS PPDU. The HE STA is only capable of receiving 1-SS PPDUs. My understanding is that this PPDU would be unclassified by the HE STA in terms of intra-BSS PPDU or inter-BSS PPDU since MAC addresses in the frame would not be decodable by the HE STA. So the basic NAV duration would be updated, not the intra-BSS NAV.	Define how STAs are "intra-BSS" protected in the presence of undecodable PPDUs. Or modify this paragraph to actually match the defined rules.	2017/1/9 9:42
5171	Dorothy Stanley	225	1 27.2.2	151	57	E	Y	151.57 27.2.2	"Maintaining two NAV is..."	change to "Maintaining two NAVs is..."	2017/1/9 9:42
5172	Dorothy Stanley	225	1 27.2.3	152	21	T	Y	152.21 27.2.3	what's an "OMI A-Control field"?	Change to "Operating Mode subfield in A-Control subfield" in all locations where "OMI A-Control field" is used, or define "OMI A-Control field"	2017/1/9 9:42
5173	Dorothy Stanley	225	1 27.4.1	157	23	E	Y	157.23 27.4.1	"recipient (see 10.24.7.1 (Introduction)." missing end parenthesis	change to "recipient (see 10.24.7.1 (Introduction))."	2017/1/9 9:42
5174	Dorothy Stanley	225	1 27.4.1	157	48	T	Y	157.48 27.4.1	"An HE STA that supports Multi-STA BlockAck shall examine each received Multi-STA sent by an STA with which it has a BA agreement." A few issues with this sentence: 1) what is meant by "shall examine each received Multi-STA"? Was the intent to examine Per STA Info subfields for each STA identified in the BA? 2) "an STA" should be "a STA" or "an HE STA"	as in comment	2017/1/9 9:42

5175	Dorothy Stanley	225	1 27.4.1	158	15	T	Y	158.15 27.4.1	I don't think a STA associates with a BSSID. Change "An HE non-AP STA that is associated with a nontransmitted BSSID" should be "An HE non-AP STA that is associated with BSS with a nontransmitted BSSID". Then fix the end of the sentence as well, change to "whose RA is set either to the (nontransmitted) BSSID of the BSS it is associated with"	as in comment	2017/1/9 9:42
5176	Dorothy Stanley	225	1 27.4.2	159	5	E	Y	159.05 27.4.2	change "an STA" to "a STA" or "an HE STA"	as in comment	2017/1/9 9:42
5177	Dorothy Stanley	225	1 27.4.4.2	160	54	E	Y	160.54 27.4.4.2	There is no clause 10.3.2.11.2	as in comment	2017/1/9 9:42
5178	Dorothy Stanley	225	1 27.4.4.2	160	60	T	Y	160.60 27.4.4.2	There is no definition for S-MPDU	provide definition	2017/1/9 9:42
5179	Dorothy Stanley	225	1 27.5.1.1	162	45	T	Y	162.45 27.5.1.1	Regarding "Downlink MU-MIMO On Partial Bandwidth Rx", Figure 9-589cl and Table 9-262aa have "DL MUMIMO On Partial Bandwidth"	make field naming consistent	2017/1/9 9:42
5180	Dorothy Stanley	225	1 27.5.1.1	162	45	T	Y	162.45 27.5.1.1	Regarding "An AP shall not transmit to a STA an HE MU PPDU with the HE-SIG-B allocating spatial streams to more than one recipient STA, unless the STA sets the Downlink MU-MIMO On Partial Bandwidth Rx subfield of the HE Capabilities element to 1.", what is the intent of not allowing DL MU-MIMO w/ HE MU PPDU if the STAs only support full bandwidth? Is the intent to use VHT PPDU? I would think in the future when all the devices are HE, we would not want a mix of VHT and HE PPDU's	Allow DL MU-MIMO with HE MU PPDU to HE STAs that do not support partial bandwidth.	2017/1/9 9:42
5181	Dorothy Stanley	225	1 27.5.1.1	162	56	T	Y	162.56 27.5.1.1	I can't find a definition for "DL OFDMA With MIMO PPDU". I can't find an HE Capabilities element with "DL OFDMA With MIMO Support" field.	Define the terms so the paragraph makes sense.	2017/1/9 9:42
5182	Dorothy Stanley	225	1 27.5.1.3	163	40	T	Y	163.40 27.5.1.3	Regarding "The STA that receives a BQRP variant Trigger frame shall follow the rules defined in 27.5.2.3 (STA behavior) to generate the HE trigger-based PPDU when the Trigger frame contains the STA's AID in any of the Per User Info fields; otherwise the STA shall follow the rules defined in 27.5.2.6 (UL OFDMA-based random access) to gain access to a random RU and generate the HE trigger-based PPDU when the Trigger frame contains one or more random RU(s)", isn't clear. What part of 27.5.2.3 would allow a STA to NOT generate the HE trigger-based PPDU? And in this case, does the "otherwise the STA shall" make UL OFDMA-based random access mandatory? Because my interpretation of 27.5.2.6 is that it is optional. Need to make sure that there is no confustion that UL	as in comment	2017/1/9 9:42
5183	Dorothy Stanley	225	1 27.5.2.1	164	14	T	Y	164.14 27.5.2.1	Define "MU-MIMO RU"	as in comment	2017/1/9 9:42
5184	Dorothy Stanley	225	1 27.5.2.1	164	14	T	Y	164.14 27.5.2.1	Define "UL OFDMA PPDU"	as in comment	2017/1/9 9:42
5185	Dorothy Stanley	225	1 27.5.2.1	164	19	T	Y	164.19 27.5.2.1	Define "UL MU-MIMO HE trigger-based PPDU"	as in comment	2017/1/9 9:42
5186	Dorothy Stanley	225	1 27.5.2.1	164	24	T	Y	164.24 27.5.2.1	Define "UL OFDMA PPDU"	as in comment	2017/1/9 9:42
5187	Dorothy Stanley	225	1 27.5.2.2.1	164	52	T	Y	164.52 27.5.2.2.1	Define "S-MPDU"	as in comment	2017/1/9 9:42
5188	Dorothy Stanley	225	1 27.5.2.2.1	164	46	E	Y	164.46 27.5.2.2.1	fix punctuation "allocation).. A value"	as in comment	2017/1/9 9:42
5189	Dorothy Stanley	225	1 27.5.2.2.2	166	17	T	Y	166.17 27.5.2.2.2	Regarding "CS Required subfield is set to 0", why is CS not required? And if the answer is because there is "UL MU Response Scheduling A-Control subfield" in the trigger, then why is CS not required with "UL MU Response Scheduling A-Control subfield"? It seems like an easy way to cheat on CS is for an AP to always include this field, especially since it duplicates the information already in the Trigger frame format. At least make the Trigger basic trigger frame CS requirements the same as the UL MU Response Scheduling A-Control requirements.	as in comment	2017/1/9 9:42

5190	Dorothy Stanley	225	1 27.5.2.3	167	59	T	Y	167.59 27.5.2.3	"If the STA is not associated with the AP, TBD."	I'm not sure how we went to letter ballot with a TBD, but obviously this needs to be fixed.	2017/1/9 9:42
5191	Dorothy Stanley	225	1 27.5.2.3	170	15	E	Y	170.15 27.5.2.3	fix punctuation "HE trigger-based PPDU.."	as in comment	2017/1/9 9:42
5192	Dorothy Stanley	225	1 27.5.2.3	170	61	T	Y	170.61 27.5.2.3	"The AP shall set the CS Required subfield to 1 except when" seems to contradict pg 166, line 27 "CS Required subfield is set to 0". Please clarify	as in comment	2017/1/9 9:42
5193	Dorothy Stanley	225	1 27.6.2	176	64	T	Y	176.64 27.6.2	If we are going to substantially improve efficiency over 11ac, we need HE beamformee's to support sounding equal to 8.	Change "For an HE beamformee, the value of this capability field shall be greater than or equal to 4." to "For an HE beamformee, the value of this capability field shall be greater than or equal to 8."	2017/1/9 9:42
5194	Dorothy Stanley	225	1 27.6.2	177	45	T	Y	177.45 27.6.2	In figure 27-3 "CSI From HE STA". Have we added CSI feedback again? Or is this Compressed Beamforming Report? As this amendment will eventually be merged into 802.11 baseline, the CSI label in this figure may be confused with 11n CSI feedback. Perhaps change "CSI" to "Feedback"	as in comment	2017/1/9 9:42
5195	Dorothy Stanley	225	1 27.6.2	178	7	T	Y	178.07 27.6.2	In figure 27-4 "CSI From HE STA". Have we added CSI feedback again? Or is this Compressed Beamforming Report, MU-Exclusive or CQI-only report? As this amendment will eventually be merged into 802.11 baseline, the CSI label in this figure may be confused with 11n CSI feedback. Perhaps change "CSI" to "Feedback"	as in comment	2017/1/9 9:42
5196	Dorothy Stanley	225	1 27.8	188	39	T	Y	188.39 27.8	There is no "Rx Channel Width" subfield	The name of the field in Figure 9-15d is "Channel Width". Unify the naming.	2017/1/9 9:42
5197	Dorothy Stanley	225	1 27.8.1	188	24	T	Y	188.24 27.8.1	Is OMI "Operating mode indication" as defined here or "Operation mode indication" as defined in 3.4	unify the definitions	2017/1/9 9:42
5198	Dorothy Stanley	225	1 27.8.3	189	36	T	Y	189.36 27.8.3	There is nothing in 27.5.2 describing what happens when UL MU Disable subfield is 1. UL MU is a critical feature for enhancing efficiency. What is the rationale for allowing non-AP STAs to disable UL MU operation?	Describe the purpose of allowing non-AP STAs to disable UL MU operation	2017/1/9 9:42
5199	Dorothy Stanley	225	1 27.8.3	189	36	T	Y	189.36 27.8.3	It seems like there needs to be a requirement that the non-AP STA does not discontinue participating in UL MU until it gets an acknowledgement from the AP. For example, if the AP did not receive the TOM, then it may continue to include the non-AP STA in UL MU exchanges.	Mandate that the non-AP STA needs to wait to discontinue participating in UL MU until it gets an acknowledgement from AP. Essentially even though this is part of TOM, processing of the trigger by the non-AP STA is a receive function.	2017/1/9 9:42
5200	Dorothy Stanley	225	1 27.9.1	190	12	T	Y	190.12 27.9.1	There is no definition for "SR PPDU"	define SR PPDU	2017/1/9 9:42
5201	Dorothy Stanley	225	1 27.9.2.1	190	24	T	Y	190.24 27.9.2.1	The language here uses "Inter-BSS PPDU", but in 27.2.1 the language uses "Inter-BSS frame". Is there an implied difference? Or are we using different terminology for the same thing?	unify terminology	2017/1/9 9:42
5202	Dorothy Stanley	225	1 27.9.2.1	190	50	T	Y	190.50 27.9.2.1	"SR Backoff procedure for SR delayed case." This supposed sentence doesn't make any sense, but perhaps it was meant to be a section heading? Need to fix this.	as in comment	2017/1/9 9:42
5203	Dorothy Stanley	225	1 27.9.2.2	191	7	T	Y	191.07 27.9.2.2	I do not see how "OBSS_PD_min" and "OBSS_PD_max" are set. I interpret this as that the non-AP STAs may set them to whatever they please. To properly manage the interference environment, the AP must have control over the OBSS_PD_min and max level the non-AP STAs use.	Define a protocol whereby the AP can dictate the OBSS_PD_min level that is used by the non-AP STAs. Included in this must be the ability to disable SR, by setting OBSS_PD_min and OBSS_PD_max both to -82dBm. And define that OBSS_PD_min and OBSS_PD_max are set by the non-AP STAs to the default values only in the absense of direction from the AP.	2017/1/9 9:42

5204	Dorothy Stanley	225	1 27.9.2.2	191	62	T	Y	191.62 27.9.2.2	what does "default" mean? Does that mean a user or vendor can change these values to something else? Define what is meant by "OBSS_PD_min_default" and "OBSS_PD_max_default". Or in otherwords, how are these variables and values used.	as in comment	2017/1/9 9:42
5205	Dorothy Stanley	225	1 27.9.2.2	191	62	T	Y	191.62 27.9.2.2	Can the STA set OBSS_PD_min or OBSS_PD_max to an arbitray value, e.g. -50dBm? Please clarify	Define that OBSS_PD_min and OBSS_PD_max are set by the non-AP STAs to the default values only in the absense of direction from the AP. Perhaps define that APs always set OBSS_PD_min and OBSS_PD_max to default value.	2017/1/9 9:42
5206	Dorothy Stanley	225	1 27.9.2.2	192	1	E	Y	192.01 27.9.2.2	"considering the antenna connector definition section 3.1"	grammar doesn't seem correct. Perhaps change to "refer to the antenna connector definition in Section 3.1"	2017/1/9 9:42
5207	Dorothy Stanley	225	1 27.9.2.2	192	11	T	Y	192.11 27.9.2.2	The unconstrained condition needs to be changed to "If OBSS_PD_Level <= OBSS_PD_min"	as in comment	2017/1/9 9:42
5208	Dorothy Stanley	225	1 27.9.2.2	192	18	T	Y	192.18 27.9.2.2	For proper management of an ESS to achieve our goal of high efficiency, the AP needs to be able to dictate the non-AP STA's transmit power level to lower levels than what may be calculated by TXPWR_max. This is especially important in dense environments. Furthermore, we need this capability even beyond the context of SR and UL MU, e.g. tx power levels when transmitting SU PPDU	define such a protocol.	2017/1/9 9:42
5209	Dorothy Stanley	225	1 27.9.2.2	192	20	T	Y	192.20 27.9.2.2	Define UL TB PPDU	as in comment	2017/1/9 9:42
5210	Dorothy Stanley	225	1 27.10.2	192	40	T	Y	192.40 27.10.2	Regarding, "HE STA that transmits an DL HE MU PPDU", can a non-AP STA transmit a DL HE MU PPDU?	as in comment	2017/1/9 9:42
5211	Dorothy Stanley	225	1 27.11.2	196	19	T	Y	196.19 27.11.2	Regarding, "A STA transmitting an HE PPDU in a direct path to a (T)DLS peer STA", we need additional control by the network over peer-to-peer operation. Specifically, channel selection in an dense ESS is critical in achieving high efficiency. The network must be able to dictate which channels may be used by clients in order to manage interference.	define such a protocol	2017/1/9 9:42
5212	Dorothy Stanley	225	1 27.11.3	196	20	T	Y	196.20 27.11.3	Always setting BEAM_CHANGE to 1 if NSS is > 2 makes no sense. If this is truly the case, you don't need this parameter as NSS provides the same information. And why is BEAM_CHANGE aways set to 1 for the first PPDU in a TXOP?	as in comment	2017/1/9 9:42
5213	Dorothy Stanley	225	1 27.11.4	196	54	T	Y	196.54 27.11.4	"may ignore the HE PPDU" - its not about ignoring the PPDU, its about following modified CCA rules	change sentence to "...and 63 may follow the spatial reuse rules as described in 27.9 (Spatial reuse operation).	2017/1/9 9:42
5214	Dorothy Stanley	225	1 27.11.4	196	63	T	Y	196.63 27.11.4	Regarding "BSS_COLOR equal to 0 shall not discard the HE PPDU", there is nothing restricting APs from setting the BSS Color to 0. In 9.4.2.219, the value 0 is defined as "indicates that there is no BSS color for this BSS". Is the intention of this requirement to really not discard any SU PPDUs from APs with BSS Color set to 0? Or is the intention more limited to the previous paragraph where a SU PDDU is sent to a non-member and we set BSS_COLOR to 0.	clarify	2017/1/9 9:42
5215	Dorothy Stanley	225	1 27.11.5	197	53	T	Y	197.53 27.11.5	Regarding "The RXVECTOR parameter FORMAT of the soliciting PPDU is not equal to HE_SU, HE_MU, or HE_EXT_SU", I'm not following the logic. Is it trying to say that don't set to all one's if the soliciting PPDU is equal to HE trigger-based PPDU? Please clarify.	as in comment	2017/1/9 9:42

5216	Dorothy Stanley	225	1 27.14.1	199	11	T	Y	199.11 27.14.1	If the APs set BSS Color to zero, then the determinition of intra-PPDU based on matching BSS Color is not going to be correct quite often. I believe we need some exceptions for the BSS Color equal 0 situation.	as in comment	2017/1/9 9:42
5217	Dorothy Stanley	225	1 27.15.2	201	28	T	Y	201.28 27.15.2	Can an HE non-AP STA transmit an HE MU PPDU? Please clarify.	as in comment	2017/1/9 9:42
5218	Dorothy Stanley	225	1 27.15.2	201	38	T	Y	201.38 27.15.2	"UL MU PPDU Support" isn't defined	define	2017/1/9 9:42
5219	Dorothy Stanley	225	1 27.15.2	201	38	T	Y	201.38 27.15.2	pg 9, line 31 states "Mandatory support for DL and UL OFDMA", which seems to conflict with the intent here that there is an HE Capability that allows the STA to not support UL MU	clarify	2017/1/9 9:42
5220	Dorothy Stanley	225	1 27.15.2	201	42	T	Y	201.42 27.15.2	I think this statement is categorically wrong "An HE STA shall send Control frames in non-HT PPDU format following the rules defined in 10.7.6" because there are a lot of conditions in 10.7.6 that do not require non-HT PPDU format.	Perhaps change the sentence to "An HE STA shall send Control frames following the rules defined in 10.7.6 (Rate selection for Control frames)) with the following exceptions:"	2017/1/9 9:42
5221	Dorothy Stanley	225	1 27.15.2	202	4	T	Y	202.04 27.15.2	I don't see a definition for ER SU PPDU	add definition	2017/1/9 9:42
5222	Dorothy Stanley	225	1 27.15.3	202	21	T	Y	202.21 27.15.3	I don't see a definition for ER SU PPDU	add definition	2017/1/9 9:42
5223	Dorothy Stanley	225	1 27.15.3	202	32	T	Y	202.32 27.15.3	I think this statement is way too restrictive, "The STA shall select a <HE-MCS, NSS> tuple from the basic HE-MCS and NSS set when protection is required (as defined in 10.26 (Protection mechanisms))", there is no need to always use basic HE-MCS and NSS sets when protection is required. 10.26 itself talks about using RTS/CTS as a protection mechanism, so with that the subsequent PPDU should not have use a basic HE-MCS.	modify statement	2017/1/9 9:42
5224	Dorothy Stanley	225	1 27.15.3	202	42	T	Y	202.42 27.15.3	Regarding, "called the CandidateMCSSet as described in 10.7.6.5.3". The description in 10.7.6.5.3 applies to HT and VHT, but does not include HE.	modify rules here or in 10.7.6.5.3 to address HE	2017/1/9 9:42
5225	Dorothy Stanley	225	1 27.15.3	202	51	T	Y	202.51 27.15.3	I don't see a definition for ER SU PPDU	add definition	2017/1/9 9:42
5226	Dorothy Stanley	225	1 27.15.3	202	57	T	Y	202.57 27.15.3	I don't see a definition for ER SU PPDU	add definition	2017/1/9 9:42
5227	Dorothy Stanley	225	1 27.15.4.3	203	52	T	Y	203.52 27.15.4.3	Regarding, "The following apply for a STA that transmits a HE PPDU with a number of spatial streams (NSS) less than or equal to 8", can a STA transmit more than 8 SS? If not, then the sentence can be deleted	as in comment	2017/1/9 9:42
5228	Dorothy Stanley	225	1 27.15.4.3	203	55	T	Y	203.55 27.15.4.3	It is unclear why or how support of HE-MCS is related to support of reception of HT MCSs. Please clarify	as in comment	2017/1/9 9:42
5229	Dorothy Stanley	225	1 27.16.1	204	56	T	Y	204.56 27.16.1	Regarding, "A STA for which dot11HEOptionImplemented is true shall set dot11VeryHighThroughputOptionImplemented or dot11HighThroughputOptionImplemented to true." is it possible for HE STA to support VHT, but not HT? Please clarify.	as in comment	2017/1/9 9:42
5230	Dorothy Stanley	225	1 27.16.3.1	207	7	T	Y	207.07 27.16.3.1	According to 9.4.2.225, "The Quiet Period Offset field is set to the offset of the start of the first quiet period from the Quiet Time Period Request frame that contains this element", so that means that all the other STAs in the BSS must receive the Quiet Time Period Request frame in order to know when the Quiet Time Period starts. I doubt this will work, as many HE STAs will not receive the Request Frame, e.g. hidden nodes, power save.	The simplest fix is to delete the protocol	2017/1/9 9:42
5231	Dorothy Stanley	225	1 27.16.3.2	207	58	E	Y	207.58 27.16.3.2	"the requested HE STA can transmit frame belongs"	fix the grammar	2017/1/9 9:42
5232	Dorothy Stanley	225	1 28.1.1	210	35	T	Y	210.35 28.1.1	change "HE_TRIG" to "HE trigger-based"	as in comment	2017/1/9 9:42

5233 Dorothy Stanley	225	1 28.1.1	211	57	T	Y	211.57 28.1.1	If we are going to substantially improve efficiency over 11ac, we need HE non-AP STAs to support DL MU-MIMO PPDUs with a total number of spatial streams equal to 8.	change total number of spatial streams requirement to 8	2017/1/9 9:42
5234 Dorothy Stanley	225	1 28.1.1	211	57	T	Y	211.57 28.1.1	Regarding, "The total number of spatial streams in the DL MU-MIMO transmission that the non-AP STA can receive shall be at least 4.", I'm assuming the intent here is that the non-AP STA should be able to handle a DL MU-MIMO transmission with four streams even if it has fewer than 4 antennas. If so, this statement isn't clear, as it could be misinterpreted as a required to receive 4 spatial streams.	Perhaps something like, "The non-AP STA shall be able to receive its intended spatial streams in a DL MU-MIMO PPDU with a total number of spatial streams of at least 4."	2017/1/9 9:42
5235 Dorothy Stanley	225	1 28.1.1	211	61	T	Y	211.61 28.1.1	If we are going to substantially improve efficiency over 11ac, we need HE non-AP STAs to support sounding with a total number of spatial streams equal to 8.	change sounding requirement to 8	2017/1/9 9:42
5236 Dorothy Stanley	225	1 28.1.1	212	4	T	Y	212.04 28.1.1	Why not support RU size of 242?	add 242 to the requirement for non-AP STA	2017/1/9 9:42
5237 Dorothy Stanley	225	1 28.1.1	212	15	T	Y	212.15 28.1.1	Why is it only optional for a 20 MHz-only STA to support RU sizes of 242 or less in a 40 MHz channel width? It shouldn't be an issue for such a device to at least support these RU sizes in the primary 20MHz subchannel. With this requirement we might not be able to include any 20 MHz-only STAs in an OFDMA transmission in a 40 MHz BSS	make this mandatory	2017/1/9 9:42
5238 Dorothy Stanley	225	1 28.1.1	212	18	T	Y	212.18 28.1.1	Make it mandatory to support 242	make this mandatory	2017/1/9 9:42
5239 Dorothy Stanley	225	1 28.1.1	212	21	T	Y	212.21 28.1.1	Make it mandatory to support 242	make this mandatory	2017/1/9 9:42
5240 Dorothy Stanley	225	1 28.1.1	212	25	T	Y	212.25 28.1.1	Regrding, "If the non-AP STA is 20 MHz-only capable then 160 MHz and 80+80 MHz channel width, 2×996-, 996- and 484-tone RU sizes in 5 GHz band are not applicable" is incorrect. A 20 MHz-only STA shall be able to receive a 20 MHz PPDU in a 160/80+80 MHz BSS.	fix this statement	2017/1/9 9:42
5241 Dorothy Stanley	225	1 28.1.1	212	35	T	Y	212.35 28.1.1	If we are going to substantially improve efficiency over 11ac, we need HE non-AP STAs to support DL MU-MIMO PPDUs with a total number of spatial streams equal to 8.	change total number of spatial streams requirement to 8	2017/1/9 9:42
5242 Dorothy Stanley	225	1 28.1.1	212	40	T	Y	212.40 28.1.1	change "HE_TRIG" to "HE trigger-based"	as in comment	2017/1/9 9:42
5243 Dorothy Stanley	225	1 28.1.2	212	57	E	Y	212.57 28.1.2	PHYs.A non-AP STA	add space after period	2017/1/9 9:42
5244 Dorothy Stanley	225	1 28.2.2	216	13	T	Y	216.13 28.2.2	Why does N_TX have "N" for both TXVECTOR and RXVECTOR?	Change TXVECTOR to Y	2017/1/9 9:42
5245 Dorothy Stanley	225	1 28.2.2	216	48	T	Y	216.48 28.2.2	How can the Value be both COMPRESSED_SV and Not present?	as in comment	2017/1/9 9:42
5246 Dorothy Stanley	225	1 28.2.2	223	52	T	Y	223.52 28.2.2	Clarify whether 0 indicates that dopper should or should not considered	as in comment	2017/1/9 9:42
5247 Dorothy Stanley	225	1 28.2.2	224	52	T	Y	224.52 28.2.2	What are the values for HE_LTF_MODE?	as in comment	2017/1/9 9:42
5248 Dorothy Stanley	225	1 28.2.2	226	14	T	Y	226.14 28.2.2	In 27.11.3 "The TXVECTOR parameter BEAM_CHANGE of an HE SU PPDU, HE extended range SU PPDU shall be set to 1 if the number of spatial streams is greater than 2 or the PPDU is the first PPDU in a TXOP."	These two definitions seem in conflict and need to be unified.	2017/1/9 9:42
5249 Dorothy Stanley	225	1 28.3.3.2	229	10	T	Y	229.10 28.3.3.2	We don't really have a definition for "DFS channel"	Take a look at 11.9.8.5 "HT-greenfield transmissions in operating classes that include a behavior limit of DFS_50_100_Behavior" for a more precise way to write this requirement	2017/1/9 9:42
5250 Dorothy Stanley	225	1 28.3.3.5	237	55	T	Y	237.55 28.3.3.5	Just to be clear "recipients of 40/80/160/80+80 OFDMA" means DL OFDMA? If so change accordingly.	as in comment	2017/1/9 9:42
5251 Dorothy Stanley	225	1 28.3.3.5	237	57	T	Y	237.57 28.3.3.5	Make this mandatory to increase flexibility of the scheduler.	as in comment	2017/1/9 9:42

5252 Dorothy Stanley	225	1 28.3.3.10.3	240	12	T	Y	240.12 28.3.3.10.3	Since single stream pilots are mandatory for UL OFDMA, UL OFDMA with MU-MIMO, and UL MU-MIMO, it makes no sense to also carry the complexity burden and potential interop issues of also having masking LTF sequence.	remove mask LTF sequence	2017/1/9 9:42
5253 Dorothy Stanley	225	1 28.3.4	242	27	T	Y	242.27 28.3.4	HE-SIG-A-R is undefined	define	2017/1/9 9:42
5254 Dorothy Stanley	225	1 28.3.5	244	20	T	Y	244.20 28.3.5	Why is N_STS <= 2 in Figure 28-10?	as in comment	2017/1/9 9:42
5255 Dorothy Stanley	225	1 28.3.9	261	40	T	Y	261.40 28.3.9	Do we have definitions for non-OFDMA HE PPDU and OFDMA HE PPDU?	define	2017/1/9 9:42
5256 Dorothy Stanley	225	1 28.3.10.4	270	13	T	Y	270.13 28.3.10.4	Should T_GI,LegacyPreamble be changed to T_GI,L-LTF in Eq 28-10?	as in comment	2017/1/9 9:42
5257 Dorothy Stanley	225	1 28.3.10.5	271	49	T	Y	271.49 28.3.10.5	P_0 be change to p_0 to match Eq 28-12	as in comment	2017/1/9 9:42
5258 Dorothy Stanley	225	1 28.3.10.6	272	34	T	Y	272.34 28.3.10.6	need to define p_1	as in comment	2017/1/9 9:42
5259 Dorothy Stanley	225	1 28.3.10.7.2	274	6	T	Y	274.06 28.3.10.7.2	What is the integer value or bit sequence for SR Disallowed?	as in comment	2017/1/9 9:42
5260 Dorothy Stanley	225	1 28.3.10.7.2	274	12	T	Y	274.12 28.3.10.7.2	What is the integer value or bit sequence for SR_Delay?	as in comment	2017/1/9 9:42
5261 Dorothy Stanley	225	1 28.3.10.7.2	276	46	T	Y	276.46 28.3.10.7.2	What is the integer value or bit sequence for SR_Restricted?	as in comment	2017/1/9 9:42
5262 Dorothy Stanley	225	1 28.3.10.7.2	278	30	T	Y	278.30 28.3.10.7.2	Regarding, "When the Bandwidth field is set to 5 or 7, the HE-SIG-B field may indicate which 20 MHz sub-channel(s) in the preamble of secondary 40 MHz channel are punctured by its RU allocation signaling; when the Bandwidth field is set to 6 or 7, the HE-SIG-B field may indicate which 20 MHz sub-channel(s) in the preamble of secondary 80 MHz channel are punctured by its RU allocation signaling." if the HE-SIG-B does not indicate which 20 MHz sub-channel is punctured then how is it determined? In other words, it seems like the "may" needs to be a shall.	as in comment	2017/1/9 9:42
5263 Dorothy Stanley	225	1 28.3.10.7.4	285	10	T	Y	285.10 28.3.10.7.4	Figure 28-19 is really low resolution and the names of the fields are incomplete.	fix the figure	2017/1/9 9:42
5264 Dorothy Stanley	225	1 28.3.10.8.1	286		T	Y	286.00 28.3.10.8.1	Regarding "Each User Block field is made up of two user fields", is it allowed to use the HE MU PPDU for a single user? If so, this statement is incorrect. Please clarify.	as in comment	2017/1/9 9:42
5265 Dorothy Stanley	225	1 28.3.10.8.2	286	44	T	Y	286.44 28.3.10.8.2	The "RU-242" labels in Figure 28-21 are confusing. The main issue is that the label implies one RU, where the content could contain signaling for many RU's. I would delete the "RU-242" block on the left side. I would probably also delete the parallelogram as well, as I don't know what it is trying to convey. In the common field, I would change "RU-242" to "-122:122". In the User Specific Field I would also change "RU-242" to "-122:122".	as in comment	2017/1/9 9:42
5266 Dorothy Stanley	225	1 28.3.10.8.2	287	8	T	Y	287.08 28.3.10.8.2	The "RU-242" labels in Figure 28-22 are confusing. The main issue is that the label implies one RU, where the content could contain signaling for many RU's. I would delete the "RU1-242" and "RU2-242" blocks on the left side. I would probably also delete the parallelograms as well, as I don't know what it is trying to convey. In the common field, I would change "RU1-242" to "-244:-3". In the User Specific Field I would also change "RU1-242" to "--244:-3". Make similar changes to channel 2	as in comment	2017/1/9 9:42

5267 Dorothy Stanley	225	1 28.3.10.8.2	287	51	T	Y	287.51 28.3.10.8.2	The "RU-242" labels in Figure 28-23 are confusing. The main issue is that the label implies one RU, where the content could contain signaling for many RU's. I would delete the "RUn-242" blocks on the left side. I would probably also delete the parallelograms as well, as I don't know what it is trying to convey. In the common field, I would change "RU1-242" to "-500:-259". In the User Specific Field I would also change "RU1-242" to "-500:-259". Make similar changes to channels 2,3, and 4.	as in comment	2017/1/9 9:42
5268 Dorothy Stanley	225	1 28.3.10.8.2	288	21	T	Y	288.21 28.3.10.8.2	Figure 28-24 looks half finished compared to the other figures, complete all the labeling as in the others.	as in comment	2017/1/9 9:42
5269 Dorothy Stanley	225	1 28.3.10.8.2	288	53	T	Y	288.53 28.3.10.8.2	Regarding "is the same as defined for the full bandwidth", does this mean that HE-SIG-B is not punctured? If not, this paragraph needs to be made clearer.	as in comment	2017/1/9 9:42
5270 Dorothy Stanley	225	1 28.3.10.8.3	289	35	T	Y	289.35 28.3.10.8.3	Do we need an equation for Beam_Change = 0?	as in comment	2017/1/9 9:42
5271 Dorothy Stanley	225	1 28.3.10.8.4	292	26	T	Y	292.26 28.3.10.8.4	Just to confirm, for entry "0110y_1y_0z_1z_0" in Table 28-21, the maximum number of MU-MIMO users per 106-tone RU is four? This is half of our claim of increasing MU-MIMO users to 8. Please clarify.	as in comment	2017/1/9 9:42
5272 Dorothy Stanley	225	1 28.3.10.8.4	293	33	T	Y	293.33 28.3.10.8.4	What does "default mode" mean? This implies other types of modes, but I don't see other types of modes described. Please clarify.	as in comment	2017/1/9 9:42
5273 Dorothy Stanley	225	1 28.3.10.8.5	293	60	T	Y	293.60 28.3.10.8.5	Regarding "Multiple RU allocations addressed to a single STA shall not be allowed in 802.11ax.", I don't think you can refer to the task group.	as in comment	2017/1/9 9:42
5274 Dorothy Stanley	225	1 28.3.10.10	313	5	T	Y	313.05 28.3.10.10	Regarding "When the 1x HE-LTF is used for non-OFDMA UL MU-MIMO, neither masking by orthogonal code nor single stream pilot are not used.", there are too many negatives in the sentence and I can't parce the meaning. Please clarify	as in comment	2017/1/9 9:42
5275 Dorothy Stanley	225	1 28.3.11.5.1	318	12	T	Y	318.12 28.3.11.5.1	Is this the same a_init from Eq 28-61? Please clarify.	as in comment	2017/1/9 9:42
5276 Dorothy Stanley	225	1 28.3.11.5.1	318	16	T	Y	318.16 28.3.11.5.1	Is this the same N_dbps,last,init from Eq 28-62? Please clarify.	as in comment	2017/1/9 9:42
5277 Dorothy Stanley	225	1 28.3.11.5.1	318	23	T	Y	318.23 28.3.11.5.1	Is this the same N_cbps,short from Eq 28-61? Please clarify.	as in comment	2017/1/9 9:42
5278 Dorothy Stanley	225	1 28.3.11.5.2	318	37	T	Y	318.37 28.3.11.5.2	Is this the same N_dbps,last,init from Eq 28-62? Please clarify.	as in comment	2017/1/9 9:42
5279 Dorothy Stanley	225	1 28.3.11.9	327	15	T	Y	327.15 28.3.11.9	Something is wrong with this sentence "in order to exploit frequency diversity for a and"	fix sentence	2017/1/9 9:42
5280 Dorothy Stanley	225	1 28.3.11.11	329	47	E	Y	329.47 28.3.11.11	looks like a broken link	fix link	2017/1/9 9:42
5281 Dorothy Stanley	225	1 28.3.14.2	341	1	T	Y	341.01 28.3.14.2	We need to specify in the subclause whether Tx Power is conducted or EIRP so there is no confusion.	as in comment	2017/1/9 9:42
5282 Dorothy Stanley	225	1 28.3.14.3	342	9	T	Y	342.09 28.3.14.3	"with P the maximum power the STA can transmit at the antenna connector", specify the units for P.	as in comment	2017/1/9 9:42
5283 Dorothy Stanley	225	1 28.3.16	344	41	T	Y	344.41 28.3.16	By Figure 28-36 if appears that only mandatory HE-LTF/GI combinations are allowed with HE NDP. If this is the case add this requirement to the list of properties.	as in comment	2017/1/9 9:42
5284 Dorothy Stanley	225	1 28.3.17.2	345	26	T	Y	345.26 28.3.17.2	Why is the minimum sensitivity for BPSK w/ DCM no better than without? If DCM doesn't improve sensitivity, then delete the feature.	as in comment	2017/1/9 9:42
5285 Dorothy Stanley	225	1 C	442	33	T	Y	442.33 C	I don't see a definition for "duration-based RTS threshold notification frame"	Add definition for "duration-based RTS threshold notification frame" or change to "HE duration-based RTS threshold in the HE Operation Parameters field"	2017/1/9 9:42
5286 Eunsung Park	225	1 28.3.3.1	228	17	E	N	228.17 28.3.3.1	The reference seems wrong in the following sentence. "The difference between OFDM and OFDMA is illustrated in Table 28-15 (CH_BANDWIDTH and for pre-HE modulated fields)."	Change the reference to Figure 28-1 (Illustration of OFDM and OFDMA concepts).	2017/1/9 9:42

5287	Eunsung Park	225	1 28.3.6.2	249	62	T	Y	249.62 28.3.6.2	If the TXVECTOR parameter BEAM_CHANGE is 0, the L-STF field needs the procedure for spatial mapping	Include the procedure for spatial mapping after applying CSD as follows. "Spatial mapping: If the TXVECTOR parameter BEAM_CHANGE is 0, apply the Q matrix as described in 28.3.10.3 (L-STF)."	2017/1/9 9:42
5288	Eunsung Park	225	1 28.3.6.2	249	62	T	Y	249.62 28.3.6.2	For the L-STF, GI insertion is not needed.	Remove the procedure to insert GI.	2017/1/9 9:42
5289	Eunsung Park	225	1 28.3.6.3	250	20	T	Y	250.20 28.3.6.3	If the TXVECTOR parameter BEAM_CHANGE is 0, the L-LTF field needs the procedure for spatial mapping	Include the procedure for spatial mapping after applying CSD as follows. "Spatial mapping: If the TXVECTOR parameter BEAM_CHANGE is 0, apply the Q matrix as described in 28.3.10.4 (L-LTF)."	2017/1/9 9:42
5290	Eunsung Park	225	1 28.3.6.4	250	52	T	Y	250.52 28.3.6.4	If the TXVECTOR parameter BEAM_CHANGE is 0, the L-SIG field needs the procedure for spatial mapping	Include the procedure for spatial mapping after applying CSD as follows. "Spatial mapping: If the TXVECTOR parameter BEAM_CHANGE is 0, apply the Q matrix as described in 28.3.10.5 (L-SIG)."	2017/1/9 9:42
5291	Eunsung Park	225	1 28.3.6.5	251	21	T	Y	251.21 28.3.6.5	If the TXVECTOR parameter BEAM_CHANGE is 0, the RL-SIG field needs the procedure for spatial mapping	Include the procedure for spatial mapping after applying CSD as follows. "Spatial mapping: If the TXVECTOR parameter BEAM_CHANGE is 0, apply the Q matrix as described in 28.3.10.6 (RL-SIG)."	2017/1/9 9:42
5292	Eunsung Park	225	1 28.3.6.6	251	54	T	Y	251.54 28.3.6.6	If the TXVECTOR parameter BEAM_CHANGE is 0, the HE-SIG-A field needs the procedure for spatial mapping	Include the procedure for spatial mapping after applying CSD as follows. "Spatial mapping: If the TXVECTOR parameter BEAM_CHANGE is 0, apply the Q matrix as described in 28.3.10.7.4 (Encoding and modulation)."	2017/1/9 9:42
5293	Eunsung Park	225	1 28.3.6.8	253	9	T	Y	253.09 28.3.6.8	For the HE-STF, the phase rotation value is always 1, and thus the clause 21.3.7.5 does not need to be referred.	Delete "and 21.3.7.5 (Definition of tone rotation)" in the relevant sentence.	2017/1/9 9:42
5294	Eunsung Park	225	1 28.3.6.8	253	16	T	Y	253.16 28.3.6.8	For the HE-STF, GI insertion is not needed.	Remove the procedure to insert GI.	2017/1/9 9:42
5295	Eunsung Park	225	1 28.3.6.9	253	25	T	Y	253.25 28.3.6.9	For the HE-LTF, there are two modes, i.e., single stream pilot and masking LTF sequence. However, the procedure for construction of HE-LTFseems to include only the single stream pilot mode.	Specify the procedure for the mode of masking LTF sequence.	2017/1/9 9:42
5296	Eunsung Park	225	1 28.3.6.9	253	33	T	Y	253.33 28.3.6.9	For the HE-LTF, the phase rotation value is always 1, and thus the clause 21.3.7.5 does not need to be referred.	Delete "and 21.3.7.5 (Definition of tone rotation)" in the relevant sentence.	2017/1/9 9:42
5297	Eunsung Park	225	1 28.3.6.10.1	254	24	T	Y	254.24 28.3.6.10.1	For the data field, the phase rotation value is always 1, and thus the clause 21.3.7.5 does not need to be referred.	Delete "and 21.3.7.5 (Definition of tone rotation)" in the relevant sentence.	2017/1/9 9:42
5298	Eunsung Park	225	1 28.3.6.10.2	255	13	T	Y	255.13 28.3.6.10.2	For the data field, the phase rotation value is always 1, and thus the clause 21.3.7.5 does not need to be referred.	Delete "and 21.3.7.5 (Definition of tone rotation)" in the relevant sentence.	2017/1/9 9:42
5299	Eunsung Park	225	1 28.3.6.11.4	255	55	T	Y	255.55 28.3.6.11.4	For the data field, the phase rotation value is always 1, and thus the clause 21.3.7.5 does not need to be referred.	Delete "and 21.3.7.5 (Definition of tone rotation)" in the relevant sentence.	2017/1/9 9:42
5300	Eunsung Park	225	1 28.3.7	256	33	T	Y	256.33 28.3.7	There are two types of MCSs, i.e., HE-MCS and HE-SIG-B-MCS. Thus, HE-SIG-B-MCSs which can be used for DCM also need to be defined.	Add "HE-SIG-B-MCSs" into the relevant sentence as follows. "It is only applied for the HE-MCSs and HE-SIG-B-MCS with indices 0, 1, 3 and 4."	2017/1/9 9:42
5301	Eunsung Park	225	1 28.3.10.7.2	275	33	T	Y	275.33 28.3.10.7.2	In Table 28-16, HE-SIG-A field of an HE SU PPDU and HE extended range SU PPDU contains Doppler field but Doppler mode has not been defined yet.	Doppler mode needs to be defined or if it will not be determined, Doppler field sholuld be just removed and reserved in the HE-SIG-A field of an HE SU PPDU and HE extended range SU PPDU.	2017/1/9 9:42
5302	Eunsung Park	225	1 28.3.10.7.2	276	33	E	N	276.33 28.3.10.7.2	There is a typo in the Table 28-17 for the description of the SIGB DCM field.	Correct the typo as follows. "HE-SIG-B"	2017/1/9 9:42
5303	Eunsung Park	225	1 28.3.10.7.2	277	35	T	Y	277.35 28.3.10.7.2	In Table 28-17, HE-SIG-A field of an HE MU PPDU contains Doppler field but Doppler mode has not been defined yet.	Doppler mode needs to be defined or if it will not be determined, Doppler field sholuld be just removed and reserved in the HE-SIG-A field of an HE MU PPDU.	2017/1/9 9:42
5304	Eunsung Park	225	1 28.3.11.15	337	5	T	Y	337.05 28.3.11.15	HE-MCS 2 and HE-SIG-B-MCS 2 are the QPSK modulation, but DCM can not be applied to these MCSs.	Delete "BPSK, QPSK and 16-QAM modulations" and specify the MCS indices as follows. "DCM is only applied to the HE-MCSs and HE-SIG-B-MCSs with indices 0, 1, 3 and 4.	2017/1/9 9:42
5305	EVGENY KHOROV	225	1 3.4	7	18	E	N	7.18 3.4	Abbreviation S-MPDU is not defined	Add abbreviation "S-MPDU Single MPDU" to Section 3.4 (Used on page 77)	2017/1/9 9:42
5306	EVGENY KHOROV	225	1 3.3	6	59	T	N	6.59 3.3	Define Broadcast RU	As in comment	2017/1/9 9:42

5307	EVGENY KHOROV	225	1 3.3.	6	59	T	N	6.59 3.3.	Define Class A and Class B	Class A STAs are high capability HE STAs and class B STAs are low capability HE STAs according to Clause 28.3.14.3	2017/1/9 9:42
5308	EVGENY KHOROV	225	1 3.3	6	59	T	N	6.59 3.3	Single MPDU (S-MPDU) is not defined	Add definition of Single MPDU (Used on page 77)	2017/1/9 9:42
5309	EVGENY KHOROV	225	1 3.4	7	4	E	N	7.04 3.4	Abbreviation CQI is not defined	Add abbreviation "CQI Channel Quality Indicator" to Section 3.4	2017/1/9 9:42
5310	EVGENY KHOROV	225	1 3.4	7	4	E	N	7.04 3.4	Abbreviation BSR is not defined	Add abbreviation "BSR Buffer Status Report" to Section 3.4	2017/1/9 9:42
5311	EVGENY KHOROV	225	1 3.4	7	4	E	N	7.04 3.4	MU-BAR is not defined	Add definition	2017/1/9 9:42
5312	EVGENY KHOROV	225	1 3.4	7	4	E	N	7.04 3.4	BSRP is not defined	Add definition	2017/1/9 9:42
5313	EVGENY KHOROV	225	1 9.2.4.6.4.1	22	48	E	N	22.48 9.2.4.6.4.1	The correct subfield name is Aggregated Control, not Aggregate Control	Replace "Aggregate" with "Aggregated"	2017/1/9 9:42
5314	EVGENY KHOROV	225	1 9.3.1.20	40	53	T	N	40.53 9.3.1.20	How to incode 26-tone RU with 7 bits of RU Start Index and Ru End Index is not defined	Add the rule similar to Table 9.25f. The first bit is 0 for the primary 80MHz channel and 1 for the secondary 80 MHz channel. The remaning 6 bits can have values from 000000 to 100100 which correspond to 37 possible 26-tone RUs	2017/1/9 9:42
5315	EVGENY KHOROV	225	1 9.3.1.23	41	47	E	N	41.47 9.3.1.23	Why (RA) is in round brackets is not clear	Remove round brackets	2017/1/9 9:42
5316	EVGENY KHOROV	225	1 9.3.1.23	41	59	E	N	41.59 9.3.1.23	No space after period (STA.If the Trigger)	Add space after the period	2017/1/9 9:42
5317	EVGENY KHOROV	225	1 9.3.1.23	41	61	E	N	41.61 9.3.1.23	No space after period (address.If the Trigger)	Add space after the period	2017/1/9 9:42
5318	EVGENY KHOROV	225	1 9.3.1.23	44	51	E	N	44.51 9.3.1.23	Values 0 to 61 maps to -20 dBm to 40 dBm	Change as "Values 0 to 60 map to -20 dBm to 40 dBm"	2017/1/9 9:42
5319	EVGENY KHOROV	225	1 9.3.1.23	45	1	T	N	45.01 9.3.1.23	The constrains on possible values of SR fields are not full.	Either give a reference to Table 28-18, or adapt the text from that table	2017/1/9 9:42
5320	EVGENY KHOROV	225	1 9.3.1.23	45	37	E	N	45.37 9.3.1.23	No space after period (access.User Info)	Add space after the period	2017/1/9 9:42
5321	EVGENY KHOROV	225	1 9.3.1.23	45	38	E	N	45.38 9.3.1.23	... with AID not equals to 0	Replace with "with AID not equal to 0"	2017/1/9 9:42
5322	EVGENY KHOROV	225	1 9.3.1.23	46	31	E	N	46.31 9.3.1.23	Grammar: B19-B13 are 0000000 indicates 26-tone RU1...	Replace with "Values of B19-B13 have the following meaning. 0000000 indicates 26-tone RU1..." The same should be done with similar sentences below till line 56	2017/1/9 9:42
5323	EVGENY KHOROV	225	1 9.3.1.23	46	59	E	N	46.59 9.3.1.23	Set to 0 for BCC	Replace with "The Coding Type Subfield is set to 0 for BCC"	2017/1/9 9:42
5324	EVGENY KHOROV	225	1 9.3.1.23	47	35	T	N	47.35 9.3.1.23	Values 0 to 90 map to -100 dBm to -20 dBm	Make the size of the range in dBm the same as the range of possible values.	2017/1/9 9:42
5325	EVGENY KHOROV	225	1 9.3.1.23.4	50	20	E	N	50.20 9.3.1.23.4	MU-RTS variant is described in a differnet way comparing with other Trigger variants. Specifically, a lot of information duplicates common Trigger frame description. Notes in fact are not notes and provide importantan information about frame format (compare with the other trigger variants).	Rewrite 9.3.1.23.4 to make the escription similar to Sections 9.3.1.23.2, 9.3.1.23.3, 9.3.1.23.5. Specifically, the following lines can be removed:28 to 34,57 to 62. Notes should be rewrite as plain text	2017/1/9 9:42
5326	EVGENY KHOROV	225	1 9.4.2.139	68	51	T	N	68.51 9.4.2.139	When data are transmitted between a non-HE STA and an HE STA, the ADDBA Capabilities may be incorrectly processed.	Make No fragmentation field equal 1 for an HE STA if its level of fragmentation = 0 and 0 otherwise	2017/1/9 9:42
5327	EVGENY KHOROV	225	1 9.4.2.200	75	49	E	N	75.49 9.4.2.200	for that (those) TWTs	Replace with "for that (those) TWT(s)"	2017/1/9 9:42
5328	EVGENY KHOROV	225	1 9.4.2.218.1	76	2	E	N	76.02 9.4.2.218.1	Double periods at the end of sentence	Remove a period	2017/1/9 9:42
5329	EVGENY KHOROV	225	1 9.4.2.218.2	77	50	E	N	77.50 9.4.2.218.2	AMPDU	Replace with A-MPDU	2017/1/9 9:42
5330	EVGENY KHOROV	225	1 9.4.2.218.2	80	26	E	N	80.26 9.4.2.218.2	Move the text describing Maximum A-MPDU Length Exponent to Table 9.262z	as in comment	2017/1/9 9:42
5331	EVGENY KHOROV	225	1 9.4.2.219	91	39	T	N	91.39 9.4.2.219	The two consequent sentences describe the same idea except for the "except" clause.	Join sentences describing the BSS Color field	2017/1/9 9:42
5332	EVGENY KHOROV	225	1 9.4.2.219	92	27	E	N	92.27 9.4.2.219	Grammar: If a HE non-AP STA	Replace "a" with "an"	2017/1/9 9:42
5333	EVGENY KHOROV	225	1 9.4.2.220	93	45	T	N	93.45 9.4.2.220	The maximal value of OCWmin and OCWmax is just 2^7-1=127, while there are some reserved bits in the field	Change size of the EOCWmin and EOCWmax fields to 4 bits.	2017/1/9 9:42
5334	EVGENY KHOROV	225	1 10.9	127	26	T	N	127.26 10.9	Section 10.31.4 (Link adaptation using the HE variant HT Control field) does not exist	Add Section 10.31.4 (Link adaptation using the HE variant HT Control field)	2017/1/9 9:42
5335	EVGENY KHOROV	225	1 9.2.4.6.4.4	25	5	T	N	25.05 9.2.4.6.4.4	Clause 9.2.4.6.4.4 does not exist	It seems that the correct clause is 10.31.4 (Link adaptation using the HE variant HT Control field). It does not exist too but there are references to this clause in the text.	2017/1/9 9:42

5336	EVGENY KHOROV	225	1 9.4.2.2.221	94	54	T	N	94.54 9.4.2.2.221	" except that a value 0 of the AIFSN field indicates that the AIFS is equal to the value of the MU EDCA Timer, i.e. EDCA is disabled for the duration specified by the MUEDCATimer for the corresponding AC". AIFS is equal to the value of the MU EDCA Timer is not the same as EDCA is disabled for the duration specified by the MUEDCATimer for the corresponding AC	Remove "AIFS is equal to the value of the MU EDCA Timer, i.e. "		2017/1/9 9:42
5337	EVGENY KHOROV	225	1 9.4.2.2.221	94	64	T	N	94.64 9.4.2.2.221	From text it is not clear whether the STA restarts the timer only if it receives a trigger frame which allocates some RU for this STA and the corresponding AC, or if it receives a trigger frame which allocates RU for ANY STA for this AC.	Replace the sentence with the following one: The MU EDCA Timer field indicates the duration of time, in units of 8 TUs, for which the provided MU EDCA parameters are used by an HE STA after reception of a Basic variant Trigger frame which allocates RU for this STA and the corresponding AC.		2017/1/9 9:42
5338	EVGENY KHOROV	225	1 9.4.2.2.221	94	64	T	N	94.64 9.4.2.2.221	What happens if the Trigger frame does not provide a preferred AC?	Add "If the Trigger frame does not contain information about preferred AC, all MU EDCA Timers shall be restarted."		2017/1/9 9:42
5339	EVGENY KHOROV	225	1 9.4.2.223	95	54	T	N	95.54 9.4.2.223	STA-2-STA operation is not defined	Replace with direct links		2017/1/9 9:42
5340	EVGENY KHOROV	225	1 9.4.2.224	96	54	T	N	96.54 9.4.2.224	The granularity of Quite Period Offset, Interval and Duration is too coarse (1TU or 1024 us) while the frame format allows to have values up to 65535 TUs, i.e. longer than 1 minute, which is hardly needed.	Express Quite Period Offset, Interval and Duration in 32 us, similarly to MCCA. Such unit provide a range for these values 32 us to 2s which is a good trade-off between granularity and scalability		2017/1/9 9:42
5341	EVGENY KHOROV	225	1 9.4.2.225	97	49	T	N	97.49 9.4.2.225	The values for Status Code are not defined	Define the values for Status Code		2017/1/9 9:42
5342	EVGENY KHOROV	225	1 9.6.29.2	104	51	E	N	104.51 9.6.29.2	Misprint: Ttable	Replace with Table		2017/1/9 9:42
5343	EVGENY KHOROV	225	1 9.6.29.2	104	49	E	N	104.49 9.6.29.2	The is missing before Quite Time Period Setup element	add "the"		2017/1/9 9:42
5344	EVGENY KHOROV	225	1 9.6.29.1	104	20	T	N	104.20 9.6.29.1	STA-to-STA operation is not defined	Replace with direct links		2017/1/9 9:42
5345	EVGENY KHOROV	225	1 9.6.28.2	103	32	T	N	103.32 9.6.28.2	Table 9.47 does not contain a value for HE Action Category	Add the row with code <ANA>, meaning "HE" and reference to Clause 9.6.28		2017/1/9 9:42
5346	EVGENY KHOROV	225	1 9.6.28.2	103	41	E	N	103.41 9.6.28.2	"the" is missing before Feadback Type subfield	add "the"		2017/1/9 9:42
5347	EVGENY KHOROV	225	1 9.6.28.2	103	41	E	N	103.41 9.6.28.2	"the" is missing before "HE MIMO Control field"	add "the"		2017/1/9 9:42
5348	EVGENY KHOROV	225	1 9.6.28.2	103	43	E	N	103.43 9.6.28.2	"the" is missing before "HE Compressed Beamforming and CQI frame"	add "the"		2017/1/9 9:42
5349	EVGENY KHOROV	225	1 9.6.28.3	104	1	T	N	104.01 9.6.28.3	Table 9.47 does not contain a value for HE Action Category	Add the row with code <ANA>, meaning "HE" and reference to Clause 9.6.28		2017/1/9 9:42
5350	EVGENY KHOROV	225	1 9.6.28.3	104	11	E	N	104.11 9.6.28.3	"the" is missing before "HE BSS Color Change Announcement frame"	add "the"		2017/1/9 9:42
5351	EVGENY KHOROV	225	1 9.6.28.3	104	1	T	N	104.01 9.6.28.3	Table 9.47 does not contain a value for Quite Time Period Action Category	Add the row with code <ANA>, meaning "Quite Time Period" and reference to Clause 9.6.29		2017/1/9 9:42
5352	EVGENY KHOROV	225	1 10.3.2.10.1	118	55	E	N	118.55 10.3.2.10.1	Space is missing before "that"	add space		2017/1/9 9:42
5353	EVGENY KHOROV	225	1 10.3.2.10.1	118	64	E	N	118.64 10.3.2.10.1	Space is missing before "for"	add space		2017/1/9 9:42
5354	EVGENY KHOROV	225	1 27.2.1	149	27	E	N	149.27 27.2.1	"the" is missing before "AP to which the STA is associated"	Add "the"		2017/1/9 9:42
5355	EVGENY KHOROV	225	1 27.2.1	149	53	E	N	149.53 27.2.1	"the" is missing before "AP to which the STA is associated"	Add "the"		2017/1/9 9:42
5356	EVGENY KHOROV	225	1 27.2.1	149	57	E	N	149.57 27.2.1	"the" is missing before "AP to which the STA is associated"	Add "the"		2017/1/9 9:42
5357	EVGENY KHOROV	225	1 27.2.1	149	62	E	N	149.62 27.2.1	"If" is not needed in the statement	Remove "if"		2017/1/9 9:42
5358	EVGENY KHOROV	225	1 27.2.2	150	25	T	N	150.25 27.2.2	The reason why AP may maintain 2 NAVs while the STAs shall maintain 2 NAVs (i.e. STAs must support more features than APs) is not clear.	Make an HE AP support 2 NAV timers		2017/1/9 9:42
5359	EVGENY KHOROV	225	1 27.2.2	151	37	E	N	151.37 27.2.2	Grammar: Note 1 is not correct	Replace the beginning of the Note 1 with "If the received PS-Poll is carried in an HE SU PPDU, ..."		2017/1/9 9:42
5360	EVGENY KHOROV	225	1 27.3.3.1	153	19	E	N	153.19 27.3.3.1	Double periods at the end of sentence	Remove a period		2017/1/9 9:42
5361	EVGENY KHOROV	225	1 27.3.3.1	153	47	T	N	153.47 27.3.3.1	S-MPDU is not defined	Define S-MPDU or replace it		2017/1/9 9:42
5362	EVGENY KHOROV	225	1 27.3.3.1	153	56	T	N	153.56 27.3.3.1	S-MPDU is not defined	Define S-MPDU or replace it		2017/1/9 9:42
5363	EVGENY KHOROV	225	1 27.5.1.3	163	35	E	N	163.35 27.5.1.3	A HE AP	Replace a with an		2017/1/9 9:42
5364	EVGENY KHOROV	225	1 27.5.2.2.1	165	3	T	N	165.03 27.5.2.2.1	From text it is not clear whether the User Info field with AID = 0 is addressed to a STA	Clarify whether the User Info field with AID = 0 is considered here to be addressed to a STA		2017/1/9 9:42

5365	EVGENY KHOROV	225	1 27.5.2.5	171	59	T	N	171.59 27.5.2.5	Using BSRP with RU allocated for random access may not be efficient if all the STAs which receive this BSRP reply	Add the following condition to the end of the sentence: if at least the buffers of the STAs are not empty	2017/1/9 9:42
5366	EVGENY KHOROV	225	1 27.5.2.6.2	173	46	E	N	173.46 27.5.2.6.2	Period and space are missing before "If"	Add a period and space before "If"	2017/1/9 9:42
5367	EVGENY KHOROV	225	1 27.6.2	177	45	T	N	177.45 27.6.2	CSI is not defined	Define CSI or correct Figure 27-3	2017/1/9 9:42
5368	EVGENY KHOROV	225	1 27.6.2	178	8	T	N	178.08 27.6.2	CSI is not defined	Define CSI or correct Figure 27-4	2017/1/9 9:42
5369	EVGENY KHOROV	225	1 27.9.2.1	190	50	E	N	190.50 27.9.2.1	It seems that the sentence is a heading	Make a Clause heading or remove the sentence	2017/1/9 9:42
5370	EVGENY KHOROV	225	1 27.5.2.3	167	59	T	N	167.59 27.5.2.3	If the STA is not associated with the AP, TBD	Define TBD	2017/1/9 9:42
5371	EVGENY KHOROV	225	1 27.5.2.5	171	41	E	N	171.41 27.5.2.5	Table 9-XX does not exist	Replace the reference with Table 9-18c	2017/1/9 9:42
5372	EVGENY KHOROV	225	1 28.3.17.3	345	64	E	N	345.64 28.3.17.3	Table xx-a does not exist	Replace the reference with Table 28-41	2017/1/9 9:42
5373	EVGENY KHOROV	225	1 10.2.1	1	1	G	N	1.01 10.2.1	Update Figure 10-1--Non-DMG STA MAC architecture with new 11ax features (OFDMA, HE PHY, etc)	As in comment	2017/1/9 9:42
5374	EVGENY KHOROV	225	1 10.22.2	129	13	T	N	129.13 10.22.2	It is not clear, what shall be done with LRC, SRC, CW[AC], etc, when a frame was transmitted several times with EDCA and then with UL OFDMA	Clarify	2017/1/9 9:42
5375	EVGENY KHOROV	225	1 27.9.2.2	191	12	E	N	191.12 27.9.2.2	Scaling of Figure 27-6 is not good	Reduce the size of the figure	2017/1/9 9:42
5376	EVGENY KHOROV	225	1 9.7.3	108	56	E	N	108.56 9.7.3	Multi-STA BA is not defined	Replace with "Multi-STA BlockAck"	2017/1/9 9:42
5377	EVGENY KHOROV	225	1 9.7.3	109	28	E	N	109.28 9.7.3	Multi-STA BA is not defined	Replace with "Multi-STA BlockAck"	2017/1/9 9:42
5378	EVGENY KHOROV	225	1 27.5.2.2.1	164	57	E	N	164.57 27.5.2.2.1	Multi-STA BA is not defined	Replace with "Multi-STA BlockAck"	2017/1/9 9:42
5379	EVGENY KHOROV	225	1 28.3.11.11	329	47	T	N	329.47 28.3.11.11	Error! Reference source not found. and Error! Reference source not found.	Correct the references	2017/1/9 9:42
5380	Geonjung Ko	225	1 9.3.1.23	47	48	T	Y	47.48 9.3.1.23	Equation 9-ax1 and 9-ax2 define the length of the Padding field in the Trigger frame and the length is the maximum length among the length for receiving STAs required to respond to the Trigger frame. Therefore when the Trigger frame includes User Info fields with the AID12 field set to 0, the random access of some STAs can be restricted by the Padding length.	The Padding length longer than the value defined by the equation should be allowed. When the Trigger frame includes User Info fields with the AID12 field set to 0, the length defined by the equation 9-ax1 and 9-ax2 can be the minimum length.	2017/1/9 9:42
5381	Geonjung Ko	225	1 28.3.20	369	5	T	Y	369.05 28.3.20	An AP does not need to issue a PHY-RXSTART.indication primitive in response to a HE trigger-based PPDU that does not overlap the primary channel, if the PPDU is not solicited by the AP.	An AP shall issue a PHY-RXSTART.indication primitive in response to a PPDU that does not overlap the primary channel, if the PPDU is the HE trigger-based PPDU the AP solicited. If the PPDU is the HE trigger-based PPDU that does not overlap the primary channel and the PPDU is not solicited by the AP, the AP shall not issue the primitive.	2017/1/9 9:42
5382	Geonjung Ko	225	1 28.3.20	369	5	E	Y	369.05 28.3.20	the HE-trigger based PPDU -> the HE trigger-based PPDU	As per comment	2017/1/9 9:42
5383	Geonjung Ko	225	1 28.3.20	369	8	T	Y	369.08 28.3.20	According to the baseline spec, the secondary channel means a 20 MHz channel. Therefore, it should be the secondary 20 MHz channel, secondary 40 MHz channel, or secondary 80 MHz channel.	As per comment	2017/1/9 9:42
5384	Geonjung Ko	225	1 27.2.2	150	57	T	Y	150.57 27.2.2	When an AP solicits an immediate response from a STA using the UL MU operation, the solicited STA may not respond to the Trigger frame after the CS mechanism. In this case, the STA shall set its NAV.	In case that the STA is solicited an immediate response by the frame but the STA cannot respond to the frame, the STA shall update its NAV.	2017/1/9 9:42
5385	Geonjung Ko	225	1 27.9	190	1	T	Y	190.01 27.9	Although the Spatial Reuse field is in the HE-SIG-A, the spec does not define the related operation.	The SRP-based Spatial Reuse operation should be defined.	2017/1/9 9:42
5386	Geonjung Ko	225	1 27.5.2.6.2	173	31	T	Y	173.31 27.5.2.6.2	We need a clarification on what "the HE AP" means. For a STA which associated with an AP, "the HE AP" would be the AP that the STA associated with. Also it should be clarified for a STA which has not associated with any APs. Without the clarification, the STA would initialize its OBO counter every time the STA receives a Beacon frame from neighboring APs.	A STA which associated with an AP initializes its OBO counter on the reception of the RAPS element from the associated AP. A STA which has not associated with any APs initializes its OBO counter on the reception of the RAPS element from the intended AP.	2017/1/9 9:42

5387	Geonjung Ko	225	1 27.11.4	196	44	T	Y	196.44 27.11.4	A BSS may change its BSS Color (Subclause 27.16.2 Selecting and advertising new BSS Color) during the operation.	The BSS shall maintain the single value of the BSS Color subfield of the HE Operation element for the lifetime of the BSS or until the BSS changes the BSS Color to the new value.	2017/1/9 9:42
5388	Geonjung Ko	225	1 27.11.4	196	49	T	Y	196.49 27.11.4	An HE STA may not receive the HE Operation element at the BSS Color change TBTT. In this case, the HE STA shall set the TXVECTOR parameter BSS_COLOR of an HE PPDU to the value indicated in the BSS Color Change Annoucement element, not in the HE Operation element.	As per comment	2017/1/9 9:42
5389	Geonjung Ko	225	1 28.2.2	226	22	T	Y	226.22 28.2.2	BSS_COLOR can be set to the value within the range 0 to 63, but sometimes the usage of value 0 is not the AP's choice. For example, if the intended recipient of a PPDU is not a member of a transmitting STA's BSS, then BSS_COLOR is set to 0 (Subclause 27.11.4 BSS_COLOR).	As per comment	2017/1/9 9:42
5390	Geonjung Ko	225	1 27.16.2	206	39	T	Y	206.39 27.16.2	We need a clarification on what is BSS Color change TBTT when the HE extended range SU PPDU format Beacon is used. When the Dual Beacon is used, two kinds of Beacon frames have different TBTTs.	Even if the STA receives any Beacon frame between Beacon frames of two PPDU formats, all STAs in the BSS shall start to use the BSS Color at the same time. e.g. at the TBTT of non-HE format Beacon frame.	2017/1/9 9:42
5391	Geonjung Ko	225	1 9.4.2.222	95	24	T	Y	95.24 9.4.2.222	When an AP uses the Dual Beacon, even if the STA receives any Beacon frame between Beacon frames of two PPDU formats, all STAs in the BSS shall start to use the BSS Color at the same time. e.g. at the TBTT of non-HE format Beacon frame. Need a clarification on a setting of the Color Switch Countdown field.	When an AP uses the Dual Beacon, a value of 0 indicates that the switch occurs at the current TBTT if the element is carried in a non-HE format Beacon frame or at the next TBTT of a non-HE format Beacon frame if the element is not carried in a nonHE format Beacon frame.	2017/1/9 9:42
5392	Geonjung Ko	225	1 27.5.2.6.2	173	31	T	Y	173.31 27.5.2.6.2	When an AP uses the Dual Beacon, a non-AP STA that receives RAPS elements from both Beacon frames of two PPDU formats would initialize its OBO counter twice. Then the STA may have less probability to access the random access RU than a STA that receives one Beacon frame.	When an AP uses the Dual Beacon, the STA should use the RAPS element from one format of Beacon frame.	2017/1/9 9:42
5393	Geonjung Ko	225	1 9.4.2.220	93	14	T	Y	93.14 9.4.2.220	When an AP uses the Dual Beacon, a non-AP STA that receives RAPS elements from both Beacon frames of two PPDU formats would initialize its OBO counter twice. Then the STA may have less probability to access the random access RU than a STA that receives one Beacon frame.	When an AP uses the Dual Beacon, the RAPS element should be included only in one format of Beacon frame between two formats of Beacon frames.	2017/1/9 9:42
5394	Geonjung Ko	225	1 27.2.1	150	15	T	Y	150.15 27.2.1	Partial BSS Color information can be included in the Partial AID field. Therefore, the decision made by using the MAC address should take precedence over the decision made by using the RXVECTOR parameter GROUP_ID and PARTIAL_AID.	As per comment	2017/1/9 9:42
5395	Geonjung Ko	225	1 27.5.2.6.2	173	37	T	Y	173.37 27.5.2.6.2	Although a STA receives a User Info field with the AID12 subfield set to 0, the STA may not have a capability to send a frame using the RU indicated by the User Info field. For example, a 20 MHz only HE STA cannot transmit a PPDU using a RU not within the primary 20 MHz channel.	If a STA is not able to transmit a frame using the RU indicated by the User Info field with the AID12 subfield set to 0, the STA should not decrement its OBO counter on the User Info field indicating the RU not capable to transmit a frame. Also when the OBO counter decrements to 0, the STA should not select the RU which is not capable.	2017/1/9 9:42
5396	Geonjung Ko	225	1 27.5.2.6.2	173	37	T	Y	173.37 27.5.2.6.2	Although a STA receives a User Info field with the AID12 subfield set to 0, the STA may not have a capability to send a frame as indicated in the User Info field. For example, the MCS subfield in the Common Info field may indicate the value which is not supported by the STA.	If a STA does not have a capability to transmit a frame as indicated by the User Info field with the AID12 subfield set to 0, the STA should not decrese its OBO counter on the User Info field and when the OBO counter is 0, the STA should not select the RU allocated by the User Info field.	2017/1/9 9:42
5397	Geonjung Ko	225	1 27.5.2.2.3	167	38	T	Y	167.38 27.5.2.2.3	It seems that the sentence of line 33 includes the sentence of line 38.	Please remove the sentence.	2017/1/9 9:42

5398	Geonjung Ko	225	1 9.3.1.23	41	47	E	Y	41.47 9.3.1.23	Currently the Trigger farme includes the RA field.	The bracket is not required in the figure.	2017/1/9 9:42
5399	Geonjung Ko	225	1 27.5.2.6.2	173	36	T	Y	173.36 27.5.2.6.2	The spec does not instruct that a STA receiving a Trigger frame soliciting the STA shall ignores the rest of User Info fields (after the User Info field with the AID12 subfield set to the STA's AID). In case that the STA is scheduled by the Trigger frame and its OBO counter decrements to zero, the scheduled STA should use the RU allocated by the User Info field with the AID12 subfield set to the STA's AID. Also the STA shall initialize its OBO counter to avoid the collision on the next random access opportunity. Allowing the scheduled STA to decrease its OBO counter can make the STA to transmit a frame using a random access RU quickly. The collision is avoided by the OBO counter of the random number and the random RU selection.	When a Trigger frame includes the User Info field with its AID12 subfield set to 12 LSBs of the AID of a STA, if the scheduled STA decrements its OBO counter to zero, the STA shall not use the RU allocated by the User Info field with the AID12 subfield set to 0 and the STA shall initialize its OBO counter.	2017/1/9 9:42
5400	Geonjung Ko	225	1 9.4.2.222	95	40	E	Y	95.40 9.4.2.222	Figure caption.	New BSS Color field format -> New BSS Color Information field format	2017/1/9 9:42
5401	Geonjung Ko	225	1 27.5.2.6.2	173	1	T	Y	173.01 27.5.2.6.2	There is always the Beacon frame from the transmitted BSSID, but Beacon frames from the nontransmitted BSSIDs may not exist. Moreover, a STA cannot determine whether a Trigger frame is soliciting STAs only associated with the BSS of the transmitted BSSID or at least two BSSs using the TA field. STAs associated with the BSS of the nontransmitted BSSID should have an opportunity to participate in the random access. Also all of STAs associated with BSSs of the transmitted BSSID and nontransmitted BSSIDs need to have fair opportunities.	STAs associated with BSSs of nontransmitted BSSIDs should use the RAPS element in a Beacon frame from the transmitted BSSID. Also it should be allowed that STAs associated with the BSS of the transmitted BSSID decrement OBO counters on the Trigger frame with the TA field set to the nontransmitted BSSID and STAs associated with BSSs of nontransmitted BSSIDs decrement OBO counters on the Trigger frame with the TA fiels set to the transmitted BSSID.	2017/1/9 9:42
5402	Geonjung Ko	225	1 27.10.4	193	58	T	Y	193.58 27.10.4	A multi-TID A-MPDU may contain A-MPDU subframes with the EOF subfield set to 1 and the MPDU Length subfield set to nonzero value. The STA that receives the A-MPDU acknowledges successful receptions of MPDUs in the above mentioned A-MPDU subframes with Per STA Info fields indicating an Ack. The TID value of a frame in an A-MPDU subframe with the EOF subfield set to 1 and the MPDU Length subfield set to nonzero value is unique among TID values of frames in the A-MPDU. Therefore, when every unsuccessful receptions of MPDUs are for a MPDU in an A-MPDU subframe with the EOF subfield set to 1 and the MPDU Length subfield set to nonzero, the Per STA Info field without Block Ack Starting Sequence Control and Block Ack Bitmap can acknowledge the successful reception of all MPDUs of a TID value without the ambiguity.	An HE STA that receives a multi-TID A-MPDU shall respond with a Multi-STA BlockAck frame that contains - One Per STA Info field indicating an Ack for each successfully received MPDU that solicits a response that is preceded by a nonzero length MPDU delimiter whose EOF is 1 (TID value equals that of the QoS Data/QoS Null frame or 15 for the Action frame), - One Per STA Info field indicating a BlockAck for each TID of a successfully received MPDU that solicits a response that is preceded by a nonzero length MPDU delimiter whose EOF is 0 (TID value equals that of the QoS Data frame), - One Per STA Info field with the Ack Type subfield set to 1 for each TID of a successfully received MPDU that solicits a response that is preceded by a nonzero length MPDU delimiter whose EOF is 0 (TID value equals that of the QoS Data frame) only when every unsuccessful receptions are for	2017/1/9 9:42

5403 Geonjung Ko	225	1 9.3.1.9.7	38	6	T	Y	38.06 9.3.1.9.7	According to the subclause 27.10.4 (A-MPDU with multiple TIDs), a multi-TID A-MPDU may contain A-MPDU subframes with the EOF subfield set to 1 and the MPDU Length subfield set to nonzero value. The STA that receives the A-MPDU acknowledges successful receptions of MPDUs in the above mentioned A-MPDU subframes with Per STA Info fields indicating an Ack. The TID value of a frame in an A-MPDU subframe with the EOF subfield set to 1 and the MPDU Length subfield set to nonzero value is unique among TID values of frames in the A-MPDU. Therefore, when every unsuccessful receptions of MPDUs are for a MPDU in an A-MPDU subframe with the EOF subfield set to 1 and the MPDU Length subfield set to nonzero, the Per STA Info field without Block Ack Starting Sequence Control and Block Ack Bitmap can acknowledge the successful reception of all	If the Ack Type subfield is 1 and the TID value of the Per AID TID Info subfield is less than 8 or equal to 15, then the Block Ack Starting Sequence Control and Block Ack Bitmap subfields are not present and the Per STA Info subfield acknowledges successful reception of a single MPDU "or all the MPDUs" indicated by the TID of the Per AID TID Info subfield.		2017/1/9 9:42
5404 Geonjung Ko	225	1 10.13.7	129	8	T	Y	129.08 10.13.7	A multi-TID A-MPDU may contain multiple A-MPDU subframes with the EOF subfield set to 1 and the MPDU Length subfield set to nonzero value. However, in the baseline spec, the EOF field can be set to 1 if the A-MPDU subframe's MPDU Length field is nonzero and the subframe is the only subframe that has a nonzero MPDU Length field. Therefore, the setting rule of the EOF field should be changed for an HE STA.	If an A-MPDU subframe's MPDU Length field is nonzero, the subframe is the only subframe that has a nonzero MPDU Length field and the TID value of the MPDU is not the same with TID values of other MPDUs in the A-MPDU, the EOF field may be set to 1.		2017/1/9 9:42
5405 Geonjung Ko	225	1 9.4.2.222	95	29	E	Y	95.29 9.4.2.222	No need of a dash in the word subfield	sub-field -> subfield		2017/1/9 9:42
5406 Geonjung Ko	225	1 9.3.1.9.1	34	30	E	Y	34.30 9.3.1.9.1	Grammar	An HE non-AP STA transmits a Multi-STA BlockAck frame with a single AID subfield or with the same values of the AID subfield in Per STA Info subfields and sets the RA field to the TA field of the soliciting frame or the address of the recipient STA whose data/management frames are acknowledged. ->An HE non-AP STA that transmits a Multi-STA BlockAck frame with a single AID subfield or with the same values of the AID subfield in Per STA Info subfields sets the RA field to the TA field of the soliciting frame or the address of the recipient STA whose data/management frames are acknowledged.		2017/1/9 9:42
5407 Geonjung Ko	225	1 9.3.1.9.7	38	1	E	Y	38.01 9.3.1.9.7	Text format	Please increase the text size of the first sentence.		2017/1/9 9:42
5408 Geonjung Ko	225	1 27.5.1.3	163	35	E	Y	163.35 27.5.1.3	Grammar	A HE AP -> An HE AP		2017/1/9 9:42
5409 Geonjung Ko	225	1 28.3.10.8.5	295	32	T	Y	295.32 28.3.10.8.5	Need a description on how the STA-ID field is used for the uplink case	As per comment		2017/1/9 9:42
5410 Geonjung Ko	225	1 27.3.2	152	53	T	Y	152.53 27.3.2	The dynamic fragmentation requires more capability than the static fragmentation for the originator. Therefore, the spec should define the related transmitter requirements as in Subclause 10.3.2.11 of the baseline spec.	As per comment		2017/1/9 9:42
5411 Geonjung Ko	225	1 27.5.2.6.2	173	45	T	Y	173.45 27.5.2.6.2	The spec needs to define the operation of a STA when the STA decrements its OBO counter to zero and has no data to transmit.	As per comment		2017/1/9 9:42
5412 Geonjung Ko	225	1 28.3.10.8	285	55	T	Y	285.55 28.3.10.8	An HE MU PPDU with the UL/DL field set to 1 is intended to one STA and the HE-SIG-B design is not efficient.	Please refine the HE-SIG-B design for the UL case to reduce the length of the HE-SIG-B field.		2017/1/9 9:42
5413 George Calcev	225	1 28.3.10.7.2	275	34	T	Y	275.34 28.3.10.7.2	"Doppler mode" is not defined	Define Doppler mode or remove all references		2017/1/9 9:42
5414 George Calcev	225	1 28.3.10.7.2	275	35	T	Y	275.35 28.3.10.7.2	"Doppler mode" is not defined	Define "Doppler mode" or remove it from the text		2017/1/9 9:42
5415 George Calcev	225	1 28.3.10.7.2	277	36	T	Y	277.36 28.3.10.7.2	"Doppler mode" not defined	Define or remove the "Doppler mode" from the text		2017/1/9 9:42
5416 George Calcev	225	1 28.3.10.7.2	277	37	T	Y	277.37 28.3.10.7.2	"Doppler mode" not defined	Define or remove "Doppler mode" from the text		2017/1/9 9:42
5417 George Calcev	225	1 9.3.1.23	45	11	T	Y	45.11 9.3.1.23	"doppler mode" not defined	Define or remove "doppler mode" from the text		2017/1/9 9:42
5418 George Calcev	225	1 9.4.2.218.3	83	41	T	Y	83.41 9.4.2.218.3	"Doppler procedure" not defined	Define "Doppler procedure" or remove it from the text		2017/1/9 9:42

5419 George Calcev	225	1 9.4.2.218.3	83	43	T	Y	83.43 9.4.2.218.3	"Doppler procedure" not defined	Define "Doppler procedure" or remove it from text	2017/1/9 9:42
5420 Graham Smith	225	1 3.2	6	50	T	Y	6.50 3.2	"A BSS transmits beacons in two PHY modes,...". A BSS does not transmit beacons an AP does, or beacons are transmitted in a BSS.	Replace "A BSS transmits beacons in two PHY modes" with "An HE AP STA transmits beacons in two PHY modes,"	2017/1/9 9:42
5421 Graham Smith	225	1 3.2	6	51	T	Y	6.51 3.2	"..beacons transmitted in HE_EXT_SU PHY format enables.." Previous sentence does not mention this "HE_EXT_SU PHY format"	Replace " HE_EXT_SU PHY" with "HE extended range PHY" or vice versa.	2017/1/9 9:42
5422 Graham Smith	225	1 3.2	6	51	E	Y	6.51 3.2	"The beacons transmitted in HE_EXT_SU PHY format enables BSS discoverability and BSS operating parameters distribution in the whole BSS coverage." Do we normally include a reason for the feature? I don't think so.	Delete cited sentence	2017/1/9 9:42
5423 Graham Smith	225	1 4.3.14a	9	18	T	Y	9.18 4.3.14a	"- An HE non-AP STA supporting 20 MHz, 40 MHz, 80 MHz, 160 MHz and 80+80 MHz is also a VHT non-AP STA -- An HE non-AP STA shall support operation in 20 MHz channel bandwidth only" First cited bullet says an HE non-AP STA supports 20, 40, 80, 160 and 80+80. But the second cited bullet says an HE non-AP STA shall only support 20. Is it trying to say that 20MHz is mandatory? Is so, say so. Or is thhis just a copy from the 2.4GHz band case and if so should not be here at all? What is it?	Delete "only" or delete bullet.	2017/1/9 9:42
5424 Graham Smith	225	1 4.3.14a	9	38	T	Y	9.38 4.3.14a	Here at L38 we see that there is mandatory support required for 160MHz but the features for an VHT STA, as refered to in line 29 have 160 as optional. Is 160 mandatory for HE? If so need to state such. If not then this needs to be optional. Which is it?	Sort it out as per comment	2017/1/9 9:42
5425 Graham Smith	225	1 4.3.14a	9	65	T	Y	9.65 4.3.14a	There is no mention of Spatial Reuse - true the spatial reuse schemes in the draft leave a lot to be desired but, who knows, maybe we will end up with something that actually will work (DSC for example). Considering that the original idea behind 11ax was for improving throughput across an area and that spatial reuse is, in fact, a very important part of that, it is amazing that it somehow got lost and we ended up with mostly go faster stripes (making it simply a straight follow on previous amendments rather than really looking at providing the means to improve area throughput by planning).	Add at leats a passing mention that spatial reuse scheme(s) are a component of HE.	2017/1/9 9:42
5426 Graham Smith	225	1 6.3.3.3.2	11	26	T	Y	11.26 6.3.3.3.2	Why use different description than either HT or VHT? Aso not so sure anything is 'specified' here, it is simply a list.	Change "Specifies the parameters within the HE Capabilities element that are supported by the STA." to "The values from the HE Capabilities element."	2017/1/9 9:42
5427 Graham Smith	225	1 6.3.3.32	11	35	T	Y	11.35 6.3.3.32	Why use different description than either HT or VHT? Aso not so sure anything is 'specified' here, it is simply a list.	Change "Specifies the parameters within the HE Operation element that are supported by theAP." to "The values from the HE Operation element."	2017/1/9 9:42
5428 Graham Smith	225	1 6.3.7.4.2	12	37	T	Y	12.37 6.3.7.4.2	Ehere did "peer STA" come from?	Delete "peer"	2017/1/9 9:42
5429 Graham Smith	225	1 6.3.8.4.2	13	5	T	Y	13.05 6.3.8.4.2	Ehere did "peer STA" come from?	Delete "peer"	2017/1/9 9:42
5430 Graham Smith	225	1 6.3.11.2.2	13	39	T	Y	13.39 6.3.11.2.2	Why use different description than either HT or VHT? I think the only terms using "MAC entity" are DMG related, do we really want to follow that. HT and VHT use "supported by the STA".	Replace 'MAC entity" wirh "STA"	2017/1/9 9:42
5431 Graham Smith	225	1 6.3.27.4.2	13	61	E	Y	13.61 6.3.27.4.2	Clause number duplicated	Delete duplication	2017/1/9 9:42
5432 Graham Smith	225	1 8.3.5.10.3	15	65	T	Y	15.65 8.3.5.10.3	What has IPI got to do with it? The only parameter present in this primitive is IPI STATE. This has nothing to do with OBSS_PD.	Delete this instruction completely.	2017/1/9 9:42

5433	Graham Smith	225	1 9.2.4.5.4	20	44	T	Y	20.44 9.2.4.5.4	"For a frame that is carried in a DL HE MU PPDU: The Ack Policy subfield for the frame that solicits an immediate response in an HE Trigger-based PPDU is set to this value (MU Ack). The addressed recipient returns an Ack, BlockAck, or Multi-STA BlockAck frame in the HE trigger-based PPDU format after a SIFS period, according to the procedures defined in 10.3.2.11.2 (Acknowledgement procedure for HE MU PPDU in MU format) and 27.5.2 (UL MU operation)." This seems to be against the idea of the "No explicit acknowledgement" which is the basic meaning of this setting. Te basic intention is that the response is something other than an ACK type. But here we see that theaddressed recipient returns an ACK, Block ACk or Multi-STA Block Ack which is totllay against the use of this setting.	Use either setting 1,1 or 0,0		2017/1/9 9:42
5434	Graham Smith	225	1 9.2.4.5.6	21	14	T	Y	21.14 9.2.4.5.6	"The queue size value is the total size, rounded up to the nearest multiple of 256 octets and expressed in units of 256 octets, of all MSDUs and A-MSDUs buffered at the STA (excluding the MSDU or A-MSDU of the present QoS Data frame sent by a non-HE STA and including the MSDUs or A-MSDUs contained in the present (A-)MPDU sent by an HE STA) in the delivery queue used for MSDUs and A-MSDUs.." The original instructionm seems pretty clear - Do not include the (A)-MSDUs in the present data frame. For the HE the instructions seems to be to include what's in the present data frame. So do we set out to be deliberately awkward? Why different?	Make the use as close as possible to non HE STAs		2017/1/9 9:42
5435	Graham Smith	225	1 9.2.4.5.6	21	19	T	Y	21.19 9.2.4.5.6	"If a QoS Data frame is fragmented and is not carried in an A-MPDU, the queue size value can remain constant in all fragments even if the amount of queued traffic changes as successive fragments are transmitted. If a QoS Data frame is fragmented and is carried in an A-MPDU, the queue size value is set as defined in 10.13.1 (A-MPDU contents)." 10.13.1 does not mention queue size, so the reference must be wrong	Find the right reference.		2017/1/9 9:42
5436	Graham Smith	225	1 9.4.2.6.1	21	60	T	Y	21.60 9.4.2.6.1	"The VHT subfield, which is B0 of the HT Control field, and the HE subfield, which is B1 of the HT Control field, indicate the variant of the HT Control field." The HE subfield is not present in the HT variant, therefore this 'further' indicates the varaint.	Replace ", indicate" with ",further indicates"		2017/1/9 9:42
5437	Graham Smith	225	1 9.2.4.6.4.1	22	49	E	Y	22.49 9.2.4.6.4.1	Figure 9-15a why the double arrow above the drawing, can't see what purpose it is serving. (Also it should have been "Aggregated"	Remove double arrow "Aggregate Control"		2017/1/9 9:42
5438	Graham Smith	225	1 9.2.4.6.4.1	23	44	T	Y	23.44 9.2.4.6.4.1	"The Padding subfield, if present, follows the last Control subfield and is set to a sequence of zeros so that the length of the A-Control subfield carried in the HT Control field is 30 bits." This is only carried in the HT Control field and the length is fixed to 30 bits. A look at the individual Control Information shows that they have reserved bits. Hence, surely each should simply have the necessary number of reserved bits to make them 30 bits in length. Then we use reserved bits in place of padding bits which is cleaner and also more flexible.	Remove the "Length..." column from Table 9-18a. Delete cited text. Note that for each of the Control information subfields the number of reserved bits is increased so tat the subfield is 30 bits.		2017/1/9 9:42
5439	Graham Smith	225	1 9.2.4.6.4.2	24	6	T	Y	24.06 9.2.4.6.4.2	Increase Reserved bit number to make length 30 bits	Figure 9-15c change Reserved bits from 1 to 5		2017/1/9 9:42
5440	Graham Smith	225	1 9.2.4.6.4.3	24	50	T	Y	24.50 9.2.4.6.4.3	Increase Reserved bit number to make length 30 bits	Figure 9-15d change Reserved bits from 3 to 21		2017/1/9 9:42

5441 Graham Smith	225	1 9.2.4.6.4.4	25	19	T	Y	25.19 9.2.4.6.4.4	Increase Reserved bit number to make length 30 bits	Figure 9-15e change Reserved bits from 9 to 23	2017/1/9 9:42
5442 Graham Smith	225	1 9.2.4.6.4.5	25	47	T	Y	25.47 9.2.4.6.4.5	Add Reserved bit number to make length 30 bits	Figure 9-15f add Reserved bits 4	2017/1/9 9:42
5443 Graham Smith	225	1 9.2.4.6.4.6	27	27	T	Y	27.27 9.2.4.6.4.6	Increase Reserved bit number to make length 30 bits	Figure 9-15g change Reserved bits from 2 to 24	2017/1/9 9:42
5444 Graham Smith	225	1 9.2.4.6.4.7	27	57	T	Y	27.57 9.2.4.6.4.7	Increase Reserved bit number to make length 30 bits	Figure 9-15h change Reserved bits from 2 to 22	2017/1/9 9:42
5445 Graham Smith	225	1 9.2.4.6.4.8	29	6	T	Y	29.06 9.2.4.6.4.8	Increase Reserved bit number to make length 30 bits	Figure 9-15i change Reserved bits from 6 to 28	2017/1/9 9:42
5446 Graham Smith	225	1 9.2.4.7	29	58	T	Y	29.58 9.2.4.7	Why is the VHT Capabilities Information field referenced and not the HE Capabilities field? Should it not reference Table 9-262z?	Change reference to Table 9.262z	2017/1/9 9:42
5447 Graham Smith	225	1 9.2.4.7	30	26	T	Y	30.26 9.2.4.7	Why is the VHT PHY characrteristics referenced and not the HE ? Should it not reference Table 28-46?	Change reference to Table 28-46	2017/1/9 9:42
5448 Graham Smith	225	1 9.2.5.2	31	11	T	Y	31.11 9.2.5.2	"In an MU-RTS frame, the Duration/ID field is set to the estimated time, in microseconds, required for the pending frame,...". Should be "...required to transmit the pending frame..."	Change "required for the pending frame" to "required to transmit the pending frame"	2017/1/9 9:42
5449 Graham Smith	225	1 9.2.5.2	31	20	T	Y	31.20 9.2.5.2	"In a MU-BAR frame, the Duration/ID field is set to the time required for the solicited HE trigger-based PPDU plus one SIFS." Should be "time required to transmit the solicited"	Change " required for the solicited" to "required to transmit the solicited"	2017/1/9 9:42
5450 Graham Smith	225	1 9.3.1.9.1	34	23	T	Y	34.23 9.3.1.9.1	"The RA field of the BlockAck frame that is not a Multi-STA BlockAck variant is set to the TA field of the soliciting frame or the address of the recipient STA whose data/management frames are acknowledged." Why did you change the existing text, it looked pretty clear as it was. Then insert a para so as to differentiate the HE additions.	Revert cited sentence back to original and then add para break.	2017/1/9 9:42
5451 Graham Smith	225	1 9.3.1.9.1	34	25	T	Y	34.25 9.3.1.9.1	"An HE AP that transmits a Multi-STA BlockAck frame with different values of the AID subfield in Per STA Info subfields sets the RA field to the broadcast address. An HE AP that transmits a Multi-STA BlockAck frame with a single AID subfield or with the same values of the AID subfield in Per STA Info subfields sets the RA field to the address of the recipient STA that requested the Block Ack or to the broadcast address." Why not then simply set the RA to the broadcast address and make this bit really simple for the AP?	Keep it simple and just set the RA to broadcast address. Replace all cited text with "An HE AP that transmits a Multi-STA BlockAck frame sets the RA field to the broadcast address."	2017/1/9 9:42
5452 Graham Smith	225	1 9.3.1.9.1	34	30	T	Y	34.30 9.3.1.9.1	"An HE non-AP STA transmits a Multi-STA BlockAck frame with a single AID subfield or with the same values of the AID subfield in Per STA Info subfields and sets the RA field to the TA field of the soliciting frame or the address of the recipient STA whose data/management frames are acknowledged." Why do we have the instruction for the AID here? This is for the RA which is set to the address of the recipient.	Replace all cited text with "An HE non-AP STA transmits a Multi-STA BlockAck frame sets the RA field to the TA field of the soliciting frame or the address of the recipient STA whose data/management frames are acknowledged."	2017/1/9 9:42

5453	Graham Smith	225	1 27.2.1	16	149	T	Y	17.49 27.2.1	This intra inter BSS stuff is a concern. The uses for this are OBSS_PD spatial reuse, intra-PPDU power save and the two NAV idea. The decision to transmit over another packet has nothing to do with whether they are in different BSSs. OBSS_PD has no indications of how to pick a value and although it seems on the surface a good idea to never transmit over an intra PPDU, if the STA wanders away it should be encouraged to transition not be extra protected. If transmitting over causes any packet to fail, then it is wrong whether it is in the same BSS or not. The inter_BSS Power save idea saves what? Any STA that determines the packet is not send to it, can doze if it wants. But it still has to have read the packet duration and the NAV to do this, so can't see why inter_BSS packet is any different and what time does it really save if using the color etc? Two NAVs is strange as	Delete Intra and Inter BSS detection.		2017/1/9 9:42
5454	Graham Smith	225	1 27.2.1	27	149	T	Y	28.49 27.2.1	"The RA field, TA field or BSSID field of the received frame with the Individual/Group bit forced to the value 0 is the same as the BSSID of AP to which the STA is associated" The forcing the Individual/Group bit to 0 only applied to RA and TA fields, not to the BSSID. Needs rewording.	To read "The RA field or TA field of the received frame with the Individual/Group bit forced to the value 0, or the BSSID field, is the same as the BSSID of AP to which the STA is associated"		2017/1/9 9:42
5455	Graham Smith	225	1 27.2.1	31	149	T	Y	32.49 27.2.1	"..and the RA field, TA field or BSSID field of the received frame with the Individual/Group bit forced to the value 0 is same as the BSSID of any member of the Multiple BSSID Set"	To read "and the RA field, TA field of the received frame with the Individual/Group bit forced to the value 0, or the BSSID field, is the same as the BSSID of any member of the Multiple BSSID Set"		2017/1/9 9:42
5456	Graham Smith	225	1 27.2.1	46	149	T	Y	47.49 27.2.1	"A frame received by the STA is an inter-BSS frame if one of the following conditions is true:" Having ploughed through the intra-BSS conditions, do we really need to have all these? Why not simply say if none of the intra-BSS conditions is met, then the frame is considered and inter-BSS frame?	Replace with "Otherwise a frame received by the STA is an inter-BSS frame." AND delete P150L15-16.		2017/1/9 9:42
5457	Graham Smith	225	1 27.2.2	24	150	T	Y	25.50 27.2.2	"An HE non-AP STA shall maintain two NAV timers" This should not be mandatory. It goes totally against the basic contention for 802.11. If two BSSs are next to each other and overlapping (as per the cell enterprise scenario 3CH) then maintaining a special NAV for each BSS does not make sense. It could cause chaos as the two BSSs cannot now share. At the best this should be deleted, at the least it should be optional.	Replace cited text with"An HE non-AP STA may maintain two NAV timers", or delete the entire section.		2017/1/9 9:42
5458	Graham Smith	225	1 27.2.2	36	150	T	Y	37.50 27.2.2	"basic NAV" is the inter-BSS or don't know, note the non capitalized 'b'. This therefore re-defines NAV as not using intra-BSS packet durations. Surely this IS the basic NAV. What is the justification for doing this seperation anyhow? If either is nonzero then the medium is busy. The NAV is always set by the last received packet so even in this two NAV case, one of them will be set. So I fail to see the difference.	Scrap this idea		2017/1/9 9:42

5459	Graham Smith	225	1 27.2.2	57	151	T	Y	58.51 27.2.2	" Maintaining two NAV is beneficial in dense deployment scenarios where a STA requires protection from frames transmitted by STAs within its BSS, i.e., intra-BSS, and avoid interference from frames transmitted by STAs in neighboring BSS, i.e., inter-BSS. " The whole idea of NAV is to keep the medium clear for a time to allow the packet exchange to complete. Hence the claim that this provides protection to intra packets is nothing new, also nothing to do with dense environments, so this statement is meaningless.	Delete this or explain better what the diffrerence is. This is nothing new.		2017/1/9 9:42
5460	Graham Smith	225	1 27.2.2	60	151	T	Y	61.51 27.2.2	"For example, in a TXOP initiated by the associated AP for UL MU transmission, the intra-BSS NAV of the STA can be set by the AP to prevent the STA from contending the channel, and the basic NAV will not be updated by the associated AP so that NAV set by inter-BSS PPDU can be considered in UL MU CS as described in 27.5.2.4 (UL MU CS mechanism)." I try to understand the example. So the intra NAV is set, as normal, but the basic NAV is not. The example then says look at 27.5.2.4. I look but there all I see is "If one or both of the NAVs are considered and the considered NAV's counter is nonzero, then the virtual CS indicates busy." (P170L37) So if either NAV is set, which it will be, the medium is busy. Try as I might I don't get it.	Either use an example that actually explains the idea and shows that it actually does something, or, if this is not possible, lose this dual NAV idea.		2017/1/9 9:42
5461	Graham Smith	225	1 27.2.2	33	150	E	Y	34.50 27.2.2	"For the two NAVs maintained by an HE STA, one is identified as intra-BSS NAV, and the second one is identified as basic NAV." Awkward. Better to put this at line 25.	At P150L25 add new sentence, to read "The two NAV timers are identified as intra-BSS NAV, and basic NAV." AND delete cited sentence.		2017/1/9 9:42
5462	Graham Smith	225	1 27.2.2	37	150	E	Y	38.50 27.2.2	"Note that the method of identifying a PPDU as intra-BSS or inter- BSS is described in 27.2.1 (Intra-BSS and inter-BSS frame detection)." Why not just "(see 27.2.1 (Intra-BSS and inter-BSS frame detection))"?	After "intra-BSS or inter-BSS add (see 27.2.1 (Intra-BSS and inter-BSS frame detection)). AND delete cited text		2017/1/9 9:42
5463	Graham Smith	225	1 27.2.2	44	150	T	Y	45.50 27.2.2	Why do we need a duration for a PS-Poll? And why the same as the duration for any data frame (ACK + SIFS)? A PS-poll does not get Ack'd (I think), and also does this mean the PS-Poll has to be sent as an HE frame? I just don't see where the advantage of this 2 NAV idea comes from. Also why point out a duration is a duration? This obsession with inter and intra is beyond me, it just gets more and more complicated. Maintaining 2 NAVs is not trivial, the advantages are not obvious if at all, and making it mandatory seems adsurd .	Delete Lines 40 - 48		2017/1/9 9:42
5464	Graham Smith	225	1 27.2.2	57	150	T	Y	58.50 27.2.2	"The STA is not solicited an immediate response by the PPDU carrying the frame." This does not read right.	Should it be "The PPDU carrying the frame is not soliciting an immediate response from the STA."		2017/1/9 9:42
5465	Graham Smith	225	1 27.2.2	59	150	T	Y	60.50 27.2.2	"The frame is not solicited by the STA if the STA is a TXOP holder" I have no idea what this means. Clarify	Clarify the meaning		2017/1/9 9:42
5466	Graham Smith	225	1 27.2.2	1	151	T	Y	2.51 27.2.2	"The frame is identified as inter-BSS or cannot be identified as intra-BSS or inter-BSS" if the frame is not identified as an intra it should be seen as an inter.	Replace sentence with "The frame is not identified as an intra-BSS frame (see 27.2.1 (Intra-BSS and inter_BSS frame detection))"		2017/1/9 9:42
5467	Graham Smith	225	1 27.2.2	5	151	T	Y	6.51 27.2.2	"The STA is not solicited an immediate response by the PPDU carrying the frame." This does not read right.	Should it be "The PPDU carrying the frame is not soliciting an immediate response from the STA."		2017/1/9 9:42

5468	Graham Smith	225	1 27.2.2	28	151	T	Y	29.51 27.2.2	"The PPDU that carried information for the RXVECTOR parameter is identified as inter-BSS or cannot be identified as intra-BSS or inter-BSS according to the rule described in 27.2.1 (Intra-BSS and inter-BSS frame detection)". Anything that is not intra, is inter.	Replace cited with "The PPDU that carried information for the RXVECTOR parameter is identified as inter-BSS (see 27.2.1 (Intra-BSS and inter-BSS frame detection))."	2017/1/9 9:42
5469	Graham Smith	225	1 27.3.2	1	153	T	Y	2.53 27.3.2	"Fragmentation of A-MSDUs is permitted when supported by the recipient". How does the STA know? Can't just say this, need to have something specific, "when xxx is present in the yyy" or such	Change the sentence to read along the lines of "Fragmentation of A-MSDUs is permitted when xxx is ...." (add specific that identifies that a STA supports it, i.e. something in the HE Capabilities?)	2017/1/9 9:42
5470	Graham Smith	225	1 27.3.3.2	47	153	T	Y	48.53 27.3.3.2	What is an S-MPDU? I can't find a definition of what this is, here or in 11mc. Assuming it is 'single MPDU', isn't this because all MPDUs are treated as A-MPDUs in VHT? So what is difference between MPDU amd S-MPDU, and non-A-MPDU? Let's see how complicated we can make this.	Define S-MPDU somewhere or better still just use 'single MPDU' if it really is different from MPDU.	2017/1/9 9:42
5471	Graham Smith	225	1 27.3.3.2	1	154	E	Y	2.54 27.3.3.2	"10.13.8 (Transport of S-MPDUs)" That is not the correct title for 10.13.8 in 11mc D8.0.	Use correct reference ans consider not introducing this "S_MPDU" term.	2017/1/9 9:42
5472	Graham Smith	225	1 27.3.3.2	50	154	E	Y	51.54 27.3.3.2	"An originator STA may transmit to a recipient STA an MPDU or S-MPDU that contains one dynamic fragment of an AMSDU if the recipient STA has indicated a value of 1 in the A-MSDU Fragmentation Support field of its HE Capabilities element". This is repeated on the next line L55-58. Hence delete here.	Delete cited text	2017/1/9 9:42
5473	Graham Smith	225	1 27.3.3.3	29	154	T	Y	30.54 27.3.3.3	"Up to one dynamic fragment of an MSDU, A-MSDU.." That means nothing or one, so the STA may transmit nothing? Does it need a rule for that?	Replace cited text with "One dynamic fragment of an MSDU, A-MSDU.."	2017/1/9 9:42
5474	Graham Smith	225	1 27.3.3.3	29	154	T	Y	30.54 27.3.3.3	"Up to one dynamic fragment of an MSDU, A-MSDU if supported by the recipient, or MMPDU for each MSDU and for the MMPDU in an A-MPDU format". Struggling to see how this differs from the bullet above it. The first bullet says a fragment iof an MSDU, A-MSDU and I can't see what "for each MSDU" means. Everything is an A-MPDU format.	Clarify the difference, if any, between these two bullets.	2017/1/9 9:42
5475	Graham Smith	225	1 27.11.4	42	196	T	Y	43.96 27.11.4	"An HE STA transmitting an HE Operation element shall select a value in the range 1 to 63 to include in the BSS Color subfield of the HE Operation element that it transmits..." So color is mandatory. Why? The three uses, OBSS_PD, inter-PPDU PS and two NAVs all can be done without color. Also the seperate treatment of the inter and intra packets is dangerous in the cases where the OBSS is close by.	Make color optional at the least. "An HE STA transmitting an HE Operation element may select a value in the range 1 to 63 to include in the BSS Color subfield of the HE Operation element that it transmits..."	2017/1/9 9:42
5476	Graham Smith	225	1 27.11.5	49	196	T	Y	50.96 27.11.5	"An HE STA receiving an HE Operation element shall set the TXVECTOR parameter BSS_COLOR..." Color should be optional at least.	"An HE STA receiving an HE Operation element may set the TXVECTOR parameter BSS_COLOR..."	2017/1/9 9:42
5477	Graham Smith	225	1 27.11.4	54	196	T	Y	55.96 27.11.4	"An HE STA that received an HE PPDU with RXVECTOR parameter BSS_COLOR with a value between 1 and 63 may ignore the HE PPDU subject to the rules as described in 27.9 (Spatial reuse operation)." This is a seperate rule that is not required here.	Delete cited sentence	2017/1/9 9:42

5478 Graham Smith	225	1 27.11.4	14	196	T	Y	15.96 27.11.4	So the STA receives a packet forom the AP to which it is associated, and needs to go throught these hoops to prove that it is from the AP to which it is associated. Does not make sense. Apart from that the two NAVs is a bad idea anyway, and the doze duration of the intra-PPDU power save ecannot soley use color, it is quite clear that a STA will just use the good old BBSID. This is just another indication of complexity for complexity's sake.	Delete lines 14 to 25.	2017/1/9 9:42
5479 Graham Smith	225	1 27.11.4	27	197	T	Y	28.97 27.11.4	"The HE non-AP STA may use the BSS color if the most recently received HE Operation element from the AP to which it is associated contained a value of 0 in the BSS Color Disabled subfield." So this is optional. Hence color should be optional	Make Color optional	2017/1/9 9:42
5480 Graham Smith	225	1 27.9.1	6	190	T	Y	7.90 27.9.1	"The objective of the HE spatial reuse operation ..." 'The' HE spatial reuse scheme indicates ther is one scheme, not true.	Delete 'the' from cited text	2017/1/9 9:42
5481 Graham Smith	225	1 27.9.1	6	190	T	Y	7.90 27.9.1	The objective of the HE spatial reuse operation is to improve the system level performance, the utilization of medium resources and power saving in dense deployment scenarios by early identification of signals from overlapping basic service sets (OBSSs) and interference management." This does not mention the basic idea in that spatial reuse allows channels to be reused more often in dense deployments.	Replace cited text with "The objective of HE spatial reuse operation is to allow channels to be reused more often across a dense deployment."	2017/1/9 9:42
5482 Graham Smith	225	1 27.9.1	10	190	T	Y	11.90 27.9.1	"When the conditions specified in 27.9 (Spatial reuse operation) are met that allow the transmission of an SR PPDU, an HE STA may transmit an SR PPDU to either an HE STA or a non-HE STA." What is an SR PPDU, it is only mentioned in this sentence. Delete, does not make sense.	Delete cited text	2017/1/9 9:42
5483 Graham Smith	225	1 27.9.2	19	190	T	Y	20.90 27.9.2	" If the PHY of a STA issues a PHY-CCA.indication with a value equal to BUSY followed by an RXSTART.indication due to a PPDU reception then the STA's MAC sublayer may a) issue a PHYCCARESET. request primitive and b) not update its NAV timers based on frames carried in the PPDU if all the following conditions are met:" So it first says BUSY, then checks it is from an OBSS, then checks the RSSI to see if below the OBSS_PD, then it can reset the CCA and not update NAV. This is the complication for only looking at OBSS. The only possible reason for restricting this to OBSS is that all the other STAs in the same network are further away than OBSS STAs. It is pretty difficult to see a set up where setting a CCA value for OBSS_PD would be such that the same value excluded STAs in the wanted network. On top of that, the mere fact of having to go through all the rules to	The OBSS_PD scheme should be dropped. There is no reason to set a threshold only fopr OBSS.	2017/1/9 9:42

5484	Graham Smith	225	1 27.9.2.1	26	190	T	Y	27.90 27.9.2.1	"The RXVECTOR parameter RSSI_LEGACY in the PHY-RXSTART.indication primitive, which defines the received power level measured from the legacy portion of the PPDU is below the OBSS_PD level (defined in 27.9.2.2 (Adjustment of OBSS_PD and transmit power))" But 27.9.2.2 does not define any level for OBSS_PD. It just says between -62 and -82 dBm. Furthermore is appears to complicate matters by providing a formula to change it with TXPWR. As we have no idea what OBSS_PD is, this statement cited here is unusable. Nowhere can I find an actual definition of OBSS_PD.	(I would prefer that this scheme were deleted but I will have to settle for) Add a definition of OBSS_PD and refer to that.		2017/1/9 9:42
5485	Graham Smith	225	1 27.9.2.1	37	190	T	Y	38.90 27.9.2.1	"...RXVECTOR parameter SPATIAL_REUSE indicates SR_Delay." What is SR_Delay? At P274L13 it mentions it but then refers to this cited section and I note that "This section needs further development". Yes it does indeed, SR_Delay needs to either dropped or defined.	I dread to say but whatever SR_Delay is it needs to be explained.... or dropped. I just hope this is not another complicated scheme purely designed to avoid DSC. Delete cited text.		2017/1/9 9:42
5486	Graham Smith	225	1 27.9.2.1	50	190	T	Y	51.90 27.9.2.1	"SR Backoff procedure for SR delayed case". Thius looks like it was meant as a heading but as SR delayed is not defined none of this makes sense.	Delete lines 50 - 57		2017/1/9 9:42
5487	Graham Smith	225	1 27.9.2.2	3	191	T	Y	4.91 27.9.2.2	"Adjusting the OBSS_PD level and transmit power can improve the system level performance and the utilization of the spectrum." A bold statement, partially true but not telling the whole story. Do we need the publicity? Delete	Delete cited text		2017/1/9 9:42
5488	Graham Smith	225	1 27.9.2.2	5	191	T	Y	6.91 27.9.2.2	"..an HE STA is allowed to adjust the OBSS_PD level in conjunction with its transmit power based on the following adjustment rule:" "Is allowed to", this reads as a "may" so use the correct term so no confusion.	Replace "is allowed to" with "may"		2017/1/9 9:42
5489	Graham Smith	225	1 27.9.2.2	7	191	T	Y	8.91 27.9.2.2	"Allowable OBSS_PDlevel", not sure what the "allowable" is supposed to mean. Is this the rule for OBSS_PDlevel, or the rule for OBSS_PD or is it a new term OBSS_PDlevel? Please clarify.	Clarify as poer comment or delete "Allowable"		2017/1/9 9:42
5490	Graham Smith	225	1 27.9.2.2	39	191	T	Y	40.91 27.9.2.2	"The OBSS_PDlevel". We need to add "value of"	"The value of the OBSS_Pdlevel"		2017/1/9 9:42
5491	Graham Smith	225	1 27.9.2.2	39	191	T	Y	40.91 27.9.2.2	"The OBSS_PDlevel is applicable to the start of a 20 MHz PPDU received on the primary 20 MHz channel". This plus the following sentences are a very long winded way of trying to say that the CCA level is adjusted with bandwidth. Simply state that if the bandwidth fiffers from 20MHz the value is increased by 10 log (Bandwidth/20MHz)	Replace L39-49 with "If the bandwidth of the received PPDU differs from 20 MHz, then the value of the OBSS_PDlevel is increased by 10 LOG (bandwidth/20 MHz)"		2017/1/9 9:42
5492	Graham Smith	225	1 27.9.2.2	7	191	T	Y	8.91 27.9.2.2	In the formula the underscaore has gone missing for the OBSS_PD max and min so as to agree with the figure.	Insert underscores for the OBSSPDmax and OBSSPDmin		2017/1/9 9:42
5493	Graham Smith	225	1 27.9.2.2	10	191	T	Y	11.91 27.9.2.2	The figure and accompanying text breaks the terms used int eh formula. The figure needs to be moved down to come after present P192L2 and also the word 'where' needs to be inserted before TXPWRref. Maybe indent as well for clarity	edits as per comment		2017/1/9 9:42

5494	Graham Smith	225	1 27.9.2.2	3	192	T	Y	4.92 27.9.2.2	"A STA can select an OBSS_PDlevel during its operation under SR mode." No idea what SR mode is supposed to mean, what is it? Is it given permission? This gets important when we consider the next sentence on L7. Also, which is much more important, this says a STA can effectively select any OBSS_PD level. No explaination as to how to go about it, this is the path to anarchy, the whole point about SR is that rules are needed to stop some STAs from simply ignoring all other STAs. As the opening sentence says that adjusting the TX PWR is a 'may', then this can be interpreted, correctly, that OBSS_PD applies to any inter_BSS packet, so haviug no rule for setting the effective CCA level is a huge omission. DSC has defined exactly how to do it. In addition, there is no need to set the effective CCA threshold for inter-BSS packets, it makes no	What is SR mode? Adopt text in 16/1063			2017/1/9 9:42
5495	Graham Smith	225	1 27.9.2.2	3	192	T	Y	4.92 27.9.2.2	"This level can be dynamically adjusted or can be static". No explaination or help is given for setting this very important parameter. The only method that has been examined is DSC. There has been general agreement that the effective CCA can be set relative to the range of the STA from its AP, and DSC has been well researched on this. We cannot just leave this value setting open as that will not allow any testin or simulation to take place and simply lewaves the whole SR process up in the air.	Adopt text in 16/1064			2017/1/9 9:42
5496	Graham Smith	225	1 27.9.2.2	11	192	T	Y	12.92 27.9.2.2	Equation 27-1 . The first line says that TXPRmax is unconstrained if OBSS_PDlevel=OBSS_PDmin. Surely it should be =< ?	Change = to =<			2017/1/9 9:42
5497	Graham Smith	225	1 27.9.2.2	62	191	T	Y	63.91 27.9.2.2	OBSS_PDmin_default = -82 dBm and OBSS_PDmax_default = -62 dBm. Are you defining new parameters or just providing simple default values. These terms do not appear in the equation so this is wrong and should simply be a statement that these values can be used a defaults.	Replace with "Recommended value for OBSS_PDmin is -82dBm and for OBSS_PDmax = -62 dBm."			2017/1/9 9:42
5498	Graham Smith	225	1 27.9.2.2	20	192	E	Y	21.92 27.9.2.2	I don't think that "TB" is defned anywhere. I assume it means 'trigger based'	Define TB			2017/1/9 9:42
5499	Graham Smith	225	1 27.9.2.2	16	192	T	Y	17.92 27.9.2.2	"If a STA regards an inter-BSS PPDU as not having been received at all using a specific OBSS_PDlevel," This is not the description of the OBSS_PD idea as per P190L19-34. Surely this is supposed to refer to the reception of an inter-BSS packet at a signal strength less than OBSS_PDlevel. Actually this has nothing to do with what follows as the TXPWR is set by the OBSS_PD value selection irrespective if there is a packet received or not. If the STA selects a particular OBSS_PD then it sets the TXPWR accordingly.	Delete cited text			2017/1/9 9:42

5500	Graham Smith	225	1 27.9.2.2	16	192	T	Y	17.92 27.9.2.2	"If a STA regards an inter-BSS PPDU as not having been received at all using a specific OBSS_PDlevel, the STA's power as measured at the output of the antenna connector, shall be equal or lower than the TXPWRmax, calculated with this specific OBSS_PDlevel with Equation (27-1)," Does the STA only adjust TXPWR when receiving an inter_BSS packet? That does not agree with teh rule as per P191L5-7 and equation 27-1 where it seems to say that if the TA chooses a particular OBSS_PD level, then the TXPWR is always set accordingly - nothing to do with reception. OR is this not the case? - very confusing.	Reword as "The STA's power as measured at the output of the antenna connector, shall be equal or lower than the TXPWRmax, calculated with the chosen OBSS_Pdlevel, as per Equation (27-1)."		2017/1/9 9:42
5501	Graham Smith	225	1 27.9.2.2	19	192	T	Y	20.92 27.9.2.2	"for the transmissions of any PPDU (including UL TB PPDU) until the end of the TXOP that the STA gains once its backoff reaches zero. The STA may increase the OBSS_PDlevel during the backoff procedure, its maximum transmit power being adjusted as defined above." All this is not required. The STA must use a maximum TXPWR once it chooses its OBSS_PD level. No need to describe the actions for a transmit power.	Delete cited text. This complete sentence L16-22 should read "The STA's power as measured at the output of the antenna connector, shall be equal or lower than the TXPWRmax, calculated with the chosen OBSS_Pdlevel, as per Equation (27-1)."		2017/1/9 9:42
5502	Graham Smith	225	1 27.9.2.2	22	192	T	Y	23.92 27.9.2.2	"The minimum OBSS_PDlevel used by the STA shall be above the received signal strength of the inter-BSS PPDU, which means that the maximum TXPWRmax shall be calculated with OBSS_PDlevel equal to the received signal strength of the inter-BSS PPDU, with Equation (27-1)." Again, the actual signal level has nothjing to do with this 'scheme'. The STA choses an OBSS_PD and thus sets its max TXPWR, that's it. I don't like it, but that that is what is previously described. It does not vary its TXPWR based upon the received signal strength.	Delete cited text.		2017/1/9 9:42
5503	Graham Smith	225	1 27.9.2.2	1	191	T	Y	2.91 27.9.2.2	This clause is confusing in that on one hand it seems to say that a STA selects an OBSS_PD level (no indication of how) and then sets its TXPWR accordingly. It does not make it clear whether this is a mandatory link between the TXPWR and OBSS_PD. If not mandatory I can't see why any STA would ever do it as by so doing it opens itself up to interference from STAs which do not do it. If it is mandatory then again I can't see why any STA would ever implement it - but they want to, go ahead. At the end of the clause it seems to be talking about only setting the TXPWR when receiving an inter-OBSS packet, but this does not make sense as the TXPWR is fixed by the selection as an OBSS_PD level. If this scheme is to be kept, (and I would argue that it should not be), then at least make it clear what it actually is and how it is to be implemented.	Clarify what the scheme is or delete the scheme.		2017/1/9 9:42
5504	Graham Smith	225	1 27.11.6	22	198	T	Y	23.98 27.11.6	"Spatial Reuse field is carried in the TXVECTOR parameter SPATIAL_REUSE of an HE PPDU and indicates spatial reuse information (See 27.9.2 (OBSS_PD-based spatial reuse operation))." I see no mention of SPATIAL_REUSE in 27.9.2. Also SR_Delay setting is sort of mentioned but not described anywhere, same with SR_Restricted entry. It looks like this text precedes the acceptanceor description of the feature. Delete.	Delete 27.11.6		2017/1/9 9:42

5505 Graham Smith	225	1 27.14.1	14	199	E	Y	15.99 27.14.1	"An HE non-AP STA has dot11IntraPPDUPowerSaveOptionActivated equal to true operates", missing 'that'	Replace with "An HE non-AP STA that has dot11IntraPPDUPowerSaveOptionActivated equal to true operates.."	2017/1/9 9:42
5506 Graham Smith	225	1 27.14.1	11	199	T	Y	12.99 27.14.1	Yet another power save scheme. In this case it is stating that a STA can go into power save if it is not interested in the received packet. Hmm...it can do that now withut the need to define what packets the STA is not interested in. In general if the packet is not for the STA, having checked the NAV/duration a STA could doze if it wants. There is no need to go through all this text which, as I said, merely defines a packet that the STA need not decode. I can't see the need for this at all and furthermore it involves no interoperability at all and is at the discretion of the STA - if it wants to doze then let it.	Delete the scheme it adds nothing new.	2017/1/9 9:42
5507 Graham Smith	225	1 27.14.2	21	200	T	Y	23.00 27.14.2	"value of 1 in the Broadcast subfield a value of 2 in the TWT Flow Identifier subfield". Is there a missing 'and', or a missing 'or". Which is it?	Add an "and" or "or" as appropriate.	2017/1/9 9:42
5508 Graham Smith	225	1 27.14.2	25	200	T	Y	27.00 27.14.2	"If random access allocations are made in a sequence of Trigger frames within a trigger-enabled TWT SP, then all the Trigger frames in the sequence shall have the Cascade Indication field set to 1, except for the last Trigger frame in the sequence, which shall have the Cascade Indication field set to 0." THis definitive requirement, I assume, is repeated somewhere else as this is not a requirement of the power save idea. A STA may choose to use the Cascade Indication field to enter the doze state, but how the and what the Cascade Indication fields are set should be in the appropriate place not here.	Either delete the cited text or make it a note, or make a reference.after "Cascade Indication field" in line 30.	2017/1/9 9:42
5509 Graham Smith	225	1 27.14.3.1	42	200	T	Y	44.00 27.14.3.1	"Opportunistic power save mechanism has the objective for an AP to split a beacon interval into several periodic broadcast TWT SPs and to provide, at the beginning of each SP, the scheduling information to all non-AP STAs" The objective is to allow power saving not the splitting of a beacon interval. Needs to be re-written .	Reword "To implement Opportunistic power save, an AP may split a beacon interval into several periodic broadcast TWT SPs and provide, at the beginning of each SP, the scheduling information to all non-AP STAs."	2017/1/9 9:42
5510 Graham Smith	225	1 27.14.3.1	56	200	E	Y	58.00 27.14.3.1	For any HE non-AP STA for which their associated AP set their corresponding bit in the traffic indication..." This reads wrong, this appears to be about APs not STAs so why does it start off talking about a STA?	Reword para. " If an AP sets the bit corresponding to an HE non-AP STA in the traffic indication virtual bitmap field of the TIM element to 0, the AP shall neither send unicast or multicast frames to that STA, nor trigger that STA for UL MU transmissions during the TWT SP and, unless otherwise specified, until the next TWT SP."	2017/1/9 9:42
5511 Graham Smith	225	1 27.15.2	24	201	T	Y	26.01 27.15.2	"An HE STA may transmit non-HT, HT, VHT PPDUs". IS the rule that an HE STA shall be capable of transmitting all these or is it all optional. I would suspect that the intention is that an HE STA shall be capable, if so needs to say so.	Replace cited text with "An HE STA shall be capable of transmitting non-HT, HT, VHT PPDUs"	2017/1/9 9:42
5512 Graham Smith	225	1 27.15.2	26	201	E	Y	28.01 27.15.2	"An HE STA may transmit an HE SU PPDU or a 242-tone HE extended range SU PPDU to a peer HE STA." Is the rule that an HE STA shall be capable of transmitting all these or is it all optional. I would suspect that the intention is that an HE STA shall be capable, if so needs to say so.	Replace cited text with "An HE STA shall be capable of transmitting an HE SU PPDU or a 242-tone HE extended range SU PPDU to a peer HE STA"	2017/1/9 9:42
5513 Graham Smith	225	1 27.15.2	45	201	E	Y	47.01 27.15.2	"...shall be carried in the same format..." "shall be in the same format" is clearer. Looking at 802.11-2016, "Carried in" is normally used for a specific PPDU. Here it is general.	Replace cited text with "shall be in the same format"	2017/1/9 9:42

5514 Graham Smith	225	1 27.15.2	47	201	E	Y	49.01 27.15.2	"...may be carried in any PPDU format..." Looking at 802.11-2016, "Carried in" is normally used for a specific PPDU. Here it is general.	Replace cited text with "...may be in any PPDU format..."	2017/1/9 9:42
5515 Graham Smith	225	1 27.15.2	63	201	E	Y	65.01 27.15.2	"...in non-HT PPDU..." Indefinite article missing	Replace cited text with "in a non-HT PPDU"	2017/1/9 9:42
5516 Graham Smith	225	1 27.15.2	2	202	E	Y	4.02 27.15.2	"in HE extended range" Indefinite article missing	Replace cited text with "in an HE extended range"	2017/1/9 9:42
5517 Graham Smith	225	1 27.15.2	28	202	E	Y	30.02 27.15.2	"A <HE-MCS, NSS> tuple", should be 'an'	Replace "A' with "An"	2017/1/9 9:42
5518 Graham Smith	225	1 27.15.2	28	202	T	Y	30.02 27.15.2	"Supported HE-MCS and NSS Set field in the HE Capabilities element". I can't find this field in the HE Capabilities element. I can find "Tx Rx HE MCS NSS Support" is that it? Also I only find detailed "Tx Rx HE MCS Support field" (Hmm... That's also an error). Which is it?	First correct Figure 9-589qj "Tx Rx HE MCS NSS Support" to read "Tx Rx HE MCS Support" Then change cited text to "Tx Rx HE MCS Support field in the HE Capabilities element"	2017/1/9 9:42
5519 Graham Smith	225	1 9.4.2.218.4	53	86	E	Y	53.86 9.4.2.218.4	"indicates the highest NSS value minus 1, supported by the STA" Comma usage seems wrong, either delete it or add another after "value".	Delete comma in cited text.	2017/1/9 9:42
5520 Graham Smith	225	1 9.4.2.218.4	60	86	T	Y	60.86 9.4.2.218.4	"Channel Bandwidth Set field at each NSS and MCS indicated in the Highest NSS Supported M1 and Highest MCS Supported subfield". Where is this "Channel Bandwidth Set" field? A search in this documment finds 4 occurances of the same sentence but I can't find a Figure or Table with it in. Add further information as to where this field is, in all four locations	Add information as to the whereabouts of the the Channel Bandwidth Set field at P86L60, P86L63, P87L34, P87L37.	2017/1/9 9:42
5521 Graham Smith	225	1 9.4.2.218.5	59	88	E	Y	59.88 9.4.2.218.5	"number of NSS values minus one for". Before at P86L53 it used "value minus 1," (Comment to remove the comma). So do we use "minus 1" or "minus one"? Admittedly 802.11-2016 does not help as there are 12 "minus 1" and 5 ",minus one". But in this document we have 17 "minus 1" and only this occurance of "minus one". So a clear decision, change it to "minus 1".	replace "minus one" in cited text to "minus 1".	2017/1/9 9:42
5522 Graham Smith	225	1 27.16.1	34	204	T	Y	36.04 27.16.1	"A STA that is starting an HE BSS shall be able to receive and transmit at each of the <HE-MCS, NSS> tuple values indicated by the Basic HE-MCS And NSS Set field of the HE Operation parameter of the MLMESTART. request primitive and shall be able to receive at each of the <HE-MCS, NSS> tuple values indicated by the Supported HE-MCS and NSS Set field of the HE Capabilities parameter of the MLMESTART. request primitive." This seems backwards to me. Surely the point is that the STA must set these tuples to agree with what it supports, not "shall be able to receive and transmit".	Replace cited text with "A STA that is starting an HE BSS shall set each of the <HE-MCS, NSS> tuple values in the Basic HE-MCS And NSS Set field of the HE Operation parameter and the HE Capabilities parameter of the MLMESTART. request primitive."	2017/1/9 9:42
5523 Graham Smith	225	1 27.16.1	39	204	T	Y	41.04 27.16.1	"The basic HE-MCS and NSS set is the set of <HE-MCS, NSS> tuples that are supported by all HE STAs that are members of an HE BSS." But according to the previous sentence the STA starting the HE BSS can set these as it wants. Surely a basic set is fixed and agreed to be common for all HE BSSs. If not, then don't use "basic". I don't know what "Basic" is meant to convey here but it does need to be spelled out.	Please define what exactly "basic set " is. Is it fixed or set by the originating STA? Also what criteria does it use to set these? Is it really up to the originating STA? Whatever it is, let's please spell it out.	2017/1/9 9:42
5524 Graham Smith	225	1 27.16.1	39	204	T	Y	41.04 27.16.1	P204 lines 39 - 49. It is very unclear as to what, why or how the originalting STA is supposed to set up the basic set. Is there an Annex explaining how the STA decides? Is the idea to limit HE STAs from joining? But what about legacy VHT or HT STAs? I have to admit I don't get it. Why can't the AP STA simply advertize what it can do, I don't see what defining a basic set adds.	Look again at this Basic set feature. It needs to be explained why it is a godd idea and what it adds. If it is a good idea it needs to be explained somewhere how a STA may use it for whatever purpose it is intended for. My recommendation, delete it.	2017/1/9 9:42

5525	Graham Smith	225	1 9.4.2.218.4	34	86	T	Y	34.86 9.4.2.218.4	I am wondering if it is possible to make this Tx Rx HE MCS Support field more complicated? We indicate the highest NSS and MCS, and then indicate, via the bitmaps, the BWs supported. Then we add the Tx and Rx NSS Descriptors. But, the bitmap indicates if Descriptor fields are present, so it is not possible to simply indicate the highest NSS and MCS and BW supported, we have to then add the Descriptors. The description seems to say that the descriptors can be omitted but not if the BW bitmaps can be. So many things come to mind. Should we not indicate which fields are optional for a start, and then get the text to be clear.	Indicate which fields are optional in FIG 9-589cm. Then make clear how the bit maps are used if the 'Descriptor" fields are not present.		2017/1/9 9:42
5526	Graham Smith	225	1 9.4.2.218.4	53	86	T	Y	53.86 9.4.2.218.4	P86 Lines 53 - 65. It looks as though this para is supposed to be summary but it fails miserably. It jumps striaght to the Descriptor description without making it clear what the Bitmaps do. It is unclear how the BWs are supported. It talks about a Channel Bandwidth Set which I can't find. The combination of bitmap and Descriptors seems to be a catch-all to allow any and every combination of BW, MCS and NSS - do we really want to do this? Do we really expect a mixture of BW and NSS for example? I can accept that the MCS may vary for a higher BW, say, but do we expect the number of SS to change? I have problems with this...maybe the description is not clear, maybe we need a table to provide examples? Maybe this summary should not be here and maybe should be at the end of the clause.	Move summary, if that's what it is meant to be (not sure as it seems to be repeated on next page,(but that's another comment) to after the individual field descriptions, and provide examples on how it is used.		2017/1/9 9:42
5527	Graham Smith	225	1 9.4.2.218.4	58	86	T	Y	58.86 9.4.2.218.4	"The Highest NSS Supported M1 subfield indicates the highest NSS value minus 1, supported by the STA that transmitted this subfield. The Highest NSS Supported M1 value is applicable to both transmissions and receptions but does not necessarily apply to all combinations of PPDU bandwidth and MCS. The PPDU bandwidth and MCS values that do not support the NSS value indicated in this subfield are described in the Tx MCS NSS Descriptors and Rx MCS NSS Descriptors subfields, if present." This trhe third sentence concerns the last fields and should be associated with those fields. Delete from end of second sentence to end of para.	Delete from end of second sentence to end of para. This description should be moved to after the Descriptor description.		2017/1/9 9:42
5528	Graham Smith	225	1 9.4.2.218.4	30	87	T	Y	30.87 9.4.2.218.4	"The PPDU bandwidth and NSS values that do not support the MCS value indicated in this subfield are described in the Tx MCS NSS Descriptors and Rx MCS NSS Descriptors subfields, if present. If no Tx MCS NSS Descriptors subfield is present, then the STA supports transmission of all combinations of PPDU bandwidth identified by the Channel Bandwidth Set field at each NSS and MCS indicated in the Highest NSS Supported M1 and Highest MCS Supported subfields. If no Rx MCS NSS Descriptors subfield is present, then the STA supports reception of all combinations of PPDU bandwidth identified by the Channel Bandwidth Set field at each NSS and MCS indicated in the Highest NSS Supported M1 and Highest MCS Supported subfields." This para is describing the Highest MCS supported. Leave it at that. We should describe the fields in order, not suddenly	Delete cited text and/or move this text to the end after the description for the Descriptors.		2017/1/9 9:42

5529	Graham Smith	225	1 9.4.2.218.4	56	87	T	Y	56.87 9.4.2.218.4	"If all of the bits of the Tx BW Bitmap subfield and all of the bits of the Rx BW Bitmap subfield are zero, then none of the subfields of the Tx Rx HE MCS Support field beyond Highest MCS Supported need to be present." If the bits are zero then that implies that the fields are present. Therefore the RX and Tx bitmaps have to be present? In addition the field is then only 6 bits. It looks as though the bit fields always have to be there.	Change cited text as follows: "If all of the bits of the Tx BW Bitmap subfield and all of the bits of the Rx BW Bitmap subfield are zero, then the Tx MCS NSS Descriptors and Rx MCS NSS Descriptor sub fields are not present."	2017/1/9 9:42
5530	Graham Smith	225	1 9.4.2.218.4	59	87	T	Y	59.87 9.4.2.218.4	"If either the Tx BW Bitmap subfield or the Rx BW Bitmap subfield has at least one bit set to 1, then both the Tx BW Bitmap subfield and the Rx BW Bitmap subfield are present, even if one of these subfields has the value of all zeros." The bit fields always need to be there based upon previous description (and comment). Simply delete this	Delete cited text.	2017/1/9 9:42
5531	Graham Smith	225	1 9.4.2.218.4	18	88	T	Y	18.88 9.4.2.218.4	Figure 9-589cn. Why 4 bits for the MCS? The Highest MCS only needed 3 (0 to 7). If you add another bit you will need to add a table explaining how the bits are used. Suggest MCS sub field is cut to 3 bits, then add in the text that the coding is as per Table 9-262ab.	MCS sub field cut to 3 bits, then add in the text that the coding is as per Table 9-262ab.	2017/1/9 9:42
5532	Graham Smith	225	1 9.4.2.218.4	64	87	T	Y	64.87 9.4.2.218.4	"Each Tx MCS NSS Descriptor indicates the value of the highest supported NSS for the indicated MCS for a specific bandwidth of operation" seems straightforward. We have a bit map telling us that this is the highest MCS and NSS supported for this BW. So what is the next text trying to say? "...and for all MCS that are higher than the indicated MCS up to but not including the next MCS in the set for this bandwidth"? Each Tx MCS NSS Descriptor indicates the value of the highest supported NSS for the indicated MCS for a specific bandwidth of operation How can we have an MCS that is higher but not including the next above the MCS to this one that is indicated as the highest? Sorry does not make any sense - is this the highest MCS or not? Either delete the second part of the text or dscribe better what you are trying to convey.	Either delete the second part of the cited text or describe better what you are trying to convey.	2017/1/9 9:42
5533	Graham Smith	225	1 9.4.2.218.4	1	88	T	Y	1.88 9.4.2.218.4	"MCS values that are lower than the lowest specified MCS within a set of Tx MCS NSS Descriptor fields implicitly support transmission of PPDUs using the highest NSS value indicated in the Highest NSS Supported subfield." Confused by the use of "set of" Tx MCS NSS Descriptor fields. A set would indicate all, up to 5, of the sub fields. So do we look through all the fields (up to five I guess), find the lowest MCS, and assume that for all BW MCSs below this use the highest NSS? This seems pretty confusing and I don't understand if this is really practical. Do we think that devices will support different NSSs for a set BW as the MCS changes? Surely we want the device to simply indicate for each BW, the max NSS and MCS and leave it at that?	Delete cited text or explain better what is intended.	2017/1/9 9:42

5534	Graham Smith	225	1 9.4.2.218.4	6	88	T	Y	6.88 9.4.2.218.4	"Each Rx MCS NSS Descriptor indicates the value of the highest supported NSS for the indicated MCS for a specific bandwidth of operation" seems straightforward. We have a bit map telling us that this is the highest MCS and NSS supported for this BW. So what is the next text trying to say? "...and for all MCS that are higher than the indicated MCS up to but not including the next MCS in the set for this bandwidth"? Each Rx MCS NSS Descriptor indicates the value of the highest supported NSS for the indicated MCS for a specific bandwidth of operation How can we have an MCS that is higher but not including the next above the MCS to this one that is indicated as the highest? Sorry does not make any sense - is this the highest MCS or not? Either delete the second part of the text or dscribe better what you are trying to convey.	Either delete the second part of the cited text or describe better what you are trying to convey.		2017/1/9 9:42
5535	Graham Smith	225	1 9.4.2.218.4	8	88	T	Y	8.88 9.4.2.218.4	"MCS values that are lower than the lowest specified MCS within a set of Rx MCS NSS Descriptor fields implicitly support transmission of PPDUs using the highest NSS value indicated in the Highest NSS Supported subfield." Confused by the use of "set of" Rx MCS NSS Descriptor fields. A set would indicate all, up to 5, of the sub fields. So do we look through all the fields (up to five I guess), find the lowest MCS, and assume that for all BW MCSs below this use the highest NSS? This seems pretty confusing and I don't understand if this is really practical. Do we think that devices will support different NSSs for a set BW as the MCS changes? Surely we want the device to simply indicate for each BW, the max NSS and MCS and leave it at that?	Delete cited text or explain better what is intended.		2017/1/9 9:42
5536	Graham Smith	225	1 9.4.2.218.4	27	88	T	Y	27.88 9.4.2.218.4	"The MCS subfield of the Tx MCS NSS Descriptor and Rx MCS NSS Descriptor subfields indicates an MCS value encoded as an unsigned integer." Why be different than the Table 9-262ab? MCS0-7 are mandatory? Just use 3 bits and be consistent.	Change cited text to "The MCS subfield of the Tx MCS NSS Descriptor and Rx MCS NSS Descriptor subfields indicates an MCS value encoded as per Table 9-262ab". Also change Fig 9-589cn accordingly.		2017/1/9 9:42
5537	Graham Smith	225	1 9.4.2.218.4	37	88	T	Y	37.88 9.4.2.218.4	Why do we need this final 'last' bit? If the bit map works, it is clear which is the last one. Get rid of this and simply have 2 reserved bits (MCS should be 3 bits)	Delete text from P88 Lines 37 to 40. Change Fig 9-589cn such that MCS is 3 bits and Last MCS NSS is replaced with "Reserved" (2 bits)		2017/1/9 9:42
5538	Graham Smith	225	1 9.4.2.218.5	21	89	T	Y	21.89 9.4.2.218.5	"PPE threshold values appear in increasing NSS value and increasing RU index value order, where lower numbered PPE Thresholds Info field bits contain PPE threshold values corresponding to lower numbered NSS values and within a set of PPE Threshold subfields corresponding to a single value of NSS, lower numbered PPE Thresholds Info field bits contain PPE threshold values corresponding to lower numbered RU index values" Starts off pretty clear but then proceeds to confuse. Dont think the rest is actually making ot any clearer, suggest it is kept simple. End sentence at the first comma and delete from there.	At the first comma end sentence and delete from there. "PPE threshold values appear in increasing NSS value and increasing RU index value order."		2017/1/9 9:42
5539	Graham Smith	225	1 3.4	18	7	T	Y	18.07 3.4	I think "RU" should be added here. It is not defined until almost at the end of the draft but is referred to in many places prior to that. Also maybe consider including it in 3.2.	Add RU in 3.4 and possibly in 3.2		2017/1/9 9:42
5540	Graham Smith	225	1 9.4.2.218.5	60	88	T	Y	60.88 9.4.2.218.5	"are included in the PPE Thresholds Info field." Should be "subfield"	Change 'field' to 'subfield'		2017/1/9 9:42

5541 Graham Smith	225	1 9.4.2.218.5	59	88	T	Y	59.88 9.4.2.218.5	"The NSS M1 subfield contains an unsigned integer that is equal to the number of NSS values minus one for which PPE threshold values are included in the PPE Thresholds Info field". All well and good but we have no idea what NSSs are actually referred to. If we simply have, say 4 NSSs how do I know if the NSS is 1-4, or 3-7? I don't get it, can you please clarify this as I can't see this working.	Clarify as per comment. Can't propopse a solution as I can't tell how this is supposed to work. Is it supposed to be the number starting at MCS0, for example?	2017/1/9 9:42
5542 Graham Smith	225	1 9.4.2.218.5	63	88	E	Y	63.88 9.4.2.218.5	"according to their RU Allocation Index values". Add reference to Table 9-262ae	after RU Allocation Index values add "(see Table 9-262ae)"	2017/1/9 9:42
5543 Graham Smith	225	1 9.4.2.218.5	21	89	T	Y	21.89 9.4.2.218.5	"PPE threshold values appear in increasing NSS value and increasing RU index value order". Why are these called PPE Threshold values when they are Constellation indexes? I can't see the connection. The PPE Threshold, I think, is 8 or 16us, but that is not what appears in this field. I think its OK to call it the PPE Threshold Info field, but the info, although used to get the PPE Threshold, is not the actual value. I think maybe use "PPET16 and PPET8 subfields"?	Replace cited text with "The PPEt16 and PPET8 Constellation indexes appear in increasing NSS value and increasing RU index value order."	2017/1/9 9:42
5544 Graham Smith	225	1 9.4.2.218.5	1	90	T	Y	1.90 9.4.2.218.5	"The PPET8 for NSSn for RUb subfield and PPET16 for NSSn for RUb subfield values are combined to determine the Maximum PE value for HE PPDUs that are transmitted to the STA sending this field and using NSS = n and an RU allocation corresponding to RU Allocation Index b, for each value of NSS and RU specified by the field." This is describing what a STA does with the Constellation indexes not anything to do with describing the contents of the field. This behavior belongs elsewhere, presumeablky in 28.3.13? HAving said that, the sentence itself has problems: how does one combine two constellation indexes?, and how does the second half of the sentence present any further information than the first half (it seems to repeat the same but differently in an attempt to confuse the reader)?	Replace cited text with "The PPET8 for NSSn for RUb subfield and PPET16 for NSSn for RUb subfield values are examined to determine the Maximum PE value for HE PPDUs that are transmitted to the STA sending this field (see XXX)" Then the rest of this description should be moved to another section maybe 28.3.13.	2017/1/9 9:42
5545 Graham Smith	225	1 9.4.2.218.5	1	90	T	Y	1.90 9.4.2.218.5	Table 9-262ad is a mess. What do the rows mean, do both columns need to be satisfied or either? I assume both. What is the "result of a comparison of index x" mean? I have no idea what the rule is. It looks as though we are comparing the constellation index of a PPDU to the PPET8 and PPET16 constellation indexes but there has been no indication of how the indexes are chosen. To be honest there has to be a better way of doing this. This entire section needs re-writing and possibly re-thinking.	Rewrite L1 - 35 and clarify what it is trying to convey. Also this text should not be here. This section should be simply the description of the field.	2017/1/9 9:42
5546 Graham Smith	225	1 9.4.2.218.5	42	88	T	Y	42.88 9.4.2.218.5	PPE Thresholds field. This has proved a struggle to understand and to try to see why it seems to be so convoluted. One suggestion that may help might be to add a sentence at the begininning that explained the use of this field.	Add at beginning such as "The PPE Thresholds field is used to determine the maximum packet extension value (see 28.3.12) for an HE PPDU of a particular RU allocation size and NSS value."	2017/1/9 9:42

5547 Graham Smith	225	1 9.4.2.218.5	21	89	T	Y	21.89 9.4.2.218.5	"Each PPET8 for NSSn for RUb subfield and PPET16 for NSSn for RUb subfield contains an integer that corresponds to a constellation index value related to the transmission constellation of an HE PPDU as defined in Table 9-262ac (Constellation index)." There is no indication of what is the criteria for entering the constellation index. Is the minimum constellation for 8 or 16us? it is the maximum? Should the 16 be higher or equal to the 8? What is it? Need to add some words so that it is clear as to how the index corresponds to the 8 or 16 us threshold.	Add some words so that it is clear as to how the index corresponds to the 8 or 16 us threshold.		2017/1/9 9:42
5548 Graham Smith	225	1 9.4.2.218.5	38	89	E	Y	38.89 9.4.2.218.5	" Table 9-262ac (Constellation index)." Delete second full stop.	Delete second full stop		2017/1/9 9:42
5549 Graham Smith	225	1 9.4.2.218.5	14	90	T	Y	14.90 9.4.2.218.5	Table 9-262ad. Can't help but feel this would be better replaced by pseudo code or simple equations.	Replace Table with something along the lines of: "For NSSn and RUb, and Constellation index of HE PPDU, x IF AND (x >= PPET8, OR(x< PPET16, PPET16 = 0)) THEN Maximum PE value = 8 us IF AND (OR(x >= PPET8, PPET8 = 0),x>= PPET16)) THEN Maximum PE value = 16 us ELSE Maximum PE value = 0 us"		2017/1/9 9:42
5550 Graham Smith	225	1 9.4.2.218.5	42	88	T	Y	42.88 9.4.2.218.5	I have made a lot of comments on this section and this is my final one. Can it be explained why we need this when we have a simple Default PE Duration field in the HE Operation Parameters field? Has it been shown that specifying a PE threshold is needed and then effectively setting a PE for every NSS and RU and BW actually is better or more efficient that this default setting? Could a simple, expanded Default PE duration have been much simpler?	Consider if a set of default values could have achieved this. What is the overriding factor for this NSS, BW or RU? I don't know enough about the need for the PE, but is there no way simple 'max' combinations of these 3 could be used for 0, 4, 8, 12 and 16us, similar to the "Basic HE-MCS and NSS Set field format, for example?		2017/1/9 9:42
5551 Graham Smith	225	1 9.4.2.219	39	91	T	Y	39.91 9.4.2.219	"The BSS Color field is an unsigned integer whose value is the BSS color of the BSS corresponding to the AP which transmitted this element, except that a value of 0 in this field indicates that there is no BSS color for this BSS." Thie information in this sentence appears to be repeated in the next para. Suggest this is deleted and the second para edited to include the 'no color' rule.	Dlete cited text. Then edit next para to read as follows as follows: "The BSS Color field is an unsigned integer whose value is the BSS Color of the BSS corresponding to the AP, IBSS STA, mesh STA or TDLS STA that transmitted this element, except that a value of 0 in this field is used if there is no BSS color for this BSS, or one or more intended recipient STAs of an HE PPDU is not a member of a transmitting STA's BSS."		2017/1/9 9:42
5552 Graham Smith	225	1 9.4.2.219	49	91	T	Y	49.91 9.4.2.219	"The Default PE Duration subfield indicates the PE duration in units of 4 ++s, for an HE trigger-based PPDU that is solicited with UL MU Response Scheduling in the A-Control subfield." How does this tie up wit the PETT I don't see how it is used, make a reference to where and how it is used.	Add a reference to where and how this default is used.		2017/1/9 9:42
5553 Graham Smith	225	1 9.4.2.219	60	91	T	Y	60.91 9.4.2.219	"The HE Duration Based RTS Threshold field enables..." Should be 'subfield'.	Change "field" to "subfield"		2017/1/9 9:42
5554 Graham Smith	225	1 9.4.2.219	55	91	T	Y	55.91 9.4.2.219	"...AP requires the non-AP HE STAs..." Associated STAs I assume.	Cited text to read "AP requires non-AP HE STAs that are associated with it..."		2017/1/9 9:42
5555 Graham Smith	225	1 9.4.2.219	60	91	T	Y	60.91 9.4.2.219	"The HE Duration Based RTS Threshold field enables an HE AP to manage..." This corresponds to dot11DurationRTSThreshold of which there is no mention in this paragraph.	Add reference to dot11DurationRTSThreshold		2017/1/9 9:42

5556 Graham Smith	225	1 9.4.2.219	60	91	T	Y	60.91 9.4.2.219	dot11DurationRTSThreshold has been introduced as an alternative to the octet based dot11RTSThreshold. I note that "HE" is missing so one implies that the TG felt that duration was a better parameter than octets and this implies it could be for all STAs, not just HE ones. Was this the intention? If so "HE duration based RTS is not correct and it is solely "duration based RTS" and so the question arises, "should this be available for all STAs?" The original RTS Threshold is on a per station basis, I don't think it is advertized or specified by a STA or AP (I need to check that). So in this case is this HE Duration based RTS field something only an AP sends to control its BSS or is it something a STA also sends. Can it be different for a STA and its AP, the opeing sentence seems to indicate it is for AP control? If so, where are the rules or informationa as to ewhere to set it? Needs	Add reference to text on how to set the value - is it only for an AP to set? Can a STA set different values to tis AP, what happens if it does?			2017/1/9 9:42
5557 Graham Smith	225	1 10.3.1	50	113	T	Y	51.13 10.3.1	"When HE duration-based RTS is enabled, the use of the RTS/CTS mechanism is under control of dot11DurationRTSThreshold." I note that 'HE' is missing from the dot11DurationRTSThreshold. So presumeably any STA could use the duration based RTS threshold, but only an HE STA will advertize it. Is that the real intention? In looking at the HE duration based RTS threshold subfield in the HE Operation Parameter field it appears as though it is for an AP to make its STA use duration RTS. Is this intended only for HE STAs?	Clarify if only HE STAs or not.			2017/1/9 9:42
5558 Graham Smith	225	1 10.3.2.4	47	114	T	Y	48.14 10.3.2.4	"If the STA is not an HE STA and When the received frame's RA is equal to the STA's own MAC address, the STA shall not update its NAV. If the STA is an HE STA and the STA is solicited for an immediate response by the PPDU carrying the received frame, the STA shall not update its NAV. If the STA is an HE STA, the STA is a TXOP holder, and the frame is solicited by the STA, then the STA shall not update its NAV." The original text simply said if the STA is the recipient (RA = STA) then do not update NAV. I think that in both of these examples that an HE STA does not update NAV this is still true? Does this now create conditions where the HE STA, receiving a packet now does update the NAV? I suspect it would be beter to leave this alone and not make the indicated changes.	Remoive the changes from cited text.			2017/1/9 9:42
5559 Graham Smith	225	1 10.3.2.4	14	115	T	Y	15.15 10.3.2.4	"The exact time of updating the NAV is described as follows." Do we need this? It does not add anything except to make the reader think tghat there is some very exact measurement taking place. Delete.	Delete cited text.			2017/1/9 9:42

5560	Graham Smith	225	1 10.3.2.4a	48	115	T	Y	49.15 10.3.2.4a	"In dense environments, managing RTS usage by an AP can help the overall interference situation since the AP may have better view of the network situation. To improve spectrum utilization, RTS usage should be duration-based, rather than length-based." This is a very general comment. There is no explianation of why duration based RTS should be better than packet length. It may be true but this would not convince anyone. PAcket length RTS was seldom used, if at all, so what does duration based bring and why would it be used?	Write a better reasoning as to why duration based RTS is either superior or will improve matters.		2017/1/9 9:42
5561	Graham Smith	225	1 10.3.2.8a	7	116	T	Y	8.16 10.3.2.8a	Figure 10-9a, Would STA1 and STA2 reply CTSs together? If so the AP may well not be able to hear them as they will interfere with each other. Same with the Acks. True CTS responds at SIFS but what happens in this case, is it such that the AP does not care? Should really add some text to explain the fighure.	Add text to explain that the CTS and Ack responses are ignored, if that is the case.		2017/1/9 9:42
5562	Graham Smith	225	1 10.3.2.8a	33	116	T	Y	34.16 10.3.2.8a	Figure 10-9b. As in Fig 10-9a the CTS and ACKs coincide ans hence may not be heard by the AP. Does this matter or is it simply ignoresd by the AP which is only interested in the Trigger frame and the Multi-STA Block Ack. If tyhis is so needs some explanatory words	Add text to explain that the CTS and Ack responses are ignored, if that is the case.		2017/1/9 9:42
5563	Graham Smith	225	1 10.3.2.8a.2	64	116	T	Y	65.16 10.3.2.8a.2	"If a PHY-RXSTART.indication primitive does not occur during the CTSTime-out interval, the STA shall conclude that the transmission of the MU-RTS frame has failed, and this STA shall invoke its backoff procedure upon expiration of the CTSTimeout interval." But the figures 10-9a and 9b show the CTS responses clashing and the CTS will not be received and the STA will retry with the same result. Will this ever work because the CTSs could clash forever.	Explain how the CTS s can be received and the MU-RTS not retried ad infinitum.		2017/1/9 9:42
5564	Graham Smith	225	1 10.3.2.10.3	7	120	E	Y	8.20 10.3.2.10.3	Space required before "Specifically"	Add space before "Specifically"		2017/1/9 9:42
5565	Graham Smith	225	1 10.3.2.10.3	8	120	E	Y	9.20 10.3.2.10.3	We need some articles inserted here.	to read "...acknowledgement in the HE MU PPDU in response to an (A-)MPDU sent in HE trigger-based PPDU,..."		2017/1/9 9:42
5566	Graham Smith	225	1 10.3.2.10.3	58	120	E	Y	59.20 10.3.2.10.3	"Impilcit BAR". Spelling	"Implicit"		2017/1/9 9:42
5567	Graham Smith	225	1 10.3.2.10.3	55	121	T	Y	56.21 10.3.2.10.3	"A STA may use a BlockAckReq frame to solicit the acknowledgment frame(s), to whom the STA sent the QoS Data frame(s) with Ack Policy subfield equal to Block Ack or from whom the STA did not receive the immediate acknowledgement frames after sending QoS Data frame(s) in a HE trigger-based PPDU with Ack Policy subfield equal to Normal Ack or Impilcit BAR" Does not read right.	To read "When a STA sends a QoS Data frame(s) with Ack Policy subfield equal to Block Ack , or when the STA did not receive the immediate acknowledgement frames after sending QoS Data frame(s) in a HE trigger-based PPDU with Ack Policy subfield equal to Normal Ack or Impliit BAR, a STA may use a BlockAckReq frame to solicit the acknowledgment frame(s)."		2017/1/9 9:42
5568	Graham Smith	225	1 10.3.5	63	122	T	Y	64.22 10.3.5	"When HE duration-based RTS is disabled, a STA using the DCF shall use an RTS/CTS exchange for indi-vidually addressed frames when the length of the PSDU is greater than the length threshold..." How does a STA know that the HE Duration-based RTS is disabled unless it is an HE STA? As written this is for any STA. Is this intended to be for any STA or just HE STAs? If RTSTHreshold is set then use that, if DurationRTSThreshold is set, then use that. Is there a problem if both set? Can set a rule for the HE STA to only obey Duration RTSThreshold. I think this needs a bit more thought or to be made clear.	Clarify if only for HE STAs or all STAs. How does a legacy STA know if duration based RTS in use? Does it matter if both or either set?		2017/1/9 9:42
5569	Graham Smith	225	1 10.12	6	128	E	Y	7.28 10.12	Delete full stop after "frame"	Delete full stop after "frame"		2017/1/9 9:42
5570	Graham Smith	225	1 10.12	8	128	E	Y	9.28 10.12	Delete comma after "frame"	Delete comma after "frame"		2017/1/9 9:42

5571 Graham Smith	225	1 10.13.1	21	128	T	Y	22.28 10.13.1	"When an A-MPDU contains multiple QoS Control fields, bits 4 shall be identical across all MPDUs that contain the QoS Control fields and bits 8-15 of these QoS Control fields shall be identical across all MPDUs with equal value of the TID subfield." This applies to all STAs so we need to check that we have not changed the original rule which is bits 4, 8-15 are the same. The new rule says that 8-15 is only the same for same TID so now can we have different TIDs within the same A-MPDU when the original rule says we can't? Why is this done and is it valid. I would like to see an explanation as htis appears to change a rule.	Delete changes		2017/1/9 9:42
5572 Graham Smith	225	1 11.2.2.	56	141	E	Y	57.41 11.2.2.	11.2.2 is incorrect should be 11.2.3	Renumber to 11.2.3		2017/1/9 9:42
5573 Graham Smith	225	1 11.2.2.	56	141	E	Y	57.41 11.2.2.	11.2.2.6 is incorrrect should be 11.2.3.6	Renumber to 11.2.3.6		2017/1/9 9:42
5574 Graham Smith	225	1 11.2.2.8	42	142	E	Y	43.42 11.2.2.8	11.2.2.8 should be 11.2.3.8	Renumber to 11.2.3.8		2017/1/9 9:42
5575 Graham Smith	225	1 27.9.2.1	190	18	T	Y	190.18 27.9.2.1	There is no definition of OBSS_PD.	Add "OBSS_PD is the CCA sensitivity when a valid signal is received from an OBSS."		2017/1/9 9:42
5576 Graham Smith	225	1 27.9.2.1	190	18	T	Y	190.18 27.9.2.1	In 802.11-2016 there is no reference at all to "PD". The term OBSS_PD is unfortunate because it conveys the concept of 'power detect' when it is truly CS/CCA. A more correct term might be "OBSS_CCA".	Replace "OBSS_PD" with "OBSS_CCA"		2017/1/9 9:42
5577 Guido Hiertz	225	1 C.3	424	46	E	Y	424.46 C.3	C.2 (Guidelines for IEEE 802.11 MIB authors/editors) in 802.11-2016 explains "Do not use symbols such as <greek-mu> in units, instead spell out the units fully, i.e., 'microseconds.'" Consequently, the use of "us" is wrong.	Replace "us" with "microseconds"		2017/1/9 9:42
5578 Guido Hiertz	225	1 28.5	373	26	E	Y	373.26 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"		2017/1/9 9:42
5579 Guido Hiertz	225	1 28.5	374	4	E	Y	374.04 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"		2017/1/9 9:42
5580 Guido Hiertz	225	1 28.5	374	39	E	Y	374.39 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"		2017/1/9 9:42
5581 Guido Hiertz	225	1 28.5	375	4	E	Y	375.04 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"		2017/1/9 9:42
5582 Guido Hiertz	225	1 28.5	375	32	E	Y	375.32 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"		2017/1/9 9:42
5583 Guido Hiertz	225	1 28.5	376	4	E	Y	376.04 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"		2017/1/9 9:42
5584 Guido Hiertz	225	1 28.5	376	32	E	Y	376.32 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"		2017/1/9 9:42
5585 Guido Hiertz	225	1 28.5	377	4	E	Y	377.04 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"		2017/1/9 9:42
5586 Guido Hiertz	225	1 28.5	377	35	E	Y	377.35 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"		2017/1/9 9:42
5587 Guido Hiertz	225	1 28.5	378	4	E	Y	378.04 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"		2017/1/9 9:42
5588 Guido Hiertz	225	1 28.5	378	39	E	Y	378.39 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"		2017/1/9 9:42
5589 Guido Hiertz	225	1 28.5	379	4	E	Y	379.04 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"		2017/1/9 9:42
5590 Guido Hiertz	225	1 28.5	379	32	E	Y	379.32 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"		2017/1/9 9:42
5591 Guido Hiertz	225	1 28.5	380	4	E	Y	380.04 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"		2017/1/9 9:42
5592 Guido Hiertz	225	1 28.5	380	32	E	Y	380.32 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"		2017/1/9 9:42
5593 Guido Hiertz	225	1 28.5	381	4	E	Y	381.04 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"		2017/1/9 9:42
5594 Guido Hiertz	225	1 28.5	381	35	E	Y	381.35 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"		2017/1/9 9:42
5595 Guido Hiertz	225	1 28.5	382	4	E	Y	382.04 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"		2017/1/9 9:42
5596 Guido Hiertz	225	1 28.5	382	39	E	Y	382.39 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"		2017/1/9 9:42

5597	Guido Hiertz	225	1 4.3.14a	9	42	T	Y	9.42 4.3.14a	Various submission show that the current 802.11ax draft is far from achieving the "4 ╬" performance improvement goal. Submission 11-15/1359 provides a simple mechanism to enhance performance in dense deployments.	Implement the changes proposed in 11-15/1013 and add "Mandatory support for QMF"	2017/1/9 9:42
5598	Guido Hiertz	225	1 4.3.14a	9	42	T	Y	9.42 4.3.14a	The 802.11ax draft adds various new features that help marketing new silicon designs. However, the draft hardly addresses any issues of dense network deployments. Submission 11-15/1015 outlines a simple mechanism to reduce traffic overhead.	Add "Mandatory support for Proxy ARP"	2017/1/9 9:42
5599	Guido Hiertz	225	1 9.4.2.218.2	78	14	E	Y	78.14 9.4.2.218.2	Microsecond must be abbreviated as "╨s."	Replace "us" with "╨s"	2017/1/9 9:42
5600	Guido Hiertz	225	1 9.4.2.218.2	78	15	E	Y	78.15 9.4.2.218.2	Microsecond must be abbreviated as "╨s."	Replace "us" with "╨s"	2017/1/9 9:42
5601	Guido Hiertz	225	1 9.4.2.218.3	83	17	E	Y	83.17 9.4.2.218.3	Microsecond must be abbreviated as "╨s."	Replace "us" with "╨s"	2017/1/9 9:42
5602	Guido Hiertz	225	1 9.4.2.218.3	83	20	E	Y	83.20 9.4.2.218.3	Microsecond must be abbreviated as "╨s."	Replace "us" with "╨s"	2017/1/9 9:42
5603	Guido Hiertz	225	1 9.4.2.218.3	83	24	E	Y	83.24 9.4.2.218.3	Microsecond must be abbreviated as "╨s."	Replace "us" with "╨s"	2017/1/9 9:42
5604	Guido Hiertz	225	1 9.4.2.218.3	83	29	E	Y	83.29 9.4.2.218.3	Microsecond must be abbreviated as "╨s."	Replace "us" with "╨s"	2017/1/9 9:42
5605	Guido Hiertz	225	1 27.6.4	179	23	E	Y	179.23 27.6.4	Microsecond must be abbreviated as "╨s."	Replace "us" with "╨s"	2017/1/9 9:42
5606	Guido Hiertz	225	1 27.6.4	179	24	E	Y	179.24 27.6.4	Microsecond must be abbreviated as "╨s."	Replace "us" with "╨s"	2017/1/9 9:42
5607	Guido Hiertz	225	1 27.6.4	179	26	E	Y	179.26 27.6.4	Microsecond must be abbreviated as "╨s."	Replace "us" with "╨s"	2017/1/9 9:42
5608	Guido Hiertz	225	1 28.2.2	223	27	E	Y	223.27 28.2.2	Microsecond must be abbreviated as "╨s."	Replace "504 us" with "504 ╨s"	2017/1/9 9:42
5609	Guido Hiertz	225	1 28.3.16	344	55	E	Y	344.55 28.3.16	Microsecond must be abbreviated as "╨s."	Replace "us" with "╨s"	2017/1/9 9:42
5610	Guido Hiertz	225	1 C.3	424	33	E	Y	424.33 C.3	C.2 (Guidelines for IEEE 802.11 MIB authors/editors) in 802.11-2016 explains "Do not use symbols such as <greek-mu> in units, instead spell out the units fully, i.e., 'microseconds.'" Consequently, the use of "us" is wrong.	Replace "us" with "microseconds"	2017/1/9 9:42
5611	Guido Hiertz	225	1 28.5	383	4	E	Y	383.04 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"	2017/1/9 9:42
5612	Guido Hiertz	225	1 28.5	383	32	E	Y	383.32 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"	2017/1/9 9:42
5613	Guido Hiertz	225	1 28.5	384	4	E	Y	384.04 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"	2017/1/9 9:42
5614	Guido Hiertz	225	1 28.5	384	32	E	Y	384.32 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"	2017/1/9 9:42
5615	Guido Hiertz	225	1 28.5	385	4	E	Y	385.04 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"	2017/1/9 9:42
5616	Guido Hiertz	225	1 28.5	386	8	E	Y	386.08 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"	2017/1/9 9:42
5617	Guido Hiertz	225	1 28.5	387	5	E	Y	387.05 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"	2017/1/9 9:42
5618	Guido Hiertz	225	1 28.5	388	5	E	Y	388.05 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"	2017/1/9 9:42
5619	Guido Hiertz	225	1 28.5	388	38	E	Y	388.38 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"	2017/1/9 9:42
5620	Guido Hiertz	225	1 28.5	389	5	E	Y	389.05 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"	2017/1/9 9:42
5621	Guido Hiertz	225	1 28.5	389	38	E	Y	389.38 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"	2017/1/9 9:42
5622	Guido Hiertz	225	1 28.5	390	5	E	Y	390.05 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"	2017/1/9 9:42
5623	Guido Hiertz	225	1 28.5	390	38	E	Y	390.38 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"	2017/1/9 9:42
5624	Guido Hiertz	225	1 28.5	391	8	E	Y	391.08 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"	2017/1/9 9:42
5625	Guido Hiertz	225	1 28.5	392	5	E	Y	392.05 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"	2017/1/9 9:42
5626	Guido Hiertz	225	1 28.5	393	5	E	Y	393.05 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"	2017/1/9 9:42
5627	Guido Hiertz	225	1 28.5	393	38	E	Y	393.38 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"	2017/1/9 9:42
5628	Guido Hiertz	225	1 28.5	394	5	E	Y	394.05 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"	2017/1/9 9:42
5629	Guido Hiertz	225	1 28.5	394	38	E	Y	394.38 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"	2017/1/9 9:42

5630	Guido Hiertz	225	1 28.5	395	5	E	Y	395.05 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"	2017/1/9 9:42
5631	Guido Hiertz	225	1 28.5	395	38	E	Y	395.38 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"	2017/1/9 9:42
5632	Guido Hiertz	225	1 28.5	396	8	E	Y	396.08 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"	2017/1/9 9:42
5633	Guido Hiertz	225	1 28.5	397	5	E	Y	397.05 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"	2017/1/9 9:42
5634	Guido Hiertz	225	1 28.5	398	5	E	Y	398.05 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"	2017/1/9 9:42
5635	Guido Hiertz	225	1 28.5	398	38	E	Y	398.38 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"	2017/1/9 9:42
5636	Guido Hiertz	225	1 28.5	399	5	E	Y	399.05 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"	2017/1/9 9:42
5637	Guido Hiertz	225	1 28.5	399	38	E	Y	399.38 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"	2017/1/9 9:42
5638	Guido Hiertz	225	1 28.5	400	5	E	Y	400.05 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"	2017/1/9 9:42
5639	Guido Hiertz	225	1 28.5	400	38	E	Y	400.38 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"	2017/1/9 9:42
5640	Guido Hiertz	225	1 28.5	401	7	E	Y	401.07 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"	2017/1/9 9:42
5641	Guido Hiertz	225	1 28.5	402	4	E	Y	402.04 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"	2017/1/9 9:42
5642	Guido Hiertz	225	1 28.5	403	4	E	Y	403.04 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"	2017/1/9 9:42
5643	Guido Hiertz	225	1 28.5	403	35	E	Y	403.35 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"	2017/1/9 9:42
5644	Guido Hiertz	225	1 28.5	404	4	E	Y	404.04 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"	2017/1/9 9:42
5645	Guido Hiertz	225	1 28.5	404	35	E	Y	404.35 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"	2017/1/9 9:42
5646	Guido Hiertz	225	1 28.5	405	4	E	Y	405.04 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"	2017/1/9 9:42
5647	Guido Hiertz	225	1 28.5	405	35	E	Y	405.35 28.5	The use of "Mbps" is wrong. After all this would mean Mega ╬ bit ╬ pico ╬ second.	Replace "Mbps" with "Mb/s"	2017/1/9 9:42
5648	Guoqing Li	225	1 27.3.4.2	155	56	E	N	155.56 27.3.4.2	"that carries one or more dynamic fragments...", for level 1 dynamic fragmentation, the MPDU or S-MPDU can contain up to one frag of each MSDU or A-MSDU. This sentence can cause confusion that level 1 fraagmentation contains more fragments from one MSDU or A-MSDU.	remove "or more dynamic fragments"	2017/1/9 9:42
5649	Guoqing Li	225	1 27.3.4.3	156	4	E	N	156.04 27.3.4.3	"that carries one or more dynamic fragments...", for level 2 dynamic fragmentation, the MPDU or S-MPDU can contain up to one frag of each MSDU or A-MSDU. This sentence can cause confusion that level 1 fraagmentation contains more fragments from one MSDU or A-MSDU.	remove "or more dynamic fragments"	2017/1/9 9:42
5650	Guoqing Li	225	1 27.4.1	157	57	T	N	157.57 27.4.1	The wording in this paragraph is not accurate.For ACK=1, TID=15, the M-BA is acknoledging a managaeent frame not a data indicated by the TID.	remove "identified by the value of the TID"	2017/1/9 9:42
5651	Guoqing Li	225	1 27.4.2	158	37	T	N	158.37 27.4.2	"to the TID value of that MPDU" , for acknolwdging action frame, this sentence is not accurate	Clarify	2017/1/9 9:42
5652	Guoqing Li	225	1 27.4.2	159	16	T	N	159.16 27.4.2	This sentence misses the case of the acknoledgement of the action frame	Clarify	2017/1/9 9:42
5653	Guoqing Li	225	1 27.4.3	159		T	N	159.00 27.4.3	The descripton is confusing. For example, if the buffer size is 31, it meets conditions of both paragraphs where one says the bigmap length shall be 64 and the other says it could be 64 or 256.	Change the second paragraph to "if....is within [65, 256], ...	2017/1/9 9:42
5654	Guoqing Li	225	1 27.4.3	159	36	T	N	159.36 27.4.3	if buffer size is 128, can the recipient dynamcally changing the bitmap length between 64 and 256? The sentence in this paragraph is not clear on this.	Clarify	2017/1/9 9:42
5655	Guoqing Li	225	1 27.4.3	159		T	N	159.00 27.4.3	The descripton is confusing. For example, if the buffer size is 31, it meets conditions of the hree paragraphs, which one can the STA uses?	change the second paragraph to "if....is within [65,1286], ...", and change third paragraph to "...within [129-256]..."	2017/1/9 9:42

5656	Guoqing Li	225	1 27.7.1	180		T	N	180.00 27.7.1	The implementation of a STA supporting the role of scheduling TWT is different from the role of scheduled STA. The capability indication should separate these two.	Separate these two capabilities, one for scheduling STA and one for scheduled STA	2017/1/9 9:42
5657	Guoqing Li	225	1 27.7.2	180	44	T	N	180.44 27.7.2	"..otherwise it is an iimpclit TWT", this sentence is misleading in that it reads like trigger-enabled and implicit are two equavalent alternativies. However, even if a TWT is trigger-enabled, it is still an implicit TWT since the impleit subfield shall set to 1.	change to "..otherwise it is not a trigger-enabled TWT"	2017/1/9 9:42
5658	Guoqing Li	225	1 27.7.2	182	6	T	N	182.06 27.7.2	Why the condition includes the exsistence of an random RU?	remove "and does not allcoate any random RU during an unannounced TWT"	2017/1/9 9:42
5659	Guoqing Li	225	1 27.7.2	182	6	T	N	182.06 27.7.2	If cascade indication is 0 allows STA to go to doze mode, then the cascade indication is similar to an EOSP indication. This needs to be defined in the trigger frame format and other parts that explain what this indication is. It is more than an indication that there will not be trigger anymore. This is also related to whether the AP is allowed to send DL traffic or not.	remove case 1) from the early TWT SP termination event list, or define more clearly that this indication is similar to EOSP bit.	2017/1/9 9:42
5660	Guoqing Li	225	1 27.7.2	182		T	N	182.00 27.7.2	case 3 and 2 are more related to whether the frame is solicitng an acknoledgement or not. And even in case 2) the STA recevies a frame with EOSP bit set to 1 which is the condition in 3).	Clarify the difference between case 3) and 2)	2017/1/9 9:42
5661	Guoqing Li	225	1 27.7.2	182	20	T	N	182.20 27.7.2	The QoS Info field in REVmc is difined differently for AP and STA, and for AP the format of the QoS info field does not contain "more data ACK" field. This is inconsistent with this paragraph which assumes both requesting and responding STA can use this field to indicate the support of more data ACK.	Modify the QoS info field to include a field called "More Data ACK" field for AP.	2017/1/9 9:42
5662	Guoqing Li	225	1 27.7.3.1	182	39	T	N	182.39 27.7.3.1	This sentence implies that a STA cannot use broadcast TWT if it has indivitual TWT. However, I don't think this is reasonable. A STA may use individual TWT to transfer periodic regular data which is predicable and use broadcast TWT for any other data that is less predictable and bursty.	remove this sentence	2017/1/9 9:42
5663	Guoqing Li	225	1 27.7.3.2	184	15	T	N	184.15 27.7.3.2	The sentence here is confusing. The trigger field is to indicate there the TWT is trigger enabled or not. It does not indicate whether it is implicit or not.	change to "othersie, it shall set the "trigger field to 0 to indicate a non-trigger-enabled TWT"	2017/1/9 9:42
5664	Guoqing Li	225	1 27.7.3.2	185	18	E	N	185.18 27.7.3.2	It is better to spell out AM as active mode	spell out "AM"	2017/1/9 9:42
5665	Guoqing Li	225	1 27.7.3.2	185	12	T	N	185.12 27.7.3.2	This paragraph seems to conflict with the previous paragraph which says the STA doesn't need to follow AP operation during CP while the previous paraph says the STA shall follow the AP operation during CP. The condition for the two cases are not clearly specified.	Clarify	2017/1/9 9:42
5666	Guoqing Li	225	1 27.7.3.3	185	47	E	N	185.47 27.7.3.3	Regarding the first "TWT SP termination event" in this line, the terminlogy in other part of this section is "early TWT SP termination event", need to be consistent to avoid confusion.	change the first "TWT SP termination event" in this line to "Early TWT SP termination event",	2017/1/9 9:42
5667	Guoqing Li	225	1 27.7.3.3	185	47	E	N	185.47 27.7.3.3	Regarding the second "TWT SP ternination event" in this line, it is referring to the end of the this SP. To diferentiate it from the early SP termination event, it is better to use another terminology such as "normal TWT SP termination event".	changethe the second "TWT SP termination event" in this line to "normal TWT SP termination event" or define TWT SP Termination event such that it includes early terination event and the even that the adjustedMinimumTWTWakedu dration has passed.	2017/1/9 9:42
5668	Guoqing Li	225	1 27.4.4.2	160	57	T	N	160.57 27.4.4.2	Why the A-MPDU in this case cannot contain Action frame? What about the case the A-MPDU is VHT single MPDU in A-MPDU?	Remove this constraint	2017/1/9 9:42
5669	Guoqing Li	225	1 27.7.3.3	185	62	E	N	185.62 27.7.3.3	This pagraph should be a third bullitin following the previous two bullitins	edit accordingly	2017/1/9 9:42

5670	Guoqing Li	225	1 27.7.3.3	186		T	N	186.00 27.7.3.3	As I understand, a STA need to send PS-Poll or APSD trigger during a TWT SP to fetch DL BU if the TWT SP is announced. The STA does not send PS-Poll or APSD trigger if the SP is unannounced. This paragraph only applies to announced SP which need to be clarifeid	Line 21, change to "...frame within that TWT SP if the TWT SP is announced"	2017/1/9 9:42
5671	Guoqing Li	225	1 27.7.3.4	186	46	T	N	186.46 27.7.3.4	Not all TWT element paramters are reserved. For example, the broadcast ID. Please see page 72, line 35047 which says how to set broadcast ID when the command type is request for braodcast TWT.	Clarify so that it is consistent with section 9.2.2.200	2017/1/9 9:42
5672	Guoqing Li	225	1 27.7.3.4	186	58	T	N	186.58 27.7.3.4	Not all TWT element paramters are reserved. For example, the broadcast ID. Please see page 72, line 35047 which says how to set broadcast ID when the command type is request for braodcast TWT.	Clarify so that it is consistent with section 9.2.2.200	2017/1/9 9:42
5673	Guoqing Li	225	1 9.4.2.200	72	35	T	N	72.35 9.4.2.200	This paragraph says how to set Broadast ID for broadcast TWT. However, in secton 27.7.3.4, line 46 and 58, it indicates that broadcast ID is reserved.	clarify so that it is consistent with section 27.7.3.4	2017/1/9 9:42
5674	Guoqing Li	225	1 27.14.3.1	200	59	T	N	200.59 27.14.3.1	Can a non-AP STA still send data through EDCA in this TWT SP when the AP set its TIM bit to 0? It's better to clarify this point.	Clarify	2017/1/9 9:42
5675	Guoqing Li	225	1 27.14.3.1	200	63	T	N	200.63 27.14.3.1	in "if the STA was not served before...", what does "served" mean here? The AP send trigger to the STA? or the AP send the STA's DL BU to the STA?	Clarify	2017/1/9 9:42
5676	Guoqing Li	225	1 27.14.2	199	60	T	N	199.60 27.14.2	As I understand, TWT element does not containt "start time of the trigger frame", it contains start time of the TWT SP. And contains indication for trigger-enabled SP and indication for random access RU. As such, the sentence here is not accurate.		2017/1/9 9:42
5677	Guoqing Li	225	1 27.14.2	200	21	E	N	200.21 27.14.2	Missing an "and" between "has a value of 1 in the broadcast sufield" and "a value of 2..."	change to "has a vlaue of 1 in the broadcast subfield and a value of 2..."	2017/1/9 9:42
5678	Guoqing Li	225	1 27.8.2	189	8	E	N	189.08 27.8.2	This sentence is badly written	change to "after transmitting the acknowledgement frame for the frame containing the OMI A-Control..."	2017/1/9 9:42
5679	Guoqing Li	225	1 27.8.3	189	29	T	N	189.29 27.8.3	Why this sentence is a note. It should be another bullitin item followig the previous bullitin.	Make this sentence a bulitin item followintg the previous one.	2017/1/9 9:42
5680	Guoqing Li	225	1 27.9.1	190	12	T	N	190.12 27.9.1	What is SR PPDU? The HE PHY does not define such an PPDU format. Seems to me, SR PPDU is a PPDU that can be initaited simultaneously using the SR mechiasm defined here which is otherwise not possible using legacy sensing mechanism. If so, this needs to be clarified since there is such PHY PPDU format called SR PPDU.	Either define SR PPDU, or clarify using different terminology.	2017/1/9 9:42
5681	Guoqing Li	225	1 27.9.2.1	190	34	T	N	190.34 27.9.2.1	why spatial reuse cannot be applied to group addressed public action frame?		2017/1/9 9:42
5682	Guoqing Li	225	1 9.3.1.23.4	50	40	T	N	50.40 9.3.1.23.4	How to set Doppler field in MU-RTS is not specified	Specify how to set the Doppler field in MU-RTS	2017/1/9 9:42
5683	Guoqing Li	225	1 27.9.2.1	190	50	E	N	190.50 27.9.2.1	Heading format is incorrect	Correct the heading format	2017/1/9 9:42
5684	Guoqing Li	225	1 27.2.3	152	25	T	N	152.25 27.2.3	what does "updating its EDCA access" mean when UL MU is disabled? What happens to the counters in this case? Regenerate according to new EDCA parameters? Or count down to zero then start using the new EDCA parameters?	Clarify	2017/1/9 9:42
5685	Guoqing Li	225	1 27.4.4.2	160	58	T	N	160.58 27.4.4.2	Why DL MU PPDU soliciting SU resposne cannot contain action frame soliciting a response?	Clarify	2017/1/9 9:42
5686	Guoqing Li	225	1 27.2.1	150	13	T	N	150.13 27.2.1	What if STA sends an HE MU PPDU? It's not forbidden in the spec, and thereforethis condition is not accurate since this HE MU PPDU may come from its own BSS.	Clarify	2017/1/9 9:42
5687	Guoqing Li	225	1 4.2.14a	9	29	T	N	9.29 4.2.14a	The mandatory support on tone more than 242 do not apply to 20MHz only devices. Though obvious this needs to be clarified.	Clarify that the RU tone more than 242 are not mandatory for 20MHz only device.	2017/1/9 9:42

5688	Guoqing Li	225	1 27.9.2.2	192	1	E	N	192.01 27.9.2.2	"considering..." is not a complete sentence.	change to something like "please refer to section 3.1 for the definition of antenna connector".	2017/1/9 9:42
5689	Guoqing Li	225	1 27.9.2.2	192	3	T	N	192.03 27.9.2.2	SR mode is not defined. It is better to define the mode in the beginning of this section.	Define what exactly is SR mode. For example, " a mode that a STA operates in a PD level that is differnet from legacy PD threshold on OBSS PPDUs"	2017/1/9 9:42
5690	Guoqing Li	225	1 27.9.2.2	192	23	T	N	192.23 27.9.2.2	"the minimum OBSS_Pdlevel...", the wording of this sentence is confusing. Isnt that the min of this value is -82?	Clarify	2017/1/9 9:42
5691	Guoqing Li	225	1 27.9.2.2	191	62	T	N	191.62 27.9.2.2	If there is a default value for OBSS_Pdmin and max, does it mean the STA can alter these values to be different from the default values? Who set these values then? AP or the STA can altler these min and max values on its own? It's better to have AP set these values, but I do not see AP broadcasting such values.	Clarify	2017/1/9 9:42
5692	Guoqing Li	225	1 27.10.2	192	40	E	N	192.40 27.10.2	Multiple sentences are refering to the use of 10.13.6, it's better to combine these sentences to avoid confusion.	Edit the paragraph to combine the sentences	2017/1/9 9:42
5693	Guoqing Li	225	1 27.10.3	193	1	E	N	193.01 27.10.3	the first paragraph is not complete, I assume it's a continuation from the previoius pagragraph	change to ",and provided that..." to complete the sentence	2017/1/9 9:42
5694	Guoqing Li	225	1 9.4.2.218.2	78	20	T	N	78.20 9.4.2.218.2	I think the multi-TID aggregation support is referring to wehther and how many TIDs the STA can receive (not transmit) in an A-MPDU. This is consistent with page 193 line 11 and 12.	change to "indicates the number of TIDs...that the STA can receive in a multi-TID AMPDU...."	2017/1/9 9:42
5695	Guoqing Li	225	1 27.10.4	194	27	E	N	194.27 27.10.4	"allocated"-->"allocates"	"allocated"-->"allocates"	2017/1/9 9:42
5696	Guoqing Li	225	1 27.10.4	194	40	T	N	194.40 27.10.4	"when any of the buffers is empty", this part of the setnence does seem necessary and only adds confusion.	Remove "when any of the buffer is empty"	2017/1/9 9:42
5697	Guoqing Li	225	1	9	60	E	N	9.60	There is no terminology as "MU OFDMA", I think it should be "OFDMA"	change "MU OFDMA" to "OFDMA"	2017/1/9 9:42
5698	Guoqing Li	225	1 27.5.1.1	162	53	T	N	162.53 27.5.1.1	The reference to HE MU PPDU should not be the padding section for trigger-based PPDU, it should refer to the DL MU PPDU padding section	Correct the reference	2017/1/9 9:42
5699	Guoqing Li	225	1 27.5.1.1	162	45	T	N	162.45 27.5.1.1	Do line 44-47 and line 56-59 say the same thing?	Clarify	2017/1/9 9:42
5700	Guoqing Li	225	1 27.5.1.1	162	56	T	N	162.56 27.5.1.1	There is terminology called "DL OFDMA with MIMO PPDU"	Use a difined terminology	2017/1/9 9:42
5701	Guoqing Li	225	1 27.5.1.1	162	58	T	N	162.58 27.5.1.1	There is no field called "DL OFDMA With MIMO Support field" in HE Capabilities Element	Use a defined terminology or define it.	2017/1/9 9:42
5702	Guoqing Li	225	1 27.5.2.1	164	14	T	N	164.14 27.5.2.1	There is no terminology called MU-MIMO RU and UL OFDMA PPDU. I think what this sentence means is "An AP shall not ....assigning spatial streams to more than one STA in an RU in the response trigger-based PPDU when the RU does not span..."	Clarify as suggested	2017/1/9 9:42
5703	Guoqing Li	225	1 27.5.2.1	164	19	T	N	164.19 27.5.2.1	There is no terminology called "UL MU-MIMO HE trigger-based PPDU"	Delete "UL MU-MIMO" from the sentence.	2017/1/9 9:42
5704	Guoqing Li	225	1 27.5.2.1	164	24	T	N	164.24 27.5.2.1	There is no terminology called "UL OFDMA PPDU"	Use a difined terminology	2017/1/9 9:42
5705	Guoqing Li	225	1 27.5.2.1	164	46	E	N	164.46 27.5.2.1	There is an extra . After "..random access allocation)".	Remove the extra period.	2017/1/9 9:42
5706	Guoqing Li	225	1 27.5.2.1	164	50	T	N	164.50 27.5.2.1	Comparing to the first bullitin which has "one or more trigger frames", the second bullitin here says "an UL MU Response scheduling", it reads like only one MPDU in the PPDU can include an UL MU response scheduling subfield. However, I don't think that's the intention of this bullitin. Multiple MPDUs can carry the UL MU response scheduling A-Control field each addressed to differnet STAs. This needs to be clarified.	Clarify, remove "An" from beginning of the sentence.	2017/1/9 9:42
5707	Guoqing Li	225	1 27.11.1	196	2	T	N	196.02 27.11.1	2047 is used as start of MAC padding on page 165 line 35 and here it's used to indicate STAs in all BSS when multiBSS is acviated. How does a STA identify if it's for start of the MAC padding or for STAs in all BSS?	Clarify	2017/1/9 9:42

5708	Guoqing Li	225	1 27.5.2.2.2	165	47	T	N	165.47 27.5.2.2.2	Why both false and true conditions are in the sentence? I think only this sentence is for the case when dot11MultiBSSIDactivated is false.	remove "when dot11MultiBSSIDactivated is false"	2017/1/9 9:42
5709	Guoqing Li	225	1 27.5.2.2.2	165	51	T	N	165.51 27.5.2.2.2	"intend to communciate" is not an accurate wording. A more suitable word is "is capable of communicating"	"intend to"-->"is capable of communicating"	2017/1/9 9:42
5710	Guoqing Li	225	1 27.5.2.2.2	165	54	T	N	165.54 27.5.2.2.2	There is no field called "multiple BSSUD support field". I think this refers to the "RX Control Frame to MultipleBSS" field in HE Capabilties Element.	change the terminology to be consistent	2017/1/9 9:42
5711	Guoqing Li	225	1 27.5.2.2.2	165	54	T	N	165.54 27.5.2.2.2	What is the meaning of "RX Control Frame to MultiBSS"? Is it capable to receive trigger frame destined to more than one BSS or it's the capability of the STA assocaited with non transmitted BSS to be able to receive frame with TA=transmitted BSSID?	Clarify	2017/1/9 9:42
5712	Guoqing Li	225	1 27.5.2.2.3	167	39	T	N	167.39 27.5.2.2.3	Iit's not clear whhich case this paragraph apply to. Does this pagraph applies to the case when trigger is the only frame in the PPDU? Does it cover the case where trigger is aggregated with data? The trigger-frame only PPDU case is already covered in the paragraph above it.	Clarify	2017/1/9 9:42
5713	Guoqing Li	225	1 27.5.2.3	167	59	T	N	167.59 27.5.2.3	There is a TBD in the spec. Define this TBD bahvior.	Define this "TBD" behavior	2017/1/9 9:42
5714	Guoqing Li	225	1 27.5.2.3	167	59	T	N	167.59 27.5.2.3	why there is a case that the STA is not associated with the AP and can receive a trigger frame destined for it? Is it for pre-associated STA during random access?	Specify how this works, or delete.	2017/1/9 9:42
5715	Guoqing Li	225	1 27.5.2.3	168	8	T	N	168.08 27.5.2.3	section 27.2.2 deals with how to update intra and inter NAV, but it doesn't specify how to set TXOP_Duration parameter. Either this is a wrong reference or section 27.2.2 should be more specific about how to set TXOP_duration field when responding a trigger frame.	Either refer to the right reference or specify how to set TXOP_duration parameter in section 27.2.2.	2017/1/9 9:42
5716	Guoqing Li	225	1 27.5.2.3	169	23	T	N	169.23 27.5.2.3	section 27.2.2 deals with how to update intra and inter NAV, but it doesn't specify how to set TXOP_Duration parameter. Either this is a wrong reference or section 27.2.2 should be more specific about how to set TXOP_duration field when responding a trigger frame.	Either refer to the right reference or specify how to set TXOP_duration parameter in section 27.2.2.	2017/1/9 9:42
5717	Guoqing Li	225	1 27.5.2.3	169	52	T	N	169.52 27.5.2.3	missing "and" between the reference of 9.7.3 and 27.10.3	add "and" between the two reference sections.	2017/1/9 9:42
5718	Guoqing Li	225	1 27.5.2.3	170	1	T	N	170.01 27.5.2.3	If the trigger is basic trigger, then there is not required type. Please clarify.	Clarify	2017/1/9 9:42
5719	Guoqing Li	225	1 27.5.2.3	170	26	T	N	170.26 27.5.2.3	line 26-32 seem to miss the condition mentioned in line 53-54.	Add the condition that the soliciting PPDU contains an UL MU response schedulig A-Control field to the list.	2017/1/9 9:42
5720	Guoqing Li	225	1 27.5.2.5	171	40	E	N	171.40 27.5.2.5	remove (#2190,2191)	remove (#2190,2191)	2017/1/9 9:42
5721	Guoqing Li	225	1 27.5.2.5	171	41	E	N	171.41 27.5.2.5	Correct the figure number 9-XX	Correct the figure number 9-XX	2017/1/9 9:42
5722	Guoqing Li	225	1 27.5.2.5	172	49	T	N	172.49 27.5.2.5	This note should be written in normative text with "shall" language	change to something like "A STA shall not transmit ....if it does not receive..."	2017/1/9 9:42
5723	Guoqing Li	225	1 27.5.2.6.2	173	46	E	N	173.46 27.5.2.6.2	missing a space between 0 and if	add a space between "0" and "if"	2017/1/9 9:42
5724	Guoqing Li	225	1 27.5.2.6.2	174	4	T	N	174.04 27.5.2.6.2	If the transmissiong using OFDMA-RA fails, can the MPDU be transmitted using regular UL OFDMA if it gets a regular trigger or can it use EDCA to transmit this failed MPDU? The text reads like that this is not allowed, however I think this should be allowed.	Clarify	2017/1/9 9:42
5725	Guoqing Li	225	1 27.5.3	175	36	T	N	175.36 27.5.3	I don't think this is correct. The AP could return OFDMA BA to multiple A-MPDUs in the proceeding TRIG PPDU. So the word "at most..." is not correct.	Remove this sentence.	2017/1/9 9:42
5726	Guoqing Li	225	1 27.5.3	175	43	T	N	175.43 27.5.3	What does "that AMPDU" mean? I think an HE MU PPDU that contains an AMPDU which aggregates data and trigger starts the cascade sequence. If so, this needs to be clarified.	Clarify	2017/1/9 9:42

5727 Guoqing Li	225	1 27.5.3	175	60	T	N	175.60 27.5.3	the receives for the DL HE MU PPDU must be different from hat of the following trigger-based PPDU since the former's receive is the non-AP STAs and the latter one's receiver is AP. This sentence does not add anything but can cause misunderstanding.	Remove this sentence.	2017/1/9 9:42
5728 Guoqing Li	225	1 27.6.1	176	9	E	N	176.09 27.6.1	It's better to change to "Similar to VHT sounding protocol..."	change to "Similar to VHT sounding protocol..."	2017/1/9 9:42
5729 Guoqing Li	225	1 4.3.14a	9	35	T	N	9.35 4.3.14a	I don't think 40MHz is mandatory at 2.4GHz, so this sentence is not accurate.	Clarify	2017/1/9 9:42
5730 Guoqing Li	225	1 4.3.14a	9	38	T	N	9.38 4.3.14a	Missing 80+80 in this sentece.	add "/80+80MHz" after "160MHz".	2017/1/9 9:42
5731 Guoqing Li	225	1 4.3.14a	9	40	T	N	9.40 4.3.14a	I think DL MU-MIMO support is mandatory. However, this sentence reads like that DL MU-MIMO is only mandatory if the HE AP supports 4 or more spatial streams.	Change to "by an HE AP and the HE AP shall support 4 or more..."	2017/1/9 9:42
5732 Guoqing Li	225	1 4.3.14a	9	60	E	N	9.60 4.3.14a	change "MU OFDMA" to "OFDMA"	change "MU OFDMA" to "OFDMA"	2017/1/9 9:42
5733 Guoqing Li	225	1 4.3.14a	9	64	T	N	9.64 4.3.14a	"scheduled trigger frame are sent...", this sentece reads like such scheduled trigger frame is mandatory behavior. However, whether HE AP setups scheduled trigger frame is part of scheduling algorithm and shouldn't be mandated.	Chagne to soemthign like the following, "Schedueld trigger frame can be sent..."	2017/1/9 9:42
5734 Guoqing Li	225	1 27.11.4	196	52	T	N	196.52 27.11.4	"from the HE STA with which...", should this HE STA be HE AP?	Change to "from the HE AP with which..."	2017/1/9 9:42
5735 Guoqing Li	225	1 27.11.2	196	12	T	N	196.12 27.11.2	Why only extended range SU PPDU is excluded in this case. If the intention is to ask 3rd party device to set NAV when transmitting RTS or CTS, then HE SU PPDU should also be included.	Chagne "an HE extended range SU PPDU" to "an HE SU PPDU or HE extended range SU PPDU"	2017/1/9 9:42
5736 Guoqing Li	225	1 27.13	199	5	E	N	199.05 27.13	This sentence doesn't seem to be in right grammer. Also, missing a "the" before "the recommended MCS"	Correct	2017/1/9 9:42
5737 Guoqing Li	225	1 27.14.2	200	1	E	N	200.01 27.14.2	The first sentence is not well written. Suggest to remove the text within the parenthesis.	Remove the text in paranthesis	2017/1/9 9:42
5738 Guoqing Li	225	1 27.14.2	200	22	T	N	200.22 27.14.2	Even if the TWT flow identifier indicates that this TWT doesn't contain random RU, I think the STA can still go to doze until the start of the SP if the AP doesn't indicate presence of DL traffic in TIM, right? If so, then there is no need to mention the ramdom access here.	Clarify	2017/1/9 9:42
5739 Guoqing Li	225	1 27.11.6	198	28	T	N	198.28 27.11.6	For SU PPDU, can the spatial reuse be set to SR_restricted? The allowed setting for SU PPDU vs. MU PPDU is not clear.	Clarify	2017/1/9 9:42
5740 Guoqing Li	225	1 27.14.2	200	22	T	N	200.22 27.14.2	I think this subsection (power save with UL OFDMA-based random access) only apply to the case when this Beacon doesn't beong to the beacon that the STA is supposed to monitor. Otherwise, if this is a Beacon that the STA is supposed to wake up and monitor based on braodcast TWT Setup, then the STA need to wake up at the start of the TWT SP anyway no matter whether it will contain random RU or not in order to get triggered by AP.	Clarify	2017/1/9 9:42
5741 Guoqing Li	225	1 27.16.2	206	53	E	N	206.53 27.16.2	A HE AP-->An HE AP	A HE AP-->An HE AP	2017/1/9 9:42
5742 Guoqing Li	225	1 27.16.2	206	58	E	N	206.58 27.16.2	A HE AP-->An HE AP	A HE AP-->An HE AP	2017/1/9 9:42
5743 Guoqing Li	225	1 27.16.1	205	36	E	N	205.36 27.16.1	Shoud this be "VHT operation element VHT Opration Information field' instead of "HT operation element...."	Clarify	2017/1/9 9:42
5744 Guoqing Li	225	1 27.16.3.1	207	7	T	N	207.07 27.16.3.1	"Can" is not a normative text, change to "should"	Can-->Should	2017/1/9 9:42
5745 Guoqing Li	225	1 28.1.1	210	34	T	N	210.34 28.1.1	Shoudn't extended range SU PPDU also be included in MCS0-7 list according to IEEE doc#1159r2	If it's missing in the list then add this into the list	2017/1/9 9:42
5746 Guoqing Li	225	1 28.1.1	212	40	T	N	212.40 28.1.1	Better to be consistent with line 36 which uses "HE trigger-based PPDU"	"HE_TRIG PPDU" to "HE trigger-based PPDU" or change l ine 36 to be "HE_TRIG PPDU"	2017/1/9 9:42
5747 Guoqing Li	225	1 28.1.1	211	34	T	N	211.34 28.1.1	"within a 20MHz PPDU and a full full bandwidth PPDU", does this full bandwidth PPDU refer to 20MHz full bandwidth PPDU or any bandwidth PPDU?	Clarify	2017/1/9 9:42
5748 Guoqing Li	225	1 28.1.2	211	56	E	N	211.56 28.1.2	missing a space between "PHYs" and "A non-AP STA".	Add a space between "PHYs" and "A non-AP STA".	2017/1/9 9:42
5749 Guoqing Li	225	1 28.1.4	213	40	E	N	213.40 28.1.4	The grammer doesn't seem right in the sentence.	including-->includes	2017/1/9 9:42

5750	Guoqing Li	225	1 28.1.4	213	58	T	N	213.58 28.1.4	trigger-based PPDU can also be sent as a response to a PPDU that carries a frame which contains UL MU Response Scheduling A-Control field.	change to "is sent in response to a PPDU that carries a trigger frame or a frame that contains UL MU Resonse scheduling A-Control field".	2017/1/9 9:42
5751	Guoqing Li	225	1 28.2.2	224	15	E	N	224.15 28.2.2	Missing an "and" between "The RU assignment in frequency domain" and "number of MU-MIMO allocations" or make it into bullitin format.	add an "and"	2017/1/9 9:42
5752	Guoqing Li	225	1 28.2.2	226	22	E	N	226.22 28.2.2	AP's choosing-->AP's choice	AP's choosing-->AP's choice	2017/1/9 9:42
5753	Guoqing Li	225	1 28.2.2	223	53	T	N	223.53 28.2.2	Though obvious, it is better to spell out what does 0 indicates and what does 1 indicates	Specify what does 0 and 1 indicates, respecetively.	2017/1/9 9:42
5754	Guoqing Li	225	1 28.1.1	210	23	T	N	210.23 28.1.1	According to SFD, STA supporting >4 spatial streams shall support LDPC and such requirment apply to 20MHz-only too. So this requirement is not correct.	Remove "except when the STA is a 20MHz only STA"	2017/1/9 9:42
5755	Guoqing Li	225	1 28.1.1	210	27	T	N	210.27 28.1.1	According to SFD, STA supporting >4 spatial streams shall support LDPC and such requirment apply to 20MHz-only too. So this requirement is not correct.	Remove "except when the STA is a 20MHz only STA"	2017/1/9 9:42
5756	Guoqing Li	225	1 10.22.2.7	132	17	T	N	132.17 10.22.2.7	What specific rules are being referred here? This subclause is "multiple frame transission". What rules are appllicable here when AP gets a respone to trigger frame? Does it intend to refer to the rules on error receovery and backoff?	Clarify	2017/1/9 9:42
5757	Guoqing Li	225	1 9.3.1.23	45	43	T	N	45.43 9.3.1.23	Line 43 of page 45 says B12 indicates primary or non-primary 80MHz.If B12 is 1, then it indicates non-primary. And then line 28 of page 46 says this bit is set to 1 (for 160M/80+80). Are these two places contradictory?	add "except when BW indicates 160MHz/80+80MHz" at the end of the sentence on line 43 of page 45.	2017/1/9 9:42
5758	Guoqing Li	225	1 9.3.1.1	55	22	T	N	55.22 9.3.1.1	Why RAPS is only in probe response, should it be also in (Re)Association response?	Include RAPS in (Re)Association response frame format	2017/1/9 9:42
5759	Guoqing Li	225	1 9.4.2.00	70	50	T	N	70.50 9.4.2.00	"as other TWT paramters are sugested by TWT scheduled STAs", does scheduled STA also suggest flow identifier? It seems to me that flow identifier is determined by the AP's scheduling algorithm and scheduled STA doesn't suggest this parameter.	Clarify	2017/1/9 9:42
5760	Guoqing Li	225	1 9.4.218.2	76	22	T	N	76.22 9.4.218.2	HE MAC Capabilities field is missing a few items: other than frag=off, bitmap=64, other bitmap size are all optional and need to have a capability indication	Add capability indication for bitmap size+Frag conbinations other than Frag=off, bitmap=64	2017/1/9 9:42
5761	Guoqing Li	225	1 10.3.2.8a.3	117	39	T	N	117.39 10.3.2.8a.3	missing "non-HT duplicate"	change to "The data rate to be used for the non-HT or non-HT duplicate..."	2017/1/9 9:42
5762	Guoqing Li	225	1 10.3.2.10.1	118	58	T	N	118.58 10.3.2.10.1	The response can be solicited by MU-BAR	chagne to "are transmitted in response to explocit BlockAckReq or MU-BAR..."	2017/1/9 9:42
5763	Guoqing Li	225	1 10.3.2.10.3	120	3	T	N	120.03 10.3.2.10.3	Missing "non-HT" from the list	change to "are allowed in non-HT, non-HT Duplicate..."	2017/1/9 9:42
5764	Hanseul Hong	225	1 9.3.1.9.3	36	20	T	N	36.20 9.3.1.9.3	B3 of fragment number subfield is always set to 0	Make B3 of fragment number subfield reserved or use it in other purpose	2017/1/9 9:42
5765	Hanseul Hong	225	1 9.4.2.200	69	36	E	N	69.36 9.4.2.200	The length of TargetWakeTime subfield is 2 in case of broadcast TWT	Change '8 or 0' to '8 or 2 or 0' for the length of TargetWakeTime subfield	2017/1/9 9:42
5766	Hanseul Hong	225	1 9.4.2.200	69	36	E	N	69.36 9.4.2.200	In broacast TWT, TWT channel subfield is not present	Change '1' to '1 or 0' for the length of TWT channel subfield	2017/1/9 9:42
5767	Hanseul Hong	225	1 9.4.2.200	70	4	T	N	70.04 9.4.2.200	In table 9-262k, TWT scheduling STAs may set TBTT negotiation subfield to 1 in case of accept/reject TWT	Delete 'scheduling STA'	2017/1/9 9:42
5768	Hanseul Hong	225	1 9.4.2.200	74	52	T	N	74.52 9.4.2.200	According to the description, the TWT Channel field in TWT element sent by an HE TWT requesting STA indicates temporary primary channel during TWT SP.	Change 'a TWT requesting STA' to 'a S1G TWT requesting STA' and 'a TWT responding STA' to 'a S1G TWT responding STA', or give some description of using temporary channel in an HE STA	2017/1/9 9:42
5769	Hanseul Hong	225	1 9.4.2.200	75	24	T	Y	75.24 9.4.2.200	It says "A TWT requesting STA sets the TWT Protection subfield to 0 if TWT protection by RAW allocation is not requested for the corresponding TWT(s)". However, an HE STA, TWT Protection subfield may be set to 1 to enable the NAV protection given by 802.11ax.	Delete the sentence or change 'A TWT requesting STA' to 'A S1G TWT requesting STA'	2017/1/9 9:42
5770	Hanseul Hong	225	1 9.4.2.224	96	28	T	N	96.28 9.4.2.224	The details of setting Quiet Time Period request elements are missing	Clarify	2017/1/9 9:42

5771	Hanseul Hong	225	1 9.4.2.224	96	28	T	N	96.28 9.4.2.224	In case of not periodic QTP, how to set Quite Time Period is not defined	define the case for not periodic QTP	2017/1/9 9:42
5772	Hanseul Hong	225	1 10.3.2.8a.2	117	11	T	Y	117.11 10.3.2.8a.2	Is it possible to transmit MU-RTS in HT PPDU or VHT PPDU format?	Clarify	2017/1/9 9:42
5773	Hanseul Hong	225	1 10.9	126	65	E	N	126.65 10.9	If the UL Power Headroom or Bandwidth Query Report operation is optional, corresponding words should be included	As in the comment	2017/1/9 9:42
5774	Hanseul Hong	225	1 10.9	127	37	E	N	127.37 10.9	Include when the Control ID subfield equals 6	Add a bullet as 'A value of 6 in the Control ID subfield when the transmitting STA follows the reverse direction protocol procedure, as described in 10.28 (Reverse direction protocol)'	2017/1/9 9:42
5775	Hanseul Hong	225	1 10.22.2.7	132	34	T	Y	132.34 10.22.2.7	If MU-RTS can be sent in HT PPDU or VHT PPDU format, describe how to set TXVECTOR parameter CH_BANDWIDTH	Clarify	2017/1/9 9:42
5776	Hanseul Hong	225	1 10.28.3	136	50	T	N	136.50 10.28.3	Since non-HE RD responder cannot send Multi-STA BlockAck, it is not needed to add it	Delete the bullet 'Mult-STA BlockAck'	2017/1/9 9:42
5777	Hanseul Hong	225	1 10.43.1	138	47	T	N	138.47 10.43.1	When the Broadcast subfield is 1, what is the value of Wake TBTT Negotiation subfield?	Clarify	2017/1/9 9:42
5778	Hanseul Hong	225	1 10.43.1	139	53	T	N	139.53 10.43.1	The 'Accept TWT with Wake TBTT Negotiation subfield = 1 0 and Broadcast subfield = 1' case is included in 'Accept TWT or Alternate TWT or Dictate TWT or Reject TWT with Wake TBTT Negotiation subfield = 0'. One is indication of broadcast TWT parameter, and the other is not allowed setting	Exclude the former case from the latter case	2017/1/9 9:42
5779	Hanseul Hong	225	1 27.2.1	149	51	T	Y	149.51 27.2.1	According the draft, when the BSS_COLOR is same and Mac address is different, it is determined as intra-BSS frame	Describe this case to be determined as inter-BSS frame	2017/1/9 9:42
5780	Hanseul Hong	225	1 27.5.1.1	162	58	T	N	162.58 27.5.1.1	DL OFDMA with MIMO Support field is not present in HE capabilites element	add it in HE capabilities element	2017/1/9 9:42
5781	Hanseul Hong	225	1 27.5.2.1	164	27	E	N	164.27 27.5.2.1	Class A subfield is present in HE capabilites element as 'Device class' subfield	Change 'Class A subfield' to 'Device class subfield'	2017/1/9 9:42
5782	Hanseul Hong	225	1 27.14.3	200	39	E	N	200.39 27.14.3	Since the details of using TIM element is about broadcast TWT, it should be merged to 27.7.3 (Broadcast TWT operation)	As in the comment	2017/1/9 9:42
5783	Hongyuan Zhang	225	1 28.3.20	368	42	T	Y	368.42 28.3.20	When HE-SIG-A CRC Fails, PHY.CCA(Busy) should not be held according to RXTIME in (28-128), which is based on some subfields of HE-SIG-A.	Creat a new RXTIME formula in this case, similar to the 11ac RXTIME formular with SignalExtension added. Refer to this new RXTIME formula if the SIGA CRC fails	2017/1/9 9:42
5784	Hongyuan Zhang	225	1 28.3.14.3	342	58	T	Y	342.58 28.3.14.3	"A STA that transmits an HE trigger-based PPDU shall have timing accuracy of +/-0.4 ++s relative to the actual ending time of the PPDU carrying the Trigger frame. This requirement does not include round trip delay."--the word "actual ending time" needs to be clarified. Same applies to 17.3.9.10 for PPDUs carrying MU-RTS.	Use better word, for example "the last sample of the PPDU as indicated by the preamble"	2017/1/9 9:42
5785	Hongyuan Zhang	225	1 28.3.14.3	342	58	T	Y	342.58 28.3.14.3	For VHT packets with short GI carrying trigger frame, the RXTIME is computed based on (21-106), which rounds to the next 4us boundary, therefore it is contradictory with the statement of "actual ending time".	Disallow SGI for HT/VHT PPDUs carrying a HE Trigger frame	2017/1/9 9:42
5786	Hongyuan Zhang	225	1 9.4.2.218.3	84	49	T	Y	84.49 9.4.2.218.3	Too many capabilities related Beamformee STS: "Beamformee STS for <=80", "NSTS_total for <=80MHz", same two capabilities for >80mHz. Almost all exisiting client devices have same numbers for these two capabilities, it is better to merge these two capabilities	Merge to "Beamformee STS for <=80MHz" and "Beamformee STS for >80MHz", each of them represents the single NSTS_total upper limit that a STA may receive in either an NDP or an DL-MUMIMO PPDU.	2017/1/9 9:42
5787	Hongyuan Zhang	225	1 28.3.10.7.2	275	34	T	Y	275.34 28.3.10.7.2	Undefined mechanism when the "Doppler" bit in SIGA is set to 1, also applicable to HE-SIG-A of HE-MU PPDU format.	Either define the PHY mechanism when Doppler bit is set to 1, or change this bit to reserved,	2017/1/9 9:42
5788	Hongyuan Zhang	225	1 27.5.2.7	174	22	T	Y	174.22 27.5.2.7	The NDP feedback report PHY format is not defined.	Either define the PHY mechanism for NDP feedback report, or remove this subclause and other related placehodlers.	2017/1/9 9:42

5789	Hongyuan Zhang	225	1 9.4.2.218.3	84	12	T	Y	84.12 9.4.2.218.3	Only maximum constellation capability for DCM in SIGB is meaningful, the max NSS capability is only applied for DCM in Data field.	B25:24, and B28:27 are for max constellation support for DCM in both Data and SIGB; B26 and B29 are for max Nss support for DCM in Data field only.	2017/1/9 9:42
5790	Hongyuan Zhang	225	1 9.4.2.218.4	86	42	T	Y	86.42 9.4.2.218.4	In 11n, all BW modes (20 and 40MHz) have the same MCS and Nss capabilities; in 11ac all BW modes within {20, 40, 80}MHz have ths same MCS and Nss capabilities, while 160/80+80MHz may define a different Nss capability; now in 11ax it seems that the presence of "Tx MCS Nss Descriptions" and "Rx MCS NSS Descriptions" fields allow any BW modes to define a different Max Nss and Max MCS capabilities, and different Nss may defined different max MCS too. Do we really need this level of flexibility? For example, for a 80MHz capable device it seems very natrual that the same number of Nss should be supported for 20, 40 and 80MHz modes because almost all the necessary hardware are already physically present. This unnecessary flexibility makes the AP rate control much more complex than the previous generations.	Consolidate the MCS/Nss capabilities, make them common for 20/40/80MHz like in 11ac.	2017/1/9 9:42
5791	Hongyuan Zhang	225	1 28.1.1	210	57	T	Y	210.57 28.1.1	4xLTF and 0.8us GI is missing for the optional PHY feature.	Add 4xLTF and 0.8us GI in a new bullet	2017/1/9 9:42
5792	Hui-Ling Lou	225	1 28.3.10.7.2	275	34	T	Y	275.34 28.3.10.7.2	Mechanism undefined when "Doppler" bit in HE-SIG-A bit is set to 1.	Define the mechanism for the case when the Doppler bit is set to 1 and reference that in Table 28-16 for Doppler bit set to 1.	2017/1/9 9:42
5793	Huizhao Wang	225	1 9.7.3	109	9	T	Y	109.09 9.7.3	ACK, Block ACK, Multi-STA Block ACK are all required to be placed at the first of subframe of an A-MPDU. How is it possible to place them if both ACK and Block ACK (or multi-STA Block ACK) are included in an A-MPDU?	Need to add a rule to ensure that in an A-MPDU, it can only contain at most one ACK, or Block ACK, or multi-STA Block ACK	2017/1/9 9:42
5794	Huizhao Wang	225	1 10.3.2.4	115	1	T	Y	115.01 10.3.2.4	The rule is not clear about updating NAV from RXVECTOR TXOP_DURATION field, when it is indicating using the PSDU's Duration field	Replace the text: "The STA does not receive a frame with the duration information indicated by a Duration field in the PSDU of the PPDU carrying the RXVECTOR parameter TXOP_DURATION" with following text: "The STA does not receive a frame with valid duration information inside Duration field in the PSDU, but it is indicated by the RXVECTOR parameter TXOP_DURATION field to use PSDU Duration field"	2017/1/9 9:42
5795	Huizhao Wang	225	1 10.3.2.8a.3	117	29	T	Y	117.29 10.3.2.8a.3	The 4th rule of responding to MU-RTS is not clear, it mentions a term "basic NAV" is 0, but no where in the text has description of "basic NAV"	Please add text to describe the term "basic NAV"	2017/1/9 9:42
5796	Huizhao Wang	225	1 10.43.1	137	47	E	Y	137.47 10.43.1	None Engish word "tha"	Change "tha" to "that"	2017/1/9 9:42
5797	Huizhao Wang	225	1 11.1.3.10	141	50	T	Y	141.50 11.1.3.10	Need detail description of different element sets may be included in beacons in non-HE and HE_EXT_SU PPDUs formats. If they are carrying different set of elements, then in order to avoid any ambiguity, need to list out which elements may differ, and the reasons behind them.	Please add detail description	2017/1/9 9:42
5798	Huizhao Wang	225	1 11.2.2.6	142	35	T	Y	142.35 11.2.2.6	There is no "More Data Ack" bit defined in QoS Capability element for AP. Bit7 is still reserved in QoS Info field when sent by AP. If HE AP wants to use this bit to signal it supports set More Data bit in ACK/Block ACK, then need to change the definition of the QoS Info field sent by AP	Please change the definition of QoS Info field sent by AP in clause 9.4.1.17	2017/1/9 9:42
5799	Huizhao Wang	225	1 27.2.1	149	19	T	Y	149.19 27.2.1	GROUP_ID and PARTIAL_AID cannot be used by non-AP STA to determine inter-BSS or intra-BSS of a frame, if it is not intended receiver because it does have the knowledge of AIDs assigments to other STAs in the same BSS	Remove "or GROUP_ID and PARTIAL_AID in VHT"	2017/1/9 9:42

5800	Huizhao Wang	225	1 27.2.2	151	15	T	Y	151.15 27.2.2	Need an example to clarify the following rule of updating intra-BSS NAV: "The STA does not receive a frame with the duration information indicated by a Duration field in the PSDU of the PPDU carrying the RXVECTOR parameter TXOP_DURATION"	Please add an example to depict this rule clearly	2017/1/9 9:42
5801	Huizhao Wang	225	1 27.3.4.3	156	31	T	Y	156.31 27.3.4.3	The rule of dropping the dynamic fragments after receiving BAR needs to further clarified that it only apply to the fragments which have not yet fully assembled to become a complete MSDU, MMPDU, A-MPDU	Replace the text: "A recipient shall discard any fragments", with following text: "A recipient shall dicard any fragments which have not fully assembled as MSDU, A-MSDU, or MMPDU"	2017/1/9 9:42
5802	Huizhao Wang	225	1 27.3.4.44	157	9	T	Y	157.09 27.3.4.44	The rule of dropping the dynamic fragments after receiving BAR needs to further clarified that it only apply to the fragments which have not yet fully assembled to become a complete MSDU, MMPDU, A-MPDU	Replace the text: "A recipient shall discard any fragments", with following text: "A recipient shall dicard any fragments which have not fully assembled as MSDU, A-MSDU, or MMPDU"	2017/1/9 9:42
5803	Huizhao Wang	225	1 27.4.1	158	13	T	Y	158.13 27.4.1	Rule of not allowed to send Mult-STA Block ACK to STAs with MultiBSS case is not clear.	Replace the text: " to the STA", with the text: " on the HE AP"	2017/1/9 9:42
5804	Huizhao Wang	225	1 27.4.3	160	5	T	Y	160.05 27.4.3	Starting Sequence number range is wrong. It should be allowed between WinStartR and WinEndR -1	Remove the text: "The Starting Sequence Number subfield of the Block Ack Starting Sequence Control subfield shall be set to any value in the range from (WinEndR -┤╟╢ BitmapLength + 1) to WinStartR"	2017/1/9 9:42
5805	Huizhao Wang	225	1 27.4.3	160	8	T	Y	160.08 27.4.3	The description of how to choose Block ACK bitmap size if its smallest bitmap size is greater than the WinSizeR is not clear	Replace the text: "The values in the recipient's record of status of MPDUs beginning with the MPDU for which the Sequence Number subfield value is equal to WinStartR and ending with the MPDU for which the Sequence Number subfield value is equal to WinEndR, wherein the length of the BlockAck Bitmap field shall be greater than or equal to the smallest BitmapLength that is greater than WinEndR -┤╟╢ WinStartR" With following text: "If the smallest BitmapLengh is greater than WinSizeR, then the Bock ACK bitmap field shall be greater than or equal to the smallest BitmapLength"	2017/1/9 9:42
5806	Huizhao Wang	225	1 27.4.3	160	17	T	Y	160.17 27.4.3	Block ACK transmit time should not be bounded by TXOP limitation	Remove the text: "NOTE 2--An HE STA can generate a Block Ack frame with variable length Block Ack Bitmap field in which case the STA ensures that the Block Ack frame response fits within the remaining duration of the TXOP."	2017/1/9 9:42
5807	Huizhao Wang	225	1 27.4.4.5	162	27	T	Y	162.27 27.4.4.5	There is no text to describe how the "broadcast RU" is signaled	Remove the text: "broadcast RU"	2017/1/9 9:42
5808	Huizhao Wang	225	1 27.5.1.3	163	43	T	Y	163.43 27.5.1.3	If a STA canot find its STA-ID in BQRP trigger frame, then this BQRP is not intended to it, and should not respond	Remove the text: "otherwise the STA shall follow the rules defined in 27.5.2.6 (UL OFDMA-based random access) to gain access to a random RU and generate the HE trigger-based PPDU when the Trigger frame contains one or more random RU(s)."	2017/1/9 9:42
5809	Huizhao Wang	225	1 27.5.2.2.2	167	17	E	Y	167.17 27.5.2.2.2	Remove unintended wording from how to assign value in AC Preference subfield	Remove "to 1"	2017/1/9 9:42
5810	Huizhao Wang	225	1 27.5.2.3	167	58	T	Y	167.58 27.5.2.3	If a STA is not associated to an AP, but received a Trigger frame from it, it should discard the Trigger frame, and does not respond with HE Trigger based PPDU	Replace the text: "TBD", with "then it shall discard the Trigger frame."	2017/1/9 9:42
5811	Huizhao Wang	225	1 27.5.2.7	174	21	T	Y	174.21 27.5.2.7	Need to add text to describe NDP feedback report	Please add the missing text to describe NDP feedback report frame format, elements, and procedure	2017/1/9 9:42
5812	Huizhao Wang	225	1 27.6.2	177	19	T	Y	177.19 27.6.2	Table YY-1 is missing	Please add the missing table YY-1	2017/1/9 9:42
5813	Huizhao Wang	225	1		1	E	Y		Check indentation at the Table of Content	Indent "access(EDCA) 30" to inline with other subclauses in the Table of Content	2017/1/9 9:42
5814	Huizhao Wang	225	1		50	E	Y		Add spece between subclause number and title	Add space between "10.10" and "Contral Wrapper Operation". And there are many places in the Table of Contents need to separate the subclause numbers from the titles	2017/1/9 9:42

5815	Huizhao Wang	225	1 4.3.14a	9	39	T	Y	9.39 4.3.14a	Missing mandagory support Rus for 80+80MHz channel	Add: "Mandatory support for 26-, 52-, 106-, 242-, 484-, 996- and 2x996-tone RUs in a 80+80 MHz channel"	2017/1/9 9:42
5816	Huizhao Wang	225	1 4.3.14a	9	46	E	Y	9.46 4.3.14a	Duplicate mention of 1024 QAMs and MCS 10/11	Since line 43 already mentioned optional support 1024QAMs, remove line 46	2017/1/9 9:42
5817	Huizhao Wang	225	1 8.3.5.12.2	16	43	E	Y	16.43 8.3.5.12.2	Need explicitly mention VHT STA for first sentence of explaining the meaning of secondary40	add: "In a VHT STA" at the beginning of the first sentence	2017/1/9 9:42
5818	Huizhao Wang	225	1 8.3.5.12.2	16	53	E	Y	16.53 8.3.5.12.2	Need explicitly mention VHT STA for first sentence of explaining the meaning of secondary80	Add "In a VHT STA" at the beginning of the first sentence	2017/1/9 9:42
5819	Huizhao Wang	225	1 9.2.4.1.8	19	40	T	Y	19.40 9.2.4.1.8	"More Data Ack" in QoS Info Field is reserved for HE AP. Need to change the QoS Info field for HE AP to have the "More Data Ack" defined	Change the QoS Info field reserved Bit7 to "More Data Ack" for HE AP as well	2017/1/9 9:42
5820	Huizhao Wang	225	1 9.2.4.1.10	20	1	T	Y	20.01 9.2.4.1.10	Referencing undefined subclause 10.51.5.4: "Rely-shared TXOP protection mechanism"	Since subclause 10.51.5.4 does not exist, please remove this sentence from the draft	2017/1/9 9:42
5821	Huizhao Wang	225	1 9.2.4.5.6	21	11	T	Y	21.11 9.2.4.5.6	There is no good reason to change the meaning of "queue size value" between non-HE STA and HE STA. Its meaning should be kept as same as in 802.11-2016, subclause 9.2.4.5.6: "The queue size value is the total size, rounded up to the nearest multiple of 256 octets and expressed in units of 256 octets, of all MSDUs and A-MSDUs buffered at the STA (excluding the MSDU or A-MSDU of the present QoS Data frame) in the delivery queue used for MSDUs and A-MSDUs with TID values equal to the value in the TID subfield of this QoS Control field."	Restore to the original text in 802.11-2016: "The queue size value is the total size, rounded up to the nearest multiple of 256 octets and expressed in units of 256 octets, of all MSDUs and A-MSDUs buffered at the STA (excluding the MSDU or A-MSDU of the present QoS Data frame) in the delivery queue used for MSDUs and A-MSDUs with TID values equal to the value in the TID subfield of this QoS Control field."	2017/1/9 9:42
5822	Huizhao Wang	225	1 9.2.4.6.4.7	27	52	E	Y	27.52 9.2.4.6.4.7	Figure 9-15g UL Power Headroom should have 3 cells	Draw the figure with three cells: B0-B4, power headroom; B5, min power indication; B6-B7, reserved	2017/1/9 9:42
5823	Huizhao Wang	225	1 9.3.1.6	33	33	T	Y	33.33 9.3.1.6	HE STA can send non-HT or non-HT dupiclated CF-END to a VHT AP as well	Change "or an HE STA to an HE AP", to: "or an HE STA to an HE AP, or a VHT AP"	2017/1/9 9:42
5824	Huizhao Wang	225	1 9.3.1.9.1	34	10	T	Y	34.10 9.3.1.9.1	B5 bit is missing in the BlockAck's BA Control field	Add B5 into the "Reserved" field: B5 to B11	2017/1/9 9:42
5825	Huizhao Wang	225	1 9.3.1.23	44	58	T	Y	44.58 9.3.1.23	Need to add the encoding table of Packet Extension subfield	Please add the encoding table of Packet Extension subfield	2017/1/9 9:42
5826	Huizhao Wang	225	1 9.3.1.23	45	9	T	Y	45.09 9.3.1.23	Need to add the encoding table of Spatial Reuse subfields	Please add the encoding table of Spatial Reuse subfields	2017/1/9 9:42
5827	Huizhao Wang	225	1 9.3.3.6	53	17	T	Y	53.17 9.3.3.6	Why the order of TWT IE is before HE Cap IE in (Re-)Assoc Resp frame? All other mgmt frames, the TWT IE is after HE Op IE	Move the TWT IE after the HE Op IE, as all other mgmt frames	2017/1/9 9:42
5828	Huizhao Wang	225	1 9.3.3.8	54	11	T	Y	54.11 9.3.3.8	why the order of TWT IE is before HE Cap IE in (Re-)Assoc Resp frame? All other mgmt frames, the TWT IE is after HE Op IE	move the TWT IE after the HE Op IE, as all other mgmt frames	2017/1/9 9:42
5829	Huizhao Wang	225	1 9.4.1.62	57	24	T	Y	57.24 9.4.1.62	Rules for "Remaining Feedback Segments" are not clear: "Set to a value between 1 and 6 for a feedback segment that is neither the first nor the last of a segmented report. Set to a value between 1 and 7 for a feedback segment that is not the last feedback segment of a segmented report."	Remove the sentence: "Set to a value between 1 and 6 for a feedback segment that is neither the first nor the last of a segmented report." Set to a value between 1 and 7 for a feedback segment that is not the last feedback segment of a segmented report."	2017/1/9 9:42
5830	Huizhao Wang	225	1 9.4.1.62	57	46	T	Y	57.46 9.4.1.62	The Description for Sounding Dialog Token Number is wrong	Remove the wrong description: "The ending RU index indicates the last RU26 for which the HE beamformer is requesting feedback.". And add description: "Copied from NDPA Sounding Dialog Token Number field"	2017/1/9 9:42
5831	Huizhao Wang	225	1 9.4.1.62	57	51	T	Y	57.51 9.4.1.62	Need to explicitly mention the following description is for reporting CQI: "In an HE Compressed Beamforming frame not carrying all or part of an HE Compressed Beamforming report, the Nc Index, Nr Index, Channel Width, Grouping, Codebook Information, Feedback Type and Sounding Dialog Token Number subfields are reserved, the First Feedback Segment subfield is set to 0 and the Remaining Feedback Segments subfield is set to 7."	Add explicit sentence to indicate the description is for CQI	2017/1/9 9:42

5832	Huizhao Wang	225	1 9.4.2.200	69	64	T	Y	69.64 9.4.2.200	Paragraph starting from line 64 is completely incomprehencable. It seems trying to describe the TWT element with broadcast = 1, how to determine the wake TBTT and listen interval, but it has failed to describe it clearly	Add graphs, and equations to show how to calculate the next wake TBTT and listen intervals between beacons	2017/1/9 9:42
5833	Huizhao Wang	225	1 9.4.2.200	69	31	T	Y	69.31 9.4.2.200	Target Wake Time field size should be either 8 or 2 octects	Change "8 or 0" to "8 or 2"	2017/1/9 9:42
5834	Huizhao Wang	225	1 9.4.2.200	70	34	T	Y	70.34 9.4.2.200	The description for TWT Setup command of Request TWT is not clear. It should just simply say that for Request TWT command, the Target Wake Time field should be set to zero.	Replace the text: "The Target Wake Time field of the TWT element contains 0s as the TWT responding STA specifies the target wake time value for this case,". With following simple text: "Target Wake Time field shall set to zero."	2017/1/9 9:42
5835	Huizhao Wang	225	1 9.4.2.200	73	16	T	Y	73.16 9.4.2.200	Deliver sounding feedback in TWT SP time may impact the performance of HE TxBF. The sounding feedback carries the channel matrix information of the moment of sounding NDP is received, need to timely delivered to the beamformer without delay, so using TWT SP time to deliver it will likely cause extra delays.	Remove: "Frames that are sent as part of a sounding feedback exchange (see 27.6 (HE sounding protocol))"	2017/1/9 9:42
5836	Huizhao Wang	225	1 9.4.2.200	73	42	T	Y	73.42 9.4.2.200	Deliver sounding feedback in TWT SP time may impact the performance of HE TxBF. The sounding feedback carries the channel matrix information of the moment of sounding NDP is received, need to timely delivered to the beamformer without delay, so using TWT	remove: "Frames that are sent as part of a sounding feedback exchange (see 27.6 (HE sounding protocol))"	2017/1/9 9:42
5837	Huizhao Wang	225	1 9.4.2.218.2	78	4	T	Y	78.04 9.4.2.218.2	Minimum Fragmentation Size should apply to all fragments, except the last one	Replace the text: "Indicates the minimum payload size in octets of the first fragment of an MSDU that is supported by the STA.". With the text: "Indicates the minimum payload size in octets of the fragment of an MSDU, except the last fragment, that is supported by the STA."	2017/1/9 9:42
5838	Huizhao Wang	225	1 9.4.2.218.2	78	19	T	Y	78.19 9.4.2.218.2	Multi-TID Aggregation Support subfield in HE Cap IE should be indicated as receive capability, not transmit capability	Replace the text: "Indicates the number of TIDs minus 1 of QoS Data frames that an HE STA can receive in a multi-TID A-MPDU" With the text: "Indicates the number of TIDs minus 1 of QoS Data frames that an HE STA can aggregate in a multi-TID A-MPDU"	2017/1/9 9:42
5839	Huizhao Wang	225	1 9.4.2.218.2	80	26	T	Y	80.26 9.4.2.218.2	Need a table to depcit the relatioship of HE Maximum A-MPDU Length Exponent and VHT Maximum A-MPDU Length Exponent. The sentence in D1.0 seems suggesting the HE Maximum A-MPDU Length Exponent value is only applied when VHT Maximum A-MPDU Length Exponent = 7, and other cases, use the VHT Maximum A-MPDU Length Exponent instead	Add a table to depict the relatiohship between VHT & HE Maximum A-MPDU Length Exponent fields	2017/1/9 9:42
5840	Huizhao Wang	225	1 9.4.2.218.2	80	41	T	Y	80.41 9.4.2.218.2	Need a table to depcit the relatioship of HE Maximum A-MPDU Length Exponent and HT Maximum A-MPDU Length Exponent (when there is no VHT Cap IE). The sentence in D1.0 seems suggesting the HE Maximum A-MPDU Length Exponent value is only applied when HT Maximum A-MPDU Length Exponent =7, and other cases, use the HT Maximum A-MPDU Length Exponent instead	Add a table to depict the relatiohship between HT & HE Maximum A-MPDU Length Exponent fields (ehen no VHT Cap IE)	2017/1/9 9:42
5841	Huizhao Wang	225	1 9.4.2.218.3	82	27	T	Y	82.27 9.4.2.218.3	When B1 = 0, B5 in Channel Width Field indicates support for 242/106/52/26 tones in 20MHz, not 40MHz for 2.4G	Change "40MHz", to "20MHz"	2017/1/9 9:42
5842	Huizhao Wang	225	1 9.4.2.218.3	82	30	T	Y	82.30 9.4.2.218.3	If B2, B3 & B4 are all zero, which means only 20MHz is supported, how can the B6 indicating support 242 tones in 40MHz and 80MHz mode?	I think the B6 means it only support 242-tones in 20MHz mode, so need to change the sentence to: "B6 to indicate only 242-tones are supported, when B2, B3 & B4 are all zeros"	2017/1/9 9:42

5843 Huizhao Wang	225	1 9.4.2.221	94	62	T	Y	94.62 9.4.2.221	MU EDCA timer field description is not clear	Change the sentence: "The MU EDCA Timer field indicates the duration of time, in units of 8 TUs, for which the provided MU EDCA parameters are used by an HE STA after reception of a Basic variant Trigger frame for the corresponding AC." To: "The MU EDCA Timer field indicates the duration of time, in units of 8 TUs, is used by an HE non-AP STA to disable EDCA function after reception of a Basic variant Trigger frame which contains User Info field AID matching its AID for the corresponding AC."	2017/1/9 9:42
5844 Huizhao Wang	225	1 9.4.2.222	95	22	T	Y	95.22 9.4.2.222	Missing description of how to update the Color Switch Countdown field	Add: If the Color Switch Countdown field value >0, then at the next TBTT, its value is decremented by 1 until it reachs 0.	2017/1/9 9:42
5845 Huizhao Wang	225	1 9.4.2.225	97	30	T	Y	97.30 9.4.2.225	The description of Quiet Time Period Offset field of Quiet Time Response element is wrong.	Replace: "Quiet Time Period Request", with "Quiet Time Period Response"	2017/1/9 9:42
5846 Huizhao Wang	225	1 9.4.2.223	95	48	T	Y	95.48 9.4.2.223	Quiet Time Period Setup element is not needed. Since the Quiet Time Period is negotiated through Request & Response alerady, this Setup element is redundent	Remove it from the text	2017/1/9 9:42
5847 Huizhao Wang	225	1 9.6.29.4	105	29	T	Y	105.29 9.6.29.4	Description of Quiet Time Period Response frame format is not correct: it is the response to the Quiet Time Request frame received, not the request to the Quiet Time Reqeust frame received	Change: "to request" to "to response"	2017/1/9 9:42
5848 Huizhao Wang	225	1 9.7.1	107	14	T	Y	107.14 9.7.1	MPDU Length field description in MPDU delimiter field does not mention HE	Add "HE" as following: "while for VHT and HE PPDUs, both subfields are used."	2017/1/9 9:42
5849 Huizhao Wang	225	1 9.7.1	108	19	T	Y	108.19 9.7.1	Need to mention that the 4095 size limitation of A-MSDU inside an A-MPDU does not apply to HE	Add "HE" as following: "The 4095-octects MPDU length limitation does not apply to A-MPDU carried in HE or VHT or DMG PPDUs"	2017/1/9 9:42
5850 Hyunhee Park	225	1 27.5.2.6.2	173	64	T	Y	173.64 27.5.2.6.2	If the Ack policy of QoS Null frame in random access is No ACK, the retransmission procedure cannot guarantee. For clarification, the Ack policy of QoS Null frame (e.g., BSR frame) should be the Normal Ack in random access.	Add below sentence in P174L6 (section 27.5.2.6.2 Random access procedure). "When a non-AP STA sends one or more QoS Null frames in an HE trigger-based PPDU in a random RU assigned by AID 0 in a Basic Trigger frame or in a BSRP Trigger frame, Ack Policy subfield of the QoS Null frame shall be set to Normal Ack."	2017/1/9 9:42
5851 Hyunhee Park	225	1 9.2.4.6.4.3	24	44	T	Y	24.44 9.2.4.6.4.3	In the Control information subfield of OMI, Channel Width is not distingushed for Rx or Tx. The Control information subfield of OMI should be revised (for example, (1) adding Tx Channel Width or (2) adding Rx/Tx indication, deleting Tx NSS, etc.)	Add Tx Channel Width in Fugure 9-15d.	2017/1/9 9:42
5852 Hyunhee Park	225	1 27.7.3.3	185	39	T	Y	185.39 27.7.3.3	P185L39 says "A TWT scheduled STA should not initiate trandsmission of frames to the TWT scheduling STA outside of broadcast TWT SPs and within trigger-enabled TWT SPs". In this case, the EDCA backoff procedure is unclear when the backoff count is finished outside of broadcast TWT SP and within trigger-enabled TWT SP. Therefore, the EDCA backoff procedure of tirgger-enabled TWT should be clarified.	Add below sentence in P185L41 for clarification of EDCA backoff procedure. "The backoff for the associated EDCAF should not countdown outside trigger-enable TWT SPs."	2017/1/9 9:42
5853 Hyunhee Park	225	1 27.2.3	152	20	T	Y	152.20 27.2.3	Basically, the HE STA enters the doze state outside trigger-enabled TWT SPs. In this case, HEMUEDCATimer doesn't need to countdown.	Add below sentence in P152P20 for clarification of HEMUEDCATimer. "The HEMUEDCATimer[AC] should not countdown outside trigger-enabled TWT SPs."	2017/1/9 9:42

5854	Hyunhee Park	225	1 27.2.3	152	11	T	Y	152.11 27.2.3	When the STA receives the Trigger frame from the AP, it shall update its CW, AIFSN, EDCA Timer in the most recently received MU EDCA Parameter Set element. In addition, when the STA sends the OMI A-Confrol field to change UL MU enable mode, in this case, it may update it CW, AIFSN, EDCA Timer in most recently received MU EDCA parameter set element. Because the UL MU enable means that it will be scheduled from the Trigger frame by the AP. Right now the change of MU EDCA parameter is quite restricted. If the STA sends the OMI A-Control field with UL MU enable, it means the STA wants to operate MU operation mode with MU EDCA parameter. Furthermore, in order to relieve of fairness between the legacy STA and MU operated STA, the MU operated STA should use MU EDCA parameter even though it requests UL MU enable	Add an update rule of CW, AIFSN and HEMUEDCATimer when an UL MU capable non-AP HE STA sends the OMI A-Confrol field to enable UL MU operation.		2017/1/9 9:42
5855	Hyunhee Park	225	1 9.2.4.6.4.4	25	9	E	N	25.09 9.2.4.6.4.4	Mistake in section number "see 9.31.4" for HE link adaptation.	Replace with "see 27.13 (Link adaptation uisng the HE variant HT Control field)".		2017/1/9 9:42
5856	Hyunhee Park	225	1 9.4.2.200	73	31	E	N	73.31 9.4.2.200	Mistake in word "STAT".	Replace with "STA"		2017/1/9 9:42
5857	Hyunhee Park	225	1 27.2.4	188	10	T	Y	188.10 27.2.4	TheTWT Flow Identifier for a Broadcast TWT element has several restrictions depending on the TWT Flow Identifier value. For flexiblity, the Flow ID should be changed for each broadcast TWT SP. For this, the TWT Information frame described in 27.7.4 can be used for each broadcast TWT SP in order to change Flow ID.	Define the change procedure of Flow ID for broadcast TWT SP by using the TWT information frame.		2017/1/9 9:42
5858	Hyunhee Park	225	1 27.5.2.6.1	172	35	T	Y	172.35 27.5.2.6.1	For random access, an HE AP may transmit a Basic Trigger frame or a BSRP Trigger frame that contains one or more RUs. However, BQRP is not described for random access. When the assigned RUs for random access are busy, a BSR and BQR inforamtion should be sent in random access. In addition, if the channel status is busy, the BSR and BQR information can be sent in random access. Therefore, the BSR and BQR information can be aggregated.	Define an aggregation method for BSR and BQR information for random access.		2017/1/9 9:42
5859	Hyunhee Park	225	1 27.5.2.6.2	173	46	E	N	173.46 27.5.2.6.2	Mistake the sentence in L46	Please put a period between "AID value 0" and "If".		2017/1/9 9:42
5860	Hyunhee Park	225	1 27.5.2.6.2	173	54	T	Y	173.54 27.5.2.6.2	If the selected RU size for random access is quite small, the STA cannot send frames in random access through the selected RU. For clarification, an RU selection rule should be defined in random access. When the selected RU size is small in random access, how the STA operate to send frames? There are many candidate optoins, for example, re-selection, fragmentation, non-transmission, etc. For clarification, an RU selection rule should be defined in random access.	Define an RU selection rule considering the RU size in random access.		2017/1/9 9:42

5861	Hyunhee Park	225	1 10.22.2.8	133	31	T	Y	133.31 10.22.2.8	In 11ax, if the AP configures EDCA TXOP parameter by itself and it obtains a TXOP duration for DL/UL MU transmission, but without any restriction, the legacy STAs associated in the BSS and the OBSS (non-)AP STAs may suffer from starvation because of the excessive long TXOP duration. Especially in dense environment, the fairness problem of OBSS STAs can be critical when the TXOP duration is determined by only the AP without any restriction. Therefore the MU TXOP Limit should be defined. The MU TXOP Limit should be defined. Since the multi-TID aggregation should be permitted within not exceeded the MU TXOP Limit. E.g., the multi-TID aggregation should be permitted within not exceeded the MU TXOP limit. In addition, if the AP is a TXOP holder and it performs multi-TID aggregation and/or MU transmission, in this case the	Define the MU TXOP Limit.		2017/1/9 9:42
5862	Hyunhee Park	225	1 9.4.2.220	93	46	E	N	93.46 9.4.2.220	Mistake in "Octets" in Figure 9-589cu.	Replace with "Bits" in Figure 9-589cu.		2017/1/9 9:42
5863	Hyunhee Park	225	1 27.14	201	11	T	Y	201.11 27.14	A STA may enter the Doze state for the TXOP duration when it receives a frame which is not intended to it in 11ac Spec. However, if a STA enters the Doze state for a TXOP duration after receiving an OBSS frame, it may miss an intra-BSS frame intended for it. Moreover, neither BSS color nor TXOP duration field is defined in VHT SIG field, a STA cannot distinguish OBSS frame from intra-BSS frame and cannot enter the TXOP PS after receiving only VHT preamble. In 11ax, since the BSS color is defined, the TXOP PS should be defined for more efficient power save in 11ax. HE TXOP power save mechanism should be defined as that an HE STA has no intended frame to receive for a TXOP to enter the Doze state, and sleep until the end of the TXOP in 11ax.	Define an HE TXOP PS.		2017/1/9 9:42
5864	Hyunhee Park	225	1 27.9.2.1	190	50	T	Y	190.50 27.9.2.1	The OBSS_PD SR backoff procedure was passed as when the receiving STA validates the conditions for spatial reuse operation by using OBSS_PD level, it shall invoke an SR backoff procedure by resuming the backoff counter countdown for the associated EDCAF. For clarification, an SRP-based SR backoff procedure should be defined. In the spec draft, SR backoff procedure is incomplete. Especially P190L50 says "SR Backoff procedure for SR delayed case". For clarification, the backoff procedures for SR delayed case and SR restricted case, respectively.	Define the SRP-based SR backoff procedure.		2017/1/9 9:42
5865	Hyunhee Park	225	1 9.4.2.200	73	14	E	N	73.14 9.4.2.200	Mistake in section number "25.14 (Link adapration using the HE variant HE Control field)".	Replace with section number "25.14 (Link adapration using the HE variant HE Control field)".		2017/1/9 9:42
5866	Hyunhee Park	225	1 9.4.2.200	73	40	E	N	73.40 9.4.2.200	Mistake in section number "25.14 (Link adapration using the HE variant HE Control field)".	Replace with section number "25.14 (Link adapration using the HE variant HE Control field)".		2017/1/9 9:42
5867	Hyunhee Park	225	1 27.14.2	200	16	E	N	200.16 27.14.2	Figure 27-7 is not readable.	Please put the high resolution figure similar with Figure 27-5.		2017/1/9 9:42
5868	Hyunhee Park	225	1 27.6.2	177	52	E	N	177.52 27.6.2	Figure 27-3 is not acceptable in the spec.	Please change the figure with block and white color similar with Figure 27-5.		2017/1/9 9:42
5869	Hyunhee Park	225	1 27.6.2	178	18	E	N	178.18 27.6.2	Figure 27-4 is not acceptable in the spec.	Please change the figure with block and white color similar with Figure 27-5.		2017/1/9 9:42

5870	James June Wang	225	1 27.9.2.1	192	3	T	Y	192.03 27.9.2.1	A STA can select an OBSS_PDlevel during its operation under SR mode. This level can be dynamically adjusted or can be static." Can OBSS_PDlevel be adjusted lower (from a higher level) once countdown starts ? This can allow a STA to transmit at a higher transmit power in the end	Add a restriction that OBSS_PDlevel shall not be adjusted lower once backoff has started with a higher OBSS_PDlevel.	2017/1/9 9:42
5871	James June Wang	225	1 28.3.10.7.2	274	6	T	Y	274.06 28.3.10.7.2	values 1 to 14 are missing in table for Spatial reuse	Use Set to value 1 to 14 corresponding to SRP value (see Table 28-19 (Spatial Reuse subfield encoding)) for SRP-based SR operation.	2017/1/9 9:42
5872	James June Wang	225	1 28.3.10.7.2	276	40	T	Y	276.40 28.3.10.7.2	In Spatial Reuse field, value 1 to 14 are missing	Use Set to value 1 to 14 corresponding to SRP value (see Table 28-19 (Spatial Reuse subfield encoding)) for SRP-based SR operation.	2017/1/9 9:42
5873	James June Wang	225	1 27.9	192	27	T	Y	192.27 27.9	Missing description of SRP-based SR Operation (27.9.3)	Add description of SRP-based SR operation (27.9.3)	2017/1/9 9:42
5874	James June Wang	225	1 10.43.1	137	47	E	Y	137.47 10.43.1	"Demand TWT indicates tha the transmitting STA will accept only the indicated TWT parameters for a TWT agreeement." typo. Should be "Demand TWT indicates that"	Change "tha" to "that"	2017/1/9 9:42
5875	James June Wang	225	1 28.3.17.6.4	349	21	T	Y	349.21 28.3.17.6.4	expression max(-72dBm, OBSS_PD) should be max(-72 dBm, OBSS_PDlevel)	as indicated in comment	2017/1/9 9:42
5876	James June Wang	225	1 28.3.17.6.4	349	36	T	Y	349.36 28.3.17.6.4	expression max(-72 dBm, OBSS_PD) should be max(-72dBm, OBSS_PDlevel (40MHz)).	as indicated.	2017/1/9 9:42
5877	James June Wang	225	1 28.3.17.6.4	349	51	T	Y	349.51 28.3.17.6.4	expression max(-69dBm, OBSS_PD) should be changed to max(-72dBm, OBSS_PDlevel (80MHz))	as indicated in comment	2017/1/9 9:42
5878	James June Wang	225	1 28.3.17.6.3	348	37	T	N	348.37 28.3.17.6.3	Table 28-43 requires that a STA transmits 40MHz, or 80MHz, 160MHz bandwidth to satisfy the lowest CCA level of -82 dBm. The transmit power density of 40, 80, or 160MHz is proportionally lower by 3, 6, 9 dB relative to that of the 20MHz transmit bandwidth. The lowest power spectral density does not reach as far as 20MHz transmit bandwidth. For STA transmitting higher bandwidth, a higher CCA level than Table28-43 by 3, 6, 9 dB depending on transmit bandwidth is 40, 80, or 160MHz should be allowed to use. If the dynamic secondary channel bandwidth detects secondary channel CCA busy, and the transmit bandwidth is reduced, the same power density as he wider intended bandwidth should be used.	Modify Table 28-43 based on intended transmit bandwidth as commented.	2017/1/9 9:42
5879	James Lepp	225	1 11.49.1	115	29	E	N	115.29 11.49.1	Subclause heading "AID assign rule" should be "AID assignment"	AID assignment	2017/1/9 9:42
5880	James Lepp	225	1 9.3.1.9.1	34	10	T	Y	34.10 9.3.1.9.1	After applying the changes described for Figure 9-33, the B5 will be missing. Is the intended change to have "BA Type" be bits 1-5, or have "Reserved" be bits 5-11?	Assign bit 5-11 as reserved.	2017/1/9 9:42
5881	James Lepp	225	1 9.2.4.2	20	1	T	Y	20.01 9.2.4.2	If you're using longer AIDs in 11ax, should table 9-5 be updated?	Make the necessary 11ax related changes to table 9-5 that 11ah previously modified regarding AIDs. (Its not currently in the 11ax draft.)	2017/1/9 9:42
5882	James Lepp	225	1 27.2.2	150	43	E	N	150.43 27.2.2	The sentences in the bullet lists in this subclause sometimes end with a period and sometimes do not.	Terminate sentences in the bullet lists consistently and in line with the style guide.	2017/1/9 9:42
5883	James Lepp	225	1 28.1.1	210	53	E	N	210.53 28.1.1	Don't refer to "Clause 28 features" in clause 28. This is a strange self reference.	Change "An HE STA may support the following Clause 28 features" to "An HE STA may support the following features"	2017/1/9 9:42
5884	James Lepp	225	1 4.3.14a	9	26	T	Y	9.26 4.3.14a	There are inconsistent statements about 40 MHz operation in the 2.4 GHz band. 4.3.14a: "In the 2.4 GHz band, ... An HE non-AP STA shall support operation in 20 MHz channel bandwidth only" 8.1.1: "An HE AP may support ... 40 MHz channel width in the 2.4 GHz band"	Decide on whether 40MHz channel width is supported in 2.4 GHz band for HE STA and make that consistent throughout the amendment.	2017/1/9 9:42
5885	James Yee	225	1 28.3.3.1	228	17	E	Y	228.17 28.3.3.1	Typo in Reference to Table 28-15.	Reference to Table 28-15 should be reference to Figure 28-1 below.	2017/1/9 9:42

5886	James Yee	225	1 28.1.1	209	64	E	Y	209.64 28.1.1		The "and" in "An HE STA refers to an AP STA and a non-AP STA" implies a HE STA functions as two STAs.	Change the "and" to "or".	2017/1/9 9:42
5887	James Yee	225	1 27.2.3	152	13	E	Y	152.13 27.2.3		HEMUEDCATimer is undefined. There is just MU EDCA Timer defined in 9.4.2.221	Replace HEMUEDCATimer with "MU EDCA Timer".	2017/1/9 9:42
5888	James Yee	225	1 27.2.3	152	37	E	Y	152.37 27.2.3		"Parameters" should be "Parameter Record"	As suggested.	2017/1/9 9:42
5889	James Yee	225	1 27.2.3	152	30	E	Y	152.30 27.2.3		The 2nd sentence of the paragraph describing the EDCA Parameter Set Update Count is a repeat of the description in 9.4.2.29 (802.11-2016) and is unnecessary.	Delete the sentence.	2017/1/9 9:42
5890	James Yee	225	1 27.7.2	181	49	E	Y	181.49 27.7.2		Typo in Reference to 11.2.2.2.6.	Should reference 11.2.2.6, not 11.2.2.2.6	2017/1/9 9:42
5891	James Yee	225	1 9.2.4.6.4	22	38	E	Y	22.38 9.2.4.6.4		The heading of this section should not be an yet to be defined abbreviation.	Change "A-Control" to "Aggregated Control".	2017/1/9 9:42
5892	James Yee	225	1 9.4.2.200	69	69	E	Y	69.69 9.4.2.200		Here and elsewhere, "field is 1" should be "field is set to 1"	As suggested.	2017/1/9 9:42
5893	James Yee	225	1 9.4.2.218.2	76	47	E	Y	76.47 9.4.2.218.2		The width of B24 should be 1-bit, not 4.	As suggested.	2017/1/9 9:42
5894	James Yee	225	1 9.4.2.218.2	78	38	E	Y	78.38 9.4.2.218.2		In the description of "All ACK Support", "is the" should be "if the"	As suggested.	2017/1/9 9:42
5895	James Yee	225	1 9.4.2.218.2	78	41	E	Y	78.41 9.4.2.218.2		In the description of "All ACK Support", reference to "25.4.2" should be to "27.4.2"	As suggested.	2017/1/9 9:42
5896	James Yee	225	1 9.4.2.218.2	80	41	E	Y	80.41 9.4.2.218.2		Typo: "the the" should be "the"	As suggested.	2017/1/9 9:42
5897	James Yee	225	1 9.4.2.221	94	37	E	Y	94.37 9.4.2.221		"Parameters" should be "Parameter Record"	As suggested.	2017/1/9 9:42
5898	James Yee	225	1 27.16.3.2	207	57	E	Y	207.57 27.16.3.2		"Quite" should be "Quiet"	As suggested.	2017/1/9 9:42
5899	James Yee	225	1 28.1.1	209	64	E	Y	209.64 28.1.1		"and" should be "or"	As suggested.	2017/1/9 9:42
5900	James Yee	225	1 28.3.3.1	228	17	E	Y	228.17 28.3.3.1		Reference to Table 28-15 should be to Figure 28-1.	As suggested.	2017/1/9 9:42
5901	James Yee	225	1 27.5.2.2.2	166	61	E	Y	166.61 27.5.2.2.2		"Type Dependent" should be "Trigger Dependent"	As suggested.	2017/1/9 9:42
5902	James Yee	225	1 10.9	127	26	E	Y	127.26 10.9		Reference to "10.31.4" should be to "27.13"	As suggested.	2017/1/9 9:42
5903	James Yee	225	1 9.2.4.6.4.4	25	9	E	Y	25.09 9.2.4.6.4.4		Reference to "9.31.4" should be to "27.13"	As suggested.	2017/1/9 9:42
5904	James Yee	225	1 9.4.2.200	73	14	E	Y	73.14 9.4.2.200		Reference to "25.14" should be to "27.13"	As suggested.	2017/1/9 9:42
5905	James Yee	225	1 11.1.3.10	141	50	T	Y	141.50 11.1.3.10		Rather than stating different elements may be carried, it should be specified what are identical elements and contents that must be carried in both types of Beacon frames.	As suggested.	2017/1/9 9:42
5906	James Yee	225	1 27.2.3	152	13	T	Y	152.13 27.2.3		By when should the non-HE STA update its QoS state variables based on the most recent MU EDCA Parameter Set element values? It seems open ended to just require "shall update".	Change "shall update" to "shall, before it transmits the nex PPDU of an affected AC, update"	2017/1/9 9:42
5907	James Yee	225	1 27.7.2	180	58	T	Y	180.58 27.7.2		It is not very clear which rules are superceded by which even though the text only says "respective rules".	Please clarify.	2017/1/9 9:42
5908	James Yee	225	1 27.2.3	152	30	G	Y	152.30 27.2.3	5889	The 2nd sentence of the paragraph describing the EDCA Parameter Set Update Count is a repeat of the description in 9.4.2.29 (802.11-2016) and is unnecessary.	Delete the sentence.	2017/1/9 9:42
5909	James Yee	225	1 9.4.2.219	91	44	T	Y	91.44 9.4.2.219		This paragraph starting with "The BSS Color field" is largely a repeat of the previous paragraph. Delete the previous paragraph and replace "is used" with "indicates that there is no BSS Color for this BSS and".	As suggested.	2017/1/9 9:42
5910	James Yee	225	1 9.4.2.219	92	19	T	Y	92.19 9.4.2.219		Having the AP 'recommend' an action is vague and anthropomorphic. Is the intent here to indicate that by setting the value to 1 then the STAs may "disable the use of BSS Color ..."? If yes, then that should be stated clearly.	As suggested.	2017/1/9 9:42
5911	James Yee	225	1 9.4.2.221	94	31	G	Y	94.31 9.4.2.221		The 2nd sentence of the paragraph describing the EDCA Parameter Set Update Count is a repeat of the description in 9.4.2.29 (802.11-2016) and is unnecessary.	Delete the sentence.	2017/1/9 9:42
5912	James Yee	225	1 9.4.2.221	94	30	T	Y	94.30 9.4.2.221		"same as the field defined in 9.4.1.17 (QoS Info field)" should more specifically refer to "same as the QoS Info field defined in 9.4.1.17 (QoS Info field) when sent by the AP"	As suggested.	2017/1/9 9:42

5913	James Yee	225	1 27.5.2.2.2	166	62	T	Y	166.62 27.5.2.2.2	I suppose setting the TID Aggregation Limit to 1 means only 1 TID is used and there is no aggregation, but it seems simpler to assign a value of 0 for a STA that has indicated no support for Multi-TID.	As suggested.	2017/1/9 9:42
5914	James Yee	225	1 9.31.2.3	41	60	T	Y	41.60 9.31.2.3	How are multiple User Info fields carried in the Trigger Frame when sent via broadcast? Is there a limit to the number of AID12 values can be present? What if the same AID12 value appears more than once? It's also not clear how multiple User Info fields are parsed by the recipient since the number of User Info fields present is not indicated.	Please clarify. For simplicity limit the number of User Info fields.	2017/1/9 9:42
5915	James Yee	225	1 9.31.2.3	47	5	T	Y	47.05 9.31.2.3	"DCM is not be used" should be clarified to say "DCM is not to be used with the HE trigger-based PPDU response".	As suggested.	2017/1/9 9:42
5916	James Yee	225	1 27.13	199	1	T	Y	199.01 27.13	The text refers to "The HE-MCS subfield of the MFB subfield of HE link adaptation field" but there is no MFB subfield defined in the HE Link Adaptation field. The overall description of the HE Link Adaptation procedure is unclear.	Please clarify.	2017/1/9 9:42
5917	James Yee	225	1 9.4.2	67	1	T	Y	67.01 9.4.2	With the introduction of new features such as OFDMA and UL MU MIMO, the existing BSS load elements (9.4.2.160 & 9.4.2.28), which address STA numbers, primary/secondary channel busy condition and DL MU-MIMO underutilization (11ac) are not sufficient for addressing the BSS load status in a 11ax BSS. A further enhanced BSS Load element needs to be defined.	Add a new information element to define 11ax BSS Load. The new IE shall address utilization status of OFDMA as well as UL/DL MU MIMO, as well as provisions to allow future extensions.	2017/1/9 9:42
5918	James Yee	225	1 9.4.2	67	1	T	Y	67.01 9.4.2	Four PPDU formats are defined for HE operations, but current power capability element (9.4.2.15 in 802.11-2016) defines only one set of max/min power for all types of PPDU. The power capability element should be enhanced to provide different PPDU formats to identify maximum and minimum transmit power.	Modify current transmit power capability element (section 9.4.2.15 in 802.11-2016) to accommodate different HE PPDU formats. Since 11ax AP needs more information about STAs' transmit power capabilities, in addition to default power accuracy defined along with device's category, the element should allow reporting with more accurate transmit power accuracy achievable by the STA.	2017/1/9 9:42
5919	James Yee	225	1 9.4.2.139	68	56	T	Y	68.56 9.4.2.139	Level 3 dynamic fragmenation is described in 27.3.3.4, 27.3.4.4 and elsewhere in this draft, but is not mentioned in the description of HE Fragmentation Operation of this section. This inconsistency needs to be corrected.	Add statements for setting the HE Fragmentation Operation field to Level 3 dynamic fragmentation. Or, remove Level 3 dynamic fragmentation from the draft.	2017/1/9 9:42
5920	James Yee	225	1 9.4.2.218.4	86	44	T	Y	86.44 9.4.2.218.4	In Figure 9-589cm, there is no defintion of m and n in the text that follows.	Add explanation of n and m in Figure 9-589cm to the text of section 9.4.2.218.4	2017/1/9 9:42
5921	James Yee	225	1 9.4.2.219	92	40	T	Y	92.40 9.4.2.219	In "The subfield set to 0, if the HE AP transmits beacons in one PHY format.", it is not clear which PHY format is to be used.	Add text to explain what "one PHY format" means and if any specific format is required.	2017/1/9 9:42
5922	James Yee	225	1 9.4.2.219	92	7	T	Y	92.07 9.4.2.219	The meaning of "corresponds" here is not clear. Although the term is used in 11.1.3.8 (of 802.11-2016 and the proposed changes in this draft), even the usage there is vague and should be defined more clearly in terms of multiple BSSID set.	Clarify what actions or properties are required for an AP to "correspond"	2017/1/9 9:42
5923	James Yee	225	1 9.4.2.219	92	11	T	Y	92.11 9.4.2.219	The definition of MaxBSSID indicator is not clear. Should properly reference to 9.4.2.46 and clearly provide HE AP behavior exceptions.There could also be multiple Multiple BSSID elements from multiple APs or the HE AP has its own Multiple BSSID element.	Clarify the defintion of MaxBSSID idicator and how to set it up when there are multiple sources of Multiple BSSID elements.	2017/1/9 9:42

5924	James Yee	225	1 9.4.2.219	92	14	T	Y	92.14 9.4.2.219	The non-zero value here is the same as the MaxBSSID from the Multiple BSSID element? The setting of a non-zero value here contradicts the value setting of MaxBSSID indicator defined in line 11 in the same paragraph.	Clarify if any non-zero value can be set or the non-zero value needs to be set as the same as the MaxBSSID indicator.	2017/1/9 9:42
5925	James Yee	225	1 9.4.2.219	92	7	E	Y	92.07 9.4.2.219	The format and flow of this paragraph describing MaxBSSID Indicator and Tx BSSID Indicator are a bit convoluted. Please improve.	As suggested.	2017/1/9 9:42
5926	James Yee	225	1 9.3.1.9.7	38	12	T	Y	38.12 9.3.1.9.7	The meaning of "all the MPDUs carried in the eliciting A-MPDU" is not clear. Does it include all MPDUs of any TIDs in the eliciting A-MPDU?	Please clarify.	2017/1/9 9:42
5927	James Yee	225	1 27.3.3.2	153	57	T	Y	153.57 27.3.3.2	The text only specifies MSDU. Is MMPDU also allowed for Level 1 Dynamic Fragmentation?	Please clarify.	2017/1/9 9:42
5928	James Yee	225	1 27.3.3.4	154	36	T	Y	154.36 27.3.3.4	Level 3 Dynamic fragmentation use is allowed under many constraints such as HT immediate ack and AMPDU sequence number range. The extra L3 Frag negotiation needed increases overhead. However, the usage scenarios and potential gain are not clear.	Provide the level 3 dynamic fragmentation usage scenarios and justify benefit/gain worthy of the complexity. Otherwise, suggest to remove level 3 dynamic fragmenation.	2017/1/9 9:42
5929	James Yee	225	1 27.3.4.1	155	39	T	Y	155.39 27.3.4.1	The receiving STA supporting dynamic defragmentation does not need to follow receiver timer rules defined in 10.6. Does this mean a receiver can has its own time-out mechanism for defragmentation? If no, what time-out rules shall the receiver follow?	Please clarify.	2017/1/9 9:42
5930	James Yee	225	1 27.2.2	150	22	T	Y	150.22 27.2.2	With more and more 802.11 devices operating in multiple modes, a STA may grab the channel and allocate partial or whole TXOP time for peer-to-peer communication or other proprietary usage, so that inter BSS STAs receiving the NAV request may not always be forbidden to access the channel. However, in the current text, STAs that receive any NAVs are not able to access the channel. A STA can give an indication showing that its intention to grab the channel does not disable channel access for inter BSS STAs. To improve overall network utilization, it is required to add such indication to enable inter-BSS NAV only mechanism.	Suggest adding mechanisms to enable single NAV (inter-NAV or intra-NAV) update, such as an additional PHY signaling or a specific MAC frame.	2017/1/9 9:42
5931	James Yee	225	1 10.3.2.4	115	31	T	Y	115.31 10.3.2.4	NAVTimeout is not defined for MU-RTS.	Amend corresponding statement in 802.11-2016 with necessary changes to include the case for MU-RTS.	2017/1/9 9:42
5932	James Yee	225	1 10.3.2.8a.2	117	5	T	Y	117.05 10.3.2.8a.2	It is not clear that if MU-RTS is sent on multiple 20MHz channels but CTS is only received on serveral of them, can the transmitter of MU-RTS proceed with the frame exchange sequence on the channels without a corresponding CTS reception?	Suggest that those channels without CTS reception corresponding to the MU-RTS should not to be used for transmission during the NAV obtained. Otherwise, statements should be added in the spec to explicitly say the transmission of MU-RTS on those channel is still interpreted as successful.	2017/1/9 9:42
5933	James Yee	225	1 10.3.2.8a.2	117	25	T	Y	117.25 10.3.2.8a.2	The specs says a MU-RTS receiver shall only respond to a CTS frame if the RU allocation subfield in the User Info of the received MU-RTS is either the primary 20 MHz channel, primary 40 MHz channel, primary 80 MHz channel, 160 MHz channel, or 80+80 MHz channel of the MU-RTS receiver. But such requirement does not exist for the MU-RTS transmitter in 10.3.2.8a.2. It is also not clear if such a requirement implies the secondary channel (or any RU on the secondary channl) of a MU-RTS receiver is never used during the MU-RTS reservation.	Either remove this requirement on the receiver side or add corresponding requirement on the transmiter side.	2017/1/9 9:42

5934	James Yee	225	1 10.3.2.8a.3	117	39	T	Y	117.39 10.3.2.8a.3	The spec implies that the reason why the data rate used for the non-HT PPDU reposnse shall be 6Mb/s is provided in 17.1.1. But such explanation does not exist there.	Either remove the reference link or add corresponding explanation in 17.1.1.	2017/1/9 9:42
5935	James Yee	225	1 10.3.2.10.1	118	55	E	Y	118.55 10.3.2.10.1	Space missing before "that" in "Responses to A-MPDUs within a VHT MU PPDU or an HE MU PPDU for DL transmission_that are not"	As suggested	2017/1/9 9:42
5936	James Yee	225	1 27.9.2.2	192	21	E	Y	192.21 27.9.2.2	A conjunction is missing between "The STA may increase the OBSS_PDlevel during the backoff procedure" and "its maximum transmit power being adjusted as defined above".	Add "such that" before "its".	2017/1/9 9:42
5937	James Yee	225	1 27.5.2.3	167	30	T	Y	167.30 27.5.2.3	The spec says the backoff procedure described in 9.22.2.2 applies to UL MU but there is nothing about UL MU in 9.22.2.2 at this point so it is not clear which of thoes rules apply. For example in 9.22.2.2 (10.22.2.2 in 802.11mc) it says "an HT STA may retransmit unacknowledged MPDUs within the same TXOP or in a subsequent TXOP". Does this also apply to an HE STA?	Please clarify.	2017/1/9 9:42
5938	James Yee	225	1 27.14.1	199	12	T	Y	199.12 27.14.1	Besides intra-PPDU power save for HE non-AP STAs, allowing them to enter doze mode till the end of an inter-BSS PPDU TXOP with received power > OBSS_PDmax may further save some power.	As suggested	2017/1/9 9:42
5939	James Yee	225	1 27.11.6	198	34	T	Y	198.34 27.11.6	More information should be provided regarding the behavior of SR_Restricted.	As suggested	2017/1/9 9:42
5940	James Yee	225	1 28.3.10.7.2	274	7	T	Y	274.07 28.3.10.7.2	The spec provided two reference sections (27.9 and 27.11.6) for "SRP-based spatial reuse" but nothing about "SRP-based spatial reuse" can be found there. The definition of "SRP-based spatial reuse" is not clear	Please clarify.	2017/1/9 9:42
5941	James Yee	225	1 28.3.10.7.2	274	12	T	Y	274.12 28.3.10.7.2	It is not clear what exactly the behavior of "SR_Delay" is and more information should be provided in 27.9.2.1 and 27.11a.	Please clarify.	2017/1/9 9:42
5942	James Yee	225	1 28.3.10.7.2	282	29	T	Y	282.29 28.3.10.7.2	Definition of SRP, TX PWRAP and Acceptable Receiver Interference levelAP are not provided.	Please clarify.	2017/1/9 9:42
5943	James Yee	225	1 27.5.1.3	163	27	T	Y	163.27 27.5.1.3	The spec says "A non-AP STA reports its channel availability information (unsolicited BQR) to the AP to which it is associated using the BQR A-Control field of frames it transmits as defined below...". It is not clear what is the definition of "a channel is available". For example, does it requires CCA idle during an interval of PIFS immediately in prior?	Please clarify.	2017/1/9 9:42
5944	James Yee	225	1 27.5.1.3	163	46	T	Y	163.46 27.5.1.3	The spec says "The STA shall include in the HE trigger-based PPDU one or more QoS Null or QoS Data frames containing the BQR A-Control field with the channel availability information...". It is not clear what is the definition of "a channel is available" in this context.	Suggest to generate the response according to inter-NAV.	2017/1/9 9:42
5945	James Yee	225	1 27.5.1.3	163	46	T	Y	163.46 27.5.1.3	The spec says "The STA shall include in the HE trigger-based PPDU one or more QoS Null or QoS Data frames containing the BQR A-Control field with the channel availability information of the STA ...". It should also mention if the BQR A-Control field shall be the same or what happens if they are not exactly the same (e.g. the last BQR A-Control recevied shall be used).	As suggested	2017/1/9 9:42
5946	James Yee	225	1 9.2.4.6.4.2	24	21	E	Y	24.21 9.2.4.6.4.2	The definition of Fval for TRSSI calculation is missing.	Please clarify.	2017/1/9 9:42

5947	James Yee	225	1 10.9	127	47	T	Y	127.47 10.9	The spec says "At most one Control subfield with a given Control ID value shall be present in the A-Control field of QoS Data or Management frames carried in an (A-)MPDU". It is not clear what to do if more than one A-Control field of a given Cotnrol ID subfield is received in QoS Data or Management frames in an (A-)MPDU.	Please clarify.	2017/1/9 9:42
5948	James Yee	225	1 27.8.2	188	48	T	Y	188.48 27.8.2	The information provided by ROM is partially overlapping with the informatiom from BQR. It is not clear if there is a rule how one relates to the other.	Please clarify.	2017/1/9 9:42
5949	James Yee	225	1 27.8.2	189	3	T	Y	189.03 27.8.2	The spec says "The OMI responder shall use the values indicated by the Rx Channel Width and Rx NSS subfields of the most recently received OMI A-Control field sent by the OMI initiator to send PPDUs to the OMI initiator in subsequent TXOP". It seems the channel availability information obtained from BQR is not considered here.	Please clarify.	2017/1/9 9:42
5950	James Yee	225	1 9.4.2.224	96	53	T	Y	96.53 9.4.2.224	The spec requires the Quiet Period Offset field is set to the offset of the start of the first quiet period from the Quiet Time Period Request. But since Quiet Time Period Request element defines a periodic sequence of quiet periods, it seems easier for implementations to just define an absoulte anchor point for the first quiet period instead of using an offset.	As suggested	2017/1/9 9:42
5951	James Yee	225	1 9.4.2.225	97	30	T	Y	97.30 9.4.2.225	Since the Quiet Time Period is periodic, it is not clear why in the response element, the first apperance of this period is expressed in offest and not an absolute time. It should be easier for implementations to just define an absoulte anchor point for the first quiet period instead of using an offset.	As suggested	2017/1/9 9:42
5952	James Yee	225	1 27.16.3.2	207	15	T	Y	207.15 27.16.3.2	The spec only provides the methods to setup new Quiet Time Periods. But once a periodic Quiet Time Period is configured, there should be some ways to cancel it when necessary.	As suggested	2017/1/9 9:42
5953	James Yee	225	1 28.3.14.3	342	20	T	Y	342.20 28.3.14.3	Table 28-40 currently specifies two classes of devices based on TX power and RSSI measurement accuracy, with +/- 3dB as the smallest minimum requirement. However, based on current technologies, we believe 3 dB is too large for devices targetting high performance.	Suggest to add a new A+ device category whose tranmit power and RSSI measurment accuracy minimum requirement is +/- 2 dB. Accordingly, the 'Device Class' field in the HE PHY Capabilities IE in 9.4.2.218.3 will require 1 more bit to express the new device class.	2017/1/9 9:42
5954	James Yee	225	1 28.3.14.3	342	53	T	Y	342.53 28.3.14.3	The carrier sense requirement is -82 dBm and -82 dBm is also the receiver minimum input level sensitivity of lowest MCS in the draft spec. The CFO/SFO requirements shown here are only defined at receive power of -60 dBm, which is not enough to help receivers usually decoding packets with power much lower than -60 dBm.	Suggest to add more CFO/SFO constraints for power below -60 dBm, such as -72 dBm, -82 dBm and even lower power.	2017/1/9 9:42
5955	James Yee	225	1 9.3.1.23	42	61	T	Y	42.61 9.3.1.23	Is it explicitly disallowed for two Trigger frames to be sent in succession? If not, then the benefits of the Cascade Indication feature is unclear.	Remove the Cascade Indication feature.	2017/1/9 9:42
5956	James Yee	225	1 9.3.1.23	42	32	T	Y	42.32 9.3.1.23	For BSR/BQR, trigger frame can use the type of BSRP/BQRP to query the necessary information by AP itself. However, there is no trigger type for "UL power headroom. With this type, AP can decide when to query A-Control with this value by itself, rather than event-driven report by STA.	Considering defining a new trigger type for "UL power headroom".	2017/1/9 9:42

5957	Jarkko Kneckt	225	1 27.7	179		T	Y	179.00 27.7	The BC TWT is not optimized for stand-by power save where the non-AP STA maintains association with the AP in minimum overhead and does not have DL or UL data to transmit in every TWT SP.	Please define a TWT Flow Identifier for broadcast TWT that is optimized to maintain association with minimum power consumption in non-AP STA. Alternatively optimize TWT Flow Identifiers 1 and 2 for stand-by power save.	2017/1/9 9:42
5958	Jarkko Kneckt	225	1 11.2.2.6	141	12	T	Y	141.12 11.2.2.6	The use of PS-Poll frame together with the TWT power save mechanism could be clarified and justified. The PS-Poll should be used only with announced TWT. The TWT SP intiated by PS-Poll should be terminated like any TWT SP, i.e. no data should be transmitted outside of TWT SP.	Please clarify how TWT and PS-Poll frames are used. It would make sense that if a PS-Poll frame is transmitted within the TWT SP and termiantion of the TWT SP also cancels the solicited DL PPDU transmission regardless if it has not been yet transmitted.	2017/1/9 9:42
5959	Jarkko Kneckt	225	1 9.4.2.200	72	26	T	Y	72.26 9.4.2.200	The Triggered TWT SP should define that AP shall transmit a Trigger frame or a frame with Reverse Direction Grant indication in the Triggered TWT SP. In both cases the AP schdules UL transmission resources for the STA. The transmission of the frame with Reverse Direction Grant is useful when data transmission is random or the AP does not have precise knowledge of the amount of UL data that a STA has or when few STAs wake up for the TWT SP. The Trigger frame and frame with RDG enables the AP to allocate transmission resource for the non-AP STA . When frame with RDG is transmitted, the transmission resources are not wasted, if the non-AP STA does not have traffic to transmit for the whole allocated resource.	Please change the text p.72, l.26 to read:" includes Trigger frames or farmes with reverse direction grant. The Trigger field is set to 1 to indicate that at least one Trigger frame or a frame with reverse direction grant is transmitted during the TWT SP."	2017/1/9 9:42
5960	Jarkko Kneckt	225	1 10.9	127	37	T	Y	127.37 10.9	The guidance for the reverse direction protocol A-Control field use is missing from the clause.	Please add the following sentence to line 37: "A value of 6 in the Control ID subfield when the transmitting STA follows the reverse direction protocol procedure as described in 10.28 (Reverse Direction Protocol)."	2017/1/9 9:42
5961	Jarkko Kneckt	225	1 9.2.4.6.4.1	23	37	E	N	23.37 9.2.4.6.4.1	The content of the Control Information subfield for reverse direction protocol is not provided	Please add to Table 9-18a to Content of the RDP:" See 9.2.4.6.4.8 (Reverse direction protocol (RDP))"	2017/1/9 9:42
5962	Jarkko Kneckt	225	1 9.2.4.6.4	22	38	E	N	22.38 9.2.4.6.4	The maximum number of title levels in 802.11 specifications is 5. A-Control field is currently using 6 title levels.	Please change the A-Control field to use five title levels.	2017/1/9 9:42
5963	Jarkko Kneckt	225	1 27.7.1	179	60	T	Y	179.60 27.7.1	A STA should be aware of broadcast TWTs with TWT Flow identifier value 3. The AP may use this type of TWT Flows to organize opportunistic power save for all STAs. It is beneficial that STAs know how long they may be in Doze state and when the TIM or FILS discovery frames will be transmitted. Also a STA should be aware of the timing of hte UL OFDMA random access opportunities.	Please change the text in p.179 l.60: "STAs should be aware of the broadcast TWTs with TWT Flow Type values 2 and 3 in order to knw the Trigger frame transmissions for the UL OFDMA random access and to benefit from the opportunistic power save. The STAs need not be mad aware of other TWT values..."	2017/1/9 9:42
5964	Jarkko Kneckt	225	1 27.7.3.1	182	31	T	Y	182.31 27.7.3.1	The broadcast TWT element may be present in the TIM frame and in FILS Discovery frame, not only in the Beacon and Probe response. The individually addressed and broadcast addressed probe response frames have the same alternatives for the transmission payload. It is not clear why the TWT element cannot be transmitted in the individually addressed probe response. In many cases the scanning STAs receive both broadcast and individually addressed probe responses.	Please change the text: "... broadcast TWT element in TIM frame, FILS Discovery frame, and in Probe Response frame."	2017/1/9 9:42
5965	Jarkko Kneckt	225	1 10.12	128	8	E	N	128.08 10.12	frame is unclear definition.	Change: "within a single QoS Data frame" to: "within a single QoS Data MPDU"	2017/1/9 9:42

5966	Jarkko Kneckt	225	1 27.7.2	180	49	T	Y	180.49 27.7.2	The TWT Channel subfield should not force the STA to operate only in 20 MHz mode during the TWT SPs. If TWT SPs with different TWT Channel values overlap it is not clear how STA operates. Should the STA operate in multiple 20 MHz channels or in the larger BW. The RX Operating mode also coordinates the BW of the STA. When BW signaling through ROMI and TWT signaling complicates the BW handling.	Please clarify whether the TWT Channel define the primary channel of the STA for the TWT duration. Please clarify what is meant by 20 MHz operation. Please clarify how a STA operates if it is served by two or more overlapping TWT SPs with different TWT Channel values. Please clarify how ROMI and TWT Channel signaling interact.	2017/1/9 9:42
5967	Jarkko Kneckt	225	1 27.7.2	180	51	T	N	180.51 27.7.2	It is not clear what mechanisms are included to the "NAV protection mechanism"; required by the protection field of the TWT.	Please clarify whether a transmission of a data frame with non-zero Duration field as the first frame in the TXOP belongs to the NAV protection mechanisms required by the Protection field?	2017/1/9 9:42
5968	Jarkko Kneckt	225	1 10.22.2.7	133	5	T	Y	133.05 10.22.2.7	It is unclear may there be just one Trigger frame or multiple trigger frames in a TXOP with TXOP Limit set to 0.	Please change to:"5) A basic trigger variant Trigger frame."	2017/1/9 9:42
5969	Jarkko Kneckt	225	1 10.22.2.8	132	64	T	Y	132.64 10.22.2.8	Please clarify can an HE MU PPDU contain a Trigger frame or UL MU Response scheduling HE Variant HT Control field to allocate resources for UL MU acknowledgements transmission.	Please add clarification are Trigger frames or UL MU response scheduling A-Control fields to solicit UL BAs allowed in HE MU DL PPDUs when the TXOPLimit is 0.	2017/1/9 9:42
5970	Jarkko Kneckt	225	1 10.43.1	137	56	T	Y	137.56 10.43.1	Table 9-262k in p.71, line 19 defines operation TWT Grouping. The TWT grouping response frame is not included to the Table 10-19a. Please add guidance for handling TWT Grouping response frame to the table 10-19a.	Please clarify how TWT Grouping Response frame is interpretted by the HE STAs. Alternatively, please define that the TWT Grouping Response frame is not used in 802.11ax.	2017/1/9 9:42
5971	Jarkko Kneckt	225	1 11.2.2.6	141	58	T	Y	141.58 11.2.2.6	It is unclear can an HE non-AP STA operate in both U-APSD and TWT at the same time.	The TWT power save mechanism is superior to U-APSD power save. For instance, scheduling support and faster service period termination make TWT better. If TWT is supported by the AP and the non-AP STA, the STA shall operate only in TWT mode.	2017/1/9 9:42
5972	Jarkko Kneckt	225	1 11.2.2.6	141	62	T	Y	141.62 11.2.2.6	An HE AP should be allowed to transmit Multi-TID A-MPDU containing BUs from multiple ACs as a response to the PS-Poll frame.	Please allow an HE AP to transmit frames from multiple AC as a response to the PS-Poll frame from HE non-AP STA.	2017/1/9 9:42
5973	Jarkko Kneckt	225	1 11.2.2.17	143	48	T	Y	143.48 11.2.2.17	Currently the Check Beacon field is updated when the Broadcast TWT element is added or removed from Beacon. To avoid Beacon bloat, the Broadcast TWT element should not be present in every beacon frame, but then the Check Beacon field may request that non-AP STAs receive the Beacon unnecesserily which may increase the non-AP STA power consumption. It would be better to update the Check Beacon field when information in Broadcast TWT element is modified. Also some description should be added that TWT element may not be present in every beacon.	Change the n) Inclusion of a Broadcast TWT element to n) Modification of a Broadcast TWT element. Also please add a note saying that Broadcast TWT element may not be present in every Beacon frame and modified TWT broadcast element means a change in the parameter value.	2017/1/9 9:42
5974	Jarkko Kneckt	225	1 11.49.1	144	30	E	N	144.30 11.49.1	New subclause 11.49 HE BSS operation does not specify HE BSS operating rules. Also the name of the clause 11.49.1 AID assign rule is misleading. First thoughts of the content of the clause are how to allocate or assign AID to new STA in the association.	Find more suitable title and location in the specification to describe how the HE STA may use spatial reuse with VHT PPDU transmissions.	2017/1/9 9:42
5975	Jarkko Kneckt	225	1 11.49.1	144	32	T	Y	144.32 11.49.1	Where is the Partial BSS Color field? Please provide the name of the frame and other details.	Please clarify where is the Partial BSS Color field.	2017/1/9 9:42
5976	Jarkko Kneckt	225	1 11.49.1	144	34	T	Y	144.34 11.49.1	The alllocated AID (5:8) and the use of the field is not described.	Please clarify how the AID field is being used and what is happening in the clause. Also please specify how a STA should use the information in the clause.	2017/1/9 9:42
5977	Jarkko Kneckt	225	1 27.3.3.2	153	47	E	N	153.47 27.3.3.2	The S-MPDU is not defined in abreviations.	Add to clause 3.4 an abbereviation and acronym for the S-MPDU.	2017/1/9 9:42

5978	Jarkko Kneckt	225	1 27.3.3.2	154	1	E	N	154.01 27.3.3.2	The name of the clause 10.13.8 is incorrect. 802.11mc D8.0 has a title 10.13.8 Transport of VHT single MPDUs	Please correct the name of the clause.	2017/1/9 9:42
5979	Jarkko Kneckt	225	1 27.4.2	158	31	E	N	158.31 27.4.2	There seems to be additional only word	Please delete the word only in the line 31.	2017/1/9 9:42
5980	Jarkko Kneckt	225	1 27.5.1.3	163	43	T	Y	163.43 27.5.1.3	It is unclear whether BQRP Trigger variant that allocates RUs for random access requires that a HE trigger-based PPDU transmitted in the RU for random access contains a BQR information in the A-Control field.	Please clarify is a STA that detects RUs for random access required to transmit BQR reports in a Trigger-based PPDU in a RU allocated for random access. Please clarify is the same requirement used for other Trigger variants as well?	2017/1/9 9:42
5981	Jarkko Kneckt	225	1 27.5.1.3	163	43	T	Y	163.43 27.5.1.3	The non-AP STA should not be forced to perform random access. The use of random access for the BQR transmission should be voluntary for the STAs. If all STAs are required to transmit BQR in random access when a Trigger contains random access RUs, the power consumption of hte STA increases unnecessarily and transmisison overhead in random access becomes high.	The non-AP STAs transmission in the Rus allocated for random access should be optional. Change the wording to say that if RUs for random access are included a non-AP STA may respond...	2017/1/9 9:42
5982	Jarkko Kneckt	225	1 27.5.1.3	163	47	T	N	163.47 27.5.1.3	The BQR support in AP and STA is already described in lines 35 -39. The second bullet has a lot of repetition.	delete the end of hte sentence. Delete:"when the AP has indicated...".	2017/1/9 9:42
5983	Jarkko Kneckt	225	1 27.5.2.2.1	164	63	T	Y	164.63 27.5.2.2.1	The standard should not encourage to put more than one Trigger frame to the A-MPDU, because multiple Trigger generate overhead and the Trigger frames will be located right after each other.	Change may to should not. Change the text to read:" More than one Trigger frame should not be aggregated..."	2017/1/9 9:42
5984	Jarkko Kneckt	225	1 27.5.2.2.3	167	34	E	N	167.34 27.5.2.2.3	Sentences in line 34 and 38 are the related to the Trigger frame transmission rules and should be discussed in the same chapter.	Please delete the sentence in line 38 - 39 and change the sentence in line 34: "An AP may use any AC for sending a PPDU that contains only Trigger frames and follows the rules defined in 10.22.2 (HCF contention based channel access(EDCA)) for obtaining and sharing the TXOP."	2017/1/9 9:42
5985	Jarkko Kneckt	225	1 27.5.2.3	167	53	E	N	167.53 27.5.2.3	Missing :	Add : to the end of the line.	2017/1/9 9:42
5986	Jarkko Kneckt	225	1 27.5.2.3	167	53	T	Y	167.53 27.5.2.3	An HE Trigger-based PPDU may be transmitted as a response to UL OFDMA based random access. The UL OFDMA random access should be referred in the clause 27.5.2.3 to include description of all mechanisms to send HE Trigger-based PPDU.	Add a reference to UL OFDMA random access as one possibility to send HE Triggered PPDU.	2017/1/9 9:42
5987	Jarkko Kneckt	225	1 27.5.2.3	169	61	E	N	169.61 27.5.2.3	The clause is not listing all Trigger types. Please add BQR response and reference.	Add reference to BQR and GCR variant MU-BAR response generation.	2017/1/9 9:42
5988	Jarkko Kneckt	225	1 27.5.2.3	169	61	T	Y	169.61 27.5.2.3	QoS Data or QoS Null frame may be used as a response to BSRP and BQR. Currenly only QoS Null is listed.	Add QoS Data as one response frame.	2017/1/9 9:42
5989	Jarkko Kneckt	225	1 27.5.2.3	170	1	T	Y	170.01 27.5.2.3	The required frame type should be specified for the Basic Trigger frame.	Change the text to read: " ... and the STA does not have a data or management frame to transmit, the STA shall..."	2017/1/9 9:42
5990	Jarkko Kneckt	225	1 27.5.2.4	170	22	E	N	170.22 27.5.2.4	The reference should be done to clause directly.	Change the sentence to read:" ED-based CCA for UL MU CS follows the procedure defined in 21.3.18.5.2 (CCA sensitivity for opearation classes requiring CCA-ED)...	2017/1/9 9:42
5991	Jarkko Kneckt	225	1 27.5.2.4	170	29	E	N	170.29 27.5.2.4	The text should discuss on the value of the Length field	change: " ... and the value of the Length..."	2017/1/9 9:42
5992	Jarkko Kneckt	225	1 27.5.2.4	170	32	T	Y	170.32 27.5.2.4	The current conditions are not in the most simple format. The most important issue for the UL MU CS is when the CS indicates idle. Also the conditions when one or two NAVs are being used are not confusing.	The virtual CS indicates idle, if: - the response generated by the STA contains an ACK frame or a BlockAck frame and the value of the Length subfield in the Common Info field of the TRigger frame is less than or equal to 418 - if one NAV is considered, the NAV was set by an intra-BSS frame, - if two NAVs are considered, the duration of the basic NAV is zero.	2017/1/9 9:42

5993	Jarkko Kneckt	225	1 27.5.2.4	170	43	E	Y	170.43 27.5.2.4	Text is long and complicated to understand. A single clause is referred multiple times. The use of acronyms is not consistent. The ED-CCA use is described in more details, Virtual CS use is not included to text.	Change to:" If the CS required subfield in a Trigger frame is set to 1, the STA may transmit an HE trigger-based PPDU when Virtual CS is idle and the CCA-ED indicates idle for each 20 MHz channels containing the allocated RUs for SIFS duration after receiving the PPDU that contains the Trigger frame.	2017/1/9 9:42
5994	Jarkko Kneckt	225	1 27.5.2.4	170	56	E	N	170.56 27.5.2.4	The busy/idle state of medium should be written more clearly.	Change to:" ...trigger-based PPDU even if the Virtual CS or CCA-ED of the 20 MHz channels containing RUs indicate busy".	2017/1/9 9:42
5995	Jarkko Kneckt	225	1 27.5.2.5	171	26	T	Y	171.26 27.5.2.5	The non-AP STA could benefit, if it could indicate its Buffer status report for all TIDs that it has buffered traffic. An exception to the Multi-TID aggregation rules could be made to allow QoS Null frames that are not acknowledged addition to any Multi-TID aggregated A-MPDU	Please allow non-AP STA to aggregate QoS Null frames that do not require ACK from any TID to A-MPDU to be able to indicate buffer status report for all TIDs that the non-AP STA has buffered traffic.	2017/1/9 9:42
5996	Jarkko Kneckt	225	1 27.5.2.5	171	44	T	N	171.44 27.5.2.5	The unsolicited BSR should be allowed to transmit as a response to all Trigger variants, except MU-RTS.	Change to: " Note 1-The STA can send an unsolicited BSR is a response to all variants of the Trigger frame, except MU-RTS variant...	2017/1/9 9:42
5997	Jarkko Kneckt	225	1 27.5.2.5	172	19	T	N	172.19 27.5.2.5	Aggregating the BSR control frame with data, control and management frame is unlikely. It is more likely that BSR control frame is aggregated with control, data OR management frame.	Change to:" aggregated with control, data or management frames..."	2017/1/9 9:42
5998	Jarkko Kneckt	225	1 27.5.2.5	172	20	T	Y	172.20 27.5.2.5	Unclear statements that may be interpretted differently resulting to interoperability problems.	Please clarify what is meant with "asks for acknowledgement" and "has high priority to be transmitted".	2017/1/9 9:42
5999	Jarkko Kneckt	225	1 27.5.2.6.1	172	34	T	Y	172.34 27.5.2.6.1	Currently every STA in proximity may perform UL OFDMA random access in every RU for UL OFDMA random access. The AP should be able to indicate that only associated STAs are allowed transmit in the random access RU. This ensures that the associated STAs are able to use UL OFDMA random access to transmit buffer status reports which reduces data transmission latency.	Please, allocate new AID value, for instance 1, to dedicate the UL OFDMA random access RU only for the associated non-AP STAs.	2017/1/9 9:42
6000	Jarkko Kneckt	225	1 27.5.2.6.1	172	35	T	Y	172.35 27.5.2.6.1	27.5.2.6.1 states that only basic variant or BSRP variant trigger may contain random access opportunities. 27.5.1.3 has a contradiction stating that BQR variant Trigger may include Rus for random access. The random access should be possible for all Trigger variants except MU-RTS.	Delete the sentence in lines 35 and 36 and add the following sentence:" One or more RUs for UL OFDMA random access may be included to all trigger frame variants, except to MU-RTS variant."	2017/1/9 9:42
6001	Jarkko Kneckt	225	1 9.3.3.6	53	36	T	Y	53.36 9.3.3.6	The RAPS information (OCWMIn and OCWMAx) should be present in the (re)association response. This allows the UL OFDMA random access immediately after the association.	Please add the RAPS information part of the HE Operation parameters, or add the RAPS element to the Association Response frame body.	2017/1/9 9:42
6002	Jarkko Kneckt	225	1 6.3.3.3.2	11	42	T	Y	11.42 6.3.3.3.2	The RAPS information should be returned in BSSDescription table of the MLME-SCAN.confirm.	Please add the RAPS information part of the HE Operation parameters, or add the RAPS element to the BSSDescription table.	2017/1/9 9:42
6003	Jarkko Kneckt	225	1 9.3.3.8	54	31	T	Y	54.31 9.3.3.8	The RAPS information (OCWMIn and OCWMAx) should be present in the (re)association response. This allows the UL OFDMA random access use	Please add the RAPS information part of the HE Operation parameters, or add the RAPS element to the Re-Association Response fare body.	2017/1/9 9:42
6004	Jarkko Kneckt	225	1 27.5.6.1	172	39	T	Y	172.39 27.5.6.1	The RAPS element should be included to association and reassociation response frames	Please allow the RAPS element to be part of the (re) assocation response frame.	2017/1/9 9:42
6005	Jarkko Kneckt	225	1 27.5.2.6.2	173	30	T	Y	173.30 27.5.2.6.2	The OCWmin value use for UL MU OFDMA random access is not clearly defined. Is the OCW set to OCWMin value everytime a new OCWMin value is obtained by the STA?	Please clarify does a reception of new OCWMin value set the OCW value to OCWMin.	2017/1/9 9:42
6006	Jarkko Kneckt	225	1 27.5.2.6.3	174	9	T	Y	174.09 27.5.2.6.3	The PPDU itself cannot fail. The reception of the PPDU or the reception of the immediate response may fail.	Clarify what is failed. Does the reception of the HE Trigger-based PPDU fail or does the immediate response fail?	2017/1/9 9:42

6007 Jarkko Kneckt	225	1 27.5.2.6.3	174	15	T	Y	174.15 27.5.2.6.3	The OCW value should be updated for each failed transmission, not only if a frame is retransmitted. Currently it is not clear how OCW is handled if the STA transmits a new frame.	Change the text:" If a response to a HE Trigger-based PPDU transmitted in random RU requiring immediate response is not received, the STA shall update its OCW to 2 X OCW +1, until the the OCW reaches value of OCWmax.	2017/1/9 9:42
6008 Jarkko Kneckt	225	1 27.5.2.6.3	174	24	T	Y	174.24 27.5.2.6.3	The clause 27.5.2.7 seems relate to the clause 27.6. The clause 27.5.2.7 is unclear and difficult to understand.	Please merge clause 27.5.2.6.3 with the clause 27.6 and delete the clause 27.5.2.7.	2017/1/9 9:42
6009 Jarkko Kneckt	225	1 27.5.3	174	32	T	Y	174.32 27.5.3	The sentence:" A TXOP can include both ..." is confusing. The cascading operation is described more clearly starting form line 34.	Delete the sentence in the line 32.	2017/1/9 9:42
6010 Jarkko Kneckt	225	1 27.6.2	176	50	T	Y	176.50 27.6.2	The Operating Mode Notification frame and the Operating Mode Indication subfield control the value of the RX NSS parameter. i.e. a non-AP STA does not have two separate RX NSS parameters as described in the current text. The last received Operating Mode Notification frame or Operating Mode Indication subfield defines the value of the RX NSS parameter.	Combine the bullets in line 50 and 57 into a single bullet. There is only a single RX NSS value.The Operating Mode Notification frame or the Operating Mode Indication HE Variant of the HT Control field that is received most recently defines the value of the RX NSS field.	2017/1/9 9:42
6011 Jarkko Kneckt	225	1 27.6.2	177	44	T	Y	177.44 27.6.2	The figure 27-3 colors are very interesting. Why there are red and blue box? What does green and yellow color indicate? Why some text is in red and other in black?	Please simplify the figure and unify its colors. Please provide legend for the colors.	2017/1/9 9:42
6012 Jarkko Kneckt	225	1 27.6.2	178	5	T	Y	178.05 27.6.2	The figure 27-4 colors are interesting. Why HE is in red? There could be just one Trigger and response that is repeated 1 ... N times. Please consider changing the green color to no color.	Please simplify the figure and unify its color coding and provide legend for the colors.	2017/1/9 9:42
6013 Jarkko Kneckt	225	1 27.8.3	189	39	T	Y	189.39 27.8.3	The NOTE is currently unclear. The NOTE sounds like a STA with UL MU Disable would respond to some Trigger frame variants.	Change the Note :"... that it will not respond to any variant of the Trigger frame."	2017/1/9 9:42
6014 Jarkko Kneckt	225	1 27.8.3	189	45	E	N	189.45 27.8.3	The TOMI description has repetition. The lines 26 - 27 and lines 45 - 46 define the maximum number of TX NSS a STA may use.	Delete the lines 45-46, because they repeat the message of the lines 26-27.	2017/1/9 9:42
6015 Jarkko Kneckt	225	1 27.8.3	189	48	T	Y	189.48 27.8.3	The TOMI description has repetition. The lines 29 -30 and lines 48 - 49 define the maximum channel width a STA may use.	Delete the lines 48 - 49, and change the note in line 29-30 to normative text.	2017/1/9 9:42
6016 Jarkko Kneckt	225	1 27.8.3	189	52	T	Y	189.52 27.8.3	The OMI information should be received from the OMI Initiator, not received by the OMI initiator.	Change the sentence in line 52 to read:"... of spatial streams that is indicated in the TX NSS subfield of the OMI A-Control field that is last received from the OMI initiator.	2017/1/9 9:42
6017 Jarkko Kneckt	225	1 27.8.3	189	54	T	Y	189.54 27.8.3	The Channel Width subfield of the ROMI should be allocated from the primary channel, not from other channels. The Current wording in TOMI field limits the maximum RU Bandwidth, but does not ensure that the indicated RU Bandwidth is in the primary channel.	Add to the end of the sentence in the line 57:" and allocated in the primary channel. "	2017/1/9 9:42
6018 Jarkko Kneckt	225	1 27.9.1	190	7	T	Y	190.07 27.9.1	It is unclear how the spatial reuse improves power saving? The spatial reuse may improve the transmission latency and system throughput in dense deployments. Perhaps as outcome of improved latency and throughput, the non-AP STA power efficiency is improved.	Please clarify how spatial reuse Improves non-AP STA power efficiency.	2017/1/9 9:42
6019 Jarkko Kneckt	225	1 27.9.1	190	11	E	N	190.11 27.9.1	There is unclear reference.	Please change the reference to 27.9.2.	2017/1/9 9:42
6020 Jarkko Kneckt	225	1 27.9.1	190	10	T	Y	190.10 27.9.1	The SR PPDU is not defined. The following clauses do not use the term SR PPDU so the general introduction and the actual description text do not match.	Clarify the general spatial reuse operation. specify the term SR PPDU if ti is used by spatial reuse definition or delete the term.	2017/1/9 9:42
6021 Jarkko Kneckt	225	1 27.9.2.1	190	36	T	Y	190.36 27.9.2.1	The sentence starting in line 36 seems to add a new condition that is not considered in the bulleted list in lines 23 -34. The new condition should be part of the bulleted list, not an exception to it.	Write the sentence as part of the bulleted list above.	2017/1/9 9:42

6022 Jarkko Kneckt	225	1 27.9.2.1	190	39	T	Y	190.39 27.9.2.1	The condition in the lines 39 - 42 is difficult to read. There seems to be first one condition then description what is done if the condition is fulfilled and then again some more conditions. Write first all conditions and then the performed operation, if the conditions are met.	Mnodify the sentence. Write all conditions first and then the operation if the conditions are fulfilled. Please ensure that all opeation alternatives are wirtten to the normative text.	2017/1/9 9:42
6023 Jarkko Kneckt	225	1 27.9.2.1	190	50	E	N	190.50 27.9.2.1	Missing title format, or unclear sentence.	Please delete the text in line 50	2017/1/9 9:42
6024 Jarkko Kneckt	225	1 27.9.2.1	190	59	T	Y	190.59 27.9.2.1	The lines 59 - 62 seems to relate to operation is allowed if the conditions in lines 20 - 34 are met. The statement in the lines 59 - 62 should be moved as next text after the conditions to ensure correct understanding of the operation.	Move the sentences in lines 59 - 62 to follow the conditions introduced in the lines 20 - 34.	2017/1/9 9:42
6025 Jarkko Kneckt	225	1 27.9.2.1	190	36	T	Y	190.36 27.9.2.1	The spatial reuse rules are not easy-to-understand. Is the reuse allowed only for the PPDU duration when HE MU PPDU is transmitted and in all other cases the channel may be considered as IDLE and there is no limitation of the duration when the spatial reuse may be performed?	Please clarify.	2017/1/9 9:42
6026 Jarkko Kneckt	225	1 27.9.2.1	190	26	T	Y	190.26 27.9.2.1	The use of the spatial reuse parameter in the RXVECTOR should be clarified or at least there should be a reference to its operation rules.	Please clarify how RXVECTOR parameter are used.	2017/1/9 9:42
6027 Jarkko Kneckt	225	1 27.9.2.1	190	19	T	Y	190.19 27.9.2.1	Can a PHY-CCA.indication indicate something else than BUSY followed by the RXSTART.indication? If the PHY-CCA Indication can have other value in this case, then it should be clarified how the STA operates in these situations. If the PHY-CCA cannot have other value, then the condition is not needed.	Please clarify the question in the comment.	2017/1/9 9:42
6028 Jarkko Kneckt	225	1 27.9.2.2	191	3	T	Y	191.03 27.9.2.2	What is system level performance?	Please clarify. Perhaps it relates to throughput, non-AP STA power consumption and latency.	2017/1/9 9:42
6029 Jarkko Kneckt	225	1 27.9.2.2	192	20	E	N	192.20 27.9.2.2	UL TB PPDU is not the correct name.	Please change to HE Trigger-based PPDU.	2017/1/9 9:42
6030 Jarkko Kneckt	225	1 27.10.4	194	35	T	Y	194.35 27.10.4	It would be beneficial to carry multi-TID A-MPDU in all SU PPDU types between HE STAs. Non-HE SU PPDUs have shorter preamble duration than HE SU PPDUs which may improve throughput.	Please allow A-MPDU Multi-TID aggregation to be transmitted in all SU PPDU types between HE STAs.	2017/1/9 9:42
6031 Jarkko Kneckt	225	1 27.10.4	195	20	T	Y	195.20 27.10.4	Can a Multi-TID A-MPDU be transmitted as a response to Trigger frame which type is other than Basic Variant Trigger frame?	Please clarify may Multi-TID A-MPDU be transmitted as a response to any Trigger frame variant, except MU-RTS.	2017/1/9 9:42
6032 Jarkko Kneckt	225	1 27.13	199	1	T	Y	199.01 27.13	The use of HE-MCS subfield in link adaptation is very loosely defined. It is not clear how the AP and the STA use the link adaptation information.	Please provide some more details how the link adaptation is used by the non-AP STA and the AP. Please describe how to recommended MFB should be used by the transmitter and the receiver. Especially it is interesting to know how non-AP STA can use link adaptation for Triggered transmissions.	2017/1/9 9:42
6033 Jarkko Kneckt	225	1 27.7.2	180	53	T	Y	180.53 27.7.2	The protection field of TWT parameters should be set to 0 in the Triggered and unannounced TWTs, because the AP should have flexibility to decide whether it desires to use NAV protection mechanism.	Please add a sentence:" The TWT Protection field shall be set to 0 in Triggered and unannounced TWTs."	2017/1/9 9:42
6034 Jarkko Kneckt	225	1 10.22.2.8	133	64	T	Y	133.64 10.22.2.8	Please clarify can any number of buffer status reports and all required bandwidth query reports be triggered in a TXOP with TXOPLimit value 0. In general it could be a good principle to allow transmission of any number of Trigger frames soliciting a specific response type transmission in an AC with TXOPLimit set to 0.	Please add clarification are Trigger frames to solicit buffer status reports and bandwidth query allowed in a TXOP with TXOPLimit set to value 0.	2017/1/9 9:42

6035	Jarkko Kneckt	225	1			T	Y		Currently all group addressed frames transmitted in the DL MU PPDU use AID value 0. The group addressed frames contain IP Multicast data and MAC level BSS discovery frames, like FILS discovery frames. The IP multicast data is typically encrypted and only used by the associated STAs. The discovery frames are used by the non-associated STAs that look for network for association. The discovery and data type of the group addressed frames should be transmitted under separate AID values to enable the non-AP STAs to select which frames they receive. fewer reception operations reduce power consumption. New AID value for discovery information allows more frequent discovery information transmissions without increasing the power consumption of the associated STAs. More frequent power consumption reduces scanning delays and scaning power consumption of the non-AP HE	Please allocate new AID value, for instance 1, to indicate RU allocation for broadcast discovery information transmission in HE DL MU PPDUs.		2017/1/9 9:42
6036	Jarkko Kneckt	225	1			T	Y		Currently, the AID may be allocated to a STA only in association. There should be a mechanims to allocate preassociation AID to be able to transmit MU DL PPDUs and HE Trigger-based PPDUs to preassociated STAs.	Please allow the AP to distribute preassociation AID in probe response frame or as part of the UL OFDMA based random access.		2017/1/9 9:42
6037	Jarkko Kneckt	225	1 27.14.2	199	53	E	N	199.53 27.14.2	The power save with UL OFDMA-based random access is related to broadcast TWT operations. The clause should be part of the clauses that define broadcast TWT operations.	Move the clause 27.14.1 as part of the Broadcast TWT clauses, for instance to new clause 27.7.3.5.		2017/1/9 9:42
6038	Jarkko Kneckt	225	1 27.14.2	200	5	T	Y	200.05 27.14.2	The Figure 27-7 is hard to understand. The trigger frame start time is shown to be long and the transmission of the Trigger frame is not started in the beginning of the trigger frame start time. There is a trigger frame that is transmitted before the TF Start time.	Please clarify the figure. The Trigger Frame start time does not look like correctly drawn to the figure.		2017/1/9 9:42
6039	Jarkko Kneckt	225	1 27.14.2	200	28	T	Y	200.28 27.14.2	The BC TWT Flow ID value 2 is used for TWTs that include random access RUs. Each TWT service period has a nominal minimum duration that defines the maximum time that STAs may transmit in the service period. The maximum duration of the TWT SP is not described in the UL OFDMA random access. Also EOSP and more data fields use in the TWT SP termination are not explained.	Please refer to the TWT SP termination rules in UL OFDMA random access. The TWT SP duration, EOSP and More Data fields should terminate the TWT SP for all power save mode STAs.		2017/1/9 9:42
6040	Jarkko Kneckt	225	1 27.14.2	200	35	T	N	200.35 27.14.2	If a non-AP STA in power save mode has transmitted during the UL OFDMA random access and the TWT SP initiated by the UL OFDMA random access has been terminated, the non-associated STA should have easy way to continue data exchange at the following TWT flows.	Please allow the non-associated STA to assign preassociation AID and to wake at the next TWT SP of the same TWT flow that it was used for the UL OFDMA random access. This ensures that AP knows when the non-associated STA is again available for the data transmission, allows the non-AP STA in power save mode to operate in Doze state and reduces contention during random access.		2017/1/9 9:42
6041	Jarkko Kneckt	225	1 27.14.3	200	37	E	N	200.37 27.14.3	The title of the opportunistic power save does not need to mention congested environment	Delete the congested environment from the title of the clause 27.14.3.		2017/1/9 9:42

6042	Jarkko Kneckt	225	1 27.14.2	200	30	T	Y	200.30 27.14.2	Currently the Cascade indication is used to indicate the end of the RU allocations for random access and that no more Trigger frames will be transmitted in the TWT SP. Two indications in the same field may complicate the TWT SP handling and random access termination. A trigger frame without RU allocated for the random access could indicate that there will not be more RUs allocated for the UL OFDMA random access in this TWT SP. This would allow different handling of the STAs that have already an AID and STAs that are performaning the random access. It is likely that first HE Triggered PPDUs are short and contain a many RUs for random access. At the end of the TWT SP there may be larger PPDUs that are used to exchagne data. If there is just the Cascade indication to control STAs availability, the STAs performing random access may need to be available unnecessarily.	Please allow STAs that are performing UL OFDMA random access return to Doze when a Trigger frame does not contain RU allocated for random access.	2017/1/9 9:42
6043	Jarkko Kneckt	225	1 27.14.2	200	30	T	Y	200.30 27.14.2	A Cascade Indication set to 0 indicates the last Trigger frame that contains UL OFDMA random access RUs. Clause 27.7.3.3 P185 L54 has a different logic for Cascade Indication handling: A non-AP STA may return to Doze, if the Trigger has Cascade Indication set to 0 and there is no RU allocated to the STA. The definition in P185 would allow a STA to continue TWE SP if it receives a Trigger with Cascade Indication set to 0 and has RUs allocated for the STA, in definition P200, the TWT SP will be terminated regardless of the allocated RUs.	Please unify the handling of the Cascade indications in TWT SPs. The TWT SP should be terminated if Cascade Indication has value 0 and there is no allocated Rus for the STA.	2017/1/9 9:42
6044	Jarkko Kneckt	225	1 27.7.3.2	184	1	T	Y	184.01 27.7.3.2	The opportunistic PS seems to suggest that any active mode non-AP STA is added to the opportunistic TWT SP, unless the FILS Discovery or TIM frame at the beginning of the opportunistic TWT SP indicate that the STA will not get service. In page 184L1 there is a contradicting statement.	Please modify the statement in the P184L1. The AP may include AID of the STA in power save mode only if it has established a membership to a broadcast TWT. The active mode STAs may be triggered at any time.	2017/1/9 9:42
6045	Jarkko Kneckt	225	1 27.14.3.2	201	15	T	Y	201.15 27.14.3.2	Please clarify that STAs in power save mode may establish a membership with opportunistic TWT if the power save mode STA desires to wake up at the beginning of the opportunistic TWT SP. Just to set a STA to Doze in opportunistic TWT SP does not need a membership establishment.	Please add a clarification that a non-AP STA should establish a BC TWT membership with opportunistic PS, if the non-AP STA desires to wake up at the beginning of the TWT SP.	2017/1/9 9:42
6046	Jarkko Kneckt	225	1 27.14.3.1	200	62	T	Y	200.62 27.14.3.1	The TIM, FILS Discovery and Beacon frame should contain two TIM elements for two different use: 1. for Opportunistic PS to indicate which STAs may get service 2. To indicate to STAs in power save mode DL Buffered traffic and which HE STAs should be available to receive and respond to a Trigger frame. Two TIM elements improve non-AP STA stand-by power save as well as opportunistic PS is available for the whole TXOP duration.	Please specify two TIM elements to Beacon, FILS Discovery and TIM frames. One TIM element is for opportunistic PS indicating will the AP Trigger the STA and the other TIM element is for stand-by PS indicating buffered DL traffic and whether the AP expects the STA to respond to the Trigger frame. If the AP does not expect the STA to respod to the Trigger, the STA may return immediately to Doze.	2017/1/9 9:42
6047	Jarkko Kneckt	225	1 27.16.3.2	207	22	E	N	207.22 27.16.3.2	The MLME primitives for QTP should be defined in the clause 6.3	Please introduce the QTP MLME primitives in clause 6.3	2017/1/9 9:42
6048	Jarkko Kneckt	225	1 27.16.3.3	208	18	T	N	208.18 27.16.3.3	If an HE AP has associated legacy non-AP STAs and the AP has established quiet period, then is the AP allowed to send data to the legacy STAs, or beacons during the quiet period.	Please clarify.	2017/1/9 9:42

6049	Jarkko Kneckt	225	1 9.4.2.200	73	3	T	N	73.03 9.4.2.200	How STAs that have established TWT Flow ID 1 or 2 transmit UL DATA? The recommendations do not allow UL data transmission.	Please allow UL and DL data frames transmission at the end of the TWT SP. Thus, the first part of the TWT may be used to exchange short signaling packets and the last part could be used for the data transmissions. Transmitting data in the same TWT SP simplifies the TWT handling.	2017/1/9 9:42
6050	Jarkko Kneckt	225	1 27.8.3	189	15	T	Y	189.15 27.8.3	The UL MU Disable field in transmit operation mode suspends the UL MU operations. When the UL MU operations are suspended the STA may only use EDCA to transmit data. In high congestion the TXOP obtaining with EDCA increases contention and adds transmission delays. The STA should be capable to use reverse direction grant to allow the non-AP STA to transmit UL. The use of RDG reduces contention in the channel, shortens the channel access delays and reduces the power consumption of the non-AP STA.	Please add UL MU operation mode to the transmission operation mode where the AP uses reverse direction grant to schedule UL transmission resources to the non-AP STA.	2017/1/9 9:42
6051	Jarkko Kneckt	225	1 9.4.2.200	69	17	T	Y	69.17 9.4.2.200	The Trigger field in the TWT currently controls whether the AP shall send a Trigger to a STA in TWT SP. The TWT should not force AP to send Trigger frames, the Triggering should be taken into use when EDCA is not performing well and AP should have flexibility to control this transition.	Delete the Trigger field in the Request Type field of the TWT element.	2017/1/9 9:42
6052	Jeongki Kim	225	1 27.14.1	199	21	T	Y	199.21 27.14.1	Intra-BSS PPDU Power saving is a micro sleep PS method based on the PPDU duration in order to minimize the STA's power consumption. In DL MU PPDU, if there is no its STA ID in STA list of SIG-B of Intra-PPDU, the STA can enter the Doze state. However, in DL MU PPDU, an A-MPDU for a STA can carry longer padding frames rather than other A-MPDUs. When the padding is very long, it's efficient for the STA to enter the Doze state during padding frames.	Add the operation mentioned in the comment into subclause 27.14.1	2017/1/9 9:42
6053	Jeongki Kim	225	1 27.14.2	200	31	T	Y	200.31 27.14.2	A Trigger frame can carry the trigger information for both scheduled STAs and OFDMA random access STAs. Although the trigger information for OFDMA random access STAs is included in some consecutive Trigger frames(not all) in a TXOP, random access STAs should be awake until receving the Trigger frame including Cascade indication set to 0. A Trigger frame for random access need to carry the information of whether random access RUs will be allocated in the next consecutive TFs in a TXOP or not	As mentioned in comment, add the related operation into subclause 27.14.2 and update the related fields in a Trigger frame	2017/1/9 9:42
6054	Jeongki Kim	225	1 27.9.2	190	15	T	Y	190.15 27.9.2	Currently, Spatial reuse is adopted for OBSS packets. In enterprise network, the SR considering ESS is more useful than considering BSS. As proposed in 947r18, AP should be able to send the BSSs list belonging to an ESS/a Group and in that case SR should be considered in the other BSSs except for the BSSs list sent by the AP	As proposed in 947r18, includes the BSSs list belonging to a ESS in a Beacon and add the related operation in the specs	2017/1/9 9:42

6055	Jeongki Kim	225	1 27.14.1	199	20	T	Y	199.20 27.14.1	BSS Color can be disabled by BSS Color Disabled subfield set to 1. In BSS Color Disabled case, Intra-PPDU PS based on BSS Color is disabled. In subclause 27.14.1, the related text needs to be updated as follows.	Change the related text as follows. -- The PPDU is an HE MU PPDU where the RXVECTOR parameter BSS_COLOR is the BSS color of the BSS with which the STA is associated, the RXVECTOR parameter UL_FLAG is 0, and the RXVECTOR parameter STA_ID_LIST does not include the identifier of the STA or the broadcast identifier(s) intended for the STA and the most recently received HE Operation element from the AP to which it is associated contained a value of 0 in the BSS Color Disabled subfield. -- The PPDU is an HE MU PPDU, HE SU PPDU or HE extended range SU PPDU and one of the following conditions are true: * The RXVECTOR parameter BSS_COLOR is the BSS color of the BSS with which the STA is	2017/1/9 9:42
6056	Jeongki Kim	225	1 27.2.2	151	12	T	Y	151.12 27.2.2	When BSS Color is diabled, the STA should not update its Intra-BSS NAV with the TXOP_DURATION of the received Intra-BSS PPDU. In subclause 27.2.2, the related texts should be updated.	Change the related text in 27.2.2 as follows: -- The PPDU that carried information of the RXVECTOR parameter is identified as intra-BSS according to the rule described in 27.2.1 (Intra-BSS and inter-BSS frame detection) and the most recently received HE Operation element from the AP to which it is associated contained a value of 0 in the BSS Color Disabled subfield	2017/1/9 9:42
6057	Jeongki Kim	225	1 10.3.2.3.7	114	32	T	Y	114.32 10.3.2.3.7	When BSS Color is diabled, EIFS can be invoked if BSS Color is disabled although a valid TXOP_DURARION is present in the received Intra-BSS PPDU because Intra-BSS NAV is not updated by TXOP_DURATION. Therefore, the EIFS related text should be updated.	Change the related text in 10.3.2.3.7 as follows: EIFS shall not be invoked if a valid TXOP_DURATION parameter is present in the RXVECTOR of a received HE PPDU and the most recently received HE Operation element from the AP to which it is associated contained a value of 0 in the BSS Color Disabled subfield	2017/1/9 9:42
6058	Jeongki Kim	225	1 27.2.1	150	16	T	Y	150.16 27.2.1	Group ID and Partial AID as well as BSS Color can be RXVECTOR paramters in VHT PPDUs.	Change the text as following: RXVECTOR parameters (e.g., BSS_COLOR in HE PPDUs or GROUP_ID and PARTIAL_AID in VHT PPDUs).	2017/1/9 9:42
6059	Jeongki Kim	225	1 27.2.1	149	51	T	Y	149.51 27.2.1	The second condition of Inter-BSS frame detection (i.e., BSSID field based detection) could be adopted for RXVECTOR parameter BSS_COLOR set to 0 as well as absence of BSS_COLOR.	Change as following: "When the RXVECTOR parameter BSS_COLOR of the PPDU carrying the frame is not present or 0,	2017/1/9 9:42
6060	Jeongki Kim	225	1 27.4.1	157	49	T	Y	157.49 27.4.1	The text need to be cleaned up or clarified. Change to: Multi-STA BlockAck frame	Changed to the following text: An HE STA that supports Multi-STA BlockAck frame shall examine each received Multi-STA BlockAck frame sent by an STA with which it has a BA agreement.	2017/1/9 9:42
6061	Jeongki Kim	225	1 9.3.1.23	45	26	T	Y	45.26 9.3.1.23	In legacy WLAN, AID range is 1~2007 and the size of STAID in HE-SIG B is 11. If there is no special reason of 12 bits AID (i.e., AID 12), then change AID 12(B0~B11) to AID 11 (B0~B10) and 1 reserved bit (B11)	As in comment	2017/1/9 9:42
6062	Jeongki Kim	225	1 9.4.2.219	91	39	T	Y	91.39 9.4.2.219	According to 27.11.4 BSS_COLOR, BSS Color (0) indicates that one or more intended recipient STAs is not a member of a transmitting STA's BSS. Therefore, the indicated paragraph (p91, l39) should be deleted.	Delete the following paragraph: "The BSS Color field is an unsigned integer whose value is the BSS color of the BSS corresponding to the AP which transmitted this element, except that a value of 0 in this field indicates that there is no BSS color for this BSS."	2017/1/9 9:42
6063	Jeongki Kim	225	1 9.4.2.218.2	79	22	T	Y	79.22 9.4.2.218.2	The function of the 'Group addressed Multi-STA BlockACK In DL MU Support ' subfield need to be defined. Define how the STA receives a group addressed Multi-STA BlockAck frame that is sent in a DL MU PPDU in a non-broadcast RU.	Define the method of sending a group addressed Multi-STA BlockACK in DL MU PPDU or clarify the 'Group addressed Multi-STA BlockACK in DL MU Support' subfield.	2017/1/9 9:42

6064 Jeongki Kim	225	1 10.9	127	38	E	Y	127.38 10.9	The paragraph of page 127, line 38~42 in 10.9 ('If the HT Control field is ....to the same value.') is the text in REVmcD8.0. The underline of the paragraph should be deleted.	Delete the underline in the paragraph of page 127, line 38~42 in 10.9 ('If the HT Control field is ....to the same value.')	2017/1/9 9:42
6065 Jeongki Kim	225	1 27.5.2.2.1	165	35	T	Y	165.35 27.5.2.2.1	Because the size of AID in User Info field is 12 bits, change the value of AID for padding from the 2047 to 4095.	Change the related text as follows: NOTE 1--TThe start of the Padding subfield is identified by a User Info field that has a value of the AID equal to 2047 4095, and the remaining subfields of the Padding field are set to 1.	2017/1/9 9:42
6066 Jeongki Kim	225	1 27.5.2.3	168	8	T	Y	168.08 27.5.2.3	TXOP_DURATION parameter setting rule is defined in 27.11.5 (TXOP_DURATION). Change the related text.	Change the related text as follows: The TXOP_DURATION parameter shall be set according the rules defined in 27.2.2 (Updating two NAVs) 27.11.5 (TXOP_DURATION)	2017/1/9 9:42
6067 Jeongki Kim	225	1 27.5.2.3	169	23	T	Y	169.23 27.5.2.3	TXOP_DURATION parameter setting rule is defined in 27.11.5 (TXOP_DURATION). Change the related text.	Change the related text as follows: The TXOP_DURATION parameter shall be set according the rules defined in 27.2.2 (Updating two NAVs) 27.11.5 (TXOP_DURATION)	2017/1/9 9:42
6068 Jeongki Kim	225	1 10.3.2.4	114	62	T	Y	114.62 10.3.2.4	The STA with one NAV should know if the NAV updated by TXOP_DURATION was set by Intra-PPDU or not before sending UL MU frame.	Insert the following theXt in 10.3.2.4: "When a STA updates its NAV with RXVECTOR parameter TXOP_DURATION, the STA shall save the RXVECTOR parameter BSS_COLOR".	2017/1/9 9:42
6069 Jeongki Kim	225	1 9.4.2.139	68	48	E	N	68.48 9.4.2.139	The indicated paragraph is modifed in the legacy spec (REVmc8.0). The modifications(i.e., underline for new text) should be present in the related paragraph. Change 'non-HE originator' to 'non-HE originator'. Change 'non-HE recipient' to 'non-HE recipient'.	Change 'non-HE originator' to 'non-HE originator'. Change 'non-HE recipient' to 'non-HE recipient'.	2017/1/9 9:42
6070 Jian Yu	225	1	7	1	G	Y	7.01	A lot of abbrevations are missing, for example: BSR, BQR etc.	Add the missing abbreviations	2017/1/9 9:42
6071 Jian Yu	225	1	9	43	T	Y	9.43	Optional support for 1024-QAM on 242-, 484- and 996-tone RUs seems to be part of Optional support for HE-MCSs 10 and 11	Delete line 43	2017/1/9 9:42
6072 Jian Yu	225	1	23	60	E	Y	23.60	the number of OFDM symbols the Data field: should be the number of OFDM symbols in the Data field	Add in	2017/1/9 9:42
6073 Jian Yu	225	1	31	27	E	Y	31.27	Dulicate index	Delete duplicate index i) and ii)	2017/1/9 9:42
6074 Jian Yu	225	1	83	19	T	Y	83.19	1x LTF and 1.6us GI for HE Trigger based PPDU is CM and no need to have B15	Delete B15	2017/1/9 9:42
6075 Jian Yu	225	1	37	51	T	Y	37.51	It is better to use AID11 instead of AID	AID11 instead of AID	2017/1/9 9:42
6076 Jian Yu	225	1	38	4	T	Y	38.04	The NOTE should be incorprated into Table 9-24b or inline instead of a NOTE.	As in comment	2017/1/9 9:42
6077 Jian Yu	225	1	40	6	T	Y	40.06	Same type and subtype	Add and Subtype after Type	2017/1/9 9:42
6078 Jian Yu	225	1	41	28	T	Y	41.28	Prevent a VHT from wrongly determinining it's AID in the VHT STA info. Should be VHT, not HE	Change to VHT from HE	2017/1/9 9:42
6079 Jian Yu	225	1	41	47	T	Y	41.47	Delete the bracket of RA	As in comment	2017/1/9 9:42
6080 Jian Yu	225	1	41	7	E	Y	41.07	Add an space between GIAND	As in comment	2017/1/9 9:42
6081 Jian Yu	225	1	42	48	T	Y	42.48	Like BA and GCR BA, MU-BAR and GCR MU-BAR can be combined into one type of trigger frame and further differentiate by BAR control. This will help to save space for other types of trigger frame.	As in comment	2017/1/9 9:42
6082 Jian Yu	225	1	44	23	T	Y	44.23	For OFDMA PPDUs, the number of HE-LTFs should be greater or equal to the maximum across RUs of the Number of HE-LTFs as defined in Table 22-13. For example, if the maximum STS is 7, the number of HE-LTF cannot be 7, but should be 8.	As in comment	2017/1/9 9:42
6083 Jian Yu	225	1	44	56	T	Y	44.56	Pre-FEC Padding Factor (2bits) and PE disambiguity (1bit) as in HE-SIG-A field should refer to the HE-SIG-A as a reference	As in comment	2017/1/9 9:42
6084 Jian Yu	225	1	45	11	T	Y	45.11	The doppler mode of transmission is not clear	Define doppler mode	2017/1/9 9:42
6085 Jian Yu	225	1	47	51	E	Y	47.51	Add a comma between PPDU and the	As in comment	2017/1/9 9:42
6086 Jian Yu	225	1	50	28	T	Y	50.28	Delete NOTE--	As in comment	2017/1/9 9:42

6087	Jian Yu	225	1	57	60	E	Y	57.60	"And" should be "and", also need to search for other "And"	As in comment	2017/1/9 9:42
6088	Jian Yu	225	1	68	56	T	Y	68.56	Level 3 is missing here	Add level 3 description, may refer to Table 9-262z	2017/1/9 9:42
6089	Jian Yu	225	1	74	52	T	Y	74.52	The ax draft contains description for 11ah draft without an clarification. For example, there is description for channel width of 1MHz and 2MHz for a BSS, whch seems very strange	Refine the whole paragraph and clarify which part is for ax and which part is for ah. Maybe should also add ah spec as a reference	2017/1/9 9:42
6090	Jian Yu	225	1	78	27	T	Y	78.27	HE Link Adaptation detail is missing, the capable bits come out of nowhere	Add the detail of HE lnk adaptation and modify the capable field according to the detail	2017/1/9 9:42
6091	Jian Yu	225	1	79	42	T	Y	79.42	Maximum AMPDU Length Exponent description is missing	Add the detail description	2017/1/9 9:42
6092	Jian Yu	225	1	91	39	T	Y	91.39	Duplicate description of the BSS color field	Delete the pragraph from Line 39 to 42	2017/1/9 9:42
6093	Jian Yu	225	1	93	51	T	Y	93.51	EOCWmin is an abbreviation of what? Should add the full name of EOCW	As in comment	2017/1/9 9:42
6094	Jian Yu	225	1	107	1	T	Y	107.01	The first line should also include HE PPDU, i.e., VHT or HE PPDU, same for Line 14	Add "or HE" between VHT and PPDU	2017/1/9 9:42
6095	Jian Yu	225	1	120	7	E	Y	120.07	Add a space before Specially	As in comment	2017/1/9 9:42
6096	Jian Yu	225	1	159	16	E	Y	159.16	Delete either	As in comment	2017/1/9 9:42
6097	Jian Yu	225	1	162	26	E	Y	162.26	A HE AP should be an HE AP	Modify as in comment, and also delete the period before.	2017/1/9 9:42
6098	Jian Yu	225	1	162	27	T	Y	162.27	Duplicated RU	Delete RU in the bracket	2017/1/9 9:42
6099	Jian Yu	225	1	162	56	T	Y	162.56	DL OFDMA with MIMO PPDU is not clear. DL OFDMA with MIMO support field is not shown in the HE Capabilities element. There is only DL MUMIMO On Partial Bandwidth field	Modify the paragraph accordingly	2017/1/9 9:42
6100	Jian Yu	225	1	164	46	E	Y	164.46	Duplicated period	Delete one of the two	2017/1/9 9:42
6101	Jian Yu	225	1	167	59	T	Y	167.59	Define TBD	As in comment	2017/1/9 9:42
6102	Jian Yu	225	1	168	46	E	Y	168.46	Duplicated "shall be set to"	Delete one of the two	2017/1/9 9:42
6103	Jian Yu	225	1	174	24	T	Y	174.24	NDP feedback report procedure lacks details	Add the details	2017/1/9 9:42
6104	Jian Yu	225	1	176	1	T	Y	176.01	A mechnasim to allow an AP to obtain UL CSI and do UL schedulign is missing.	Add the details, will bring a proposal	2017/1/9 9:42
6105	Jian Yu	225	1	137	42	T	Y	137.42	TWT Setup/Teardown frames are S1G category action frame and should be clarified that 802.11ax uses the same frames or some other frames.	As in comment	2017/1/9 9:42
6106	Jian Yu	225	1	172	23	T	Y	172.23	An emergency service mechanism should be introduced in UL OFDMA based random access procedure to further prioritize he emergency traffic	Add the details, will bring a proposal	2017/1/9 9:42
6107	Jian Yu	225	1	198	61	T	Y	198.61	Link adaptation using the HE variant HT Control field part lacks details	Add the details	2017/1/9 9:42
6108	Jian Yu	225	1	200	5	T	Y	200.05	Replace the figure with a high resolution one	As in comment	2017/1/9 9:42
6109	Jian Yu	225	1	211	26	E	Y	211.26	Use DL/UL instead of downlink and uplink	As in comment	2017/1/9 9:42
6110	Jian Yu	225	1	211	13	T	Y	211.13	DL OFDMA in the bracket doesn't truly reflect the previous sentence. It should be DL OFDMA without MU MIMO. DL MU MIMMO should be DL MU MIMO without OFDMA. It is better to have somewhere to define what is DL/UL OFDMA, DL/UL MU-MIMO, DL/UL MU MIMO with OFDMA.	As in comment	2017/1/9 9:42
6111	Jian Yu	225	1	220	13	T	Y	220.13	OFDMA MU PPDU is not clear.	Define OFDMA MU PPDU or replace with a more clear terminology, say, non-full BW MU PPDU, or HE MU PPDU using OFDMA transmission as on page 230	2017/1/9 9:42
6112	Jian Yu	225	1	238	58	E	Y	238.58	SIGB should be SIG-B	Modify across all the draft	2017/1/9 9:42
6113	Jian Yu	225	1	242	22	T	Y	242.22	Add HE-SIG-A-R before HE-SIG-B as in L27	As in comment	2017/1/9 9:42
6114	Jian Yu	225	1	249	40	T	Y	249.40	Power boosting should be reflected in the encoding process	As in comment	2017/1/9 9:42
6115	Jian Yu	225	1	274	6	T	Y	274.06	Further develop the spatial reuse field, same for page 274, L6 and page 276 L40	As in comment	2017/1/9 9:42
6116	Jian Yu	225	1	285	5	T	Y	285.05	Replace the figure with a high resolution one	As in comment	2017/1/9 9:42
6117	Jian Yu	225	1	286	5	T	Y	286.05	Replace the figure with a high resolution one	As in comment	2017/1/9 9:42
6118	Jian Yu	225	1	293	8	T	Y	293.08	y2y1y0 applies to not only 106-RU case	Add clarification	2017/1/9 9:42
6119	Jian Yu	225	1	301	64	T	Y	301.64	Add 4X HE-LTF and 0.8us GI as an optional mode	As in comment	2017/1/9 9:42
6120	Jian Yu	225	1	317	14	T	Y	317.14	B7-B15 can be used to indicate the length of a S-MPDU, so that the overhead caused by the delimtier can be 0.	As in comment and will bring a proposal	2017/1/9 9:42

6121	Jian Yu	225	1	282	51	T	Y	282.51	"L = 20" should be "L = 41 for the HE-SIG-B User Block field that contains information for two STAs, L=20 when the last User Block field contains information for one STA."	Modify as in comment	2017/1/9 9:42
6122	Jianhan Liu	225	1 Annex B		34	E	N	Annex B	In Annnex B, "HEW" should be chaned to "HE"	Change "HEW" to "HE"	2017/1/9 9:42
6123	Jianhan Liu	225	1 28.3.10.7.2	275	35	T	N	275.35 28.3.10.7.2	In "Table 28-16--HE-SIG-A field of an HE SU PPDU and HE extended range SU PPDU", B15 is defined as Doppler bit to indicate if Dopploer mode is applied. However, Doppler mode is not clearly defined.	Define the "Doppler Mode" in detail	2017/1/9 9:42
6124	Jianhan Liu	225	1 9.3.1.23	43	43	T	N	43.43 9.3.1.23	In "Table 9-25c--GI And LTF Type subfield encoding" includes option of 2x LTF+0.8us GI. Since the trigger-based PPDU has timing synchronizaion requirement of +/- 0.4 us, 0.8us GI is too short.	Remove the option 2x LTF + 0.8 ++s GI	2017/1/9 9:42
6125	Jianhan Liu	225	1 28.3.17.6.4	349	7	T	N	349.07 28.3.17.6.4	add the CCA rule for preamble puncturing	add the CCA rule for preamble puncturing	2017/1/9 9:42
6126	Jianhan Liu	225	1 28.2.2	221	18	E	N	221.18 28.2.2	change "channel bonding" to "preamble puncturing"	change "channel bonding" to "preamble puncturing"	2017/1/9 9:42
6127	Jing Ma	225	1	86	18	G	Y	86.18	Clarify SRP-based SR operation described here which is supposed to indicated by this subfield. SRP-based SR operation description is not clear in the draft.	as the comment	2017/1/9 9:42
6128	Jing Ma	225	1	99	12	G	N	99.12	Define the exact L3 FRAG ADDBA Request frame action field format	as the comment	2017/1/9 9:42
6129	Jing Ma	225	1	99	16	G	N	99.16	Define the exact L3 FRAG ADDBA Response frame action field format	as the comment	2017/1/9 9:42
6130	Jing Ma	225	1	99	18	G	N	99.18	Define the exact L3 FRAG ADDBA Response frame action field format	as the comment	2017/1/9 9:42
6131	Jing Ma	225	1	153	47	E	N	153.47	Clarify the definition of S-MPDU in the draft to avoid confusion. There is another description "sub frames of A-MPDU" in the draft. Does S-MPDU mean sub frame of A-MPDU?	Make the descriptions consistent or clarify the definition and describe the difference	2017/1/9 9:42
6132	Jing Ma	225	1	151	56	G	N	151.56	Clarify the benefit of updating two NAVs more clearly. The description about the need to run two NAVs in the draft is not clear enough. What if update one NAV considering OBSS-based SR operation (described in 27.9) which is simpler than running two NAVs.	as the comment	2017/1/9 9:42
6133	Jing Ma	225	1	154	26	E	N	154.26	Suggest to change "10.13.8 (Transport of S-MPDU)" which is not present in baseline (802.11-2016) to the "10.13.8 (Transport of VHT single MPDU)" which is present in baseline (802.11-2016)	as the comment	2017/1/9 9:42
6134	Jing Ma	225	1	155	53	E	N	155.53	Suggest to change the title of subclause 27.3.4.2 from "27.3.4.2 Level 1 dynamic defragmentation" to "27.3.4.2 Level 1 dynamic fragmentation"	as the comment	2017/1/9 9:42
6135	Jing Ma	225	1	157	49	G	N	157.49	A BA agreement supported Multi-STA BlockAck operation should be specified, because in baseline, the Block Ack session is established between a originator and a recipient by exchanging ADDBA Request frame, ADDBA Response, ADDBA DEL frame. A BA agreement session established among a originator and multiple recipients should be specified.	as the comment	2017/1/9 9:42
6136	Jing Ma	225	1	163	53	E	N	163.53	Suggest to change the title of subclause 27.5.2 from "UL MU operation" to 'HE UL MU operation' for keeping it consistent with 27.5. 1 HE DL MU operation	as the comment	2017/1/9 9:42
6137	Jing Ma	225	1	164	45	E	N	164.45	Suggest to remove a redundant period in the sentence.	as the comment	2017/1/9 9:42
6138	Jing Ma	225	1	168	45	E	N	168.45	Suggest to remove a redundant 'shall be set to' in the sentence.	as the comment	2017/1/9 9:42
6139	Jing Ma	225	1	174	17	T	Y	174.17	Clarify whether the short & long retry counter should be updated or not for every retransmission in random access operation	as the comment	2017/1/9 9:42

6140	Jing Ma	225	1	194	35	E	N	194.35	Suggest to revise the typo 'HE ER SU PPDU' to 'HE EX SU PPDU'	as the comment	2017/1/9 9:42
6141	Jing Ma	225	1	207	21	E	N	207.21	According to the description written below Figure 27-8, the 'Request AP MAC' and 'Requester AP' should be 'Responder AP MAC' and 'Responder AP SME' respectively in Figure 27-8	as the comment	2017/1/9 9:42
6142	Jing Ma	225	1	274	6	G	Y	274.06	Clarify SRP-based spatial reuse operation which is supposed to be disallowed by Spatial Reuse bits here. SRP-based SR operation description is not clear in the draft.	as the comment	2017/1/9 9:42
6143	Jing Ma	225	1		40	G	Y		Clarify SRP-based spatial reuse operation. There are some indication bits in frames which are defined to set or disallow SRP-based spatial reuse operation, but SRP-based SR operation description is not clear in the draft.	as the comment	2017/1/9 9:42
6144	Jing Ma	225	1	174	24	G	N	174.24	Clarify more details about NDP feedback report procedure such as which kind of trigger frame and how to solicit NDP feedback report.	as the comment	2017/1/9 9:42
6145	Jing Ma	225	1	175	40	G	N	175.40	Clarify what the last PPDU of MU cascading sequence means. Should it be DL HE PPDU or UL HE trigger-based PPDU, or either of them?	as the comment	2017/1/9 9:42
6146	Jing Ma	225	1	175	56	T	N	175.56	Clarify the contents possibly including in the HE trigger-based PPDU in the MU cascading sequence for avoiding confusion.	as the comment	2017/1/9 9:42
6147	Jing Ma	225	1	175	5	T	N	175.05	Clarify the operation in case of that HE MU PPDU and HE trigger-based PPDU exchange failure happens during the MU cascading sequence transmission. E.g. in Figure 27-2, if the first exchange of HE MU PPDU of AP and HE trigger-based PPDUs from STA1 and STA2, should AP invoke backoff procedure for the next try?	as the comment	2017/1/9 9:42
6148	Jing Ma	225	1	175	62	T	N	175.62	Recovery procedure should be specified in MU cascading sequence operation	as the comment	2017/1/9 9:42
6149	Jing Ma	225	1	190	12	E	N	190.12	Add a definition of SR PPDU for avoiding confusion.	as the comment	2017/1/9 9:42
6150	Jing Ma	225	1	190	50	G	N	190.50	the SR backoff procedure for SR delayed case (described form line 50 ~57) is covered by SR backoff procedure specified from line 59 ~ 61. Because the PHYCCARESET.request primitive is already specified to be issued at the end of the PPDU in case of SR_delayed (form line 36 ~ 37), the STA may resume its backoff procedure when the STA'S MAC sublayer issues the PHYCCARESET.request primitive at the end of PPDU, following the specification of SR backoff procedure described from line 59 ~ 61. Suggest to merge SR delayed case backoff procedure and SR backoff procedure together as "If an HE STA's MAC sublayer issues a PHY-CCARESET.request primitive and not update its NAV timer as allowed above, the HE STA may resume its backoff procedure when the medium condition is IDLE as defined in 10.22.2.2 (EDCA	as the comment	2017/1/9 9:42
6151	Jinjing Jiang	225	1 9.3.1.23.3	50	13	T	Y	50.13 9.3.1.23.3	Can MU-BAR frame solicit a ACK frame?	Please clarify	2017/1/9 9:42
6152	Jinjing Jiang	225	1 27.2.1	150	13	T	Y	150.13 27.2.1	an HE MU PPDU could also be Uplink transmission from a STA of the same BSS to the associated AP	change to downlink HE MU PPDU	2017/1/9 9:42
6153	Jinjing Jiang	225	1 27.9.2.1	190	50	T	Y	190.50 27.9.2.1	the sentence is redudant or not complete	delete it or clarify	2017/1/9 9:42
6154	Jinjing Jiang	225	1 27.5.2.6.1	172	35	T	Y	172.35 27.5.2.6.1	It seems only basic trigger and BSRP trigger could initiate random acess OFDMA, how about other variants, such as BQRP?	Please clarify	2017/1/9 9:42
6155	Jinjing Jiang	225	1 27.5.3	175	35	T	Y	175.35 27.5.3	Multi-STA Block Ack frame is a variant of BloackAck frame.	change to "at most one Ack or BlockAck frame...."	2017/1/9 9:42

6156	Jinjing Jiang	225	1 27.14.2	199	62	E	Y	199.62 27.14.2	The figure is not readable; it seems in the draft TF is not universally used for the acronym of Trigger Frame	redraw the figure; remove "(TF)"	2017/1/9 9:42
6157	Jinjing Jiang	225	1 27.8.2	189	8	T	Y	189.08 27.8.2	The sentence is broken. Meanwhile, it seems not very necessary to have this paragraph.	Rewrite the sentence or delete it	2017/1/9 9:42
6158	Jinjing Jiang	225	1 27.8.3	189	25	T	Y	189.25 27.8.3	The AP as the TOM initiator should be singled out rather than meshed in the descriptions for STAs	Put line 25 at the beginning of this section and clearly mention whether AP can have TOM indication	2017/1/9 9:42
6159	Jinjing Jiang	225	1 27.2.3	152	19	T	Y	152.19 27.2.3	The HEMUEDCATimer[AC] should be reset/restarted upon each triggered event including the AC	As in the comments	2017/1/9 9:42
6160	Jinjing Jiang	225	1 27.2.3	152	18	T	Y	152.18 27.2.3	There should be recommended guideline for HEMUEDCATimer setting to ensure channel access fairness between SU and MU	Please provide the details	2017/1/9 9:42
6161	Jinjing Jiang	225	1 27.5.2.6.2	173	36	E	Y	173.36 27.5.2.6.2	"AID value 0" should be changed into "AID 0"	As in the comments	2017/1/9 9:42
6162	Jinjing Jiang	225	1 27.5.1.1	162	49	E	Y	162.49 27.5.1.1	"The transmission of each RU" should be "The transmission on each RU"	As in the comments	2017/1/9 9:42
6163	Jinjing Jiang	225	1 27.5.1.3	163	19	T	Y	163.19 27.5.1.3	It is confusing to see "HE bandwidth query report opertion for DL MU" belongs to the DL MU operation. It should be similar to buffer status report operation, residing in the UL MU operation	As in the comments; please clarify	2017/1/9 9:42
6164	Jinjing Jiang	225	1 27.5.1.3	163	35	T	Y	163.35 27.5.1.3	The paragraph from line 35 to 50 should be rewritten to reflect that if an HE AP solicits the BQR report, the STA shall include in the HE trigger-baseed PPUD blabla...Current texts seems mandating the BAR A-Control fields in HE trigger-based PPDU even not being queried by the AP	As in the commnets	2017/1/9 9:42
6165	Jinjing Jiang	225	1 27.5.1.2	163	3	T	Y	163.03 27.5.1.2	Here HE MU PPDU payload seems only describing the DL version, how about the UL one	Add "DL" in front of the subsection title	2017/1/9 9:42
6166	Jinjing Jiang	225	1 27.5.2.2.1	165	1	T	Y	165.01 27.5.2.2.1	line 1-6 is a duplicate of line 18-19	As in the comments	2017/1/9 9:42
6167	Jinjing Jiang	225	1 27.5.2.2.1	164	46	T	Y	164.46 27.5.2.2.1	the non-associated STA for UL OFDMA-based random access is not defined in 27.5.2.6	Either remove line 46-48 or define it in 27.5.2.6	2017/1/9 9:42
6168	Jinjing Jiang	225	1 27.5.2.2.1	164	53	T	Y	164.53 27.5.2.2.1	What is S-MPDU? VHT single MPDU? It is not formally defined in the draft or 802.11-16; please quote the correct 10.13.8 section title; and if carried in VHT single MPDU, should "Are"-->"Is"	Define the term before use it	2017/1/9 9:42
6169	Jinjing Jiang	225	1 27.5.2.2.3	167	35	E	Y	167.35 27.5.2.2.3	"If the PPDU contains frames that are not Trigger frames in addition to a Trigger frame", confusing English	This line is awkward, please revise	2017/1/9 9:42
6170	Jinjing Jiang	225	1 27.11.6	198	24	T	Y	198.24 27.11.6	Are there only two options for SPATIAL_REUSE?	Please clarify	2017/1/9 9:42
6171	Jinjing Jiang	225	1 10.3.2.10.1	118	48	T	Y	118.48 10.3.2.10.1	For acknowledgement procedure for DL MU PPDU in SU format, it assumes that at most one STA does not have a BA session. Otherwise it is impossible to solicit two consequetive ACKs	Clarify the case that 2 or more STAs have a single Data MPDU contained in the HE MU PPDU for DL transmsssion	2017/1/9 9:42
6172	Jinjing Jiang	225	1 10.3.2.10.2	119	36	T	Y	119.36 10.3.2.10.2	Figure 10-12a: "A-MPDU with trigger contraining UL trigger information" is not a good description	change to "An A-MPDU containing UL trigger information"	2017/1/9 9:42
6173	Jinjing Jiang	225	1 10.3.2.10.3	120	12	T	Y	120.12 10.3.2.10.3	Multi-STA Block Ack frame is a variant of BloackAck frame.	Change to "is either a BlockAck frame or an Ack frame"	2017/1/9 9:42
6174	Jinjing Jiang	225	1 10.9	127	44	T	Y	127.44 10.9	A-Control field is actually a subfield	Change/check "A-Control field" to "A-Control subfield" throughout the draft; there are multiple other places have such a problem...	2017/1/9 9:42
6175	Jinjing Jiang	225	1 10.9	127	53	T	Y	127.53 10.9	Line 45-46 already states that the Control subfield must be supported by the STA	This paragraph is redundent	2017/1/9 9:42
6176	Jinjing Jiang	225	1 27.2.1	150	15	T	Y	150.15 27.2.1	It seems that to firmly determine whether a frame is intra-BSS or inter-BSS, in certain cases, the whole PPDU needs to be decoded rather than only looking at the BSS Color (e.g., dense environments with BSS color collision). However, certain spatial reuse mechanism needs to issue CCA reset primitive before the end of PPDU (see 27.9.2.1). The requirement seems contradicting each other, which leads to the infeasibility of spatial reuse.	Please clarify	2017/1/9 9:42

6177	Jin-Sam Kwak	225	1 27.2.2	150	57	T	Y	150.57 27.2.2	Although an AP solicits a STA using a Trigger frame, the STA may not respond to the Trigger frame due to the CS result. Following the current spec, the STA does not update its NAV and this would cause the interference.	We need a rule to make the STA to update its NAV when the STA is solicited an immediate response by the frame but the STA is not able to respond to the frame.	2017/1/9 9:42
6178	Jin-Sam Kwak	225	1 27.9	190	1	T	Y	190.01 27.9	We have the Spatial Reuse field in the HE-SIG-A and the well utilization of the field would be helpful.	Please define the SRP-based Spatial Reuse operation.	2017/1/9 9:42
6179	Jin-Sam Kwak	225	1 27.16.2	206	39	T	Y	206.39 27.16.2	In case that an AP uses the Dual Beacon, all of STAs associated with the AP should identify the same BSS Color change TBTT.	Please define the BSS Color change TBTT to be the same to all of STAs in a BSS when the BSS uses the Dual Beacon.	2017/1/9 9:42
6180	Jin-Sam Kwak	225	1 27.5.2.6.2	173	37	T	Y	173.37 27.5.2.6.2	Even though a STA receives a Trigger frame containing the User Info field that indicates the random access RU, the STA may not have a capability to transmit a frame on the RU.	If a STA does not have a capability to access the random access RU indicated by a Trigger frame, the STA should not decrease its OBO counter on the random access RU.	2017/1/9 9:42
6181	Jin-Sam Kwak	225	1 27.5.2.6.2	173	36	T	Y	173.36 27.5.2.6.2	The spec should define the operation when a STA that is scheduled by a Trigger frame receives User Info fields indicating the random access RU.	As per comment	2017/1/9 9:42
6182	Jin-Sam Kwak	225	1 27.5.2.6.2	173	1	T	Y	173.01 27.5.2.6.2	The spec should define the random access procedure when the multiple BSSID function is used.	As per comment	2017/1/9 9:42
6183	Jin-Sam Kwak	225	1 27.10.4	193	58	T	Y	193.58 27.10.4	As discussed till now, the shorter Multi-STA BlockAck frame is desirable. When a STA receives all of nonzero length MPDUs with the corresponding EOF subfield set to 0 in a multi-TID A-MPDU, the STA can acknowledge the reception for the MPDUs using a Multi-STA BlockAck frame without the bitmap for the MPDUs indicating each TID.	Please extend the case of a Per STA Info subfield without the Block Ack Starting Sequence Control field and the Block Ack Bitmap field.	2017/1/9 9:42
6184	Jin-Sam Kwak	225	1 9.3.1.9.7	38	6	T	Y	38.06 9.3.1.9.7	As discussed till now, the shorter Multi-STA BlockAck frame is desirable. When a STA receives all of nonzero length MPDUs with the corresponding EOF subfield set to 0 in a multi-TID A-MPDU, the STA can acknowledge the reception for the MPDUs using a Multi-STA BlockAck frame without the bitmap for the MPDUs indicating each TID.	Please extend the case of a Per STA Info subfield without the Block Ack Starting Sequence Control field and the Block Ack Bitmap field.	2017/1/9 9:42
6185	Jin-Sam Kwak	225	1 9.7.3	109	3	T	Y	109.03 9.7.3	The current A-MPDU contents table prevents QoS No Ack Data aggregation with other QoS Data of other TIDs that solicit immediate responses	Update table 9-425	2017/1/9 9:42
6186	Jin-Sam Kwak	225	1 9.7.3	111	3	T	Y	111.03 9.7.3	In MU cascading, TXOP holder may transmit Ack/M-BA frame in response to HE TB PPDU aggregated with QoS Data not soliciting an immediate response. Table 9-426 must be updated	As in comment	2017/1/9 9:42
6187	Jin-Sam Kwak	225	1 27.10.4	193	32	T	Y	193.32 27.10.4	The criteria for distinguishing among S-MPDU, A-MPDU, and multiple TID A-MPDU is not clear enough	Need to clarify	2017/1/9 9:42
6188	Jin-Sam Kwak	225	1 27.5.2.6.2	173	45	T	Y	173.45 27.5.2.6.2	If a STA does not have any data to transmit, it shall not participate random access procedure, or, at least it shall not transmit anything including QoS Null even if its OBO becomes 0.	As per comment	2017/1/9 9:42
6189	Jin-Sam Kwak	225	1 10.22.2.8	133	25	T	Y	133.25 10.22.2.8	The baseline spec does not allow a transmission that exceeds the TXOP limit for any fragmentable data. TXOP limit rules must be updated for HE STAs capable of dynamic fragmentation.	As per comment	2017/1/9 9:42
6190	Jin-Sam Kwak	225	1 27.8.3	189	35	T	Y	189.35 27.8.3	The description of the normative behavior of OMI responder regarding UL MU Disable subfield is not clear enough	Need to clarify	2017/1/9 9:42
6191	Jin-Sam Kwak	225	1 9.2.4.6.4.7	28	1	T	Y	28.01 9.2.4.6.4.7	How an non-AP STA chooses each available channel bitmap subfield encoding (20/40/80/160) when reporting BQR in solicited/unsolicited modes? There should be a rule for BQR's BW bitmap selection.	As in comment.	2017/1/9 9:42

6192	Jin-Sam Kwak	225	1 27.8.1	188	22	T	Y	188.22 27.8.1	In 11.42 Notification of operating mode changes, AP's procedure for changing its operating mode setting is well described. However, it is not clear how AP can change its operating mode with OMI A-Control field. Throughout the section 27.8, please clarify the behavior of HE AP and HE non-AP STA respectively fro changing its operating mode with OMI A-Control.	As in comment.	2017/1/9 9:42
6193	Jin-Sam Kwak	225	1 28.3.17.6.4	349	7	T	Y	349.07 28.3.17.6.4	The current PHY-CCA.indication primitive only provides CCA results of primary, secondary, secondary40, and secondary80. In order to support BW options of current preamble puncturing mode, additional PHY-CCA.indication primitives should be defined.	As in comment.	2017/1/9 9:42
6194	Jin-Sam Kwak	225	1 9.4.2.218.3	84	26	T	Y	84.26 9.4.2.218.3	For UL HE MU PPDU transmission from an STA to an AP, the current SIG-A/B design incurs overhead because the current format is designed for DL MU signaling. SIG-B's RU allocation and User specific fields can be redundant overheads for UL HE MU PPDU.	Please specify UL HE MU PPDU's SIG-A/B signaling detail.	2017/1/9 9:42
6195	John Buffington	225	1 27.5.2.3	167	59	T	Y	167.59 27.5.2.3	Non-associated behavior is not defined and marked as TBD. Can't determine ramifications of design until it is created and defined.	Solicit members for methods to satisfy the non-associated behavior.	2017/1/9 9:42
6196	John Buffington	225	1 27.5.2.5	171	39	T	Y	171.39 27.5.2.5	Unknown reference in description of "(#2190, 2191)".	Please clarify reference or remove it if it's a mistake.	2017/1/9 9:42
6197	John Buffington	225	1 28.3.11.5	317	46	T	Y	317.46 28.3.11.5	Unknown reference of "(#838)".	Please clarify reference or remove it if it's a mistake.	2017/1/9 9:42
6198	John Buffington	225	1 C.3	422	52	T	Y	422.52 C.3	Unknown reference of "(#1313)".	Please clarify reference or remove it if it's a mistake.	2017/1/9 9:42
6199	John Buffington	225	1 General			E	N	General	In Contents section, a number lines are missing a space (" ") between the Clause number and Clause name.	Where needed, please add space between Clause number and Clause name in the Contents section.	2017/1/9 9:42
6200	John Coffey	225	1 3.2	4	56	E	Y	4.56 3.2	The definition style is inconsistent with the usage for other bandwidths.	Add "transmitted" before "using".	2017/1/9 9:42
6201	John Coffey	225	1 3.2	4	60	E	Y	4.60 3.2	The definition style is inconsistent with the usage for other bandwidths.	Add "transmitted" before "using".	2017/1/9 9:42
6202	John Coffey	225	1 3.2	4	63	E	Y	4.63 3.2	The definition style is inconsistent with the usage for other bandwidths.	Add "transmitted" before "using".	2017/1/9 9:42
6203	John Coffey	225	1 3.2	5	2	E	Y	5.02 3.2	The definition style is inconsistent with the usage for other bandwidths.	Add "transmitted" before "using".	2017/1/9 9:42
6204	John Coffey	225	1 3.2	5	6	E	Y	5.06 3.2	The definition style is inconsistent with the usage for other bandwidths.	Add "transmitted" before "using".	2017/1/9 9:42
6205	John Coffey	225	1 3.2	5	10	E	Y	5.10 3.2	The definition style is inconsistent with the usage for other bandwidths.	Add "transmitted" before "using".	2017/1/9 9:42
6206	John Coffey	225	1 3.2	5	14	E	Y	5.14 3.2	The definition style is inconsistent with the usage for other bandwidths.	Add "transmitted" before "using".	2017/1/9 9:42
6207	John Coffey	225	1 3.2	5	31	E	Y	5.31 3.2	The definition style is inconsistent with the usage for other bandwidths.	Add "transmitted" before "using".	2017/1/9 9:42
6208	John Coffey	225	1 3.2	5	35	E	Y	5.35 3.2	The definition style is inconsistent with the usage for other bandwidths.	Add "transmitted" before "using".	2017/1/9 9:42
6209	John Coffey	225	1 3.2	5	39	E	Y	5.39 3.2	The definition style is inconsistent with the usage for other bandwidths.	Add "transmitted" before "using".	2017/1/9 9:42
6210	John Coffey	225	1 3.2	5	43	E	Y	5.43 3.2	The definition style is inconsistent with the usage for other bandwidths.	Add "transmitted" before "using".	2017/1/9 9:42
6211	John Coffey	225	1 3.2	5	47	E	Y	5.47 3.2	The definition style is inconsistent with the usage for other bandwidths.	Add "transmitted" before "using".	2017/1/9 9:42
6212	John Coffey	225	1 3.2	5	51	E	Y	5.51 3.2	The definition style is inconsistent with the usage for other bandwidths.	Add "transmitted" before "using".	2017/1/9 9:42
6213	John Coffey	225	1 3.2	5	55	E	Y	5.55 3.2	The definition style is inconsistent with the usage for other bandwidths.	Add "transmitted" before "using".	2017/1/9 9:42
6214	John Coffey	225	1 3.2	5	59	E	Y	5.59 3.2	The definition style is inconsistent with the usage for other bandwidths.	Add "transmitted" before "using".	2017/1/9 9:42
6215	John Coffey	225	1 3.2	6	11	E	Y	6.11 3.2	The definition style is inconsistent with the usage for other bandwidths.	Add "transmitted" before "using".	2017/1/9 9:42
6216	John Coffey	225	1 3.2	6	15	E	Y	6.15 3.2	The definition style is inconsistent with the usage for other bandwidths.	Add "transmitted" before "using".	2017/1/9 9:42
6217	John Coffey	225	1 3.2	6	19	E	Y	6.19 3.2	The definition style is inconsistent with the usage for other bandwidths.	Add "transmitted" before "using".	2017/1/9 9:42

6218 John Coffey	225	1 3.2	6	23	E	Y	6.23 3.2	The definition style is inconsistent with the usage for other bandwidths.	Add "transmitted" before "using".	2017/1/9 9:42
6219 John Coffey	225	1 3.2	6	27	E	Y	6.27 3.2	The definition style is inconsistent with the usage for other bandwidths.	Add "transmitted" before "using".	2017/1/9 9:42
6220 John Coffey	225	1 3.2	6	41	E	Y	6.41 3.2	"An high efficiency STA"?	Change "an" to "a".	2017/1/9 9:42
6221 John Coffey	225	1 3.2	6	44	E	Y	6.44 3.2	Why is the TA "represented by" the address defined in the text that follows. It *is* the address defined in the text that follows.	Change "It is represented by" to "The TA is".	2017/1/9 9:42
6222 John Coffey	225	1 3.2	6	47	E	Y	6.47 3.2	The "but with" text is too informal and colloquial for a Definitions section.	Change "by the IEEE ... set to 1" to "equal to the IEEE medium access control (MAC) individual address of the transmitting VHT STA in all bits except for the Individual/Group bit, which is set to 1."	2017/1/9 9:42
6223 John Coffey	225	1 3.2	6	50	T	Y	6.50 3.2	The definition of an HE dual beacon starts with an action: "A BSS transmits beacons in two PHY modes ...". This is very unclear. The BSS shall transmit beacons in two PHY modes? Or the BSS may transmit beacons in two PHY modes? And either way, what is this doing in a definitions section?	Rewrite the definition so that it defines the term purportedly being defined. In particular, if or when a BSS uses HE dual beacons, are both beacons "HE dual beacons", or is only the one transmitted in HE_EXT_SU PY format a dual beacon? Or is it the case that neither is, and instead the BSS is in "HE dual beacon mode"? And isn't it normally the case that beacons are transmitted by an "AP", not a BSS? Clarify.	2017/1/9 9:42
6224 John Coffey	225	1 3.2	6	50	E	Y	6.50 3.2	Case disgareement: "The beacons ... enables".	Change "enables" to "enable".	2017/1/9 9:42
6225 John Coffey	225	1 3.2	6	52	E	Y	6.52 3.2	What is meant by "in the whole BSS coverage"? It seems that something like "the whole area covered by the BSS" must be intended. But this raises more questions than it answers. The BSS coverage is normally defined by the area covered by the normal beacon: if a STA can't hear beacons, it isn't in the BSS in any useful sense. So the dual beacons, and the entire "extended range" functionality *expands* the BSS coverage. Is this the intention? If so, it would be better to say so, rather than claiming a different benefit.	Change "the whole BSS coverage" to "the entire coverage area of the BSS, as newly expanded by the HE dual beacon modes".	2017/1/9 9:42
6226 John Coffey	225	1 3.2	6	52	E	Y	6.52 3.2	The sentence "The beacons transmitted ... whole BSS coverage" describes a purported benefit of the feature being defined. Why is this kind of advocacy included in a definitions section? The section should stick to definitions and stay away from advertising and boosterism.	Delete the sentence.	2017/1/9 9:42
6227 John Coffey	225	1 3.2	6	50	E	Y	6.50 3.2	"High Efficient"?	Change to High Efficiency (or "Highly Efficient" if you like).	2017/1/9 9:42
6228 John Coffey	225	1 3.2	6	50	T	Y	6.50 3.2	The entire HE dual beacon mode purportedly enables increased BSS coverage. In dense deployments this will reduce spatial reuse, and thus will run counter to the main aims of the project. It serves to clutter up an already bloated draft amendment.	Delete the definition of HE dual beacon and all references to it in the draft.	2017/1/9 9:42
6229 John Coffey	225	1 4	9	20	E	Y	9.20 4	"... support operation in 20 MHz channel bandwidth only" is peculiar. The impression is given that 40 MHz and wider channels may not be used. Why is the "only" needed here?	Delete "only".	2017/1/9 9:42
6230 John Coffey	225	1 4	9	26	E	Y	9.26 4	"... support operation in 20 MHz channel bandwidth only" is peculiar. The impression is given that 40 MHz channels may not be used. Why is the "only" needed here?	Delete "only".	2017/1/9 9:42
6231 John Coffey	225	1 4	9	51	E	Y	9.51 4	Inconsistent style: other elements of the list no not end with a full stop.	Delete the full stop.	2017/1/9 9:42
6232 John Coffey	225	1 4	9	65	T	Y	9.65 4	"The Trigger frame schedule may be set" is unclear in multiple ways. Why the definite article? Is there only one possible schedule? The text also suggests that Trigger frames are usually scheduled (or always scheduled?).	Change to "Trigger frames may be scheduled ...".	2017/1/9 9:42

6233	John Coffey	225	1 4	9	51	T	Y	9.51 4	Is this "basic trigger" or "Basic Trigger"? The usage is inconsistent even on this page. In a list of what is mandatory it should be clear.	Change to "Basic Trigger".	2017/1/9 9:42
6234	John Coffey	225	1 4	9	65	T	Y	9.65 4	The sentence refers to "the" non-AP STA. This is very confusing. Which one?	Rewrite the sentence so that it makes sense.	2017/1/9 9:42
6235	John Coffey	225	1 4	9	64	T	Y	9.64 4	"Scheduled Trigger frames are sent" is unclear in several ways. Is this intended to convey that Scheduled Trigger frames shall be transmitted by APs, or that they may be transmitted?	Rewrite the sentence so that it is clear whether the behavior described is optional or mandatory.	2017/1/9 9:42
6236	John Coffey	225	1 4	9	64	E	Y	9.64 4	Generally throughout the draft frames are "transmitted". Here and in a handful of other cases they are "sent". It would be better to choose one term and stick to it.	Change "sent" to "transmitted".	2017/1/9 9:42
6237	John Coffey	225	1 6.3.4.2.2	12	7	E	Y	12.07 6.3.4.2.2	Inconsistent formatting: the text in the second column ends with a full stop, unlike the text in the table on the previous page.	Delete the full stop here, or add it in the earlier and all other cases.	2017/1/9 9:42
6238	John Coffey	225	1 6.3.7.2.2	12	39	E	Y	12.39 6.3.7.2.2	Inconsistent formatting: the text in the second column ends with a full stop, unlike the text in the table on the previous page.	Delete the full stop here, or add it in the earlier and all other cases.	2017/1/9 9:42
6239	John Coffey	225	1 6.3.8.4.2	13	6	E	Y	13.06 6.3.8.4.2	Inconsistent formatting: the text in the second column ends with a full stop, unlike the text in the table on the previous page.	Delete the full stop here, or add it in the earlier and all other cases.	2017/1/9 9:42
6240	John Coffey	225	1 6.3.11.2.2	13	40	E	Y	13.40 6.3.11.2.2	Inconsistent formatting: the text in the second column ends with a full stop, unlike the text in the table on the previous page.	Delete the full stop here, or add it in the earlier and all other cases.	2017/1/9 9:42
6241	John Coffey	225	1 6.3.11.2.2	13	49	E	Y	13.49 6.3.11.2.2	Inconsistent formatting: the text in the second column ends with a full stop, unlike the text in the table on the previous page.	Delete the full stop here, or add it in the earlier and all other cases.	2017/1/9 9:42
6242	John Coffey	225	1 6.3.27.4.2	14	13	E	Y	14.13 6.3.27.4.2	Inconsistent formatting: the text in the second column ends with a full stop, unlike the text in the table on the previous page.	Delete the full stop here, or add it in the earlier and all other cases.	2017/1/9 9:42
6243	John Coffey	225	1 6.3.27.4	13	59	E	Y	13.59 6.3.27.4	Subsection 6.3.27.4 is numbered twice.	Correct it.	2017/1/9 9:42
6244	John Coffey	225	1 6.3.27.4.2	13	61	E	Y	13.61 6.3.27.4.2	Subsection 6.3.27.4.2 is numbered twice.	Correct it.	2017/1/9 9:42
6245	John Coffey	225	1 9.2.4.1.8	19	35	E	Y	19.35 9.2.4.1.8	Generally throughout the draft frames are "transmitted". Here and in a handful of other cases they are "sent". It would be better to choose one term and stick to it.	Change "sent" to "transmitted".	2017/1/9 9:42
6246	John Coffey	225	1 9.2.4.1.8	19	37	E	Y	19.37 9.2.4.1.8	Generally throughout the draft frames are "transmitted". Here and in a handful of other cases they are "sent". It would be better to choose one term and stick to it.	Change "sent" to "transmitted".	2017/1/9 9:42
6247	John Coffey	225	1 9.2.4.1.8	19	35	E	Y	19.35 9.2.4.1.8	"The AP optionally sets" doesn't seem to be quite right.	Change to "The AP may set"	2017/1/9 9:42
6248	John Coffey	225	1 9.2.4.1.8	19	35	E	Y	19.35 9.2.4.1.8	In the sentence starting "The AP optionally sets", the first two instances of "and" seem to imply that all these cases are treated in the same way. That is, the behavior is optional for the AP, but if implemented, the same behavior applies to all of these cases. Is this the intention? There doesn't seem to be a compelling reason.	Change the first two instances of "and" to "or".	2017/1/9 9:42
6249	John Coffey	225	1 9.2.4.1.8	19	35	T	Y	19.35 9.2.4.1.8	The sentence is ambiguous. When we have a list of cases followed by a condition, are we supposed to interpret the condition as applying only to the last element of the list, or to the entire list? Here the "from which it has received" is a condition; does this condition apply to both the non-HE STA and HE STA cases, or only to the HE STA case?	Clarify the meaning.	2017/1/9 9:42
6250	John Coffey	225	1 9.2.4.1.8	19	35	E	Y	19.35 9.2.4.1.8	The sentence is too long. Too many conditions and qualifiers are strung together. "... and ... from which ... that contains ... in which ... and that ... that are ... and that is". This is practically unreadable.	Reword to simplify the sentence. Add a table or a diagram.	2017/1/9 9:42
6251	John Coffey	225	1 9.2.4.1.8	19	43	E	Y	19.43 9.2.4.1.8	"A TDLS peer STA optionally sets" doesn't seem to be quite right.	Change to "A TDLS peer STA may optionally set"	2017/1/9 9:42

6252 John Coffey	225	1 9.2.4.1.8	19	45	T	Y	19.45 9.2.4.1.8	The sentence is ambiguous. When we have a list of cases followed by a condition, are we supposed to interpret the condition as applying only to the last element of the list, or to the entire list? Here the "that has" is a condition; does this condition apply to both the non-HE STA and HE STA cases, or only to the HE STA case?	Clarify the meaning.	2017/1/9 9:42
6253 John Coffey	225	1 9.2.4.5.4	20	44	T	Y	20.44 9.2.4.5.4	Inconsistent terminology: in "DL HE MU PPDU", the STA type is in the middle, whereas in practically every oher instance the type is at the beginning.	Change "a DL HE MU PPDU" to "an HE DL MU PPDU".	2017/1/9 9:42
6254 John Coffey	225	1 9.2.4.5.4	20	48	E	Y	20.48 9.2.4.5.4	Inconsistent usage (in the same paragraph): is it HE Trigger-based PPDU or HE trigger-based PPDU? Usage throughout the draft is lopsidedly in favor of "HE trigger-based PPDU". The draft should choose one variant and stick to it.	Change "HE Trigger-based PPDU" to "HE trigger-based PPDU".	2017/1/9 9:42
6255 John Coffey	225	1 9.2.4.5.6	21	2	E	Y	21.02 9.2.4.5.6	Generally throughout the draft frames are "transmitted". Here and in a handful of other cases they are "sent". It would be better to choose one term and stick to it.	Change "sending" to "transmitting".	2017/1/9 9:42
6256 John Coffey	225	1 9.2.4.5.6	21	2	T	Y	21.02 9.2.4.5.6	Inconsistent terminology: in "non-AP HE STA", the STA type is in the middle, whereas in practically every oher instance the type is at the beginning.	Change "a non-AP HE STA" to "an HE non-AP STA".	2017/1/9 9:42
6257 John Coffey	225	1 9.2.4.6.4.2	23	60	E	Y	23.60 9.2.4.6.4.2	Missing text: "the number of OFDM symbols the Data field".	Add "in" before "the".	2017/1/9 9:42
6258 John Coffey	225	1 9.2.4.6.4.2	24	18	E	Y	24.18 9.2.4.6.4.2	Missing article: "all AP's antennas".	Change to "all the AP's antennas".	2017/1/9 9:42
6259 John Coffey	225	1 9.2.4.6.4.2	24	21	E	Y	24.21 9.2.4.6.4.2	Missing punctuation, inconsistent usage: "except for the value 31 that indicates" doesn't look quite right, and it's also inconsistent with the usage in the previous paragraph.	Change to "except for the value 31, which indicates".	2017/1/9 9:42
6260 John Coffey	225	1 9.2.4.6.4.3	24	63	E	Y	24.63 9.2.4.6.4.3	Confusing text: why "the" non-AP STA? Which one? Later in the paragraph we have "An AP".	Change "the" to "a".	2017/1/9 9:42
6261 John Coffey	225	1 9.2.4.6.4.4	25	9	E	Y	25.09 9.2.4.6.4.4	Missing or incorrect cross-reference: section 9.31.4 is referenced but no such section exists in the draft.	Correct it.	2017/1/9 9:42
6262 John Coffey	225	1 9.2.4.6.4.4	25	25	E	Y	25.25 9.2.4.6.4.4	The phrase "recommended number of spatial streams" is cryptic. More information should be provided about which party is recommending what to which other party.	Provide additional, clarifying information.	2017/1/9 9:42
6263 John Coffey	225	1 9.2.4.6.4.7	27	47	E	Y	27.47 9.2.4.6.4.7	"HE DL HE MU" has a superfluous "HE.	Delete the second instance of "HE".	2017/1/9 9:42
6264 John Coffey	225	1 9.2.4.6.4.7	27	64	E	Y	27.64 9.2.4.6.4.7	Inconsistent terminology: in "DL HE MU transmission", the STA type is in the middle, whereas in practically every oher instance the type is at the beginning.	Change "DL HE MU" to "HE DL MU".	2017/1/9 9:42
6265 John Coffey	225	1 9.2.4.6.4.7	28	14	E	Y	28.14 9.2.4.6.4.7	Inconsistent usage: in this entry, the two cases are separated by ba comma, whereas in all others they're separated by an "and".	Change "," to "and".	2017/1/9 9:42
6266 John Coffey	225	1 9.2.5.2	31	19	E	Y	31.19 9.2.5.2	Inconsistent usage: here we have "a MU-BAR", whereas in most other cases we have "an MU-BAR". It would be better to choose one form and to stick to it.	Change "a" to "an".	2017/1/9 9:42
6267 John Coffey	225	1 9.2.5.2	31	33	E	Y	31.33 9.2.5.2	"... time required to transmit multiple BlockAck frames" is inexact.	Add "associated" or "applicable" somewhere.	2017/1/9 9:42
6268 John Coffey	225	1 9.2.5.2	32	4	E	Y	32.04 9.2.5.2	Repeated text: "time already used time".	Delete one instance of "time".	2017/1/9 9:42
6269 John Coffey	225	1 9.2.5.7	32	44	E	Y	32.44 9.2.5.7	Missing article: "in HE trigger-based PPDU".	Change to "in an HE trigger-based PPDU".	2017/1/9 9:42
6270 John Coffey	225	1 9.2.5.7	32	44	E	Y	32.44 9.2.5.7	"... rule of setting ..."? This is the only instance of "rule of" in the entire draft, and it seems odd. "Rule of law", "rule *for* setting".	Change to "rule for setting".	2017/1/9 9:42
6271 John Coffey	225	1 9.3.1.5	33	19	E	Y	33.19 9.3.1.5	Inconsistent usage: throughout the draft we have "an" HE STA, but here we have "a" HE STA.	Change "a" to "an".	2017/1/9 9:42

6272 John Coffey	225	1 9.3.1.8.1	33	45	T	Y	33.45 9.3.1.8.1	Inconsistent usage: here we have "The TA field value is". In many (most?) other places in the draft we have "The TA field is". What distinction is intended between these two forms? If no distinction is intended, the same form should be used.	Delete "value".	2017/1/9 9:42
6273 John Coffey	225	1 9.3.1.8.1	33	49	T	Y	33.49 9.3.1.8.1	Inconsistent usage: here we have "The TA field value is". In many (most?) other places in the draft we have "The TA field is". What distinction is intended between these two forms? If no distinction is intended, the same form should be used.	Delete "value".	2017/1/9 9:42
6274 John Coffey	225	1 9.3.1.9.1	34	22	E	Y	34.22 9.3.1.9.1	"The RA field of the BlockAck frame that is not a Multi-STA BlockAck variant"?	Change "the BlockAck frame" to "a BlockAck frame".	2017/1/9 9:42
6275 John Coffey	225	1 9.3.1.9.1	34	38	T	Y	34.38 9.3.1.9.1	Inconsistent usage: here we have "The TA field value is". In many (most?) other places in the draft we have "The TA field is". What distinction is intended between these two forms? If no distinction is intended, the same form should be used.	Delete "value".	2017/1/9 9:42
6276 John Coffey	225	1 9.3.1.9.1	34	51	E	Y	34.51 9.3.1.9.1	"... does not ... and ..."?	Change the last "and" to "or".	2017/1/9 9:42
6277 John Coffey	225	1 9.3.1.9.1	35	47	E	Y	35.47 9.3.1.9.1	Inconsistent usage: "in the Table". This construction appears many times in the draft, but nevertheless it doesn't even have consistency as an argument in its favor, since "in Table x.y" also appears many times.	Change "in the Table" to "in Table".	2017/1/9 9:42
6278 John Coffey	225	1 9.3.1.9.7	37	24	E	Y	37.24 9.3.1.9.7	Superfluous comma.	Delete it.	2017/1/9 9:42
6279 John Coffey	225	1 9.3.1.9.7	38	36	E	Y	38.36 9.3.1.9.7	Incorrect rendering of defined term: "VHT Single MPDU". The baseline defines "VHT single MPDU".	Change "VHT Single MPDU" to "VHT single MPDU".	2017/1/9 9:42
6280 John Coffey	225	1 9.3.1.9.7	39	39	E	Y	39.39 9.3.1.9.7	Inconsistent usage: "in the Table". This construction appears many times in the draft, but nevertheless it doesn't even have consistency as an argument in its favor, since "in Table x.y" also appears many times.	Change "in the Table" to "in Table".	2017/1/9 9:42
6281 John Coffey	225	1 9.3.1.9.7	39	52	E	Y	39.52 9.3.1.9.7	Inconsistent usage: "in the Table". This construction appears many times in the draft, but nevertheless it doesn't even have consistency as an argument in its favor, since "in Table x.y" also appears many times.	Change "in the Table" to "in Table".	2017/1/9 9:42
6282 John Coffey	225	1 9.3.1.20	40	24	E	Y	40.24 9.3.1.20	Inconsistent usage: here we have the STA Info "subfield", whereas everywhere else in the draft it's the STA Info "field". If the same thing is intended, the same term should be used.	Change "subfield" to "field". (Or change all instances of "STA Info field" to "STA Info subfield" throughout the draft.)	2017/1/9 9:42
6283 John Coffey	225	1 9.3.1.20	41	1	E	Y	41.01 9.3.1.20	Missing space: "inTable".	Change to "in Table".	2017/1/9 9:42
6284 John Coffey	225	1 9.3.1.20	41	2	E	Y	41.02 9.3.1.20	Missing full stop.	Add full stop.	2017/1/9 9:42
6285 John Coffey	225	1 9.3.1.20	41	28	E	Y	41.28 9.3.1.20	" ... it's ..." Tut, tut.	Fix.	2017/1/9 9:42
6286 John Coffey	225	1 9.3.1.20	41	29	E	Y	41.29 9.3.1.20	Inconsistent usage: here we have the "HE STA info" field or subfield or whatver, whereas in the rest of the draft we have simply "STA Info" field or subfield. If the same item is being referenced, the same term should be used.	Delete "HE".	2017/1/9 9:42
6287 John Coffey	225	1 9.3.1.20	41	29	E	Y	41.29 9.3.1.20	Missing noun: HE STA Info what?	Chage to "HE STA Info field".	2017/1/9 9:42
6288 John Coffey	225	1 9.3.1.23	41	59	E	Y	41.59 9.3.1.23	Missing space: "STA.If"	Add space.	2017/1/9 9:42
6289 John Coffey	225	1 9.3.1.23	41	61	E	Y	41.61 9.3.1.23	Missing space: "address.If".	Add space.	2017/1/9 9:42
6290 John Coffey	225	1 9.3.1.23	41	65	T	Y	41.65 9.3.1.23	Inconsistent usage: here we have "The TA field value is". In many (most?) other places in the draft we have "The TA field is". What distinction is intended between these two forms? If no distinction is intended, the same form should be used.	Delete "value".	2017/1/9 9:42
6291 John Coffey	225	1 9.3.1.23	44	62	E	Y	44.62 9.3.1.23	Inconsistent usage: "For HE trigger-based PPDU".	Change to "For an HE trigger-based PPDU".	2017/1/9 9:42
6292 John Coffey	225	1 9.3.1.23	45	7	E	Y	45.07 9.3.1.23	Inconsistent usage: "When operating 40 MHz". Sundry variations appear throughout the draft. It would be better to select one and stick to it.	Change to "For 40 MHz channel width".	2017/1/9 9:42
6293 John Coffey	225	1 9.3.1.23	45	7	E	Y	45.07 9.3.1.23	"in 2.4GHz": missing article and missing space (inconsistent usage).	Change to "in the 2.4 GHz".	2017/1/9 9:42

6294 John Coffey	225	1 9.3.1.23	45	7	E	Y	45.07 9.3.1.23	Missing article: "to same values". At a stretch this construction might be acceptable if consistently followed, but the very next sentence has an article included.	Change to "to the same values".	2017/1/9 9:42
6295 John Coffey	225	1 9.3.1.23	45	8	E	Y	45.08 9.3.1.23	Missing article: "SR field 3 is set to same value". Inconsistent usage within the same sentence.	Change to "SR field is set to the same value".	2017/1/9 9:42
6296 John Coffey	225	1 9.3.1.23	45	11	E	Y	45.11 9.3.1.23	Missing capitalization. "Doppler" is a proper noun.	Change "doppler" to "Doppler".	2017/1/9 9:42
6297 John Coffey	225	1 9.3.1.23	45	16	E	Y	45.16 9.3.1.23	Missing term: "in the HE-SIG-A2 of the"	Change to "in the HE-SIG-A2 subfield of the".	2017/1/9 9:42
6298 John Coffey	225	1 9.3.1.23	45	14	E	Y	45.14 9.3.1.23	Missing article and missing term: "in HE-SIG-A2 of the".	Change to "in the HE-SIG-A2 subfield of the".	2017/1/9 9:42
6299 John Coffey	225	1 9.3.1.23	45	17	E	Y	45.17 9.3.1.23	Missing term: "in the HE-SIG-A2 of the"	Change to "in the HE-SIG-A2 subfield of the".	2017/1/9 9:42
6300 John Coffey	225	1 9.3.1.23	45	37	E	Y	45.37 9.3.1.23	Missing space" access.User".	Add space.	2017/1/9 9:42
6301 John Coffey	225	1 9.3.1.23	45	38	E	Y	45.38 9.3.1.23	Peculiar usage: "not equals to 0".	Change to "not equal to 0".	2017/1/9 9:42
6302 John Coffey	225	1 9.3.1.23	46	27	E	Y	46.27 9.3.1.23	The text "for a 20 MHz, 40 MHz, and 80 MHz PPDU" seems odd (case agreement, for one thing).	Change to "for 20 MHz, 40 MHz, and 80 MHz PPDUs".	2017/1/9 9:42
6303 John Coffey	225	1 9.3.1.23	46	33	E	Y	46.33 9.3.1.23	Confusing language: "in an increeasing order". Why "an"? Is there more than one order?	Delete "an".	2017/1/9 9:42
6304 John Coffey	225	1 9.3.1.23	46	42	E	Y	46.42 9.3.1.23	Confusing language: "in an increeasing order". Why "an"? Is there more than one order?	Delete "an".	2017/1/9 9:42
6305 John Coffey	225	1 9.3.1.23	46	52	E	Y	46.52 9.3.1.23	Confusing language: "in an increeasing order". Why "an"? Is there more than one order?	Delete "an".	2017/1/9 9:42
6306 John Coffey	225	1 9.3.1.23	46	47	E	Y	46.47 9.3.1.23	Missing details: the sentence beginning "Similar ordering" invites the reader to fill in details. Why not provide the details directly?	Delete the sentence beginning with "Similar ordering" and replace it with text providing the relevant details.	2017/1/9 9:42
6307 John Coffey	225	1 9.3.1.23	46	54	E	Y	46.54 9.3.1.23	Missing details: the sentence beginning "Similar ordering" invites the reader to fill in details. Why not provide the details directly?	Delete the sentence beginning with "Similar ordering" and replace it with text providing the relevant details.	2017/1/9 9:42
6308 John Coffey	225	1 9.3.1.23	46	59	E	Y	46.59 9.3.1.23	Inexact (and inconsistent) usage: inappropriate use of imperative.	Change sentence to 'It is set to 0 for BCC and is set to 1 for LDPC."	2017/1/9 9:42
6309 John Coffey	225	1 9.3.1.23	47	3	T	Y	47.03 9.3.1.23	"A value of 1 indicates that the HE trigger-based PPDU shall use DCM as defined in 28.3.11.15". But DCM (as defined in 28.3.11.15) is an optional mode. Is the idea that the bit can only be set to 1 if the STA has indicated support for DCM? What is the expected behavior if the STA has not indicated support for DCM but this bit is set to 1 anyway?	Add text restricting the cases in which the bit can be set to 1, and providing error recovery if the bit is set incorrectly.	2017/1/9 9:42
6310 John Coffey	225	1 9.3.1.23	47	5	E	Y	47.05 9.3.1.23	Ungrammatical language: "A value of 0 indicates that DCM is not be used."	Change to "... is not to be used". Or to "is not being used". Or "... shall not be used" (to mirror the language in the preceding sentence, to which it corresponds).	2017/1/9 9:42
6311 John Coffey	225	1 9.3.1.9.7	38	39	E	Y	38.39 9.3.1.9.7	Throughout the draft, usage oscillates between "is as defined in Table/Figure" and "is defined in Table/Figure". The latter seems to have the majority. It would be better to choose one variant and to stick to it.	Delete "as".	2017/1/9 9:42
6312 John Coffey	225	1 9.3.1.9.7	38	19	E	Y	38.19 9.3.1.9.7	Throughout the draft, usage oscillates between "is as defined in Table/Figure" and "is defined in Table/Figure". The latter seems to have the majority. It would be better to choose one variant and to stick to it.	Delete "as".	2017/1/9 9:42
6313 John Coffey	225	1 9.3.1.9.7	39	38	E	Y	39.38 9.3.1.9.7	Throughout the draft, usage oscillates between "is as defined in Table/Figure" and "is defined in Table/Figure". The latter seems to have the majority. It would be better to choose one variant and to stick to it.	Delete "as".	2017/1/9 9:42
6314 John Coffey	225	1 9.3.1.23	41	42	E	Y	41.42 9.3.1.23	Throughout the draft, usage oscillates between "is as defined in Table/Figure" and "is defined in Table/Figure". The latter seems to have the majority. It would be better to choose one variant and to stick to it.	Delete "as".	2017/1/9 9:42

6315 John Coffey	225	1 9.3.1.23	46	64	E	Y	46.64 9.3.1.23	Throughout the draft, usage oscillates between "is as defined in Table/Figure" and "is defined in Table/Figure". The latter seems to have the majority. It would be better to choose one variant and to stick to it.	Delete "as".	2017/1/9 9:42
6316 John Coffey	225	1 9.3.1.23.5	51	20	E	Y	51.20 9.3.1.23.5	Throughout the draft, usage oscillates between "is as defined in Table/Figure" and "is defined in Table/Figure". The latter seems to have the majority. It would be better to choose one variant and to stick to it.	Delete "as".	2017/1/9 9:42
6317 John Coffey	225	1 9.3.1.23.7	51	60	E	Y	51.60 9.3.1.23.7	Throughout the draft, usage oscillates between "is as defined in Table/Figure" and "is defined in Table/Figure". The latter seems to have the majority. It would be better to choose one variant and to stick to it.	Delete "as".	2017/1/9 9:42
6318 John Coffey	225	1 9.4.2.221	94	53	E	Y	94.53 9.4.2.221	Throughout the draft, usage oscillates between "is as defined in Table/Figure" and "is defined in Table/Figure". The latter seems to have the majority. It would be better to choose one variant and to stick to it.	Delete "as".	2017/1/9 9:42
6319 John Coffey	225	1 9.4.2.221	94	60	E	Y	94.60 9.4.2.221	Throughout the draft, usage oscillates between "is as defined in Table/Figure" and "is defined in Table/Figure". The latter seems to have the majority. It would be better to choose one variant and to stick to it.	Delete "as".	2017/1/9 9:42
6320 John Coffey	225	1 9.4.2.222	95	28	E	Y	95.28 9.4.2.222	Throughout the draft, usage oscillates between "is as defined in Table/Figure" and "is defined in Table/Figure". The latter seems to have the majority. It would be better to choose one variant and to stick to it.	Delete "as".	2017/1/9 9:42
6321 John Coffey	225	1 28.3.8	266	60	E	Y	266.60 28.3.8	Throughout the draft, usage oscillates between "is as defined in Table/Figure" and "is defined in Table/Figure". The latter seems to have the majority. It would be better to choose one variant and to stick to it.	Delete "as".	2017/1/9 9:42
6322 John Coffey	225	1 28.3.11.9	324	41	E	Y	324.41 28.3.11.9	Throughout the draft, usage oscillates between "is as defined in Table/Figure" and "is defined in Table/Figure". The latter seems to have the majority. It would be better to choose one variant and to stick to it.	Delete "as".	2017/1/9 9:42
6323 John Coffey	225	1 9.3.1.23	44	57	T	Y	44.57 9.3.1.23	Inconsistent terminology: here we have "the trigger-based PPDU", whereas almost everywhere else in the draft we have "the HE trigger-based PPDU". If the same thing is intended, the same term should be used.	Change to "the HE trigger-based PPDU".	2017/1/9 9:42
6324 John Coffey	225	1 9.3.1.23	44	62	E	Y	44.62 9.3.1.23	Missing article: "for HE trigger-based PPDU".	Change to "for an HT trigger-based PPDU".	2017/1/9 9:42
6325 John Coffey	225	1 9.3.1.23	46	33	T	Y	46.33 9.3.1.23	Imprecise language: "in an increasing order". Why "an"?	Delete "an".	2017/1/9 9:42
6326 John Coffey	225	1 9.3.1.23	46	42	T	Y	46.42 9.3.1.23	Imprecise language: "in an increasing order". Why "an"?	Delete "an".	2017/1/9 9:42
6327 John Coffey	225	1 9.3.1.23	46	51	T	N	46.51 9.3.1.23	Imprecise language: "in an increasing order". Why "an"?	Delete "an".	2017/1/9 9:42
6328 John Coffey	225	1 9.3.1.23.4	50	28	T	Y	50.28 9.3.1.23.4	Inconsistent usage: here we have "The TA field value is". In many (most?) other places in the draft we have "The TA field is". What distinction is intended between these two forms? If no distinction is intended, the same form should be used.	Delete "value".	2017/1/9 9:42
6329 John Coffey	225	1 9.3.1.23.4	50	61	T	Y	50.61 9.3.1.23.4	Imprecise language: "in an increasing order". Why "an"?	Delete "an".	2017/1/9 9:42
6330 John Coffey	225	1 9.3.3.1	52	43	E	Y	52.43 9.3.3.1	Typographical error: "pre-sent".	Change to "present".	2017/1/9 9:42
6331 John Coffey	225	1 9.3.3.6	53	36	E	Y	53.36 9.3.3.6	Typographical error: "pre-sent".	Change to "present".	2017/1/9 9:42
6332 John Coffey	225	1 9.3.3.8	54	30	E	Y	54.30 9.3.3.8	Typographical error: "pre-sent".	Change to "present".	2017/1/9 9:42
6333 John Coffey	225	1 9.3.3.11	55	26	E	Y	55.26 9.3.3.11	Typographical error: "pre-sent".	Change to "present".	2017/1/9 9:42
6334 John Coffey	225	1 9.4.1.62	56	46	E	Y	56.46 9.4.1.62	Inconsistent terminology: here we have "indexes", whereas in all other places in the draft we have "indices". It would be better to select one form and to stick to it.	Change "indexes" to "indices".	2017/1/9 9:42

6335	John Coffey	225	1 9.4.1.63	58	14	E	Y	58.14 9.4.1.63	Clumsy language: "explanation on". Whether it is incorrect, or simply a rare alternative to "explanation of", it should be changed.	Change to "explanation of".	2017/1/9 9:42
6336	John Coffey	225	1 9.4.1.63	58	17	E	Y	58.17 9.4.1.63	Strange run-on sentence: "... Beamforming Feedback Matrix subfield), Nc is ...". Why is there a comma here?	Change comma to full stop.	2017/1/9 9:42
6337	John Coffey	225	1 9.4.1.63	58	16	E	Y	58.16 9.4.1.63	Puzzling and ambiguous construction: in the sentence beginning "The explanation on ...", are we to understand that 19.3.12.3.6 is in Table 9-67?	Clarify in one way or another. For example, it might be worth splitting this sentence up into several shorter ones.	2017/1/9 9:42
6338	John Coffey	225	1 9.4.1.63	58	18	E	Y	58.18 9.4.1.63	Missing conjunction: ", Nr is".	Change to ", and Nr is".	2017/1/9 9:42
6339	John Coffey	225	1 9.4.1.63	58	24	T	Y	58.24 9.4.1.63	In the context of a draft specification, what exactly is meant by the wording "The beamforming matrix V is formed by the beamformee as follows"? Is this intended as a mandatory requirement, or is it a recommendation? At present it's worded simply as a statement of fact. If the beamformee carries this step out incorrectly, would the device be non-compliant with the specification?	Rewrite to clarify whether the actions described are mandatory or optional.	2017/1/9 9:42
6340	John Coffey	225	1 9.4.1.63	58	24	E	Y	58.24 9.4.1.63	Detailed accounts of receiver behavior are not generally included in other places of the draft or in the base standard. Since we're defining a standardized air interface, receiver details are normally not included.	Reowrd to eliminate the receiver point of view. This can be done by changing the description to what the transmitter is conveying and/or a description of what a receiver may do.	2017/1/9 9:42
6341	John Coffey	225	1 9.4.1.63	58	26	T	Y	58.26 9.4.1.63	Imprecise language: "estimates the ... channel, and based on that channel ...". As worded, the basis appears to be the channel, not the estimated channel. If the esimated channel is meant, say so.	Change "based on that channel" to "based on that estimated channel".	2017/1/9 9:42
6342	John Coffey	225	1 9.4.1.63	63	23	E	Y	63.23 9.4.1.63	Unusual usage: "with the column l".	Change to "with column l".	2017/1/9 9:42
6343	John Coffey	225	1 9.4.1.64	64	6	E	Y	64.06 9.4.1.64	Confusing wording: "for each of the space time stream (1 to Nc)".	Change to "for each space time stream" or "for each of the space time streams".	2017/1/9 9:42
6344	John Coffey	225	1 9.4.1.64	64	9	E	Y	64.09 9.4.1.64	In the sentence "Starting from the lowest frequency subcarrier and continuing to the highest frequency subcarrer.", where is the verb?	Add a verb or otherwise rephrase.	2017/1/9 9:42
6345	John Coffey	225	1 9.4.1.64	64	11	E	Y	64.11 9.4.1.64	Missing article: "for delta SNR subfield".	Add "the" after "for".	2017/1/9 9:42
6346	John Coffey	225	1 9.4.1.64	64	11	E	Y	64.11 9.4.1.64	Is this the "delta SNR subfield" or the "Delta SNR subfield"? As a named subfield it should be capitalized.	Change "delta SNR" to "Delta SNR".	2017/1/9 9:42
6347	John Coffey	225	1 9.4.2.169	68	56	T	Y	68.56 9.4.2.169	Confusing variation in terms: here we have "HE fragmentation Operation subfield", whereas elsewhere we have "HE Fragnentation Operation subfield". Are these variants all describing the same thing? If so, the same term must be used.	Change "HE fragmentation Operation subfield" to "HE Fragmentation Operation subfield".	2017/1/9 9:42
6348	John Coffey	225	1 9.4.2.169	68	57	T	Y	68.57 9.4.2.169	Confusing variation in terms: here we have "HE fragmentation operation subfield", whereas elsewhere we have "HE Fragnentation Operation subfield" (and earlier in the same paragraph we have "HE fragmentation Operation subfield). Are these variants all describing the same thing? If so, the same term must be used.	Change "HE fragmentation operation subfield" to "HE Fragmentation Operation subfield".	2017/1/9 9:42
6349	John Coffey	225	1 9.4.2.169	69	59	E	Y	69.59 9.4.2.169	Superfluous comma: ", otherwise".	Delete comma.	2017/1/9 9:42
6350	John Coffey	225	1 9.4.2.200	71	4	E	Y	71.04 9.4.2.200	Unclear wording: "... contains 0s as the TWT ..." looks at first sight as if the TWT whatever contains 0s. In context it seems that the "as" means "because" here. The stray clause tacked on at the end by a comma doesn't help.	Change "as" to "because".	2017/1/9 9:42
6351	John Coffey	225	1 9.4.2.200	71	4	E	Y	71.04 9.4.2.200	The sentence in the fifth column has independent clasues linked by a comma without a coordinating conjunction. This is ungrammatical usage and it hurts clarity.	Change the comma to a semicolon.	2017/1/9 9:42
6352	John Coffey	225	1 9.4.2.200	73	9	T	Y	73.09 9.4.2.200	Garbled text: "Feedback can be contained is the QoS Control field".	Change "is" to "in".	2017/1/9 9:42
6353	John Coffey	225	1 9.4.2.200	73	34	T	Y	73.34 9.4.2.200	Garbled text: "Feedback can be contained is the QoS Control field".	Change "is" to "in".	2017/1/9 9:42

6354 John Coffey	225	1 9.4.2.200	74	4	E	Y	74.04 9.4.2.200	Anthropomorphism: "the TWT requesting STA expects". The STA is an object and does not "expect" anything.	Reword to remove the anthoropomorphism.	2017/1/9 9:42
6355 John Coffey	225	1 9.4.2.200	74	7	E	Y	74.07 9.4.2.200	Anthropomorphism: "the TWT requesting STA expects". The STA is an object and does not "expect" anything.	Reword to remove the anthoropomorphism.	2017/1/9 9:42
6356 John Coffey	225	1 9.4.2.200	74	21	E	Y	74.21 9.4.2.200	Inconsistent usage / "wicked which": here we have "which corresponds", whereas in most other places in the draft we have "that corresponds".	Change "which" to "that".	2017/1/9 9:42
6357 John Coffey	225	1 9.4.2.200	74	27	E	Y	74.27 9.4.2.200	Inconsistent usage / "wicked which": here we have "which corresponds", whereas in most other places in the draft we have "that corresponds".	Change "which" to "that".	2017/1/9 9:42
6358 John Coffey	225	1 9.4.2.200	74	36	E	Y	74.36 9.4.2.200	Independent clauses linked by a comma without a coordinating conjunction.	Change comma to semicolon.	2017/1/9 9:42
6359 John Coffey	225	1 9.4.2.200	74	43	E	Y	74.43 9.4.2.200	Superfluous comma: ", is not present".	Delete comma.	2017/1/9 9:42
6360 John Coffey	225	1 9.4.2.200	74	59	E	Y	74.59 9.4.2.200	Missing space: "BSS.The".	Add space.	2017/1/9 9:42
6361 John Coffey	225	1 9.4.2.200	75	20	E	Y	75.20 9.4.2.200	Incomplete case switch: "that (those) TWTs" reads as "that TWTs or those TWTs". To be consistent the "TWTs" needs to be modified also.	Change "TWTs" to "TWT(s)".	2017/1/9 9:42
6362 John Coffey	225	1 9.4.2.200	75	49	E	Y	75.49 9.4.2.200	Incomplete case switch: "that (those) TWTs" reads as "that TWTs or those TWTs". To be consistent the "TWTs" needs to be modified also.	Change "TWTs" to "TWT(s)".	2017/1/9 9:42
6363 John Coffey	225	1 9.4.2.200	75	50	T	Y	75.50 9.4.2.200	The second case here is when the relevant STA is not an S1G STA, whereas earlier in the same section (P75 L20) the condition is "within an HE BSS". Is there some distinction intended? Can TWT be used in non-S1G, non-HE BSSs?	Change "is not an S1G STA" to "is an HE STA".	2017/1/9 9:42
6364 John Coffey	225	1 9.4.2.218.2	77	21	E	Y	77.21 9.4.2.218.2	Inconsistent usage: here we have "Indicates if the STA supports", whereas elsewhere in the same table we have "Indicates support by an HE STA". It would be better to pick one form and to stick to it.	Change "Indicates if the STA supports" to "Indicates support by an HE STA for".	2017/1/9 9:42
6365 John Coffey	225	1 9.4.2.218.2	77	39	E	Y	77.39 9.4.2.218.2	In the Definitions column, we have "a STA", whereas elsewhere in the same column we (mostly) have "an HE STA". Is any distinction intended? If not, the same term should be used.	Change "a STA" to "an HE STA".	2017/1/9 9:42
6366 John Coffey	225	1 9.4.2.218.2	77	40	E	Y	77.40 9.4.2.218.2	Inconsistent usage: we have both "a S-MPDU" and "an S-MPDU" in the draft. Though the former is used more often, the latter seems correct.	Change "a S-MPDU" to "an S-MPDU".	2017/1/9 9:42
6367 John Coffey	225	1 9.4.2.218.2	77	41	E	Y	77.41 9.4.2.218.2	Inconsistent usage: we have both "a S-MPDU" and "an S-MPDU" in the draft. Though the former is used more often, the latter seems correct.	Change "a S-MPDU" to "an S-MPDU".	2017/1/9 9:42
6368 John Coffey	225	1 9.4.2.218.2	77	43	T	Y	77.43 9.4.2.218.2	Use of undefined term: "Single MPDU". From the capitalization, it must be inferred that this is a defined term, but where is the definition? The draft also uses "single MPDU", and for good measure both "VHT Single MPDU" and "VHT single MPDU". The baseline	Clarify.	2017/1/9 9:42
6369 John Coffey	225	1 9.4.2.218.2	77	46	T	Y	77.46 9.4.2.218.2	Use of undefined term: "Single MPDU". From the capitalization, it must be inferred that this is a defined term, but where is the definition? The draft also uses "single MPDU", and for good measure both "VHT Single MPDU" and "VHT single MPDU". The baseline	Clarify.	2017/1/9 9:42
6370 John Coffey	225	1 9.4.2.218.2	77	48	T	Y	77.48 9.4.2.218.2	Use of undefined term: "Single MPDU". From the capitalization, it must be inferred that this is a defined term, but where is the definition? The draft also uses "single MPDU", and for good measure both "VHT Single MPDU" and "VHT single MPDU". The baseline	Clarify.	2017/1/9 9:42

6371 John Coffey	225	1 9.4.2.218.2	77	52	T	Y	77.52 9.4.2.218.2	Use of undefined term: "Single MPDU". From the capitalization, it must be inferred that this is a defined term, but where is the definition? The draft also uses "single MPDU", and for good measure both "VHT Single MPDU" and "VHT single MPDU". The baseline	Clarify.	2017/1/9 9:42
6372 John Coffey	225	1 9.4.2.218.2	77	56	E	Y	77.56 9.4.2.218.2	In the Definitions column, we have "a STA", whereas elsewhere in the same column we (mostly) have "an HE STA". Is any distinction intended? If not, the same term should be used.	Change "a STA" to "an HE STA".	2017/1/9 9:42
6373 John Coffey	225	1 9.4.2.218.2	78	16	E	Y	78.16 9.4.2.218.2	In the Definitions column, we have "a non-AP STA", whereas elsewhere in the same column we have "an HE STA".	Change "a non-AP STA" to "an HE non-AP STA".	2017/1/9 9:42
6374 John Coffey	225	1 9.4.2.218.2	78	26	E	Y	78.26 9.4.2.218.2	Inconsistent usage: here we have "Indicates whether the STA supports", whereas elsewhere in the same table we have "Indicates support by an HE STA". It would be better to pick one form and to stick to it.	Change "Indicates whether the STA supports" to "Indicates support by an HE STA for".	2017/1/9 9:42
6375 John Coffey	225	1 9.4.2.218.2	78	38	E	Y	78.38 9.4.2.218.2	Inconsistent usage: here we have "Indicates whether the STA supports", whereas elsewhere in the same table we have "Indicates support by an HE STA". It would be better to pick one form and to stick to it.	Change "Indicates whether the STA supports" to "Indicates support by an HE STA for".	2017/1/9 9:42
6376 John Coffey	225	1 9.4.2.218.2	78	52	E	Y	78.52 9.4.2.218.2	In the Definitions column, we have "a non-AP STA", whereas elsewhere in the same column we have "an HE STA".	Change "a non-AP STA" to "an HE non-AP STA".	2017/1/9 9:42
6377 John Coffey	225	1 9.4.2.218.2	79	14	E	Y	79.14 9.4.2.218.2	In the Definitions column, we have "a STA", whereas elsewhere in the same column we (mostly) have "an HE STA". Is any distinction intended? If not, the same term should be used.	Change "a non-AP STA" to "an HE non-AP STA".	2017/1/9 9:42
6378 John Coffey	225	1 9.4.2.218.2	79	22	E	Y	79.22 9.4.2.218.2	In the Definitions column, we have "a non-AP STA", whereas elsewhere in the same column we have "an HE STA".	Change "a STA" to "an HE STA".	2017/1/9 9:42
6379 John Coffey	225	1 9.4.2.218.2	79	34	E	Y	79.34 9.4.2.218.2	Unusual and awkward syntax: "Indicates support for a [STA] to follow the OFDMA random access procedure ...".	Change to "Indicates suppport by [a STA] for the OFDMA random access procedure …".	2017/1/9 9:42
6380 John Coffey	225	1 9.4.2.218.2	79	34	E	Y	79.34 9.4.2.218.2	In the Definitions column, we have "a non-AP STA", whereas elsewhere in the same column we have "an HE STA".	Change "a non-AP STA" to "an HE non-AP STA".	2017/1/9 9:42
6381 John Coffey	225	1 9.4.2.218.2	79	57	E	Y	79.57 9.4.2.218.2	Inconsistent usage: here we have "Indicates whether the non-AP STA supports", whereas elsewhere in the same table we have "Indicates support by an HE STA". It would be better to pick one form and to stick to it.	Change "Indicates whether the non-AP STA supports" to "Indicates support by an HE non-AP STA for".	2017/1/9 9:42
6382 John Coffey	225	1 9.4.2.218.2	79	57	E	Y	79.57 9.4.2.218.2	In the Definitions column, we have "a non-AP STA", whereas elsewhere in the same column we have "an HE STA".	Change "a non-AP STA" to "an HE non-AP STA".	2017/1/9 9:42
6383 John Coffey	225	1 9.4.2.218.2	79	57	E	Y	79.57 9.4.2.218.2	Inconsistent usage: here we have "the" STA, whereas in a majority of other cases in the same table we have "a" STA. Why the variation? It would be better to choose one form and to stick to it.	Change "the" to "a" or "an", as appropriate.	2017/1/9 9:42
6384 John Coffey	225	1 9.4.2.218.2	80	4	E	Y	80.04 9.4.2.218.2	Inconsistent usage: here we have "Indicates whether or not the STA", whereas elsewhere in the same table we have "Indicates support for". This is the fourth distinct variant in the same table.	Change "Indicates whether or not the STA supports" to "Indicates support for".	2017/1/9 9:42
6385 John Coffey	225	1 9.4.2.218.2	80	4	E	Y	80.04 9.4.2.218.2	In the Definitions column, we have "the STA", whereas elsewhere in the same table we have "an HE STA".	Change "the STA" to "an HE STA".	2017/1/9 9:42
6386 John Coffey	225	1 9.4.2.218.2	80	19	E	Y	80.19 9.4.2.218.2	In the Definitions column, we have "a non-AP STA", whereas elsewhere in the same column we have "an HE STA".	Change "a non-AP STA" to "an HE non-AP STA".	2017/1/9 9:42
6387 John Coffey	225	1 9.4.2.218.2	80	27	E	Y	80.27 9.4.2.218.2	Missing article: "in HE Capabilities element".	Change to "in the HE Capabilities element".	2017/1/9 9:42
6388 John Coffey	225	1 9.4.2.218.2	80	27	E	Y	80.27 9.4.2.218.2	Missing article: in VHT Capabilities element".	Change to "in the VHT Capabilities element".	2017/1/9 9:42
6389 John Coffey	225	1 9.4.2.218.2	80	28	E	Y	80.28 9.4.2.218.2	Missing article: "of A-MPDU".	Change to "of an A-MPDU".	2017/1/9 9:42

6390	John Coffey	225	1 9.4.2.218.2	80	28	T	Y	80.28 9.4.2.218.2	Why "Receive" rather than "receive"? Is this a defined term?	Change "Receive" to "receive".	2017/1/9 9:42
6391	John Coffey	225	1 9.4.2.218.2	80	30	E	Y	80.30 9.4.2.218.2	Missing article: "When Maximum A-MPDU Length Exponent subfield".	Change to "When the Maximum A-MPDU Length Exponent subfield".	2017/1/9 9:42
6392	John Coffey	225	1 9.4.2.218.2	80	31	E	Y	80.31 9.4.2.218.2	Missing article: "in Maximum A-MPDU Length Exponent subfield".	Change to "in the Maximum A-MPDU Length Exponent subfield".	2017/1/9 9:42
6393	John Coffey	225	1 9.4.2.218.2	80	31	E	Y	80.31 9.4.2.218.2	Missing article: "in VHT Capabilities element".	Change to "in the VHT Capabilities element".	2017/1/9 9:42
6394	John Coffey	225	1 9.4.2.218.2	80	32	E	Y	80.32 9.4.2.218.2	Missing article: "of A-MPDU".	Change to "of an A-MPDU".	2017/1/9 9:42
6395	John Coffey	225	1 9.4.2.218.2	80	33	E	Y	80.33 9.4.2.218.2	Missing article: "When Maximum A-MPDU Length Exponent subfield".	Change to "When the Maximum A-MPDU Length Exponent subfield".	2017/1/9 9:42
6396	John Coffey	225	1 9.4.2.218.2	80	32	T	Y	80.32 9.4.2.218.2	Why "Receive" rather than "receive"? Is this a defined term?	Change "Receive" to "receive".	2017/1/9 9:42
6397	John Coffey	225	1 9.4.2.218.2	80	33	E	Y	80.33 9.4.2.218.2	Missing article: "in HE Capabilities element".	Change to "in the HE Capabilities element".	2017/1/9 9:42
6398	John Coffey	225	1 9.4.2.218.2	80	35	E	Y	80.35 9.4.2.218.2	Missing article: "in Maximum A-MPDU Length Exponent subfield".	Change to "in the Maximum A-MPDU Length Exponent subfield".	2017/1/9 9:42
6399	John Coffey	225	1 9.4.2.218.2	80	35	E	Y	80.35 9.4.2.218.2	Missing article: "in VHT Capabilities element".	Change to "in the VHT Capabilities element".	2017/1/9 9:42
6400	John Coffey	225	1 9.4.2.218.2	80	35	E	Y	80.35 9.4.2.218.2	Superfluous comma: ", otherwise".	Delete comma.	2017/1/9 9:42
6401	John Coffey	225	1 9.4.2.218.2	80	37	E	Y	80.37 9.4.2.218.2	Missing article: "in Maximum A-MPDU Length Exponent subfield".	Change to "in the Maximum A-MPDU Length Exponent subfield".	2017/1/9 9:42
6402	John Coffey	225	1 9.4.2.218.2	80	37	E	Y	80.37 9.4.2.218.2	Missing article: "in HE Capabilities element".	Change to "in the HE Capabilities element".	2017/1/9 9:42
6403	John Coffey	225	1 9.4.2.218.2	80	41	E	Y	80.41 9.4.2.218.2	Missing article: "include VHT Capabilities element".	Change to "include the VHT Capabilities element" (or "include a VHT Capabilities element").	2017/1/9 9:42
6404	John Coffey	225	1 9.4.2.218.2	80	43	E	Y	80.43 9.4.2.218.2	Missing article: "in HE Capabilities element".	Change to "in the HE Capabilities element".	2017/1/9 9:42
6405	John Coffey	225	1 9.4.2.218.2	80	44	E	Y	80.44 9.4.2.218.2	Missing article: "in HE Capabilities element".	Change to "in the HE Capabilities element".	2017/1/9 9:42
6406	John Coffey	225	1 9.4.2.218.2	80	44	T	Y	80.44 9.4.2.218.2	Why "Receive" rather than "receive"? Is this a defined term?	Change "Receive" to "receive".	2017/1/9 9:42
6407	John Coffey	225	1 9.4.2.218.2	80	45	E	Y	80.45 9.4.2.218.2	Missing article: "When Maximum A-MPDU Length Exponent subfield".	Change to "When the Maximum A-MPDU Length Exponent subfield".	2017/1/9 9:42
6408	John Coffey	225	1 9.4.2.218.2	80	45	E	Y	80.45 9.4.2.218.2	Missing article: "in HE Capabilities element".	Change to "in the HE Capabilities element".	2017/1/9 9:42
6409	John Coffey	225	1 9.4.2.218.2	80	47	T	Y	80.47 9.4.2.218.2	Why "Receive" rather than "receive"? Is this a defined term?	Change "Receive" to "receive".	2017/1/9 9:42
6410	John Coffey	225	1 9.4.2.218.2	80	48	E	Y	80.48 9.4.2.218.2	Missing article: "When Maximum A-MPDU Length Exponent subfield".	Change to "When the Maximum A-MPDU Length Exponent subfield".	2017/1/9 9:42
6411	John Coffey	225	1 9.4.2.218.2	80	48	E	Y	80.48 9.4.2.218.2	Missing article: "in HE Capabilities element".	Change to "in the HE Capabilities element".	2017/1/9 9:42
6412	John Coffey	225	1 9.4.2.218.2	80	50	E	Y	80.50 9.4.2.218.2	Missing article: "in Maximum A-MPDU Length Exponent subfield".	Change to "in the Maximum A-MPDU Length Exponent subfield".	2017/1/9 9:42
6413	John Coffey	225	1 9.4.2.218.2	80	50	E	Y	80.50 9.4.2.218.2	Missing article: "in HT Capabilities element".	Change to "in the HT Capabilities element".	2017/1/9 9:42
6414	John Coffey	225	1 9.4.2.218.2	80	53	E	Y	80.53 9.4.2.218.2	Missing article: "in Maximum A-MPDU Length Exponent subfield".	Change to "in the Maximum A-MPDU Length Exponent subfield".	2017/1/9 9:42
6415	John Coffey	225	1 9.4.2.218.2	80	53	E	Y	80.53 9.4.2.218.2	Missing article: "in HE Capabilities element".	Change to "in the HE Capabilities element".	2017/1/9 9:42
6416	John Coffey	225	1 9.4.2.218.3	82	14	E	Y	82.14 9.4.2.218.3	Incorrect case or missing word: "STA support 40 MHz".	Change to "that the STA supports 40 MHz" or "STA support for 40 MHz".	2017/1/9 9:42
6417	John Coffey	225	1 9.4.2.218.3	82	17	E	Y	82.17 9.4.2.218.3	Incorrect case or missing word: "STA support 40 MHz and 80 MHz".	Change to "STA support for 40 MHz and 80 MHz".	2017/1/9 9:42
6418	John Coffey	225	1 9.4.2.218.3	82	27	T	Y	82.27 9.4.2.218.3	Why "Reserved" rather than "reserved"? Is this a defined term?	Change "Reserved" to "reserved".	2017/1/9 9:42
6419	John Coffey	225	1 9.4.2.218.3	82	32	T	Y	82.32 9.4.2.218.3	Why "Reserved" rather than "reserved"? Is this a defined term?	Change "Reserved" to "reserved".	2017/1/9 9:42
6420	John Coffey	225	1 9.4.2.218.3	82	44	E	Y	82.44 9.4.2.218.3	Inconsistent (and odd) usage: "advertised of 2.4 GHz". Why "of"? Earlier in the same column we have "advertised "on" 5 GHz, also somewhat odd.	Choose a consistent form.	2017/1/9 9:42
6421	John Coffey	225	1 9.4.2.218.3	83	16	T	Y	83.16 9.4.2.218.3	Incorrect units: in the second column, the units "us" are used.	Change to "ms".	2017/1/9 9:42
6422	John Coffey	225	1 9.4.2.218.3	83	19	T	Y	83.19 9.4.2.218.3	Incorrect units: in the second column, the units "us" are used.	Change to "ms".	2017/1/9 9:42
6423	John Coffey	225	1 9.4.2.218.3	83	25	T	Y	83.25 9.4.2.218.3	Incorrect units: in the second column, the units "us" are used.	Change to "ms".	2017/1/9 9:42
6424	John Coffey	225	1 9.4.2.218.3	83	28	T	Y	83.28 9.4.2.218.3	Incorrect units: in the second column, the units "us" are used.	Change to "ms".	2017/1/9 9:42
6425	John Coffey	225	1 9.4.2.218.3	84	54	E	Y	84.54 9.4.2.218.3	Superfluous comma: "Otherwise, reserved".	Delete comma.	2017/1/9 9:42
6426	John Coffey	225	1 9.4.2.218.3	85	11	E	Y	85.11 9.4.2.218.3	Superfluous comma: "Otherwise, reserved".	Delete comma.	2017/1/9 9:42
6427	John Coffey	225	1 9.4.2.218.3	85	23	E	Y	85.23 9.4.2.218.3	Superfluous comma: "Otherwise, reserved".	Delete comma.	2017/1/9 9:42
6428	John Coffey	225	1 9.4.2.218.3	85	29	E	Y	85.29 9.4.2.218.3	Superfluous comma: "Otherwise, reserved".	Delete comma.	2017/1/9 9:42

6429 John Coffey	225	1 9.4.2.218.3	86	31	T	Y	86.31 9.4.2.218.3	Vague and unhelpful terminology: "Class A STAs are high capability devices and Class B STAs are low capability devices." Since the terms "high capability" and "low capability" are not defined here, this statement does not provide useful information. At best it conveys a rough intuitive idea of what was intended. This might be appropriate in marketing slides or a tutorial presentation but it should have no place in a specification.	Change to "Class A STAs support the mandatory features described in x.y.z.w" or appropriate equivalent text.	2017/1/9 9:42
6430 John Coffey	225	1 9.4.2.218.3	86	53	E	Y	86.53 9.4.2.218.3	Superfluous comma.	Delete comma.	2017/1/9 9:42
6431 John Coffey	225	1 9.4.2.218.3	87	41	E	Y	87.41 9.4.2.218.3	Incomplete case switch: "a set of [...] field(s)" expands to "a set of [...] field" or "a set of [...] fields".	Change "a set of" to "a (set of)".	2017/1/9 9:42
6432 John Coffey	225	1 9.4.2.218.3	87	49	E	Y	87.49 9.4.2.218.3	Incomplete case switch: "a set of [...] field(s)" expands to "a set of [...] field" or "a set of [...] fields".	Change "a set of" to "a (set of)".	2017/1/9 9:42
6433 John Coffey	225	1 9.4.2.218.3	87	57	T	Y	87.57 9.4.2.218.3	The text provides a case in which certain subfields "do not need to be present". This seems to imply that the subfields could be present even though they do not need to be. Why allow an extra case? Is the assumption that subfields that do not need to be present will therefore not be present in different implementations?	Change "do not need to be present" to "are not present" (or shall not be present, or equivalent text).	2017/1/9 9:42
6434 John Coffey	225	1 9.4.2.218.5	89	21	E	Y	89.21 9.4.2.218.5	Long run-on sentence: the sentence starting "PPE threshold values appear" is too long. The meaning would be clearer if it were split into two.	Split the sentence.	2017/1/9 9:42
6435 John Coffey	225	1 9.4.2.218.5	89	27	E	Y	89.27 9.4.2.218.5	In the text "for all values of n and b where ...", it seems that "for which" is meant instead of "where".	Change "where" to "for which".	2017/1/9 9:42
6436 John Coffey	225	1 9.4.2.218.5	90	5	E	Y	90.05 9.4.2.218.5	Inconsistent usage: the quantities "n" and "b" should be italicized.	Italicize the quantities "n" and "b".	2017/1/9 9:42
6437 John Coffey	225	1 9.4.2.219	91	40	T	Y	91.40 9.4.2.219	Unnecessary variant used for defined term: "BSS color". The term is "BSS Color".	Change to "BSS Color".	2017/1/9 9:42
6438 John Coffey	225	1 9.4.2.219	91	41	E	Y	91.41 9.4.2.219	Inconsistent usage / "wicked which": here we have "which transmitted", whereas in every other place in the draft we have "that transmitted".	Change "which" to "that".	2017/1/9 9:42
6439 John Coffey	225	1 9.4.2.219	91	41	T	Y	91.41 9.4.2.219	Unnecessary variant used for defined term: "BSS color". The term is "BSS Color".	Change to "BSS Color".	2017/1/9 9:42
6440 John Coffey	225	1 9.4.2.219	91	55	E	Y	91.55 9.4.2.219	Inconsistent usage: here we have "non-AP HE STA", whereas almost everywhere else in the draft we have "HE non-AP STA".	Change to "HE non-AP STA".	2017/1/9 9:42
6441 John Coffey	225	1 9.4.2.219	92	3	T	Y	92.03 9.4.2.219	Unnecessary variant used for defined term: "BSS color". The term is "BSS Color".	Change to "BSS Color".	2017/1/9 9:42
6442 John Coffey	225	1 9.4.2.219	92	3	T	Y	92.03 9.4.2.219	(Second instance on same line:) Unnecessary variant used for defined term: "BSS color". The term is "BSS Color".	Change to "BSS Color".	2017/1/9 9:42
6443 John Coffey	225	1 9.4.2.219	92	4	T	Y	92.04 9.4.2.219	Unnecessary variant used for defined term: "BSS color". The term is "BSS Color".	Change to "BSS Color".	2017/1/9 9:42
6444 John Coffey	225	1 9.4.2.219	92	5	E	Y	92.05 9.4.2.219	Missing article: "from Multiple BSSID element".	Change to "from the Multiple BSSID element".	2017/1/9 9:42
6445 John Coffey	225	1 9.4.2.219	92	10	E	Y	92.10 9.4.2.219	Missing article: "corresponds to transmitted BSSID".	Change to "corresponds to a transmitted BSSID".	2017/1/9 9:42
6446 John Coffey	225	1 9.4.2.219	92	14	E	Y	92.14 9.4.2.219	Missing article: "to non-zero value".	Change to "to a non-zero value".	2017/1/9 9:42
6447 John Coffey	225	1 9.4.2.219	92	23	T	Y	92.23 9.4.2.219	Unnecessary variant used for defined term: "BSS color". The term is "BSS Color".	Change to "BSS Color".	2017/1/9 9:42
6448 John Coffey	225	1 9.4.2.219	92	28	E	Y	92.28 9.4.2.219	Incorrect form of article / inconsistent usage: here we have "a HE non-AP STA", whereas in most other places in the draft we have "an HE non-AP STA".	Change "a" to "an".	2017/1/9 9:42
6449 John Coffey	225	1 9.4.2.219	92	28	E	Y	92.28 9.4.2.219	Missing word or article: "from associated AP".	Change to "its associated AP".	2017/1/9 9:42
6450 John Coffey	225	1 9.4.2.219	92	29	E	Y	92.29 9.4.2.219	Missing article: "should not exclusively use BSS Color paramter".	Change to "should not exclusively use the BSS Color parameter".	2017/1/9 9:42
6451 John Coffey	225	1 9.4.2.219	92	29	E	Y	92.29 9.4.2.219	Missing article or wrong case: "in making decision".	Change to "in making a decision" or "in making decisions".	2017/1/9 9:42

6452 John Coffey	225	1 9.4.2.219	92	29	T	Y	92.29 9.4.2.219	Normative statement that is contradicted later in the same paragraph: "should not exlusively use". At the end of the paragraph we find that this only applies if there has been no intervening contrary signaling from the AP. The conflict is minor but unnecessary, and it would be better to avoid it.	Reword to eliminate the contradiction: for example, if the most recently received HE Element from that AP contains a 1, then ... etc.	2017/1/9 9:42
6453 John Coffey	225	1 9.4.2.220	93	53	E	Y	93.53 9.4.2.220	Missing qualifier / inconsistent usage: here we have "STA" whereas elsewhere we have "HE STA".	Change "a STA" to "an HE STA".	2017/1/9 9:42
6454 John Coffey	225	1 9.4.2.220	93	62	E	Y	93.62 9.4.2.220	Missing word / awkward suage: "retransmission attempts of UL OFDMA random access".	Change to "retransmission attempts of UL OFDMA transmissions".	2017/1/9 9:42
6455 John Coffey	225	1 9.4.2.219	92	30	E	Y	92.30 9.4.2.219	Incorrect conjunction: the sentence structure is not entirely clear but it seems reasonable to assume that the last "and" could be followed by another instance of "should not exclusively use ...". But in that case the conjunction is wrong.	Change "and" to "or".	2017/1/9 9:42
6456 John Coffey	225	1 9.4.2.219	92	30	E	Y	92.30 9.4.2.219	Inconsistent usage: "the non-AP STA". Since "HE non-AP STA" has been mentioned earlier in the paragraph, it is arguably permissible to use "non-AP STA" or even simply "STA" here, but for consistency and clarity purposes it seems better to use terms consistently.	Change "the non-AP STA" to "the HE non-AP STA".	2017/1/9 9:42
6457 John Coffey	225	1 9.4.2.219	92	31	E	Y	92.31 9.4.2.219	Missing article / inconsistent usage: "HE non-AP STA" at beginning of sentence.	Change to "An HE non-AP STA".	2017/1/9 9:42
6458 John Coffey	225	1 9.4.2.219	92	32	T	Y	92.32 9.4.2.219	Vague and imprecise language: "(re)enable BSS Color related features". What precisely does "related" mean here? For example, the ability of an AP to recommend disabling BSS Color use by associated STAs is clearly "related" to BSS Color; is this included or not? It is, to be sure, not too hard to guess that the intention was that it is not included, but the specification should not put the reader in the position to have to guess.	Change "BSS Color related features" to a list or reference to a list of exactly which features are meant.	2017/1/9 9:42
6459 John Coffey	225	1 9.4.2.221	94	4	E	Y	94.04 9.4.2.221	Inconsistent terminology: here we have "non-AP STAs" whereas in most places in the draft we have "HE non-AP STAs".	Change "non-AP STAs" to "HE non-AP STAs".	2017/1/9 9:42
6460 John Coffey	225	1 9.4.2.221	94	32	E	Y	94.32 9.4.2.221	Inconsistent erminology: here we have "non-AP STA", whereas in most places in the draft we have "HE non-AP STAs".	Change "non-AP STAs" to "HE non-AP STAs".	2017/1/9 9:42
6461 John Coffey	225	1 9.4.2.221	94	37	E	Y	94.37 9.4.2.221	Missing article: "The format of [A, B, C, and D] fields".	Change to "The format of the [A, B, C, and D] fields".	2017/1/9 9:42
6462 John Coffey	225	1 9.4.2.221	94	39	T	Y	94.39 9.4.2.221	Here format is "illustrated" in the Figure, whereas in most other places in the draft, format is "defined" in a figure. Is the present statement normative or is it an explanatory restatement of an explicit definition somewhere else?	If this is intended to be the definition, change "illusrated" to "defined".	2017/1/9 9:42
6463 John Coffey	225	1 9.4.2.221	94	52	T	Y	94.52 9.4.2.221	Here format is "illustrated" in the Figure, whereas in most other places in the draft, format is "defined" in a figure. Is the present statement normative or is it an explanatory restatement of an explicit definition somewhere else?	If this is intended to be the definition, change "illusrated" to "defined".	2017/1/9 9:42
6464 John Coffey	225	1 9.4.2.221	94	59	T	Y	94.59 9.4.2.221	Here format is "illustrated" in the Figure, whereas in most other places in the draft, format is "defined" in a figure. Is the present statement normative or is it an explanatory restatement of an explicit definition somewhere else?	If this is intended to be the definition, change "illusrated" to "defined".	2017/1/9 9:42
6465 John Coffey	225	1 9.4.2.223	95	51	E	Y	95.51 9.4.2.223	Solecism: "an STA-to-STA operation".	Delete "an".	2017/1/9 9:42
6466 John Coffey	225	1 9.4.2.223	95	55	T	Y	95.55 9.4.2.223	Variant terms used for the same feature: "STA-2-STA operation". A matter of a few sentences earlier we have "STA-to-STA". Which is it?	Change "STA-2-STA" to "STA-to-STA".	2017/1/9 9:42
6467 John Coffey	225	1 9.4.2.223	96	19	E	Y	96.19 9.4.2.223	Missing article: "is set to duration".	Change to "is set to a duration".	2017/1/9 9:42

6468	John Coffey	225	1 9.4.2.223	96	23	E	Y	96.23 9.4.2.223	Solecism: incorrect use of definite article: "the HE STA supporting it". Is there just one HE STA supporting it?	Change "the" to "an" or "any".	2017/1/9 9:42
6469	John Coffey	225	1 9.4.2.223	96	23	T	Y	96.23 9.4.2.223	Vague and uninformative language: "indicates a specified operation". Which oiperation? Where is it specified?	Provide additional, clarifying information. If this operation is specified elsewhere in the draft, say so and provide a reference. If the specification is by the vendor, and thus outside the scope of this draft, delete the word "specified".	2017/1/9 9:42
6470	John Coffey	225	1 9.4.2.223	96	23	T	Y	96.23 9.4.2.223	Ambiguous langauge: "The Vendor Specific Service ID field indicates a specified operation, and the HE STA that supports it". Does "it" refer to the Vendor Specific Service ID field or the specified operation?	Clarify.	2017/1/9 9:42
6471	John Coffey	225	1 9.4.2.224	96	32	T	Y	96.32 9.4.2.224	The format of the element is "shown" in the Figure. In many other places in the draft, format is defined in figures. In the present instance, is this showing really a definition? If so, say so.	Change "shown" to "defined".	2017/1/9 9:42
6472	John Coffey	225	1 9.4.2.224	96	62	E	Y	96.62 9.4.2.224	Missing article: "is set to duration".	Change to "is set to the duration".	2017/1/9 9:42
6473	John Coffey	225	1 9.4.2.225	97	43	T	Y	97.43 9.4.2.225	Vague and uninformative language: "indicates a specified operation". Which oiperation? Where is it specified?	Provide additional, clarifying information. If this operation is specified elsewhere in the draft, say so and provide a reference. If the specification is by the vendor, and thus outside the scope of this draft, delete the word "specified".	2017/1/9 9:42
6474	John Coffey	225	1 9.4.2.225	97	43	E	Y	97.43 9.4.2.225	Solecism: incorrect use of definite article: "the HE STA supporting it". Is there just one HE STA supporting it?	Change "the" to "an" or "any".	2017/1/9 9:42
6475	John Coffey	225	1 9.6.8.36	99	61	E	Y	99.61 9.6.8.36	Independent clauses linked by a comma without a coordinating conjunction.	Change comma to semicolon.	2017/1/9 9:42
6476	John Coffey	225	1 9.6.29.3	105	4	E	Y	105.04 9.6.29.3	Missing article: "sent by HE STA".	Change to "sent by an HE STA".	2017/1/9 9:42
6477	John Coffey	225	1 9.6.29.3	105	5	E	Y	105.05 9.6.29.3	Missing article: "indicated by Quiet Time Period Request element".	Change to "indicated by the Quiet Time Period Request element".	2017/1/9 9:42
6478	John Coffey	225	1 9.7.1	106	4	T	Y	106.04 9.7.1	In the first and third elements of the list, it is stated that "The content of these octets is unspecified. However in the second element we have no such phrase. Since there can be more than zero EOF Padding Subframes, either the content needs to be specified or a note added to say that the content is left unspecified.	Either the content needs to be specified or a note added to say that the content is left unspecified.	2017/1/9 9:42
6479	John Coffey	225	1 9.7.1	106	36	E	Y	106.36 9.7.1	Inconsistent usage: we have both "a S-MPDU" and "an S-MPDU" in the draft. Though the former is used more often, the latter seems correct.	Change "a S-MPDU" to "an S-MPDU".	2017/1/9 9:42
6480	John Coffey	225	1 9.7.1	107	3	T	Y	107.03 9.7.1	In equation (9-5), L_MPDU is defined for VHT, HT, and DMG PPDUs, but not foe HE PPDUs. What is the definition for HE PPDUs?	Modify equation (9-5) to add a definition of L_MPDU for HE PPDUs.	2017/1/9 9:42
6481	John Coffey	225	1 9.7.1	107	15	T	Y	107.15 9.7.1	The last sentence of the Note discusses HT and VHT PPDUs, but not HE PPDUs. What pattern is followed by HE PPDUs?	Modify the Note to describe the pattern for HE PPDUs.	2017/1/9 9:42
6482	John Coffey	225	1 9.7.3	107	35	E	Y	107.35 9.7.3	Incorrect conjunction: "An A-MPDU carried in an HE SU PPDU, HE extended range SU PPDU, HE trigger-based PPDU and HE MU PPDU". It will be a rare A-MPDU that is carried in all four of these.	Change "and" to "or".	2017/1/9 9:42
6483	John Coffey	225	1 9.7.3	107	53	E	Y	107.53 9.7.3	Superfluous verbiage: what difference does the word 'all" make here, and how would the meaning change if it was deleted?	Delete "all".	2017/1/9 9:42
6484	John Coffey	225	1 9.7.3	107	53	T	Y	107.53 9.7.3	Instead of "(all) HE trigger-based PPDUs addressed to the same AP", it would be more precise to write "HE trigger-based PPDUs transmitted simultaneously to the same AP", or in response to the same HE trigger frame, or something. HE trigger-based PPDUs transmitted at different times do not have to carry the same value, even if they are addressed to the same AP.	Change "all HE trigger-based PPDUs addressed to the same AP" to "HE trigger-based PPDUs transmitted simultaneously to the same AP".	2017/1/9 9:42

6485	John Coffey	225	1 9.7.3	107	65	E	Y	107.65 9.7.3	Incorrect and superfluous definite article: "The further restrictions".	Change to "Further restrictions".	2017/1/9 9:42
6486	John Coffey	225	1 9.7.3	108	19	T	Y	108.19 9.7.3	"The 4095-octet limit does not apply to A-MPDUs carried in VHT or DMG PPDUs". Well and good, but what about HE PPDUs?	Add appropriate statement about HE PPDUs.	2017/1/9 9:42
6487	John Coffey	225	1 9.7.3	108	40	T	Y	108.40 9.7.3	Garbled text, unclear meaning: "by a TXOP holder, TXOP responder that does not include or solicit an immediate response". Apart from being ungrammatical, does the clause starting "that" apply to both TXOP holder and TXOP responder or just to the latter? Here we are left to try to guess from the change tracking marks.	Change "TXOP holder, TXOP responder" to "TXOP holder or TXOP responder" (if that is what is meant).	2017/1/9 9:42
6488	John Coffey	225	1 9.7.3	108	50	E	Y	108.50 9.7.3	Missing article: "transmitted by AP".	Change to "transmitted by an AP".	2017/1/9 9:42
6489	John Coffey	225	1 9.7.3	108	50	E	Y	108.50 9.7.3	Ungrammatical construction: "transmitted by (an) AP in an HE BSS that also needs to transmit one of the following". It is the AP, not the HE BSS, that might need to transmit one of the following.	Reword appropriately.	2017/1/9 9:42
6490	John Coffey	225	1 9.7.3	109	24	E	Y	109.24 9.7.3	Inconsistent usage: here we have "In [...]: If" (capital), whereas elsewhere in the draft, including several instances in the same table entry, we have "In [...]: if" (lower case).	Change "If" to "if".	2017/1/9 9:42
6491	John Coffey	225	1 9.7.3	110	12	E	Y	110.12 9.7.3	Missing article: "except HE BSS".	Change to "except an HE BSS".	2017/1/9 9:42
6492	John Coffey	225	1 9.7.3	110	14	E	Y	110.14 9.7.3	Inconsistent usage / "wicked which": here we have "which corresponds", whereas in most other places in the draft we have "that corresponds".	Change "which" to "that".	2017/1/9 9:42
6493	John Coffey	225	1 10.3.2.4	115	8	E	Y	115.08 10.3.2.4	Missing article: "carried information". Some information?	Change to "carried the information".	2017/1/9 9:42
6494	John Coffey	225	1 10.3.2.4	115	8	E	Y	115.08 10.3.2.4	Missing article: "is not HE trigger-based PPDU triggered by the STA".	Change to "is not an HE trigger-based PPDU triggered by the STA".	2017/1/9 9:42
6495	John Coffey	225	1 10.3.2.4	115	18	E	Y	115.18 10.3.2.4	Odd and ungrammatical construction: "before the end of the PPDU, in this case, this NAV update operation".	Change to "before the end of the PPDU, in which case the MAV update operation".	2017/1/9 9:42
6496	John Coffey	225	1 10.3.2.4	115	40	E	Y	115.40 10.3.2.4	Inconsistent usage: here we have "non-AP HE STA", whereas almost everywhere else in the draft we have "HE non-AP STA".	Change to "HE non-AP STA".	2017/1/9 9:42
6497	John Coffey	225	1 10.3.2.4a	115	49	E	Y	115.49 10.3.2.4a	Unclear wording: "managing RTS use by an AP". Apparently what is meant is management by an AP of RTS usage throughout the BSS, not management of the use of RTS by the AP specifically.	Reword to clarify.	2017/1/9 9:42
6498	John Coffey	225	1 10.3.2.4a	115	49	E	Y	115.49 10.3.2.4a	Situation situation: the word is used twice in the same sentence. It's both vague and colloquial and it would be better if it wasn't used at all. It doesn't appear anywhere else in the draft.	Reword to eliminate use of "situation".	2017/1/9 9:42
6499	John Coffey	225	1 10.3.2.4a	115	50	E	Y	115.50 10.3.2.4a	Missing article: "may have better view".	Change to "may have a better view", or (better) reword to eliminate the phrase entirely.	2017/1/9 9:42
6500	John Coffey	225	1 10.3.2.8a.1	116	4	E	Y	116.04 10.3.2.8a.1	Repeated full stops.	Remove one full stop.	2017/1/9 9:42
6501	John Coffey	225	1 10.3.2.8a.3	118	34	E	Y	118.34 10.3.2.8a.3	Awkward usage: "follow the synchronization requirement as defined". The word 'as" contributes nothing.	Delete "as".	2017/1/9 9:42
6502	John Coffey	225	1 10.3.2.10.1	118	55	E	Y	118.55 10.3.2.10.1	Missing space: "transmissionthat".	Add space.	2017/1/9 9:42
6503	John Coffey	225	1 10.3.2.10.1	119	8	T	Y	119.08 10.3.2.10.1	Use of undefined term: "Single MPDU". From the capitalization, it must be inferred that this is a defined term, but where is the definition? The draft also uses "single MPDU", and for good measure both "VHT Single MPDU" and "VHT single MPDU". The baseline	Clarify.	2017/1/9 9:42
6504	John Coffey	225	1 10.3.2.10.1	119	12	E	Y	119.12 10.3.2.10.1	Why "could"? The use of the conditional tense is puzzling, as indeed it was in the previous sentence. There are no other occurrences of 'could" in the draft. In present tense, "can" would seem inappropriate in context: "might" would be preferable".	Change tense and use "might" instead of "can".	2017/1/9 9:42
6505	John Coffey	225	1 10.3.2.10.3	120	7	E	Y	120.07 10.3.2.10.3	Missing space: "medium.Specifically".	Add space.	2017/1/9 9:42
6506	John Coffey	225	1 10.3.2.10.3	120	8	E	Y	120.08 10.3.2.10.3	Missing article: "sent in HE trigger-based PPDU".	Change to "sent in an HE trigger-based PPDU".	2017/1/9 9:42

6507	John Coffey	225	1 10.3.2.10.3	120	8	E	Y	120.08 10.3.2.10.3	Missing article: "acknowledgement in HE MU PPDU".	Change to "acknowledgement in an HE MU PPDU".	2017/1/9 9:42
6508	John Coffey	225	1 10.3.2.10.3	120	8	E	Y	120.08 10.3.2.10.3	Missing article: "in response to (A)-MPDU".	Change to "in response to a(n) (A)-MPDU".	2017/1/9 9:42
6509	John Coffey	225	1 10.3.2.10.3	120	58	E	Y	120.58 10.3.2.10.3	Inconsistent (and awkward) usage: here we have "a HE trigger-based PPDU", whereas in virtually every other place in th draft, we have "an HE trigger-based PPDU".	Change "a" to "an".	2017/1/9 9:42
6510	John Coffey	225	1 10.3.2.10.3	121	55	T	Y	121.55 10.3.2.10.3	Garbled text: "A STA may use a BlockAckReq frame to solicit the acknowledgment frames" from, presumably, some other STA. But which one? The text goes on to say ", to whom the STA sent the QoS Data frame(s)", which makes it sound as if the STA is soliciting acknowledgment frames from the acknowledgment frames.	Reword to identify the STA(s) from which the acknowledgment frames are solicited.	2017/1/9 9:42
6511	John Coffey	225	1 10.3.2.10.3	121	55	E	Y	121.55 10.3.2.10.3	Anthoropomorphism: "to whom". The destination was an object, not a person.	Reword to eliminate the anthropomorphism.	2017/1/9 9:42
6512	John Coffey	225	1 10.3.2.10.3	121	56	E	Y	121.56 10.3.2.10.3	Anthoropomorphism: "from whom". The origin was an object, not a person.	Reword to eliminate the anthropomorphism.	2017/1/9 9:42
6513	John Coffey	225	1 10.3.2.10.3	121	58	E	Y	121.58 10.3.2.10.3	Inconsistent article form: here we have "a HE trigger-based PPDU", whereas almost everywhere else in the draft we have "an HE trigger-based PPDU".	Change to "an HE trigger-based PPDU".	2017/1/9 9:42
6514	John Coffey	225	1 10.3.5	121	5	T	Y	121.05 10.3.5	A STA may use RTS/CTS when it is "necessary" to distribute the NAV or when it is "necessary" to establish protection. Here "necessary" seems too strong a word: whether establishing protection is "necessary" depends on whether other STAs would transmit if protection was not established, which is never known to a STA. Perhaps this isn't what is intended by "necessary", but if not, why is the word there? We would have more-or-less the same meaning without it.	Delete "when it is necessary" (two places).	2017/1/9 9:42
6515	John Coffey	225	1 10.3.5	122	1	T	Y	122.01 10.3.5	"When HE duration-based RTS is enabled, a non-AP STA shall ...". Shouldn't that be an HE non-AP STA?	Change "a non-AP STA" to "an HE non-AP STA".	2017/1/9 9:42
6516	John Coffey	225	1 10.3.5	122	40	T	Y	122.40 10.3.5	"... static fragmentation is used". It seems that what is intended is that dynamic fragmentation is not used, not that static fragmentation is necessarily used.	Change "static fragmentation is used" to "only static fragmentation may be used".	2017/1/9 9:42
6517	John Coffey	225	1 10.7.9	125	35	E	Y	125.35 10.7.9	Inconsistent usage: here we have "and", whereas elsewhere in the table in similar contexts we have "or".	Change "and" to "or".	2017/1/9 9:42
6518	John Coffey	225	1 10.9	127	11	T	Y	127.11 10.9	Unresolved "<reference>".	Resolve it.	2017/1/9 9:42
6519	John Coffey	225	1 10.13.2	128	42	E	Y	128.42 10.13.2	Inconsistent usage: in this paragraph we have "for an HT PPDU", "for a VHT PPDU", and "for a DMG STA" in the appropriate places, but there is no corresponding text for an HE PPDU.	Immediately before the closing full stop, add " (for an HE PPDU)".	2017/1/9 9:42
6520	John Coffey	225	1 10.22.2.2	129	28	E	Y	129.28 10.22.2.2	Case agreement issue: "one or more immediate response". It seems that usage varies but that the majority convention is to use the plural in such cases. (As is done further down on the same page, at line 34, for example.)	Change to "one or more immediate responses".	2017/1/9 9:42
6521	John Coffey	225	1 10.22.2.2	129	47	E	Y	129.47 10.22.2.2	Spurioiis square bracket: "TXOP holder]".	Delete square bracket.	2017/1/9 9:42
6522	John Coffey	225	1 10.22.2.2	130	2	E	Y	130.02 10.22.2.2	Missing article: "in HE".	Change to "in an HE".	2017/1/9 9:42
6523	John Coffey	225	1 10.22.2.2	130	2	E	Y	130.02 10.22.2.2	Inconsistent form: here we have "HE trigger based PPDU", whereas almost everywhere else in the draft we have "HE trigger-based PPDU". It would be better to keep the term consistent.	Change to "HE trigger-based PPDU".	2017/1/9 9:42
6524	John Coffey	225	1 10.22.2.2	130	7	E	Y	130.07 10.22.2.2	Missing article: "in HE".	Change to "in an HE".	2017/1/9 9:42
6525	John Coffey	225	1 10.22.2.2	130	7	E	Y	130.07 10.22.2.2	Inconsistent form: here we have "HE trigger based PPDU", whereas almost everywhere else in the draft we have "HE trigger-based PPDU". It would be better to keep the term consistent.	Change to "HE trigger-based PPDU".	2017/1/9 9:42

6526	John Coffey	225	1 10.22.2.2	130	12	E	Y	130.12 10.22.2.2	Inconsistent form: here we have "HE trigger based PPDU", whereas almost everywhere else in the draft we have "HE trigger-based PPDU". It would be better to keep the term consistent.	Change to "HE trigger-based PPDU".	2017/1/9 9:42
6527	John Coffey	225	1 10.22.2.4	130	38	E	Y	130.38 10.22.2.4	Missing article: "Address 2 field".	Change to "the Address 2 field".	2017/1/9 9:42
6528	John Coffey	225	1 10.22.2.5	131	17	E	Y	131.17 10.22.2.5	Inapposite use of indefinite articles: "For an HT STA, a VHT STA, and an HE STA, an EDCA TXOP is obtained". This makes it sound as if the statement applies to one example of each.	Change to "For HT STAs, VHT STAs, and HE STAs, an EDCA TXOP is obtained".	2017/1/9 9:42
6529	John Coffey	225	1 10.22.2.5	131	20	T	Y	131.20 10.22.2.5	Missing case: the editing to accommodate the HE case has had the effect of rendering the timing undefined for the HT case operating at 2.4 GHz. Without the addition of the underlined text, it's clear that the relevant interval is PIFS, but with the addition we have "PIFS interval for the 5 GHz band or DIFS interval for an HE STA operating in the 2.4 GHz band." What about an HT STA operating in the 2.4 GHz band?	Revise the definition to fill in the missing case.	2017/1/9 9:42
6530	John Coffey	225	1 10.22.2.6	131	31	E	Y	131.31 10.22.2.6	Wrong article: "transmitted in the VHT MU PPDU".	Change to "transmitted in a VHT MU PPDU".	2017/1/9 9:42
6531	John Coffey	225	1 10.22.2.6	131	41	E	Y	131.41 10.22.2.6	Wrong article: "in the HE MU PPDU". Is there just one?	Change to "in an HE MU PPDU".	2017/1/9 9:42
6532	John Coffey	225	1 10.22.2.7	131	24	E	Y	131.24 10.22.2.7	Missing article: "than RXVECTOR parameter".	Change to "than the RXVECTOR parameter".	2017/1/9 9:42
6533	John Coffey	225	1 10.22.2.7	132	25	E	Y	132.25 10.22.2.7	Wrong article: "if the RTS frame".	Change to "if an RTS frame".	2017/1/9 9:42
6534	John Coffey	225	1 10.22.2.7	132	39	E	Y	132.39 10.22.2.7	Singular used where plural required: "for all intended receiver".	Change to "for all intended receivers".	2017/1/9 9:42
6535	John Coffey	225	1 10.22.2.9	133	37	E	Y	133.37 10.22.2.9	Independent clauses linked by a comma without a coordinating conjunction.	Change comma to semicolon.	2017/1/9 9:42
6536	John Coffey	225	1 10.22.2.9	133	37	E	Y	133.37 10.22.2.9	Unusual phrasing: "if any of the following conditions", when the text goes on to list two conditions.	Change "any" to "either".	2017/1/9 9:42
6537	John Coffey	225	1 10.22.2.9	133	38	T	Y	133.38 10.22.2.9	What is meant by the phrase "otherwise it resets the NAV"? Is this descriptive or normative?	Change "it resets" to "it shall reset" (if this is what is intended).	2017/1/9 9:42
6538	John Coffey	225	1 10.24.10.3	134	41	E	Y	134.41 10.24.10.3	Missing article: "the STA shall transmit BlockAck frame".	Change to "a BlockAck frame".	2017/1/9 9:42
6539	John Coffey	225	1 10.24.10.3	134	47	E	Y	134.47 10.24.10.3	Missing space: "ackretransmission".	Add space.	2017/1/9 9:42
6540	John Coffey	225	1 10.24.10.3	134	63	E	Y	134.63 10.24.10.3	Wrong case: "BlockAck frame" (from group members 3 and 4).	Change to "BlockAck frames".	2017/1/9 9:42
6541	John Coffey	225	1 10.28.3	136	38	T	Y	136.38 10.28.3	"Can" used where shall / should / may required.	Change "can" to "may" (if that is what is intended).	2017/1/9 9:42
6542	John Coffey	225	1 10.28.4	137	9	E	Y	137.09 10.28.4	Wrong article: "the non-HE RD responder".	Change to "a non-HE responder".	2017/1/9 9:42
6543	John Coffey	225	1 10.28.4	137	10	E	Y	137.10 10.28.4	Wrong article: "the HE RD responder".	Change to "an HE RD responder".	2017/1/9 9:42
6544	John Coffey	225	1 10.28.4	137	17	E	Y	137.17 10.28.4	Wrong article: "the non-HE RD responder".	Change to "a non-HE responder".	2017/1/9 9:42
6545	John Coffey	225	1 10.28.4	137	18	E	Y	137.18 10.28.4	Wrong article: "the HE RD responder".	Change to "an HE RD responder".	2017/1/9 9:42
6546	John Coffey	225	1 10.43.1	137	48	E	Y	137.48 10.43.1	Typo: "tha".	Change to "that".	2017/1/9 9:42
6547	John Coffey	225	1 10.43.1	137	49	T	Y	137.49 10.43.1	Inconsistent use of defined term: here we have "accept TWT", whereas elsewhere we have "Accept TWT".	Change "accept TWT" to "Accept TWT".	2017/1/9 9:42
6548	John Coffey	225	1 10.43.1	137	50	T	Y	137.50 10.43.1	Inconsistent use of defined term: here we have "alternate TWT", whereas elsewhere we have "Alternate TWT".	Change "alternate TWT" to "Aternate TWT".	2017/1/9 9:42
6549	John Coffey	225	1 10.43.1	137	51	T	Y	137.51 10.43.1	Inconsistent use of defined term: here we have "dictate TWT", whereas elsewhere we have "Dictate TWT".		2017/1/9 9:42
6550	John Coffey	225	1 10.43.1	139	48	E	Y	139.48 10.43.1	Typo: "is a not a".	Change to "is not a".	2017/1/9 9:42
6551	John Coffey	225	1 11.1.3.8	141	22	T	Y	141.22 11.1.3.8	Incorrect use of definite article: "An HE STA that communicates with the HE AP whose MaxBSSID Indicator field is set to n". Why "the" HE AP? Is there only one? In the relevant text in section 9, all that is said is that the AP sets the MaxBSSID field to a non-zero value.	Change "the HE AP" to "an HE AP".	2017/1/9 9:42
6552	John Coffey	225	1 11.1.3.8	141	23	E	Y	141.23 11.1.3.8	Incorrect form of imperative: "shall decodes".	Change to "shall decode".	2017/1/9 9:42
6553	John Coffey	225	1 11.1.3.10	141	32	E	Y	141.32 11.1.3.10	Superfluous definite article: "to ensure the BSS discoverability".	Delete "the".	2017/1/9 9:42
6554	John Coffey	225	1 11.1.3.10	141	32	T	Y	141.32 11.1.3.10	Inconsistent usage of defined terms: here we have "beacon frames", whereas everywhere else in the drfat, including several places in the same section, we have "Beacon frames".	Change "beacon frames" to "Beacon frames".	2017/1/9 9:42

6555 John Coffey	225	1 11.1.3.10	141	33	E	Y	141.33 11.1.3.10	Solecism: "for the whole BSS coverage".	Change to "to ensure coverage of the whole BSS" or delete the phrase entirely.	2017/1/9 9:42
6556 John Coffey	225	1 11.1.3.10	141	43	T	Y	141.43 11.1.3.10	There's something odd about this idea of dual beacons. Superficlally, the idea is attractive: the extended range SU modes (purportedly) extend range, so it's natural to think of some way of conveying beacon information to the new, extended range. But there are many modes that extend range beyond 6 Mb/s: LDPC, DCM, STBC, TxBF, as well as HE_EXT_SU, with all permissible combinations (many optional). If the principle is that every mode has a corresponding beacon, then we have a nightmare of beacon proliferation. If instead the principle is that we have a common beacon understandable by all, why, we have that already with the good old 6 Mb/s normal beacon. The text in the current draft has the feel of a half-worked out add-on. It would be better to do this properly or not at all. Incidentally there is not one word about extended range in the PAR or CSD, so this is	Delete this sentence and all references to dual beacons in the draft.	2017/1/9 9:42
6557 John Coffey	225	1 11.1.3.10	141	36	E	Y	141.36 11.1.3.10	Incorrect use of definite article: "The HE AP that transmits Beacon frames in two PHY formats". Is there just one?	Change to "An HE AP ...".	2017/1/9 9:42
6558 John Coffey	225	1 11.1.3.10	141	45	E	Y	141.45 11.1.3.10	Missing word: "The Beacon frame transmitted in HE extended range SU PPDU has".	Change to "The Beacon frame transmitted in HE extended range SU PPDU format has".	2017/1/9 9:42
6559 John Coffey	225	1 11.1.3.10	141	45	E	Y	141.45 11.1.3.10	Strange syntax: "plus the TBTT offset which value is a half of the value of the Beacon Interval field". Who writes this stuff?	Reword.	2017/1/9 9:42
6560 John Coffey	225	1 11.1.3.10	141	51	T	Y	141.51 11.1.3.10	Inconsistent use of defined term: here we have "HE EXT_SU", whereas everywhere else in the draft we have "HE_EXT_SU".	Change "HE EXT_SU" to "HE_EXT_SU".	2017/1/9 9:42
6561 John Coffey	225	1 11.1.3.10	141	51	E	Y	141.51 11.1.3.10	Missing article or wrong tense: "may contain different set of elements".	Change to "may contain a different set of elements" or "may contain different sets of elements".	2017/1/9 9:42
6562 John Coffey	225	1 11.2.2.6	142	18	E	Y	142.18 11.2.2.6	Missing hyphen: "deliveryenabled".	Add hyphen.	2017/1/9 9:42
6563 John Coffey	225	1 11.2.2.8	142	57	E	Y	142.57 11.2.2.8	The marathon sentence "A STA that stays awake to receive group addressed BUs shall elect to receive all group addressed non-STBC transmissions or all group addressed STBC transmissions and remain awake until the More Data subfield of the appropriate type (non-STBC or STBC) of group addressed BUs indicates there are no further buffered group addressed BUs of that type, or until a TIM is received indicating there are no more buffered group addressed BUs of that type, or until an FMS Descriptor element is received indicating that there are no further buffered group addressed BUs for which the STA has previously received an FMS Response element in a frame that has a value in Address 1 that matches its MAC address or that has an Address 1 value that is a group address corresponding to a group of which it is a member and that was transmitted by the	Break this sentence into several sentences, or at the very least several subclauses separated by item identifiers. Add a table and a diagram.	2017/1/9 9:42
6564 John Coffey	225	1 11.2.2.8	143	5	E	Y	143.05 11.2.2.8	Superfluous word: "shall operate exactly as if". What is the difference between operating "exactly" as if and operating merely "as if"? For example, elsewhere (28.3.11.8) we see that "the operation of the interleaver is the same as if": are we to conclude that the operation doesn't have to be "exactly" the same, since there the word is omitted?	Delete "exactly".	2017/1/9 9:42

6565	John Coffey	225	1 11.2.2.8	143	8	E	Y	143.08 11.2.2.8	Superfluous word: "shall operate exactly as if". What is the difference between operating "exactly" as if and operating merely "as if"? For example, elsewhere (28.3.11.8) we see that "the operation of the interleaver is the same as if": are we to conclude that the operation doesn't have to be "exactly" the same, since there the word is omitted?	Delete "exactly".	2017/1/9 9:42
6566	John Coffey	225	1 11.2.2.8	143	12	E	Y	143.12 11.2.2.8	Superfluous word: "shall operate exactly as if". What is the difference between operating "exactly" as if and operating merely "as if"? For example, elsewhere (28.3.11.8) we see that "the operation of the interleaver is the same as if": are we to conclude that the operation doesn't have to be "exactly" the same, since there the word is omitted?	Delete "exactly".	2017/1/9 9:42
6567	John Coffey	225	1 11.49.1	144	37	T	Y	144.37 11.49.1	Unnecessary variant used for defined term: "BSS color". The term is "BSS Color".	Change to "BSS Color".	2017/1/9 9:42
6568	John Coffey	225	1 17.3.9.10	145	55	E	Y	145.55 17.3.9.10	Typo: "when measured as the 10% point".	Change to "when measured at the 10% point".	2017/1/9 9:42
6569	John Coffey	225	1 17.3.9.10	145	57	T	Y	145.57 17.3.9.10	Incorrect statement of mandatory requirement: "The residual CFO error measurement shall be made on the". This is a mandatory statement about how a measurement is to be made on a device to verify whether that device is compliant or not; it's not a requirement on the device itself. The device itself doesn't have to make any measurements at all. Apparently what is intended is to clarify the meaning of the requirement on the device from the previous sentence. It would be better to say so explicitly.	Reword to clarify that this text acts as part of the definition of the residual CFO error, and not as a requirement that any measurement has to be performed.	2017/1/9 9:42
6570	John Coffey	225	1 17.3.9.10	145	61	E	Y	145.61 17.3.9.10	Wrong form of indefinite article: "an non-HT".	Change to "a non-HT".	2017/1/9 9:42
6571	John Coffey	225	1 17.3.9.10	145	65	E	Y	145.65 17.3.9.10	Inconsistent form: here we have "HE trigger based PPDU", whereas almost everywhere else in the draft we have "HE trigger-based PPDU". It would be better to keep the term consistent.	Change to "HE trigger-based PPDU".	2017/1/9 9:42
6572	John Coffey	225	1 17.3.9.10	145	65	E	Y	145.65 17.3.9.10	Wrong case: "requirement for HE trigger(-)based PPDU".	Change "PPDU" to "PPDUs".	2017/1/9 9:42
6573	John Coffey	225	1 27.1	149	7	E	Y	149.07 27.1	This is the only place in the draft where the term "banned" occurs, and it isn't present anywhere in the 2016 rollup of the base standard either. Let's not introduce new terms for basic concepts where they are not needed.	Change to "HE STAs shall not use HCCA or TSPEC".	2017/1/9 9:42
6574	John Coffey	225	1 27.2.1	149	18	T	Y	149.18 27.2.1	From the text "An HE STA determines whether a received frame is an inter-BSS or an intra-BSS frame by using ...", it is not clear whether a normative requirement is being described. That is, the text tells us how an HE STA makes this determination, but not whether it is required to make the determination in the first place.	Clarify whether this is a requirement or not. If so, say so explicitly. If not, reword to make it clear that there is no requirement.	2017/1/9 9:42
6575	John Coffey	225	1 27.2.1	149	18	T	Y	149.18 27.2.1	Various methods are given for "determining" whether a received frame is an inter-BSS or intra-BSS frame. With the (possible) exception of MAC address, they all have some probability of false classification. As such, it seems that what is being described is an estimate of the inter-BSS / intra-BSS classification, not a definitive determination. If that's the case, it is misleading to write that the HE STA "determines" anything.	Reword appropriately. For example, if it's intended that the HE STA must make some attempt at a classiifcation, but that it doesn't necessarily have to use the MAC address, then change to something like "An HE STA shall attempt to classify received frames as inter-BSS or intra-BSS using one or more of the following criteria", etc.	2017/1/9 9:42

6576	John Coffey	225	1 27.2.1	149	18	T	Y	149.18 27.2.1	The text discusses a determination of whether a received frame is inter-BSS or intra-BSS, but at the end of the section it's mentioned (or acknowledged) that frames may satisfy one or more conditions for both. It's very murky what happens then. The draft goes on to provide one way of making a decision (check the MAC address) but doesn't say whether it's required or not. So we don't know (a) if the HE STA is required to do any of this; (b) if it starts the process, is it required to run all the methods or just some?; (c) if it's not required to run all the methods, can it give up its attempt to classify if it gets conflicting answers from the ones it tries?	Reword appropriately.	2017/1/9 9:42
6577	John Coffey	225	1 27.2.1	149	18	T	Y	149.18 27.2.1	The text discusses a determination of whether a received frame is inter-BSS or intra-BSS, but at the end of the section it's mentioned (or acknowledged) that frames may not satisfy any of the conditions. Given this possibility, it is misleading to state that the STA makes a determination about whether the frame is one or the other.	Reword appropriately to allow for the possibility that the HE STA may be unable to make a determination.	2017/1/9 9:42
6578	John Coffey	225	1 27.2.1	149	26	T	Y	149.26 27.2.1	Unnecessary variant used for defined term: "BSS color". The term is "BSS Color".	Change to "BSS Color".	2017/1/9 9:42
6579	John Coffey	225	1 27.2.1	149	39	T	Y	149.39 27.2.1	Unnecessary variant used for defined term: "BSS color". The term is "BSS Color".	Change to "BSS Color".	2017/1/9 9:42
6580	John Coffey	225	1 27.2.1	149	50	T	Y	149.50 27.2.1	Unnecessary variant used for defined term: "BSS color". The term is "BSS Color".	Change to "BSS Color".	2017/1/9 9:42
6581	John Coffey	225	1 27.2.1	150	9	T	Y	150.09 27.2.1	Unnecessary variant used for defined term: "BSS color". The term is "BSS Color".	Change to "BSS Color".	2017/1/9 9:42
6582	John Coffey	225	1 27.2.1	150	13	T	Y	150.13 27.2.1	Why does an HE AP interpret each HE MU PPDU as inter-BSS?	Clarify.	2017/1/9 9:42
6583	John Coffey	225	1 27.2.1	150	17	T	Y	150.17 27.2.1	"the decision made by using the MAC address takes precedence". The entire section is written in a way that makes requirements frustratingly elusive. The present text is one example among many. Since the text says "the decision", are we to conclude that it is mandatory for the STA to process the MAC address for all received frames? if a STA decided--for power save purposes of for any other reason--to make the conservative decision that the received PPDU should count as both intra-BSS and inter-BSS, would that impact any other device in the network negatively? If not, why insist on HE STAs processing the MAC address? Or more basically, is this in fact what the draft requires?	Clarify this and the entire section. In doing so, please make appropriate and precise use of the key words "shall", "should", and "may", as appropriate.	2017/1/9 9:42
6584	John Coffey	225	1 27.2.1	150	20	T	Y	150.20 27.2.1	The section consists of a long (and none-too-clearly written) set of procedures on "determining" whether PPDUs are intra-BSS or inter-BSS. It seems that this is intended to be mandatory. If mandatory, it doesn't appear anywhere nearly useful enough to justify encumbering devices (dual NAV doesn't count). If optional, it doesn't justify cluttering up the draft.	Delete this section and all references to it in the draft.	2017/1/9 9:42
6585	John Coffey	225	1 27.2.1	150	36	E	Y	150.36 27.2.1	Missing text: "or cannot".	Change to "or that cannot".	2017/1/9 9:42
6586	John Coffey	225	1 27.2.1	150	37	E	Y	150.37 27.2.1	The text "the method of identifying a PPDU as intra-BSS or inter-BSS" conveys the idea that a PPDU can definitely be so identified. Since the text also acknowledges in several places that such a decision may not be possible, this is misleading.	Reword to clarify.	2017/1/9 9:42
6587	John Coffey	225	1 27.2.2	151	37	E	Y	151.37 27.2.2	Garbled text: "if a PS-Poll is received carried in a received HE SU PPDU ...".	Reword to clarify.	2017/1/9 9:42
6588	John Coffey	225	1 27.2.2	151	56	E	Y	151.56 27.2.2	Singular used where plural required: "by intra-BSS PPDU".	Change to "intra-BSS PPDUs".	2017/1/9 9:42

6589	John Coffey	225	1 27.2.2	151	57	E	Y	151.57 27.2.2	Singular used where plural required: "by inter-BSS PPDU".	Change to "inter-BSS PPDUs".	2017/1/9 9:42
6590	John Coffey	225	1 27.2.2	151	57	E	Y	151.57 27.2.2	Inconsistent usage: "two NAV". In the previous sentence it's "two NAVs".	Change to "two NAVs".	2017/1/9 9:42
6591	John Coffey	225	1 27.2.2	151	58	E	Y	151.58 27.2.2	Missing word(s) or garbled syntax: "where a STA requires protection from ... or avoid interference". This maps to 'where a STA requires avoid interference".	Revise appropriately.	2017/1/9 9:42
6592	John Coffey	225	1 27.2.2	151	60	E	Y	151.60 27.2.2	Singular used where plural required: "in neighboring BSS".	Change to "in neighboring BSSs".	2017/1/9 9:42
6593	John Coffey	225	1 27.2.2	151	64	T	Y	151.64 27.2.2	The illustrative example is extraordinarily unconvincing. Is this really the best justification for forcing all HE STAs to go through the extended rigmarole of classifying every PPDU as intra-BSS or inter-BSS? Even taking the example at face value, what is gained by having the STA set its "intra-BSS NAV" when it receives its AP's initial frame, as opposed to setting the plain old NAV? Either way that STA wouldn't be permitted to transmit, so what has all the extra processing and classification bought? The straightforward way would be to have all STAs other than those addressed by the AP to set the (N.B. "the", since there would be only one) NAV. The NAV is one of the basic underpinnings of the entire current success of 802.11 and extraordinary justification should be necessary before any changes are made to it.	Delete this section, the definition of dual NAV, and all references to dual NAV in the draft.	2017/1/9 9:42
6594	John Coffey	225	1 27.2.3	152	11	E	Y	152.11 27.2.3	Inconsistent usage: here we have "non-AP HE STA", whereas almost everywhere else in the draft we have "HE non-AP STA".	Change to "HE non-AP STA".	2017/1/9 9:42
6595	John Coffey	225	1 27.2.3	152	22	E	Y	152.22 27.2.3	Independent clauses linked by a comma without a coordinating conjunction.	Change comma to semicolon.	2017/1/9 9:42
6596	John Coffey	225	1 27.2.3	152	25	E	Y	152.25 27.2.3	Case disagreement: "a QoS frames".	Change "frames" to "frame".	2017/1/9 9:42
6597	John Coffey	225	1 27.2.3	152	29	E	Y	152.29 27.2.3	Wrong article: "the HE non-AP UL MU capable STA". Is there just one?	Change to "an HE non-AP UL MU capable STA".	2017/1/9 9:42
6598	John Coffey	225	1 27.3.1	152	41	T	Y	152.41 27.3.1	Descriptive language used where it seems normative language must have been intended: an HE STA "supports" static fragmentation. How do you know what it supports? Apparently what is meant is that an HE STA shall support static fragmentation. If so, it would be better to say so.	Change "An HE STA supports" to "An HE STA shall support".	2017/1/9 9:42
6599	John Coffey	225	1 27.3.1	152	42	T	Y	152.42 27.3.1	Descriptive language used where it seems normative language must have been intended: an HE STA "can also support" dynamic fragmentation. The ability of a device to do so should not be in question; what is apparently intended is that an HE STA is permitted to do so. If so, it would be better to say so.	Change "can" to "may".	2017/1/9 9:42
6600	John Coffey	225	1 27.3.1	152	46	T	Y	152.46 27.3.1	Descriptive language used where it seems normative language must have been intended: "An HE STA can dynamically fragment". The ability of a device to do so should not be in question; what is apparently intended is that an HE STA is permitted to do so. If so, it would be better to say so.	Change "can" to "may".	2017/1/9 9:42
6601	John Coffey	225	1 27.3.3.1	153	33	E	Y	153.33 27.3.3.1	Singular used when plural might be required: "failed fragment".	Change "failed fragment" to "failed fragment(s)".	2017/1/9 9:42
6602	John Coffey	225	1 27.3.3.4	154	40	E	Y	154.40 27.3.3.4	Wrong article: "The receiver STA that accepts".	Change to "A receiver STA that accepts".	2017/1/9 9:42
6603	John Coffey	225	1 27.3.4.1	155	23	T	Y	155.23 27.3.4.1	Cross-reference to nonexistent section: "227.3.3.4".	Change to "27.3.3.4".	2017/1/9 9:42
6604	John Coffey	225	1 27.3.4.3	156	27	E	Y	156.27 27.3.4.3	Independent clauses run together without required punctuation: "is successfully transmitted (...) otherwise".	Change "otherwise" to "; otherwise".	2017/1/9 9:42
6605	John Coffey	225	1 27.3.4.3	156	32	E	Y	156.32 27.3.4.3	Garbled text: "unless it receives a ... frame ... when the". Wherefore "when"?	Change "when" to "in which".	2017/1/9 9:42

6606	John Coffey	225	1 27.3.4.4	156	51	E	Y	156.51 27.3.4.4	Missing space: "that was setup".	Change "setup" to "set up".	2017/1/9 9:42
6607	John Coffey	225	1 27.3.4.4	157	11	E	Y	157.11 27.3.4.4	Garbled text: "if it receives a ... frame ... when the". Wherefore "when"?	Change "when" to "in which".	2017/1/9 9:42
6608	John Coffey	225	1 27.4.1	157	21	T	Y	157.21 27.4.1	Descriptive language used where it seems normative language must have been intended: "An HE STA can use". The ability of a device to do so should not be in question; what is apparently intended is that an HE STA is permitted to do so. If so, it would be better to say so.	Change "can" to "may".	2017/1/9 9:42
6609	John Coffey	225	1 27.4.1	157	33	E	Y	157.33 27.4.1	Missing article "sending Multi-STA BlockAck frame".	Change to "sending a Multi-STA BlockAck frame".	2017/1/9 9:42
6610	John Coffey	225	1 27.4.1	157	33	E	Y	157.33 27.4.1	Grabled text: "using one of rate, MCS, NSS".	Correct or clarify.	2017/1/9 9:42
6611	John Coffey	225	1 27.4.1	157	49	T	Y	157.49 27.4.1	Use of undefined term / garbled text: "each received Multi-STA sent".	Change to "each Multi-STA BlockAck frame sent".	2017/1/9 9:42
6612	John Coffey	225	1 27.4.1	157	49	E	Y	157.49 27.4.1	Solecism: "an STA".	Change to "a STA".	2017/1/9 9:42
6613	John Coffey	225	1 27.4.1	157	61	E	Y	157.61 27.4.1	Inconsistent usage: here we have "a MU-BAR", whereas in most other cases we have "an MU-BAR". It would be better to choose one form and to stick to it.	Change "a" to "an".	2017/1/9 9:42
6614	John Coffey	225	1 27.4.1	158	1	E	Y	158.01 27.4.1	Inconsistent usage: here we have "a MU-BAR", whereas in most other cases we have "an MU-BAR". It would be better to choose one form and to stick to it.	Change "a" to "an".	2017/1/9 9:42
6615	John Coffey	225	1 27.4.1	158	12	E	Y	158.12 27.4.1	Inapposite phrasing: "whose destination STAs associate with". The STAs have presumably already associated with the APs, so the present tense is misplaced.	Change to "whose destination STAs are associated with".	2017/1/9 9:42
6616	John Coffey	225	1 27.4.1	158	12	E	Y	158.12 27.4.1	Use of plural where singular required: "with more than one APs".	Change to "with more than one AP".	2017/1/9 9:42
6617	John Coffey	225	1 27.4.1	158	16	E	Y	158.16 27.4.1	Awkward phrasing or missing text: "and has".	Change to "and that has".	2017/1/9 9:42
6618	John Coffey	225	1 27.4.1	158	19	E	Y	158.19 27.4.1	Inconsistent terminology: here we have "MU BAR", whereas in almost every other case we have "MU-BAR". It would be better to choose one form and to stick to it.	Add hyphen.	2017/1/9 9:42
6619	John Coffey	225	1 27.4.2	158	42	E	Y	158.42 27.4.2	Unclear language: "intended to an originator". What does this mean?	Clarify.	2017/1/9 9:42
6620	John Coffey	225	1 27.4.2	159	5	E	Y	159.05 27.4.2	Solecism: "an STA".	Change to "a STA".	2017/1/9 9:42
6621	John Coffey	225	1 27.4.2	159	16	T	Y	159.16 27.4.2	Missing condition: "either" followed by only one condition. Presumably there should be additional text: "or [other condition]".	Add appropriate condition.	2017/1/9 9:42
6622	John Coffey	225	1 27.4.3	159	55	E	Y	159.55 27.4.3	Unclear language: "intended to a STA". What does this mean?	Clarify.	2017/1/9 9:42
6623	John Coffey	225	1 27.4.3	160	8	T	Y	160.08 27.4.3	Missing condition / garbled text: the third item doesn't parse correctly. In the first two bullet items we had a clear action ("is set"; "shall'), but there is no applicable one in the third bullet item. (the one "shall" ties back only to the "wherein").	Clarify.	2017/1/9 9:42
6624	John Coffey	225	1 27.4.4.1	160	38	E	Y	160.38 27.4.4.1	Inconsistent usage: here we have "a MU-BAR", whereas in most other cases we have "an MU-BAR". It would be better to choose one form and to stick to it.	Change "a" to "an".	2017/1/9 9:42
6625	John Coffey	225	1 27.4.4.2	160	52	E	Y	160.52 27.4.4.2	Garbled text / anthropomorphism: "An AP that sends a DL MU PPDU that intends to solicit". The DL MU PPDU doesn't intend anything. The AP is a decision-making agent but even then it's still an object.	Change "that intends to solicit" to "that is intended to solicit".	2017/1/9 9:42
6626	John Coffey	225	1 27.4.4.2	160	61	E	Y	160.61 27.4.4.2	Inconsistent usage: we have both "a S-MPDU" and "an S-MPDU" in the draft. Though the former is used more often, the latter seems correct.	Change "a S-MPDU" to "an S-MPDU".	2017/1/9 9:42
6627	John Coffey	225	1 27.4.4.2	160	61	E	Y	160.61 27.4.4.2	Unclear language: "intended to it". What does this mean?	Clarify.	2017/1/9 9:42
6628	John Coffey	225	1 27.4.4.2	160	63	E	Y	160.63 27.4.4.2	Unclear language: "intended to it". What does this mean?	Clarify.	2017/1/9 9:42
6629	John Coffey	225	1 27.4.4.2	161	1	E	Y	161.01 27.4.4.2	Unclear language: "intended to it". What does this mean?	Clarify.	2017/1/9 9:42
6630	John Coffey	225	1 27.4.4.2	161	5	E	Y	161.05 27.4.4.2	Incorrect use of definite article: "The control response frame".	Change to "A control response frame".	2017/1/9 9:42

6631 John Coffey	225	1 27.4.4.3	161	11	E	Y	161.11 27.4.4.3	Garbled text / anthropomorphism: "An AP that sends a DL MU PPDU that intends to solicit". The DL MU PPDU doesn't intend anything. The AP is a decision-making agent but even then it's still an object.	Change "that intends to solicit" to "that is intended to solicit".	2017/1/9 9:42
6632 John Coffey	225	1 27.4.4.3	161	15	E	Y	161.15 27.4.4.3	Missing preposition: "is always responded with".	Change to "is always responded to with".	2017/1/9 9:42
6633 John Coffey	225	1 27.4.4.3	161	19	E	Y	161.19 27.4.4.3	Inconsistent usage: we have both "a S-MPDU" and "an S-MPDU" in the draft. Though the former is used more often, the latter seems correct.	Change "a S-MPDU" to "an S-MPDU".	2017/1/9 9:42
6634 John Coffey	225	1 27.4.4.3	161	19	E	Y	161.19 27.4.4.3	Unclear language: "intended to it". What does this mean?	Clarify.	2017/1/9 9:42
6635 John Coffey	225	1 27.4.4.3	161	22	E	Y	161.22 27.4.4.3	Unclear language: "intended to it". What does this mean?	Clarify.	2017/1/9 9:42
6636 John Coffey	225	1 27.4.4.3	161	27	E	Y	161.27 27.4.4.3	Unclear language: "intended to it". What does this mean?	Clarify.	2017/1/9 9:42
6637 John Coffey	225	1 27.4.4.3	161	30	T	Y	161.30 27.4.4.3	Inconsistent terminology: here we have "a Trigger-based PPDU", whereas almost everywhere else in the draft we have "an HE trigger-based PPDU". If the same thing is intended, the same term should be used.	Change "a Trigger-based PPDU" to "an HE trigger-based PPDU".	2017/1/9 9:42
6638 John Coffey	225	1 27.4.4.4	161	37	E	Y	161.37 27.4.4.4	Garbled text / anthropomorphism: "that intends to solicit". The Basic variant Trigger frame doesn't intend anything. The non-AP STA is a decision-making agent but even then it's still an object.	Change "that intends to solicit" to "that is intended to solicit".	2017/1/9 9:42
6639 John Coffey	225	1 27.4.4.4	161	42	T	Y	161.42 27.4.4.4	Use of undefined term: "Single MPDU". From the capitalization, it must be inferred that this is a defined term, but where is the definition? The draft also uses "single MPDU", and for good measure both "VHT Single MPDU" and "VHT single MPDU". The baseline	Clarify.	2017/1/9 9:42
6640 John Coffey	225	1 27.4.4.4	161	56	T	Y	161.56 27.4.4.4	Use of undefined term: "Single MPDU". From the capitalization, it must be inferred that this is a defined term, but where is the definition? The draft also uses "single MPDU", and for good measure both "VHT Single MPDU" and "VHT single MPDU". The baseline	Clarify.	2017/1/9 9:42
6641 John Coffey	225	1 27.4.4.4	161	57	T	Y	161.57 27.4.4.4	Use of undefined term: "Single MPDU". From the capitalization, it must be inferred that this is a defined term, but where is the definition? The draft also uses "single MPDU", and for good measure both "VHT Single MPDU" and "VHT single MPDU". The baseline	Clarify.	2017/1/9 9:42
6642 John Coffey	225	1 27.4.4.4	161	60	E	Y	161.60 27.4.4.4	Incorrect inclusion of indefinite article: "in a DL SU PPDU format". Is there more than one such format?	Delete "a".	2017/1/9 9:42
6643 John Coffey	225	1 27.4.4.5	162	5	E	Y	162.05 27.4.4.5	Garbled text / anthropomorphism: "that intends to solicit". The Basic variant Trigger frame doesn't intend anything. The non-AP STA is a decision-making agent but even then it's still an object.	Change "that intends to solicit" to "that is intended to solicit".	2017/1/9 9:42
6644 John Coffey	225	1 27.4.4.5	162	10	T	Y	162.10 27.4.4.5	Undefined term: "S-MPDU". No definition appears in the draft, and it isn't part of 802.11-2016 either.	Define the term.	2017/1/9 9:42
6645 John Coffey	225	1 27.4.4.5	162	11	T	Y	162.11 27.4.4.5	Undefined term: "S-MPDU". No definition appears in the draft, and it isn't part of 802.11-2016 either.	Define the term.	2017/1/9 9:42
6646 John Coffey	225	1 27.4.4.5	162	12	E	Y	162.12 27.4.4.5	Inconsistent usage: here we have "HE-AP", whereas everywhere else in the draft we have "HE AP". It would be bettre to choose one form and to stick to it.	Change to "HE AP".	2017/1/9 9:42
6647 John Coffey	225	1 27.4.4.5	162	14	E	Y	162.14 27.4.4.5	Missing article: "with Ack frame".	Change to "with an Ack frame".	2017/1/9 9:42

6648	John Coffey	225	1 27.4.4.5	162	15	T	Y	162.15 27.4.4.5	Use of undefined term: "Single MPDU". From the capitalization, it must be inferred that this is a defined term, but where is the definition? The draft also uses "single MPDU", and for good measure both "VHT Single MPDU" and "VHT single MPDU". The baseline defines "VHT single MPDU" (note: no capitalization). It is unacceptable to force the reader to guess what is meant.	Clarify.	2017/1/9 9:42
6649	John Coffey	225	1 27.4.4.5	162	19	E	Y	162.19 27.4.4.5	Singular used where plural required: "to each of the STA".	Change "STA" to "STAs".	2017/1/9 9:42
6650	John Coffey	225	1 27.4.4.5	162	23	E	Y	162.23 27.4.4.5	Garbled text: "announce the report the reception".	Ungarble it.	2017/1/9 9:42
6651	John Coffey	225	1 27.4.4.5	162	23	E	Y	162.23 27.4.4.5	Singluar / plural matching issue: "the receivers of [...] frame".	Change "frame" to "frames".,	2017/1/9 9:42
6652	John Coffey	225	1 27.4.4.5	162	26	E	Y	162.26 27.4.4.5	Typo: two consecutive full stops.	Delete one full stop.	2017/1/9 9:42
6653	John Coffey	225	1 27.4.4.5	162	26	E	Y	162.26 27.4.4.5	Inconsistent usage: "A HE AP". Almost everywhere else in the draft we have "An HE".	Change "A" to "An".	2017/1/9 9:42
6654	John Coffey	225	1 27.4.4.5	162	27	E	Y	162.27 27.4.4.5	Inconsistent form: here we have "a non-AP HE STA", whereas in most other places in the draft we have "an HE non-AP STA". It would be better to choose one form and to stick to it.	Change "a non-AP HE STA" to "an HE non-AP STA".	2017/1/9 9:42
6655	John Coffey	225	1 27.4.4.5	162	28	E	Y	162.28 27.4.4.5	Adjective used where adverb required: "immediate preceding",	Change to "immediately preceding".	2017/1/9 9:42
6656	John Coffey	225	1 27.5.1.1	162	45	E	Y	162.45 27.5.1.1	Wrong article: "with the HE-SIG-B".	Change to "with an HE-SIG-B".	2017/1/9 9:42
6657	John Coffey	225	1 27.5.1.2	163	5	E	Y	163.05 27.5.1.2	Wrong article: "within a same HE MU PPDU".	Change to "within the same HE MU PPDU".	2017/1/9 9:42
6658	John Coffey	225	1 27.5.1.2	163	10	E	Y	163.10 27.5.1.2	Singlau / plural matching issue: "one of the STA-ID field".	Change "field" to "fields".	2017/1/9 9:42
6659	John Coffey	225	1 27.5.1.3	163	35	E	Y	163.35 27.5.1.3	Inconsistent usage: here we have "A HE AP", whereas almost everywhere else in the draft we have "An HE AP".	Change "a" to "an".	2017/1/9 9:42
6660	John Coffey	225	1 27.5.1.3	163	40	E	Y	163.40 27.5.1.3	Wrong article: "The STA that receives".	Change "The" to "A".	2017/1/9 9:42
6661	John Coffey	225	1 27.5.2.1	163	58	E	Y	163.58 27.5.2.1	Superfluous article: "The UL MU operation".	Change to "UL MU operation".	2017/1/9 9:42
6662	John Coffey	225	1 27.5.2.2.1	164	42	E	Y	164.42 27.5.2.2.1	Case agreement issue: "frames that includes".	Change to "frames that include".	2017/1/9 9:42
6663	John Coffey	225	1 27.5.2.2.1	164	46	E	Y	164.46 27.5.2.2.1	Double full stop.	Delete a "full stop".	2017/1/9 9:42
6664	John Coffey	225	1 27.5.2.2.1	164	53	E	Y	164.53 27.5.2.2.1	Inconsistent usage: we have both "a S-MPDU" and "an S-MPDU" in the draft. Though the former is used more often, the latter seems correct.	Change "a S-MPDU" to "an S-MPDU".	2017/1/9 9:42
6665	John Coffey	225	1 27.5.2.2.1	165	23	E	Y	165.23 27.5.2.2.1	Unclear language / colloquial use: "at least ... [time] ... passes".	Change "passes" to "elapses".	2017/1/9 9:42
6666	John Coffey	225	1 27.5.2.2.1	165	32	E	Y	165.32 27.5.2.2.1	Unusual phrasing: "larger than or equal to".	Change "larger" to "greater".	2017/1/9 9:42
6667	John Coffey	225	1 27.5.2.2.2	165	63	E	Y	165.63 27.5.2.2.2	Use of plural where singular required: "with more than one APs".	Change "APs" to "AP".	2017/1/9 9:42
6668	John Coffey	225	1 27.5.2.2.2	165	63	E	Y	165.63 27.5.2.2.2	Inconsistent usage: here we have "a MU-RTS", whereas in most other cases we have "an MU-RTS". It would be better to choose one form and to stick to it.	Change "a" to "an".	2017/1/9 9:42
6669	John Coffey	225	1 27.5.2.2.2	165	65	E	Y	165.65 27.5.2.2.2	Inconsistent usage: here we have "a MU-BAR", whereas in most other cases we have "an MU-BAR". It would be better to choose one form and to stick to it.	Change "a" to "an".	2017/1/9 9:42
6670	John Coffey	225	1 27.5.2.2.2	166	28	E	Y	166.28 27.5.2.2.2	Superfluous word: "either explicit, or implicitly or both". What function does the word "either" play and how would the meaning change if it is deleted?	Delete "either".	2017/1/9 9:42
6671	John Coffey	225	1 27.5.2.2.2	166	28	E	Y	166.28 27.5.2.2.2	Superfluous comma: "explicity, or implicitly or both". Wihtout the first "or" this might be acceptable, but overall it seems best to delete the comma.	Delete comma.	2017/1/9 9:42
6672	John Coffey	225	1 27.5.2.2.2	166	53	E	Y	166.53 27.5.2.2.2	Missing article: "allocate UL subchannel".	Change to "allocate an UL subchannel".	2017/1/9 9:42
6673	John Coffey	225	1 27.5.2.2.2	166	59	E	Y	166.59 27.5.2.2.2	Unclear language: "intended to it". What does this mean?	Clarify.	2017/1/9 9:42
6674	John Coffey	225	1 27.5.2.2.2	166	65	E	Y	166.65 27.5.2.2.2	Missing space at end of sentence.	Add space.	2017/1/9 9:42
6675	John Coffey	225	1 27.5.2.2.2	167	1	E	Y	167.01 27.5.2.2.2	Missing space: "PPDU.A".	Add space.	2017/1/9 9:42

6676	John Coffey	225	1 27.5.2.3	167	48	E	Y	167.48 27.5.2.3	Superfluous word: "that contains [...] or contains [...]". It would be reasonable to write 'That contains X or that contains contains Y", and better to write "That contains X or Y". The construction in the draft is odd.	Delete the second instance of "contains".	2017/1/9 9:42
6677	John Coffey	225	1 27.5.2.3	167	67	T	Y	167.67 27.5.2.3	UNRESOLVED TBD. DRAFTS MUST BE COMPLETE BEFORE BEING SENT TO LETTER BALLOT. IT IS UNACCEPTABLE TO HAVE ANY UNRESOLVED TBDs AND THIS SHOULD HAVE DISQUALIFIED THE LETTER BALLOT FROM BEING LAUNCHED.	Resolve the TBD.	2017/1/9 9:42
6678	John Coffey	225	1 27.5.2.3	168	46	E	Y	168.46 27.5.2.3	Rhubarb rhubarb.	Fix.	2017/1/9 9:42
6679	John Coffey	225	1 27.5.2.3	168	51	E	Y	168.51 27.5.2.3	Rhubarb rhubarb.	Fix.	2017/1/9 9:42
6680	John Coffey	225	1 27.5.2.3	168	59	E	Y	168.59 27.5.2.3	Wrong article" set to the value based on". If it's just "based on", it would be better to use the indefiniet article.	Change "the" to "a".	2017/1/9 9:42
6681	John Coffey	225	1 27.5.2.3	169	1	T	Y	169.01 27.5.2.3	Ungrammatical and confusing text: what is the "containing an UL MU Response Scheduling A-Control subfield" referring to? By setting this text off in commas, it seems it doesn't refer to the soliciting MPDU(s) (which would cause a case agreement problem). But read literally, the clause set off in commas seems to refer to the STA.	Rewrite to clarify. If the clause set off by commas referes to the soliciting MPDU(s), remove commas and correct case. If it refers to the HE trigger-based PPDU, move it earlier in the sentence, to follow "HE trigger-based PPDU".	2017/1/9 9:42
6682	John Coffey	225	1 27.5.2.3	169	8	E	Y	169.08 27.5.2.3	Missing article: "of [X], [Y], [Z] and [W] fields".	Add "the" after "of".	2017/1/9 9:42
6683	John Coffey	225	1 27.5.2.3	169	12	E	Y	169.12 27.5.2.3	Superfluous comma: "BSS_Color, and DCM". In a list of two elements where "and" is used, a comma is not needed and indeed just confuses the matter.	Delete comma.	2017/1/9 9:42
6684	John Coffey	225	1 27.5.2.3	169	35	E	Y	169.35 27.5.2.3	Wrong article: "The STA that responds". Is there just one?	Change "The" to "A".	2017/1/9 9:42
6685	John Coffey	225	1 27.5.2.3	169	41	T	Y	169.41 27.5.2.3	Inconsistent terminology: here we have "the trigger-based PPDU", whereas almost everywhere else in the draft we have "the HE trigger-based PPDU". If the same thing is intended, the same term should be used.	Change to "the HE trigger-based PPDU".	2017/1/9 9:42
6686	John Coffey	225	1 27.5.2.3	169	53	E	Y	169.53 27.5.2.3	Missing text: "and subject to".	Change to "and is subject to".	2017/1/9 9:42
6687	John Coffey	225	1 27.5.2.3	169	60	E	Y	169.60 27.5.2.3	Inconsistent terminology: here we have "MU BAR", whereas in almost every other case we have "MU-BAR". It would be better to choose one form and to stick to it.	Add hyphen.	2017/1/9 9:42
6688	John Coffey	225	1 27.5.2.3	170	15	E	Y	170.15 27.5.2.3	Awkward usage: "with a same HE trigger-based PPDU".	Change to "within the same HE trigger-based PPDU".	2017/1/9 9:42
6689	John Coffey	225	1 27.5.2.4	170	48	E	Y	170.48 27.5.2.4	Superfluous and ungrammatical "of": "multiple of 20 MHz".	Delete "of".	2017/1/9 9:42
6690	John Coffey	225	1 27.5.2.4	170	61	T	Y	170.61 27.5.2.4	A question of clarification: the AP does not have to set CS Required = 1 when all HE trigger-based frames contain an Ack or BlackAck frame. When taken together with the rest of the draft, does this mean that all solicited HR trigger-based frames may contain ONLY an Ack or BlackAck? Or may these HE trigger-based frames contain other data aggregated with or piggybacked onto the Ack or BlockAck? The latter should be clearly unacceptable, as it would permit a radical departure from the fundamental groundrules of the entire technology via the simple expedient of tacking an Ack or BlockAck onto other data.	Clarify that the condition means that all solicited HE trigger-based frames shall contain ONLY an Ack or BlockAck.	2017/1/9 9:42
6691	John Coffey	225	1 27.5.2.4	170	61	T	Y	170.61 27.5.2.4	Why is there an exception to the usual CS rules when the HE trigger-based frames contain an Ack or BlockAck? The CS rules are there to ensure coexistence, and any departure from them needs to be justified by (at least) a demonstrated infeasibility of any alternative. Here that has not been demonstrated and it seems it could not be demonstrated: the existing rules have served the technology very well, including Acks and BlockAcks.	Remove the exception for the case where all solicitied HE trigger-based PPDUs contain an Ack or BlockAck.	2017/1/9 9:42

6692	John Coffey	225	1 27.5.2.4	170	63	T	Y	170.63 27.5.2.4	It seems from this text that an AP can unilaterally permit STAs to transmit "without regard to the busy-idle state of the medium" (line 56 above) for a time up to 584 microseconds (line 2 of the next page). Yes, there are some restrictions, but on the other hand we should note that when this permission is granted, mutliple STAs are simultaneously permitted to ignore the normal rules. This seems very strange. No such permission should ever be given unless there is a strong showing of necessity, which doesn't seem to be the case here. Even if the mechanism is included, there should be much stronger safeguards before it is invoked.	Delete the CS Required bit and all text associated with CS Required = 0 in the draft.	2017/1/9 9:42
6693	John Coffey	225	1 27.5.2.5	171	11	E	Y	171.11 27.5.2.5	"to assist its AP in allocating UL MU resources in an efficient way." In a technical specification, there should be minimal advocacy / advertising / marketing: the text should be kept as factual as possible. In this case, what is gained by the inclusion of the words "in an efficient way", and how would the meaning change is they are deleted?	Delete "in an efficient way".	2017/1/9 9:42
6694	John Coffey	225	1 27.5.2.5	171	40	E	Y	171.40 27.5.2.5	Superfluous text, apparently left over from editing notes: "(#2190, #2191)".	Delete.	2017/1/9 9:42
6695	John Coffey	225	1 27.5.2.5	171	41	T	Y	171.41 27.5.2.5	Incomplete cross-reference: "Table 9-XX".	Add full table number.	2017/1/9 9:42
6696	John Coffey	225	1 27.5.2.5	171	56	T	Y	171.56 27.5.2.5	Inconsistent terminology: here we have "the trigger-based PPDU", whereas almost everywhere else in the draft we have "the HE trigger-based PPDU". If the same thing is intended, the same term should be used.	Change to "the HE trigger-based PPDU".	2017/1/9 9:42
6697	John Coffey	225	1 27.5.2.5	171	59	T	Y	171.59 27.5.2.5	Inconsistent terminology: here we have "the Trigger-based PPDU", whereas almost everywhere else in the draft we have "the HE trigger-based PPDU". If the same thing is intended, the same term should be used.	Change to "the HE trigger-based PPDU".	2017/1/9 9:42
6698	John Coffey	225	1 27.5.2.5	172	8	E	Y	172.08 27.5.2.5	Superfluous right parenthesis.	Delete it.	2017/1/9 9:42
6699	John Coffey	225	1 27.5.2.5	172	10	T	Y	172.10 27.5.2.5	Inconsistent terminology: here we have "the trigger-based PPDU", whereas almost everywhere else in the draft we have "the HE trigger-based PPDU". If the same thing is intended, the same term should be used.	Change to "the HE trigger-based PPDU".	2017/1/9 9:42
6700	John Coffey	225	1 27.5.2.5	172	20	E	Y	172.20 27.5.2.5	Garbled text: what does "that asks for" refer to? If it's the control, data, and management frames then it should be 'ask", while if it's the BSRP Trigger frame, then the next subclause needs to be set off with commas.	Clarify and correct.	2017/1/9 9:42
6701	John Coffey	225	1 27.5.2.5	172	20	T	Y	172.20 27.5.2.5	The statement that the acknowledgment has "high priority" doesn't seem to mean much. High compared with what? It may be that "highest" is meant, but if so, it's essential to say so, because that's not what the text says now.	Change "high" to "highest" (if this is what is intended).	2017/1/9 9:42
6702	John Coffey	225	1 27.5.2.6.1	172	29	E	Y	172.29 27.5.2.6.1	Superfluous comma: ", otherwise".	Delete comma.	2017/1/9 9:42
6703	John Coffey	225	1 27.5.2.6.1	172	52	E	Y	172.52 27.5.2.6.1	Wrong article: "The non-AP STA with dot11OFDMARandomAccessOptionImlemented set to true". Is there just one?	Change "The" to "A".	2017/1/9 9:42
6704	John Coffey	225	1 27.5.2.6.1	172	54	E	Y	172.54 27.5.2.6.1	Confusing language: why do we have "The HE STA" here? If this refers back to the STA in the previous sentence, we would expect to see simply "The STA". Note that the previous sentence didn't even mention the HE part.	Delete "HE".	2017/1/9 9:42
6705	John Coffey	225	1 27.5.2.6.2	173	19	E	Y	173.19 27.5.2.6.2	Inconsistent form: here we have "HE Trigger-based PPDU for STA2", whereas almost everywhere else in the draft we have "HE trigger-based".	Change "HE Trigger-based PPDU" to "HE trigger-based PPDU".	2017/1/9 9:42

6706	John Coffey	225	1 27.5.2.6.2	173	19	E	Y	173.19 27.5.2.6.2	Inconsistent form: here we have "HE Trigger-based PPDU for STA1", whereas almost everywhere else in the draft we have "HE trigger-based".	Change "HE Trigger-based PPDU" to "HE trigger-based PPDU".	2017/1/9 9:42
6707	John Coffey	225	1 27.5.2.6.2	173	46	E	Y	173.46 27.5.2.6.2	Missing full stop at end of sentence.	Add full stop.	2017/1/9 9:42
6708	John Coffey	225	1 27.5.2.6.2	173	46	E	Y	173.46 27.5.2.6.2	Missing space between sentences.	Add space.	2017/1/9 9:42
6709	John Coffey	225	1 27.5.2.6.2	173	50	T	Y	173.50 27.5.2.6.2	"If the selected RU is considered busy": this raises the question of how HE devices in OBSSs should consider the initial tirgger frame, assuming they are able to decode it. One plausible rule is that they should interpret the medium as busy, just as if an initial CTS-to-Self had been transmitted (even though the following transmission(s) will be UL from other STAs, not DL by the original trransmitter). But another way of looking at it is that as a policy issue, we're in a contention-based access mode, albeit one that only HE devices understand, and that devices in OBSSs may still contend for the medium and use it if it's idle. It's not clear which of these is intended here; perhaps the OBSS STAs simply set their Inter-BSS NAV and we have the first possibility by default. If so, it seems the wrong approach. The amendment is supposed to provide high efficiency in dense environments and as a	Clarify the rules for HE devices in OBSSs. Clarify or specify, as appropriate, that such devices may access the medium notwithstanding receipt of the initial trigger frame.	2017/1/9 9:42
6710	John Coffey	225	1 27.5.2.6.2	173	52	E	Y	173.52 27.5.2.6.2	Grammatical error: "does not decrements". It either "decrements" or "does not decrement".	Change to "does not decrement".	2017/1/9 9:42
6711	John Coffey	225	1 27.5.2.6.2	174	19	T	Y	174.19 27.5.2.6.2	How does coexistence with deployed legacy devices, especially those in OBSSs, work? Here it seems that the HE AP transmits an initial trigger frame, which holds all devices within range off the medium for the signaled duration. Perhaps HE devices in OBSSs may still transmit (this is not clear), but certainly legacy devices in OBSSs cannot. These legacy devices may suffer a huge loss of access to the medium if use of this mode becomes prevalent. Essentially, instead of the HE non-AP STAs that take advantage of this mode having to fight their own way to the top via ordinary EDCA, their AP unilaterally seizes the medium with AP priority and these devices then share the rarified space with each other. This is far too favorable to HE devices and some controls are necessary. At the very least recomemnded practices for best behavior need to be specified.	Provide specifications for recommended behavior for APs that use this mode, that will have the effect of allowing fair access to the medium by legacy devices in OBSSs. (Note: a sketch of one approach that would be acceptable can be found in doc. IEEE 802.11/16-0102r1, slides 20-23.)	2017/1/9 9:42
6712	John Coffey	225	1 27.5.2.6.2	174	19	T	Y	174.19 27.5.2.6.2	In some ways the random access OFDMA modes are an odd fit for the 11ax project: one of the main benefits of OFDMA is the potential increase in efficiency from the removal of most contention-based overhead (collisions, RTS, CTS, unused backoffs slots). This potential increase in efficiency may provide a net gain even after accounting for the new, considerably longer, HE preambles. But with random access OFDMA we still have the contention overhead but now with the new, longer, preambles as well. Perhaps there's an arguable potential range difference, but once again range extension isn't part of the project. A stronger justification is that 11ax will involve OFDMA as a major component, and it's difficult to jump straight from contention-based access to fully scheduled operation; perhaps there should be a way of bridging the two modes of operation. However even	Permit the AP to send an immediate supplementary frame identifying RU's and for each RU a list of STAs. These STAs may access the RU if it's not already in use. If none on the list does (or are seen to do so), other STAs start counting down their OCW backoff counters as in the current draft.	2017/1/9 9:42

6713 John Coffey	225	1 27.5.2.7	174	24	E	Y	174.24 27.5.2.7	Strange wording: "feedbacks". This construction seems to suggest that there can be such a thing as "a feedback".	Change "short feedbacks" to "short frames carrying feedback".	2017/1/9 9:42
6714 John Coffey	225	1 27.5.2.7	174	24	E	Y	174.24 27.5.2.7	Advertising alert: "from a very high number of STAs". Please avoid words like "very", which have no normative content but that seem to be making a sales pitch.	Change "from a very high number of STAs" to "from multiple STAs".	2017/1/9 9:42
6715 John Coffey	225	1 27.5.2.7	174	25	E	Y	174.25 27.5.2.7	Superfluous comma: "HE STAs,".	Delete it.	2017/1/9 9:42
6716 John Coffey	225	1 27.5.2.7	174	25	E	Y	174.25 27.5.2.7	Advertising alert part 2: "in an efficient manner". What is achieved by including this text in the draft, especially since the word "short" is already present in the same sentence? The AP would hardly send short frames in an inefficient manner?	Delete "in an efficient manner".	2017/1/9 9:42
6717 John Coffey	225	1 27.5.2.7	174	25	E	Y	174.25 27.5.2.7	Strange wording: "feedbacks". This construction seems to suggest that there can be such a thing as "a feedback".	Change "feedbacks" to "frames carrying feedback".	2017/1/9 9:42
6718 John Coffey	225	1 27.5.2.7	174	27	E	Y	174.27 27.5.2.7	Strange wording: "feedbacks". This construction seems to suggest that there can be such a thing as "a feedback".	Change "feedbacks" to "frames carrying feedback".	2017/1/9 9:42
6719 John Coffey	225	1 27.5.2.7	174	28	T	Y	174.28 27.5.2.7	The NDP feedback report is optional for a non-AP STA, but what about the remaining case? Is it mandatory or optional for an AP?	Specify whether this mode is mandatory or optional for HE APs.	2017/1/9 9:42
6720 John Coffey	225	1 27.5.2.7	174	28	T	Y	174.28 27.5.2.7	The heading includes the word "procedure"; where is it? How does the AP signal that the responding STAs can only send NDP frames?	Define a proecdure or delete the mode.	2017/1/9 9:42
6721 John Coffey	225	1 27.5.3	174	33	T	Y	174.33 27.5.3	Descriptive text used where it seems normative text must have been intended: "A TXOP can include". If the intention is to clarify that this is permitted, it is essential to say so.	Change the sentence to "An AP may include both DL MU and UL MU transmissions in a TXOP."	2017/1/9 9:42
6722 John Coffey	225	1 27.5.3	174	36	T	Y	174.36 27.5.3	Descriptive text used where it seems normative text must have been intended: "an HE AP can initiate". If the intention is to clarify that this is permitted, it is essential to say so.	Change "can" to "may".	2017/1/9 9:42
6723 John Coffey	225	1 27.5.3	174	35	E	Y	174.35 27.5.3	Missing article: "If MU Cascading Support field".	Change to "If the MU Cascading Support field".	2017/1/9 9:42
6724 John Coffey	225	1 27.5.3	175	44	E	Y	175.44 27.5.3	Strange use of plural form: "contents".	Change to "content".	2017/1/9 9:42
6725 John Coffey	225	1 27.5.3	175	47	E	Y	175.47 27.5.3	Missing article: "If MU Cascading Support field".	Change to "If the MU Cascading Support field".	2017/1/9 9:42
6726 John Coffey	225	1 27.5.3	175	52	E	Y	175.52 27.5.3	Missing article: "If MU Cascading Support field".	Change to "If the MU Cascading Support field".	2017/1/9 9:42
6727 John Coffey	225	1 27.5.3	175	53	E	Y	175.53 27.5.3	Strange and non-standard wording: "the HE AP associated by the HE non-AP STA". This construction does not seem to appear anywhere in the 3,534 pages of the 2016 rollup of the base standard. Let's not add it now.	Change "associated by the HE non-AP STA" to "with which the HE non-AP STA is associated".	2017/1/9 9:42
6728 John Coffey	225	1 27.5.3	175	61	E	Y	175.61 27.5.3	Inconsistent terminology: in "DL HE MU PPDU", the STA type is in the middle, whereas in practically every oher instance the type is at the beginning.	Change "DL HE MU" to "HE DL MU".	2017/1/9 9:42
6729 John Coffey	225	1 27.5.3	175	62	E	Y	175.62 27.5.3	Inconsistent terminology: in "DL HE MU PPDU", the STA type is in the middle, whereas in practically every oher instance the type is at the beginning.	Change "DL HE MU" to "HE DL MU".	2017/1/9 9:42
6730 John Coffey	225	1 27.6.2	176	22	E	Y	176.22 27.6.2	Inconsistent usage: here we have "a NDP", weheras elsewhere we have "an NDP". The latter seems better.	Change "a NDP" to "an NDP".	2017/1/9 9:42
6731 John Coffey	225	1 27.6.2	176	26	E	Y	176.26 27.6.2	Independent clauses linked by a comma without a coordinating conjunction.	Change comma to semicolon.	2017/1/9 9:42
6732 John Coffey	225	1 27.6.2	177	16	T	Y	177.16 27.6.2	Inconsistent use of defined term: here we have "STA info", whereas elsewhere we have "STA Info". If the same item is intended, the same term must be used.	Change "STA info" to "STA Info".	2017/1/9 9:42
6733 John Coffey	225	1 27.6.2	177	20	T	Y	177.20 27.6.2	Missing cross-reference: "Table YY-1". There appears to be no such table.	Add the table.	2017/1/9 9:42
6734 John Coffey	225	1 27.6.2	178	40	E	Y	178.40 27.6.2	Superfluous comma.	Delete comma.	2017/1/9 9:42
6735 John Coffey	225	1 27.6.4	179	24	T	Y	179.24 27.6.4	Non-existent unit used: "0.8 us".	Change to "ms".	2017/1/9 9:42
6736 John Coffey	225	1 27.6.4	179	24	T	Y	179.24 27.6.4	Non-existent unit used: "1.6 us".	Change to "ms".	2017/1/9 9:42
6737 John Coffey	225	1 27.6.4	179	25	T	Y	179.25 27.6.4	Non-existent unit used: "3.2 us".	Change to "ms".	2017/1/9 9:42

6738	John Coffey	225	1 27.6.4	179	27	T	Y	179.27 27.6.4	Non-extistent unit used: "4 us".	Change to "ms".	2017/1/9 9:42
6739	John Coffey	225	1 27.7.2	180	33	E	Y	180.33 27.7.2	Grammatical error: "all non-AP STAs, which are associated to it". The comma has the effect of saying that all non-AP STAs are associated to the AP, rather than the presumably intended meaning of restricting the set of non-AP STAs to those that are so associated.	Delete comma.	2017/1/9 9:42
6740	John Coffey	225	1 27.7.2	180	33	E	Y	180.33 27.7.2	"Wicked which": in standard American English usage, "that" is preferred to "which" in this context. ("Fowler's rule"; still debated by the language mavens.)	Change "which" to "that".	2017/1/9 9:42
6741	John Coffey	225	1 27.7.2	180	58	E	Y	180.58 27.7.2	Spelling error: "supercede" should be "supersede", the former is incorrect whether we are using American or British English. (The 2016 rollup of the base standard has three instances of "supercede": oy vey!)	Change to "supersede".	2017/1/9 9:42
6742	John Coffey	225	1 27.7.2	180	59	E	Y	180.59 27.7.2	Missing space: "that is setup".	Change "setup" to "set up".	2017/1/9 9:42
6743	John Coffey	225	1 27.7.2	180	60	E	Y	180.60 27.7.2	Missing space: "that is setup".	Change "setup" to "set up".	2017/1/9 9:42
6744	John Coffey	225	1 27.7.2	181	31	E	Y	181.31 27.7.2	Missing right parenthesis.	Add right parenthesis.	2017/1/9 9:42
6745	John Coffey	225	1 27.7.2	181	38	T	Y	181.38 27.7.2	Inconsistent terminology: here we have "the trigger-based PPDU", whereas almost everywhere else in the draft we have "the HE trigger-based PPDU". If the same thing is intended, the same term should be used.	Change to "the HE trigger-based PPDU".	2017/1/9 9:42
6746	John Coffey	225	1 27.5.3	175	60	E	Y	175.60 27.5.3	Case disagreement: the HE trigger-based PPDUs that follows".	Fix.	2017/1/9 9:42
6747	John Coffey	225	1 27.7.2	181	40	T	Y	181.40 27.7.2	Inconsistent terminology: here we have "the trigger-based PPDU", whereas almost everywhere else in the draft we have "the HE trigger-based PPDU". If the same thing is intended, the same term should be used.	Change to "the HE trigger-based PPDU".	2017/1/9 9:42
6748	John Coffey	225	1 27.7.3.1	182	35	E	Y	182.35 27.7.3.1	Inconsistent usage: here we have "non-AP HE STA", whereas almost everywhere else in the draft we have "HE non-AP STA".	Change to "HE non-AP STA".	2017/1/9 9:42
6749	John Coffey	225	1 27.7.3.3	185	47	E	Y	185.47 27.7.3.3	Wrong article: "The TWT SP termination event occurs".	Change to "A TWT SP termination event occurs".	2017/1/9 9:42
6750	John Coffey	225	1 27.7.3.3	186	16	E	Y	186.16 27.7.3.3	Wrong article: "The TWT scheduled STA that is in PS mode". Is there just one?	Change "The" to "A".	2017/1/9 9:42
6751	John Coffey	225	1 27.7.3.3	186	17	T	Y	186.17 27.7.3.3	Inconsistent terminology: here we have "the trigger-based PPDU", whereas almost everywhere else in the draft we have "the HE trigger-based PPDU". If the same thing is intended, the same term should be used.	Change to "the HE trigger-based PPDU".	2017/1/9 9:42
6752	John Coffey	225	1 27.7.3.3	186	20	E	Y	186.20 27.7.3.3	Wrong article: "the PS-Poll or APSD trigger frame".	Change "the" to "a".	2017/1/9 9:42
6753	John Coffey	225	1 27.7.4	187	41	E	Y	187.41 27.7.4	Spurious hyphenation: "expected to wake-up".	Change to "expected to wake up".	2017/1/9 9:42
6754	John Coffey	225	1 27.8.2	188	55	E	Y	188.55 27.8.2	Wrong article: "the frame".	Change to "a frame".	2017/1/9 9:42
6755	John Coffey	225	1 27.8.2	188	58	E	Y	188.58 27.8.2	Wrong article: "the immediate acknowledgment".	Change to "an immediate acknowledgement".	2017/1/9 9:42
6756	John Coffey	225	1 27.8.2	188	61	E	Y	188.61 27.8.2	Wrong article: "the immediate acknowledgment".	Change to "an immediate acknowledgement".	2017/1/9 9:42
6757	John Coffey	225	1 27.8.2	189	8	E	Y	189.08 27.8.2	Garbled text: "After transmitting the acknowledgement frame immediate response immediate acknowledgement". What is that?	Clarify.	2017/1/9 9:42
6758	John Coffey	225	1 27.8.2	189	13	E	Y	189.13 27.8.2	Wrong verb form: "needs".	Change to "need".	2017/1/9 9:42
6759	John Coffey	225	1 27.9.1	190	7	T	Y	190.07 27.9.1	How do the spatial reuse modes help the goal of power saving, as is asserted here? Under legacy rules a STA simply evaluates the power of the incoming frame and if it exceeds the threshold, the STA stops there. The new rules involve various attempts to read further into the incoming frame to decide whether it's intra-BSS or inter-BSS, which has to consume more power, not less. It would be confusing and misleading to list power saving as an "objective" if no net power saving occurs.	Delete "and power saving".	2017/1/9 9:42

6760	John Coffey	225	1 27.9.1	190	11	T	Y	190.11 27.9.1	Use of undefined term: apparently when conditions are right for an "SR PPDU", an HE STA may go ahead and transmit an "SR PPDU". But what is an "SR PPDU"? The term appears nowhere in the draft except for this sentence.	Provide a definition for SR PPDU.	2017/1/9 9:42
6761	John Coffey	225	1 27.9.2.1	190	24	T	Y	190.24 27.9.2.1	"The received PPDU is an Inter-BSS PPDU" (as in 27.2.1). This excludes one of the main cases where spatial reuse might may some promise: an HE STA finishes transmitting and starts assessing the medium again, and finds that there are ongoing frames being transmitted. Perhaps the STA could conclude that these must be Inter-BSS (though that would require changes in 27.2.1, because it doesn't seem to be there now), but that would cause all Inter-BSS PPDUs to be subject to interference, and would vitiate the other conditions further below in this same section. However there is a way: there is already the concept of SR_Delay in the draft, and (assuming that this isn't shorthand for SRP_Delay, but instead a delay for all spatial reuse) the delay could be set to a uniform length that's long enough for reasonable PPDUs to finish. So: HE STA finishes its transmission, starts	Rewrite the spatial reuse modes to eliminate the required classifcation into Inter-BSS and Intra-BSS, and add a uniform delay before spatial reuse may take effect, this delay to exceed a reasonable fragment size for legacy devices.	2017/1/9 9:42
6762	John Coffey	225	1 27.9.2.1	190	36	T	Y	190.36 27.9.2.1	Almost the entire OBSS_PD mode / SRP mode lacks basic protections to prevent matters from going disastrously wrong, as is all too possible. Unlike virtually any other mode, 'bad' OBSS_PD decisions are not automatically self-righting (as too ambitious an MCS would be, for example) and do not have a natural limit to the damage that can be caused (as nnecessary use of RTS/CTS would be, for example). Worse, the effects of a 'bad' OBSS-PD decision will typically not be felt by the offending device, but instead by a victim device in a different BSS, with no messaging system provided to alert any devices in the system to the problem. This is likely to cause particularly severe problems for already deployed non-HE devices, which have been designed without taking into the account the possibility that 802.11 might later adopt such a scheme. However there is one small bright spot: the text	Modify so that the medium cannot be declared idle until at least enough time has passed that a minimum length fragment can be transmitted and acknowledged.	2017/1/9 9:42
6763	John Coffey	225	1 27.9.2.1	190	51	E	Y	190.51 27.9.2.1	Sentence lacks a verb: "SR Backoff procedure for SR delayed case". Is this a failed subheading?	Change to subheading or delete.	2017/1/9 9:42
6764	John Coffey	225	1 27.9.2.1	190	59	E	Y	190.59 27.9.2.1	Awkward phrasing / missing text: "and not update".	Change to "and has not updated".	2017/1/9 9:42
6765	John Coffey	225	1 27.9.2.1	190	60	T	Y	190.60 27.9.2.1	"the HE STA may resume its backoff procedure when the medium condition is IDLE". The timing involved is severely underdefined. In ordinary operation, a channel assessment is carried out at the beginning of a slot, and if the channel is idle, the backoff counter counts down before the end of the slot, thus preserving synchronization along slot boundaries. With the OBSS_PD rules, the HE STA must perform all sorts of assessments of the incoming PPDU, extending well past the initial slot boundary and possibly / probably not ending near a slot boundary. When it finally declares the medium is idle and resumes backoff countdown, does it do so immediately or in synchronization with the original slot boundaries or in synchronization with the slot boundaries of the OBSS PPDU? This is not specified in the draft.	Specify it.	2017/1/9 9:42

6766	John Coffey	225	1 27.9.2.1	190	60	T	Y	190.60 27.9.2.1	The issue of the timing of channel idle decisions psoses problems for fairness between HE devices. Compare two similarly situated HE STAs in the same BSS, STA A and STA B. Each sees an OBSS PPDU at essentialy the same power, but STA A makes the decision that the received frame is Inter-BSS marginally faster. Clearly STA A gains an advantage in medium access over STA B. By itself this might not necessarily be bad, if STA A does so by virtue of better processing. But as it is, it will be very difficult for an outsider to verify just how STA A has made its decision, since much depends in the received power levels at the STA's antenna connector, which will not be available to an outsider. Essentially STA A could deliver itself a meaningful and recurring advantage in channel access over STA B, perhaps by cutting a few non-observable corners. This is an undesirable state of affairs that	Specify a standardized delay (number of slots) for the decision to be made.			2017/1/9 9:42
6767	John Coffey	225	1 27.9.2.2	191	3	T	Y	191.03 27.9.2.2	With the definitions in the rest of the draft, the sentence "Adjusting the OBSS_PD level and transmit power can improve the system level performance and the utilization of the spectrum" is one-sided and incomplete. It would be at least equally true to say that adjusting the OBSS_PD level and transmit power can degrade system level performance and utilization of the spectrum, perhaps disastrously so. if the subject is to be raised at all, then basic respect for truth and objectivity should demand a balanced discussion with ample warning of the potential negative effects, not a biased piece of advertising fluff.	Delete the sentence.			2017/1/9 9:42
6768	John Coffey	225	1 27.9.2.2	191	24	T	Y	191.24 27.9.2.2	The adjustments in OBSS_PD shown in this diagram represent a great increase in the level of interference that will be seen by the intended receiver of the frame that is currently under way. *Every* device that is permitted to transmit under current rules will still be allowed to transmit under the rule in the diagram. In addition, many more devices will be allowed to transmit. Even worse, *every* new device that is allowed to transmit will be allowed to do so at a transmit power level that results in the maximum level of interference that would apply under the existing rules: essentially the rule requires the new, interfering transmitter to reduce its transmit power, but only by just enough to get the interference down to that existing maximum. The justifications that have been given for this radical departure from prior practice seem extraordinarily weak, and essentially seem to boil down	Remove the entire OBSS_PD mode and all references to it and all modes that enable it in whole or in part from the draft.			2017/1/9 9:42
6769	John Coffey	225	1 27.10.2	192	41	E	Y	192.41 27.10.2	Incorrect form of indefinite article: "an DL". If the term is to stay in the same form, this needs to be changed.	Change "an" to "a".			2017/1/9 9:42
6770	John Coffey	225	1 27.10.2	192	41	E	Y	192.41 27.10.2	Inconsistent terminology: in "DL HE MU PPDU", the STA type is in the middle, whereas in practically every oher instance the type is at the beginning.	Change "DL HE MU" to "HE DL MU".			2017/1/9 9:42
6771	John Coffey	225	1 27.10.3	193	22	T	Y	193.22 27.10.3	Use of undefined term: "Single MPDU". From the capitalization, it must be inferred that this is a defined term, but where is the definition? The draft also uses "single MPDU", and for good measure both "VHT Single MPDU" and "VHT single MPDU". The baseline	Clarify.			2017/1/9 9:42
6772	John Coffey	225	1 27.10.4	194	35	T	Y	194.35 27.10.4	Use of undefined term: HE ER SU PPDU.	Provide a definition.			2017/1/9 9:42

6773 John Coffey	225	1 27.10.4	195	38	E	Y	195.38 27.10.4	Inconsistent terminology: in "DL HE MU PPDU", the STA type is in the middle, whereas in practically every oher instance the type is at the beginning.	Change "DL HE MU" to "HE DL MU".	2017/1/9 9:42
6774 John Coffey	225	1 27.11.3	196	30	E	Y	196.30 27.11.3	List of two elements connected only by a comma.	Delete comma and add "or".	2017/1/9 9:42
6775 John Coffey	225	1 27.11.4	196	59	E	Y	196.59 27.11.4	"not a member of a transmitting STA's BSS": why "a"? Could this be anything other than *the* STA referenced in the previous sentence?	Change "a" to "the".	2017/1/9 9:42
6776 John Coffey	225	1 27.11.4	197	3	E	Y	197.03 27.11.4	"to the value of the value": is there some distinction intended from the simpler and more natural "to the value"?	Delete "of the value".	2017/1/9 9:42
6777 John Coffey	225	1 27.11.4	197	9	T	Y	197.09 27.11.4	Unnecessary variant used for defined term: "BSS color". The term is "BSS Color".	Change to "BSS Color".	2017/1/9 9:42
6778 John Coffey	225	1 27.11.4	197	10	E	Y	197.10 27.11.4	Confusing syntax, with subordinate clause run into main clause: "An HE AP that decides to discontinue the use of the BSS color for the BSS that it serves, for example, after detecting a BSS Color overlap with an OBSS shall set". Here the "shall set" refers back to the HE AP, even though the sentence as structured seems to urge the reader to link it to the OBSS.	Change to "An HE AP that decides to discontinue the use of the BSS color for the BSS that it serves, for example after detecting a BSS Color overlap with an OBSS, shall set".	2017/1/9 9:42
6779 John Coffey	225	1 27.11.4	197	19	T	Y	197.19 27.11.4	An "HE non-AP STA should use [...] instead of the BSS_COLOR". Wait a moment, didn't we read just on the preceding page that an HE STA "shall maintain that single value of the BSS Color subfield for the lifetime of the BSS" (P196 LL43-44)? So already the text is contradicting itself. This needs to be resolved.	Reconcile the two statements at issue. For example, add some "Except when ..." qualifier to the earlier statement.	2017/1/9 9:42
6780 John Coffey	225	1 27.11.4	197	27	E	Y	197.27 27.11.4	Wrong article: "The HE non-AP STA". Is there just one?	Change "The" to "An".	2017/1/9 9:42
6781 John Coffey	225	1 27.11.4	197	27	T	Y	197.27 27.11.4	Unnecessary variant used for defined term: "BSS color". The term is "BSS Color".	Change to "BSS Color".	2017/1/9 9:42
6782 John Coffey	225	1 27.14.1	199	20	T	Y	199.20 27.14.1	Unnecessary variant used for defined term: "BSS color". The term is "BSS Color".	Change to "BSS Color".	2017/1/9 9:42
6783 John Coffey	225	1 27.14.1	199	28	T	Y	199.28 27.14.1	Unnecessary variant used for defined term: "BSS color". The term is "BSS Color".	Change to "BSS Color".	2017/1/9 9:42
6784 John Coffey	225	1 27.14.1	199	30	T	Y	199.30 27.14.1	Unnecessary variant used for defined term: "BSS color". The term is "BSS Color".	Change to "BSS Color".	2017/1/9 9:42
6785 John Coffey	225	1 27.14.1	199	36	T	Y	199.36 27.14.1	Unnecessary variant used for defined term: "BSS color". The term is "BSS Color".	Change to "BSS Color".	2017/1/9 9:42
6786 John Coffey	225	1 27.16.2	206	25	T	Y	206.25 27.16.2	"An HE AP may choose to change the BSS Color under certain conditions". That's not what was said back on page 196 (lines 43-44), where HE STAs had to use the same BSS Color for the lifetime of the BSS. The reader shouldn't have to flip backwards and forwards through the specification to see if apparently definitive requirements are countermanded by statements far away.	Reconcile the two statements at issue. For example, add some "Except when ..." qualifier to the earlier statement.	2017/1/9 9:42
6787 John Coffey	225	1 27.16.2	206	27	T	Y	206.27 27.16.2	"one other OBSS AP in the neighborhood that uses the same color as the BSS Color of its BSS". Sorry, this is quite muddled. Defined terms need to be capitalized; otherwise they retain their everyday meaning. So "color", lower case, is an actual color of the rainbow. The color of the AP depends on how it is painted. The BSS doesn't have a color. The draft uses colloquial shortcuts that aren't even short: why not simply say "one other OBSS AP in the neighborhood that uses that same BSS Color"?	Change to "one other OBSS AP in the neighborhood that uses the same BSS Color".	2017/1/9 9:42
6788 John Coffey	225	1 27.16.2	206	29	E	Y	206.29 27.16.2	"The algorithm to choose a new BSS Color is beyond the scope of this standard." Why "the" algorithm? Is there just one?	Change to "Methods and criteria for choosing a new BSS Color are beyond the scope of this standard".	2017/1/9 9:42
6789 John Coffey	225	1 27.16.2	206	51	T	Y	206.51 27.16.2	Unnecessary variant used for defined term: "BSS color". The term is "BSS Color".	Change to "BSS Color".	2017/1/9 9:42
6790 John Coffey	225	1 27.16.2	206	54	E	Y	206.54 27.16.2	Inconsistent usage: "A HE AP". Almost everywhere else in the draft we have "An HE".	Change "A" to "An".	2017/1/9 9:42

6791	John Coffey	225	1 27.16.2	206	59	E	Y	206.59 27.16.2	Inconsistent usage: "A HE AP". Almost everywhere else in the draft we have "An HE".	Change "A" to "An".	2017/1/9 9:42
6792	John Coffey	225	1 27.3.16.1	207	6	T	Y	207.06 27.3.16.1	Unclear and ambiguous description of normative behavior: "The QTP (quiet time period) defines a period for STA-to-STA operation during which only the HE STA which supports the STA-to-STA operation can transmit frames". Where in the draft is this "STA-to-STA operation" defined? If there are multiple HE (non-AP) STAs that support this STA-to-STA operation, may (or "can") all of them transmit frames during any QTP, or is it only the "requester" HE STA that may do so?	Clarify.	2017/1/9 9:42
6793	John Coffey	225	1 27.3.16.1	207	6	T	Y	207.06 27.3.16.1	Incorrect (or at least unclear) use of definite article: "the HE STA which". Is there only one such HE STA?	Clarify.	2017/1/9 9:42
6794	John Coffey	225	1 27.3.16.1	207	6	T	Y	207.06 27.3.16.1	Incorrect (or at least unclear) use of definite article: "the STA-to-STA operation". Is there only one such STA-to-STA operation?	Clarify.	2017/1/9 9:42
6795	John Coffey	225	1 27.3.16.1	207	6	T	Y	207.06 27.3.16.1	Contradictory statements about normative behavior: in the first sentence the quiet time period is described as a period "during which only [...] [one?] HE STA may transmit frames", but in the second and third sentences of the same paragraph we have statements that other HE STAs "should" remain quiet during these periods. So is it madatory or optional for other HE STAs to stay quiet?	At minimum, change "may" to "should" in the first sentence. Reword furtehr as appropriate to remove the awkwardness.	2017/1/9 9:42
6796	John Coffey	225	1 27.3.16.1	207	7	T	Y	207.07 27.3.16.1	Compare the statements "During the period an HE STA should not transmit frames unless it participates in the STA-to-STA operation" and "All HE STAs in the HE BSS not participating in the STA-to-STA operation should stay quiet during the period", which we have in consecutive sentences. What does the latter sentence add to the description of the recommended behavior for a non-participating HE STA? It seems to be a subset of the behavior described in the former sentence (since it repeats the recommended behavior but limits the recommendation to HE STAs in the (same?) HE BSS).	If the latter sentence adds anything, explain. If not, delete the sentence.	2017/1/9 9:42
6797	John Coffey	225	1 27.3.16.2	207	19	E	Y	207.19 27.3.16.2	Mismatched terms: "Quiet Time Period Operation (Figure 27-8 (Quieting time period operation)". Is is Quiet or Quieting?	Pick one term and stick to it.	2017/1/9 9:42
6798	John Coffey	225	1 27.3.16.2	207	52	T	Y	207.52 27.3.16.2	Ambiguous text: "if a Quiet Time Period Response frame is received with". Are we supposed to understand that the reception is by the "requester" HE STA? If so, why not say so?	Change "ir received with" to is received by the requester HE STA with".	2017/1/9 9:42
6799	John Coffey	225	1 27.3.16.2	207	52	E	Y	207.52 27.3.16.2	Awkward phrasing: "with the matching dialog token and response token".	Change to "with dialog toekn matching the response token" or some other less awkward wording.	2017/1/9 9:42
6800	John Coffey	225	1 27.3.16.2	207	52	E	Y	207.52 27.3.16.2	Run-on text with unclear intended parsing: "If [a frame] is received with the matching dialog token and response token with a status code set to a value of SUCCESS". Is it the response token or the frame that has the status code?	Clarify. Inserting a comma somewhere might suffice.	2017/1/9 9:42
6801	John Coffey	225	1 27.3.16.2	207	57	T	Y	207.57 27.3.16.2	Use of undefined term: "the Quite Time Period". Quite what?	Change "Quite" to "Quiet".	2017/1/9 9:42
6802	John Coffey	225	1 27.16.3.2	207	57	T	Y	207.57 27.16.3.2	Unclear and possibly garbled text: "the requested HE STA". What does this mean? Elsewhere in the same section we have "requester" HE STA so perhaps this is a misprint.	Change "requested" to "requester".	2017/1/9 9:42

6803 John Coffey	225	1 27.16.3.2	207	57	T	Y	207.57 27.16.3.2	Descriptive language used where it seems normative language must have been intended: the HE STA "can" transmit frames. The ability of the HE STA to transmit frames is not in question; presumably what is meant is that in the circumstances described, the HE STA is permitted to transmit frames.	Change "can" to "may".	2017/1/9 9:42
6804 John Coffey	225	1 27.16.3.2	207	57	T	Y	207.57 27.16.3.2	Unclear and ungrammatical text: "can transmit frames belongs to the requested type of STA-to-STA operation". What does this mean?	Clarify.	2017/1/9 9:42
6805 John Coffey	225	1 27.16.3.2	207	57	T	Y	207.57 27.16.3.2	Imprecise (possibly) normative text: "When a Quiet Time Period Setup frame is received, the requested(/r) HE STA can/may transmit". Isn't the whole point that that these "quiet times" repeat themselves periodidcally up to some limit, potentially at least? So whatever is being described here, it can't be the period immediately after reception of the setup frame.	Add appropriate text to clarify when the requester HE STA can or may transmit whatever it is supposed to be transmitting under this protocol.	2017/1/9 9:42
6806 John Coffey	225	1 27.16.3.2	207	58	T	Y	207.58 27.16.3.2	Normative text tied entirely to vendor specific elements: "the requested [requester?] HE STA can [may?] transmit frame belongs [?] to the requested type of STA-to-STA operation indicated by the vendor specific service identifier". Normally vendor specific behavior is outside the scope of the standard, but here we have an elaborate new protocol whose behavior is defined entirely in terms of vendor specific behavior. Are we allowed to mix normative text and vendor specific definitions in this way? And even if we are allowed to, should we? What is gained?	Change "frame" to "frames" and delete the text from "belongs to" to the end of the sentence.	2017/1/9 9:42
6807 John Coffey	225	1 27.16.3.2	207	59	T	Y	207.59 27.16.3.2	There's something odd about the entire discussion in subsection c. On the surface it seems to discuss the frames that may be sent in a QTP. But earlier, in 27.16.3.1, it is stated that non-participating HE STAs "should" not transmit during a quiet period. From this we can infer that remaining quiet during this "quiet period" is optional, and any and all HE STAs may transmit any frames they like during the same period. So what role does subsection c play? Where does the behavior it describes fall on the shall / should may spectrum?	Reword to clarify the role this subsection plays. Assuming that we keep the "should"s in 27.16.3.1, perhaps the best that can be done is to recast this subsection as a suggested example of what can be done. ("For example, an HE STA may ... .')	2017/1/9 9:42
6808 John Coffey	225	1 27.16.3.2	207	62	E	Y	207.62 27.16.3.2	Missing word: "inform the AP the type".	Change to "inform an AP of the type".	2017/1/9 9:42
6809 John Coffey	225	1 27.16.3.3	208	5	T	Y	208.05 27.16.3.3	Mandatory requirements embedded in optional mode: earlier it's stated that an AP "may" operate this way, but here we have a "shall". If this is just an illustrative example, it is confusing and inappropriate to have mandatory language included.	Reword to eliminate the "shall". If the idea is to describe some sort of conditionally mandatory behavior, then reword the introductory language to make it clear that this is an optional mode rather than simly an illustrative example.	2017/1/9 9:42
6810 John Coffey	225	1 27.16.3.3	208	11	T	Y	208.11 27.16.3.3	Mandatory requirements embedded in optional mode: earlier it's stated that an AP "may" operate this way, but here we have a "shall". If this is just an illustrative example, it is confusing and inappropriate to have mandatory language included.	Reword to eliminate the "shall". If the idea is to describe some sort of conditionally mandatory behavior, then reword the introductory language to make it clear that this is an optional mode rather than simly an illustrative example.	2017/1/9 9:42
6811 John Coffey	225	1 27.16.3.3	208	13	E	Y	208.13 27.16.3.3	Incorrect article: "the copy". Is there just one?	Change to "a copy".	2017/1/9 9:42
6812 John Coffey	225	1 27.16.3.3	208	23	E	Y	208.23 27.16.3.3	Missing article" "the Quiet Period Duration field of Quiet Period Setup frame".	Change to "the Quiet Period Duration field of a Quiet Period Setup frame".	2017/1/9 9:42
6813 John Coffey	225	1 27.16.3.3	208	23	T	Y	208.23 27.16.3.3	Incorrect use of definite article: "to the value no larger". Is there just one?	Change to "to a value no larger".	2017/1/9 9:42

6814 John Coffey	225	1 27.16.3.3	208	35	T	Y	208.35 27.16.3.3	During these "quiet periods", other HE STAs that follow the recomemnded procedure are held off the air. But there is no requirement that the requester HE STA actually has to transmit anything. Thus we have a procedure that permits STAs to reserve the medium without any requirement that it should actually be used, or any convenient method of terminating its use if the requester HE STA does not transmit (or is not allowed to transmit, under the CCA rules). This is the epitome of bad practice. The recommended practice should be modified so that other HE STAs are allowed to transmit once it becomes clear that this quiet period is not going to be used.	Modify the "should" statements in 27.16.3.1 to something appropriately shorter than the fll quiet period.		2017/1/9 9:42
6815 John Coffey	225	1 27.16.3.3	208	35	T	Y	208.35 27.16.3.3	In the illustrative example of behavior by the AP, we have the statement that the AP "shall" schedule the quiet period(s) according to the accepted request. The dividing line between mandatory and optional is very murky here since the example is introduced with a "may". But taking the "shall" at face value, we have the peculiar situation where a requester HE STA may request many repetitions of a quiet period, then not transmit during the first few quiet periods, and the AP would still be compelled to issue new QTP setups according to the original schedule. This is bad practice. Requests to hold the medium silent for transmissions that never arrive should not be honored.	Modify the language to make it clear (after clarifying the whole shall / should / may status of the whole mechanism) that an AP is under no obligation to issue QTP setup frames, regardless of any previously "accepted" request.		2017/1/9 9:42
6816 John Coffey	225	1 27.16.3.3	208	35	T	Y	208.35 27.16.3.3	The entire quiet time period mechanism is odd and unconvincing. Legacy devices will not understand, and will not remain quiet. Even for HE STAs, it is just a recommendation that the device "should" remain quiet, which is usually not worth anything. In a dense environment in which some devices follow the recommendation and others do not, the "quiet period" will actually be quite noisy. So what's the point? Apart from that the mechanism, even if it worked, would allow devices to make arbitrary reservations of the medium without a requirement for actually using it, and without a method of canceling unused quiet periods; even if this worked, it shouldn't be allowed.	Delete the "quiet time period" and all references to it in the draft.		2017/1/9 9:42
6817 John Coffey	225	1 28.1.1	209	18	E	Y	209.18 28.1.1	Inconsistent usage: here we have "non-AP HE STA", whereas almost everywhere else in the draft we have "HE non-AP STA".	Change to "HE non-AP STA".		2017/1/9 9:42

6818	John Coffey	225	1 28.1.4	213	51	T	Y	213.51 28.1.4	11ax suffers from a severe case of mode bloat. The amendment would be greatly improved by eliminating the great number of modes that have limited application and are of secondary importance to the main modes and project objectives. A goal of extended range appears absolutely nowhere in the PAR or CSD, yet it clutters up the amendment in many places. The HE_EXT_SU mode defined here has the feel of a slapdash add-on. Extending range in many ways works counter to the main goals of the 11ax amendment, since long-range (low-rate) modes will displace high-rate uses of the medium. If extended range is nevertheless deemed an important goal, let's do it properly by defining a new project that will consider all aspects of the problem, including the aspect of future extensibility. Shoehorning a minor mode into the 11ax amendment is the wrong way	Eliminate the HE_EXT_SU mode and all references to it in the draft.	2017/1/9 9:42
6819	John Coffey	225	1 28.1.4	213	53	T	Y	213.53 28.1.4	"Support for the HE extended range PPDU format is mandatory". When this topic was discussed and voted on, there were many questions on whether there was sufficient justification to make the mode mandatory. The questions were never answered satisfactorily, and as far as I recall no real attempt was made to provide justification. It seems the mode is designated mandatory because the proposers wished it so, and for no other substantive reason. This is a very unsatisfactory way of developing a standard. The mode seems of limited importance, and its stated benefits are entirely orthogonal to the stated goals of the project. If it is to remain in the draft at all, it should be optional only.	Change "mandatory" to "optional".	2017/1/9 9:42
6820	John Coffey	225	1 28.2.2	217	37	E	Y	217.37 28.2.2	Grammatical error: "for and HE MU PPDU".	Change to "for an HE MU PPDU".	2017/1/9 9:42
6821	John Coffey	225	1 28.2.2	217	41	E	Y	217.41 28.2.2	Missing article (inconsistent usage): "For HE trigger-based PPDU". By itself this might be acceptable in a table, were it not for contrary examples in the same entry.	Change to "For an HE trigger-based PPDU".	2017/1/9 9:42
6822	John Coffey	225	1 28.2.2	218	38	E	Y	218.38 28.2.2	Missing article (inconsistent usage): "In HE SU PPDU, ...". By itself this might be acceptable in a table, were it not for contrary examples in the same entry.	Change to "In an HE SU PPDU, ..."	2017/1/9 9:42
6823	John Coffey	225	1 28.2.2	220	14	E	Y	220.14 28.2.2	Independent clauses linked by a comma without a coordinating conjunction.	Change comma to semicolon.	2017/1/9 9:42
6824	John Coffey	225	1 28.2.2	224	7	E	Y	224.07 28.2.2	Why "and"? These frames occur one at a time.	Change "and" to "or".	2017/1/9 9:42
6825	John Coffey	225	1 28.3.3.9.1	229	50	E	Y	229.50 28.3.3.9.1	Wrong article: the PPDU format, but a PPDU.	Change "the" to "an".	2017/1/9 9:42
6826	John Coffey	225	1 28.3.3.6	238	7	E	Y	238.07 28.3.3.6	Inconsistent usage: here we have "non-AP HE STA", whereas almost everywhere else in the draft we have "HE non-AP STA".	Change to "HE non-AP STA".	2017/1/9 9:42
6827	John Coffey	225	1 28.3.3.6	238	7	E	Y	238.07 28.3.3.6	"Only a non-AP HE STA can be a 20 MHz only STA": this is clumsily worded and confusing. Clearly 11a, 11g, and 11n STAs can (may?) be 20 MHz only STAs. It would be simpler and better to reword to exclude HE APs.	Change to "HE APs may not be 20 MHz only STAs".	2017/1/9 9:42
6828	John Coffey	225	1 28.3.3.6	238	10	E	Y	238.10 28.3.3.6	Inconsistent usage: here we have "non-AP HE STA", whereas almost everywhere else in the draft we have "HE non-AP STA".	Change to "HE non-AP STA".	2017/1/9 9:42
6829	John Coffey	225	1 28.3.3.6	238	11	E	Y	238.11 28.3.3.6	Inconsistent usage: here we have "non-AP HE STA", whereas almost everywhere else in the draft we have "HE non-AP STA".	Change to "HE non-AP STA".	2017/1/9 9:42
6830	John Coffey	225	1 28.3.3.6	238	13	E	Y	238.13 28.3.3.6	Inconsistent usage: here we have "non-AP HE STA", whereas almost everywhere else in the draft we have "HE non-AP STA".	Change to "HE non-AP STA".	2017/1/9 9:42

6831	John Coffey	225	1 28.3.3.8.3	239	32	E	Y	239.32 28.3.3.8.3	Inconsistent terminology: in "DL HE MU PPDU", the STA type is in the middle, whereas in practically every oher instance the type is at the beginning.	Change "DL HE MU" to "HE DL MU".	2017/1/9 9:42
6832	John Coffey	225	1 28.3.6.6	251	30	E	Y	251.30 28.3.6.6	Awkward usage: "For an X, Y, and Z". It would be more natural to write "For an X, Y, or Z", or alternatively "In X, Y, and Z PPDUs".	Change to either suggested format.	2017/1/9 9:42
6833	John Coffey	225	1 28.3.6.8	253	17	E	Y	253.17 28.3.6.8	Inconsistent (and awkward) usage: here we have "a HE trigger-based PPDU", whereas in virtually every other place in th draft, we have "an HE trigger-based PPDU".	Change to "an HE trigger-based PPDU".	2017/1/9 9:42
6834	John Coffey	225	1 28.3.6.10	253	51	E	Y	253.51 28.3.6.10	Awkward usage: "in an X, Y, and Z". It would be more natural to write "in X, Y, and Z PPDUs".	Change to "Construction of the Data field in HE SU PPDUs, HE extended range SU PPDUs, and HE trigger-based PPDUs".	2017/1/9 9:42
6835	John Coffey	225	1 28.3.6.10.1	253	57	E	Y	253.57 28.3.6.10.1	Awkward usage: "in an X, Y, and Z". It would be more natural to write "in X, Y, and Z PPDUs".	Change to "The construction of the Data field in HE SU PPDUs, HE extended range SU PPDUs, and HE trigger-based PPDUs".	2017/1/9 9:42
6836	John Coffey	225	1 28.3.6.10.2	254	39	E	Y	254.39 28.3.6.10.2	Awkward usage: "in an X, Y, and Z". It would be more natural to write "in X, Y, and Z PPDUs".	Change to "The construction of the Data field in HE SU PPDUs, HE extended range SU PPDUs, and HE trigger-based PPDUs".	2017/1/9 9:42
6837	John Coffey	225	1 28.3.7	256	22	T	Y	256.22 28.3.7	The draft adds two new optional 1024-QAM based MCSs (MCSs 10 and 11): options piled on top of options, as the 256-QAM based MCSs (MCSs 8 and 9) are also optional. The document that introduces them (15/1070r3, September 2015) is remarkably candid about the motivation. After wading through 8 pages listing 111 co-authors, we have ""average throughput enhancement of 4X' may not be so appealing to market even if it is very important technically". (!). But fear not, because "1024 QAM provides a good marketing point on 11ax". It also aims to "Keep superior to other standards in terms of modulation technology (LTE decided to use 256QAM)". These are deeply unworthy justifications for adding modes to the standard. We have been reminded repeatedly that the PAR and CSD act as a 'contract' between the Working Group and the IEEE-SA, and	Delete the 1024-QAM modes and all references and supporting modes in the draft.	2017/1/9 9:42
6838	John Coffey	225	1 28.3.7	256	30	T	Y	256.30 28.3.7	In a severely bloated amendment, we should look for ways to simplify the text and to focus on the central goals of the project. One way is to remove minor modes that are only tangentially related to the goals of the project. One of these is DCM, yet another low-rate range-extension mode in an amendment that has nothing to do with range extension. There is not one word about range extension in the PAR or CSD, yet range extension modes clutter up the draft. To the extent that low-rate modes displace use of higher ratre modes on the medium, they actually work counter to the goals of the amendment. It may very well be that range extension would make a worthy and interesting project in itself, with a carefully worked out PAR and CSD. DCM is an optional, low-rate mode that can't even be used in conjunction with other range extension modes (STBC). It's a marginal special case and the	Delete DCM and all references to it in the draft.	2017/1/9 9:42
6839	John Coffey	225	1 28.3.7	256	31	E	Y	256.31 28.3.7	Awkward usage: "in an X, Y, and Z". It would be more natural to write "for Xs, Ys, and Zs".	Change to "in HE SU PPDUs, HE trigger-based PPDUs, and HE extended range SU PPDUs".	2017/1/9 9:42

6840 John Coffey	225	1 28.3.7	256	31	E	Y	256.31 28.3.7	Inconsistent ordering of alternatives: here three possibilities are listed in the order HE SU PPDU, HE trigger-based PPDU, HE extended range SU PPDU. Elsewhere the order is different: for example there are instances where the second and third elements in the list are switched. It would be better to adopt a consistent orderng.	Change to the order HE SU PPDU, HE extended range SU PPDU, HE trigger-based PPDU.	2017/1/9 9:42
6841 John Coffey	225	1 28.3.9	264	47	E	Y	264.47 28.3.9	Inconsistent terminology: in "DL HE MU PPDU", the STA type is in the middle, whereas in practically every oher instance the type is at the beginning.	Change "DL HE MU" to "HE DL MU".	2017/1/9 9:42
6842 John Coffey	225	1 28.3.10.7.2	274	6	T	Y	274.06 28.3.10.7.2	Technical term used with incomplete or missing description: "SRP-based spatial reuse". The reference given is 27.9 but I don't find it there.	Either provide a definition for SRP-based spatial reuse or delete all mention of it from the draft.	2017/1/9 9:42
6843 John Coffey	225	1 28.3.10.7.2	274	6	T	Y	274.06 28.3.10.7.2	Apparently there are two spatial reuse modes, OBSS_PD and SRP-based. ("Apparently", because both are underdefined.) It is widely understood that having multiple different modes to accomplish the same objective is the kiss of death for all of them: cf. especially the 802.11n experience with beamforming. Having multiple modes works against the principles of standardization, reduces the chances of any one mode succeeding, and by tying up scarce Task Group resources delays the entire technology.	Either merge all spatial reuse functions into a single, unified, *standardized* mode, or delete them all from the draft.	2017/1/9 9:42
6844 John Coffey	225	1 28.3.10.7.2	274	6	T	Y	274.06 28.3.10.7.2	"Set to SR Disallowed to disallow SRP-based spatial reuse". Why restrict the disallowing only to SRP-based spatial reuse? The draft would be vastly improved if all spatial reuse can be disallowed, on a packet-by-packet basis. All types of spatial reuse, very much including OBSS_PD, have the potential to make matters worse at the victim transmitter, yet the current draft allows only the interferer to make the decision about whether to use one form of spatial reuse. (Incidentally, if we won't even insist on protection of our own transmissions, we have no standing whatsoever to object to LAA, LTE-U, WiLDEbeeste, and all the others from talking all over Wi-Fi. Honour code for one, honour code for all.) What is the downside and why is this straightforward step resisted? There may be a fear that devices "set and forget" the switchoff bit. But in fact vendors are intensely	Delete "SRP-based".	2017/1/9 9:42
6845 John Coffey	225	1 28.3.10.7.2	274	10	T	Y	274.10 28.3.10.7.2	"NOTE–This part needs further development." Well, yes! As an aside (though I think a relevant one) why does it need more development at this late stage? It must be connected with the complexity of the spatial reuse problem, which is on a vastly diffreent scale to the regular modes we consider. Adding a new 1024-QAM MCS or another power-save mode mostly affects individual links and so any problems are largely contained. Not so with spatial reuse, where everything affects everything else. A faulty spatial reuse mode or implementation could have disastrous consequences for other devices and BSSs, including the legacy installed base. We would be far better off to give this problem the respect it deserves by creating a new Task Group within 802.11 to consider it carefully, properly, and comprehensively. It can't be shoehorned into 802.11ax at this late stage. That's an aside because a	Delete spatial reuse, of whatever variety, and all references to it in the draft.	2017/1/9 9:42
6846 John Coffey	225	1 28.3.10.7.2	278	9	E	Y	278.09 28.3.10.7.2	Contraction used: "doesn't". Please don't.	Change to "does not".	2017/1/9 9:42

6847	John Coffey	225	1 28.3.10.7.2	282	39	E	Y	282.39 28.3.10.7.2	Redundant text: "If SRP is below < -80 dBm".	Remove "<".	2017/1/9 9:42
6848	John Coffey	225	1 28.3.10.7.4	283	17	E	Y	283.17 28.3.10.7.4	Awkward usage: why "and"?	Change to "or".	2017/1/9 9:42
6849	John Coffey	225	1 28.3.10.7.4	283	30	E	Y	283.30 28.3.10.7.4	Awkward usage: why "and"?	Change to "or".	2017/1/9 9:42
6850	John Coffey	225	1 28.3.10.8.4	290	45	E	Y	290.45 28.3.10.8.4	Superfluous comma: ", otherwise".	Delete comma.	2017/1/9 9:42
6851	John Coffey	225	1 28.3.10.8.4	290	51	E	Y	290.51 28.3.10.8.4	Superfluous comma: ", otherwise".	Delete comma.	2017/1/9 9:42
6852	John Coffey	225	1 28.3.10.8.5	293	64	E	Y	293.64 28.3.10.8.5	Solecism: "an STA".	Change to "a STA".	2017/1/9 9:42
6853	John Coffey	225	1 28.3.10.8.5	296	22	E	Y	296.22 28.3.10.8.5	Solecism: "an STA".	Change to "a STA" or "an HE STA".	2017/1/9 9:42
6854	John Coffey	225	1 28.3.10.8.5	296	22	E	Y	296.22 28.3.10.8.5	Missing article: "in MU-MIMO allocation".	Change to "in an MU-MIMO allocation".	2017/1/9 9:42
6855	John Coffey	225	1 28.3.10.9	298	37	E	Y	298.37 28.3.10.9	Missing word / awkward usage: "except HE trigger-based PPDU".	Add "for" after "except".	2017/1/9 9:42
6856	John Coffey	225	1 28.3.10.9	298	42	E	Y	298.42 28.3.10.9	Missing word / awkward usage: "except HE trigger-based PPDU".	Add "for" after "except".	2017/1/9 9:42
6857	John Coffey	225	1 28.3.10.9	299	13	E	Y	299.13 28.3.10.9	Missing word / awkward usage: "except HE trigger-based PPDU".	Add "for" after "except".	2017/1/9 9:42
6858	John Coffey	225	1 28.3.10.9	299	1	E	Y	299.01 28.3.10.9	Missing word / awkward usage: "except HE trigger-based PPDU".	Add "for" after "except".	2017/1/9 9:42
6859	John Coffey	225	1 28.3.10.9	299	20	E	Y	299.20 28.3.10.9	Missing word / awkward usage: "except HE trigger-based PPDU".	Add "for" after "except".	2017/1/9 9:42
6860	John Coffey	225	1 28.3.10.9	299	26	E	Y	299.26 28.3.10.9	Missing word / awkward usage: "except HE trigger-based PPDU".	Add "for" after "except".	2017/1/9 9:42
6861	John Coffey	225	1 28.3.10.9	299	32	E	Y	299.32 28.3.10.9	Missing word / awkward usage: "except HE trigger-based PPDU".	Add "for" after "except".	2017/1/9 9:42
6862	John Coffey	225	1 28.3.10.9	299	37	E	Y	299.37 28.3.10.9	Missing word / awkward usage: "except HE trigger-based PPDU".	Add "for" after "except".	2017/1/9 9:42
6863	John Coffey	225	1 28.3.10.10	301	50	E	Y	301.50 28.3.10.10	Plural used where singular required: "more than one RUs".	Change "RUs" to "RU".	2017/1/9 9:42
6864	John Coffey	225	1 28.3.10.10	311	37	E	Y	311.37 28.3.10.10	Missing word: "in an X, Y, Z, W" requires link before final element.	Add "or" before "HE trigger-based PPDU".	2017/1/9 9:42
6865	John Coffey	225	1 28.3.12	339	41	E	Y	339.41 28.3.12	Independent clauses linked by a comma without a coordinating conjunction.	Change comma to semicolon.	2017/1/9 9:42
6866	John Coffey	225	1 28.3.14.1	340	52	E	Y	340.52 28.3.14.1	Confusing article: "the" synchronization related issues". Which ones? How does the inclusion of "the" change the meaning of this sentence?	Remove "the".	2017/1/9 9:42
6867	John Coffey	225	1 28.3.14,1	340	52	E	Y	340.52 28.3.14,1	Vague wording: synchronization "related" issues. Are there synchronization "related" issues that would not be understood by the more straightforward "synchronization issues"? If so, please specify them. Otherwise please omit vague terms.	Remove "related".	2017/1/9 9:42
6868	John Coffey	225	1 28.3.14.1	340	56	E	Y	340.56 28.3.14.1	Awkward, ungrammatical, and slightly confusing construction: "participating STAs HE trigger-based PPDU transmission." Here "STAs" should be "STAs'" and "transmission" should be transmissions". But it would be better to recast the sentence as in the proposed resolution.	Change to "the HE trigger-based PPDU transmissions of participating STAs".	2017/1/9 9:42
6869	John Coffey	225	1 28.3.14.1	340	57	T	Y	340.57 28.3.14.1	"An AP can schedule" … should this really be "can", or is "may" meant?	If the intended meaning is that the AP is permitted to take the action described, then change to "may".	2017/1/9 9:42
6870	John Coffey	225	1 28.3.14.1	340	58	T	Y	340.58 28.3.14.1	Imprecise specification of mandatory requirement: "A STA ... shall support power correction described in 28.3.14.2". As worded, this would be satisfied by a STA that satisfied some (any) of the requirements in 28.3.14.2, even if it did not support all of them. The draft should make it clear exactly what is required.	Add "as" before "described".	2017/1/9 9:42
6871	John Coffey	225	1 28.3.14.1	340	59	T	Y	340.59 28.3.14.1	Imprecise specification of mandatory requirement: "... and shall meet pre-correction accuracy requirements described in 28.3.14.3". As worded, this would be satisfied by a STA that satisfied some (any) of the pre-correction accuracy requirements in 28.3.14.3, even if it did not support all of them. The draft should make it clear exactly what is required.	Add "the" before "pre-correction accuracy requirements".	2017/1/9 9:42
6872	John Coffey	225	1 28.3.14.2	341	18	E	Y	341.18 28.3.14.2	Awkward phrasing: "Target_RSSI is dBm value ..."	Change to "Target_RSSI is the value, in dBm, ...".	2017/1/9 9:42

6873 John Coffey	225	1 28.3.14.2	341	44	E	Y	341.44 28.3.14.2	Missing article (inconsistent usage): "For HE trigger-based PPDU". In most other places in the draft, we have "an HE trigger-based PPDU".	Change to "For an HT trigger-based PPDU".	2017/1/9 9:42
6874 John Coffey	225	1 28.3.14.2	341	58	E	Y	341.58 28.3.14.2	Missing article (inconsistent usage): "of HE trigger-based PPDU". In most other places in the draft, we have "an HE trigger-based PPDU".	Change to "of an HT trigger-based PPDU".	2017/1/9 9:42
6875 John Coffey	225	1 28.3.14.2	341	59	E	Y	341.59 28.3.14.2	Missing article (inconsistent usage): "of HE trigger-based PPDU". In most other places in the draft, we have "an HE trigger-based PPDU".	Change to "of an HT trigger-based PPDU".	2017/1/9 9:42
6876 John Coffey	225	1 28.3.14.2	341	61	E	Y	341.61 28.3.14.2	Awkward phrasing: "HR_STA is dBm value ..."	Change to "HR_STA is the value, in dBm, ...".	2017/1/9 9:42
6877 John Coffey	225	1 28.3.14.2	341	61	E	Y	341.61 28.3.14.2	Missing article (inconsistent usage): "in HE trigger-based PPDU". In most other places in the draft, we have "an HE trigger-based PPDU".	Change to "in an HE trigger-based PPDU".	2017/1/9 9:42
6878 John Coffey	225	1 28.3.18.4.4	356	6	E	Y	356.06 28.3.18.4.4	Missing article (inconsistent usage): "in HE trigger-based PPDU". By itself this might be acceptable in a table, were it not for contrary examples in the same table.	Change to "in an HE trigger-based PPDU".	2017/1/9 9:42
6879 John Coffey	225	1 28.3.18.4.4	359	17	E	Y	359.17 28.3.18.4.4	Inconsistent form: here we have "HE trigger based PPDU", whereas almost everywhere else in the draft we have "HE trigger-based PPDU". It would be better to keep the term consistent.	Change to "HE trigger-based PPDU".	2017/1/9 9:42
6880 John Coffey	225	1 28.3.20	368	48	T	Y	368.48 28.3.20	Unnecessary variant used for defined term: "BSS color". The term is "BSS Color".	Change to "BSS Color".	2017/1/9 9:42
6881 John Coffey	225	1 28.3.20	368	49	T	Y	368.49 28.3.20	Unnecessary variant used for defined term: "BSS color". The term is "BSS Color".	Change to "BSS Color".	2017/1/9 9:42
6882 John Coffey	225	1 28.3.20	369	6	E	Y	369.06 28.3.20	Inconsistent form: here we have "HE-trigger based PPDU", whereas almost everywhere else in the draft we have "HE trigger-based PPDU". It would be better to keep the term consistent.	Change to "HE trigger-based PPDU".	2017/1/9 9:42
6883 John Coffey	225	1 28.3.20	369	39	T	Y	369.39 28.3.20	Unnecessary variant used for defined term: "BSS color". The term is "BSS Color".	Change to "BSS Color".	2017/1/9 9:42
6884 John Coffey	225	1 28.3.20	369	40	T	Y	369.40 28.3.20	Unnecessary variant used for defined term: "BSS color". The term is "BSS Color".	Change to "BSS Color".	2017/1/9 9:42
6885 John Coffey	225	1 28.3.20	369	40	E	Y	369.40 28.3.20	Contraction used: "doesn't". Please don't.	Change to "does not".	2017/1/9 9:42
6886 John Coffey	225	1 28.3.20	369	65	T	Y	369.65 28.3.20	Unnecessary variant used for defined term: "BSS color". The term is "BSS Color".	Change to "BSS Color".	2017/1/9 9:42
6887 John Coffey	225	1 28.3.20	369	65	T	Y	369.65 28.3.20	(Second instance on same line:) Unnecessary variant used for defined term: "BSS color". The term is "BSS Color".	Change to "BSS Color".	2017/1/9 9:42
6888 John Coffey	225	1 28.3.20	369	65	E	Y	369.65 28.3.20	Contraction used: "doesn't". Please don't.	Change to "does not".	2017/1/9 9:42
6889 John Coffey	225	1 28.3.20	370	23	T	Y	370.23 28.3.20	Unnecessary variant used for defined term: "BSS color". The term is "BSS Color".	Change to "BSS Color".	2017/1/9 9:42
6890 John Coffey	225	1 28.3.20	370	23	T	Y	370.23 28.3.20	(Second instance on same line:) Unnecessary variant used for defined term: "BSS color". The term is "BSS Color".	Change to "BSS Color".	2017/1/9 9:42
6891 John Coffey	225	1 28.3.20	370	23	T	Y	370.23 28.3.20	Contraction used: "doesn't". Please don't.	Change to "does not".	2017/1/9 9:42
6892 John Coffey	225	1 C.3	420	38	E	Y	420.38 C.3	Superfluous comma: ", otherwise".	Delete comma.	2017/1/9 9:42
6893 John Coffey	225	1 C.3	420	52	E	Y	420.52 C.3	Superfluous comma: ", otherwise".	Delete comma.	2017/1/9 9:42
6894 John Coffey	225	1 C.3	421	15	E	Y	421.15 C.3	Superfluous comma: ", otherwise".	Delete comma.	2017/1/9 9:42
6895 John Coffey	225	1 C.3	421	29	E	Y	421.29 C.3	Superfluous comma: ", otherwise".	Delete comma.	2017/1/9 9:42
6896 John Coffey	225	1 C.3	421	56	E	Y	421.56 C.3	Superfluous comma: ", otherwise".	Delete comma.	2017/1/9 9:42
6897 John Coffey	225	1 C.3	422	6	E	Y	422.06 C.3	Superfluous comma: ", otherwise".	Delete comma.	2017/1/9 9:42
6898 John Coffey	225	1 C.3	422	20	E	Y	422.20 C.3	Superfluous comma: ", otherwise".	Delete comma.	2017/1/9 9:42
6899 John Coffey	225	1 C.3	423	15	E	Y	423.15 C.3	Superfluous comma: ", otherwise".	Delete comma.	2017/1/9 9:42

6900	John Coffey	225	1 1	1	1	G	Y	1.01 1		The purported goal of the ax project was to achieve a 4x improvement in system throughput in dense environments. It seems the current draft falls far short of this goal. Either there needs to be more persuasive justification, or the stated goals should be changed. N.B.: it is not remotely persuasive to cite numbers derived from extended range modes in such calculations. A mode that provides data connectivity where none would have existed under the baseline standard would provide an infinite "improvement" if we arllowed x/0 calculations, but this would be an abuse of language. No reasonable reader would interpret such a range extension as an "infinite" throughput improvement. If it had been considered important to extend range, it would have been very easy to say so. What is needed, therefore, is a showing that under a reasonable prior deployment	Provide detailed justification for the 4x improvement goal in scenarios where the 'before' deployment is credible: at a minimum, each pair of connected devices should be capable of supporting a reasonable throughput in the absence or silence of all others. In particular, do not use range extension modes in this calculation. If the current draft cannot credibly support anywhere near to a 4x improvement, as seems all too likely to be the case, then revise the PAR and CSD.		2017/1/9 9:42
6901	John Coffey	225	1 1	1	1	T	Y	1.01 1		The IEEE 802 Executive Committee has determined that the proceedings of Task Group ax were impacted by dominance by the 'DensiFi' group of companies. Since Draft 1.0 was largely developed and was completed and approved, while DensiFi was still in existence, the integrity of the draft as a whole must be considered severely compromised by the adjudged dominant behavior. While changes may now be made, the burden is on those who want to propose changes to get a 75% majority to do so. It would be better to require 75% to approve the various constituent elements of draft 1.0 affirmatively. This can be accomplished relatively easily by deleting the entire draft, and by considering motions to reapprove it feature by or section by section This might not take long if organized efficiently, and it would greatly add to the prospects for successful deployment of the	Delete the entire draft. (Reconsider the constituent elements feature by feature or section by section.)		2017/1/9 9:42
6902	Jonathan Segev	225	1 3	137	60	G	N	137.60 3		Table 10-19a TWT operation uses in alternating "first STA" "second STA" however 10.43.1 uses the terminology TWT Requesting STA and TWT Responding STA.	Replace first and second STA with TWT Requesting and TWT Responding STAs respectively.		2017/1/9 9:42
6903	Joseph Levy	225	1		1	E	N			ToC has formatting error	Clean up the formatting, line overflow, location of Page number		2017/1/9 9:42
6904	Joseph Levy	225	1		18	E	N			ToC has formatting error	Clean up the formatting, line overflow, location of Page number		2017/1/9 9:42
6905	Joseph Levy	225	1		11	E	N			ToC has formatting error	Clean up the formatting, line overflow, location of Page number		2017/1/9 9:42
6906	Joseph Levy	225	1		36	E	N			ToC has formatting error	Clean up the formatting, line overflow, location of Page number		2017/1/9 9:42
6907	Joseph Levy	225	1		1	E	N			Table of figures has formatting error	Clean up the formatting, line overflow, location of Page number		2017/1/9 9:42
6908	Joseph Levy	225	1		1	E	N		6907	Table of figures has formatting error	Clean up the formatting, line overflow, location of Page number		2017/1/9 9:42
6909	Joseph Levy	225	1		3	E	N			Table of figures has formatting error	Clean up the formatting, line overflow, location of Page number		2017/1/9 9:42
6910	Joseph Levy	225	1		29	E	N			Table of tables has formatting error	Clean up the formatting, make this entry a single line.		2017/1/9 9:42
6911	Joseph Levy	225	1 3.2	4	53	T	Y	4.53 3.2		The definition is not complete as is should be defined as a PPDU	Replace the text "One of the following" with "One of the following PPDUs:		2017/1/9 9:42
6912	Joseph Levy	225	1 3.2	5	29	T	Y	5.29 3.2		The definition is not complete as is should be defined as a PPDU	Replace the text "One of the following" with "One of the following PPDUs:		2017/1/9 9:42
6913	Joseph Levy	225	1 3.2	6	8	T	Y	6.08 3.2		The definition is not complete as is should be defined as a PPDU	Replace the text "One of the following" with "One of the following PPDUs:		2017/1/9 9:42
6914	Joseph Levy	225	1 3.2	6	65	T	Y	6.65 3.2		Define what a High Efficacy (HE) STA is, as this term is used throughout the amendment	Provide a definition		2017/1/9 9:42
6915	Joseph Levy	225	1 3.2	6	65	T	Y	6.65 3.2		Define what a High Efficacy (HE) non-AP STA is, as this term is used throughout the amendment	Provide a definition		2017/1/9 9:42

6916	Joseph Levy	225	1 3.2	6	65	T	Y	6.65 3.2	Define what a High Efficacy (HE) AP is, as this term is used throughout the amendment	Provide a definition	2017/1/9 9:42
6917	Joseph Levy	225	1 3.2	6	50	T	Y	6.50 3.2	The definition of high efficient dual beacon is a bit odd as it is not really a beacon but an operating mode that allow for the transmission of both a non-HE formatted beacon and an HE formatted beacon. Hence the definition should be for the mode.	rewrite the definition of the HE Dual Beacon to be for the HE Dual Beacon Mode.	2017/1/9 9:42
6918	Joseph Levy	225	1 3.2	6	50	T	Y	6.50 3.2	The term: high efficient dual beacon, HE dual beacon, or high efficient (HE) dual beacon does not appear in this amendment anywhere accept the in definitions clause. Why is this being defined, if it is not used?	Either add the term to some clauses in the amendment or delete the definition.	2017/1/9 9:42
6919	Joseph Levy	225	1 3.2	6	60	T	Y	6.60 3.2	Consider renaming the TWT scheduling STA to be a TWT scheduling AP or TWT scheduling HE AP. The text seems to indicate that all TWT scheduling STAs are HE APs - which is a very confusing statement. If TWT scheduling is only a function of a HE AP, then it should be clear that it is an AP and not just a STA.	Rename the "target wake time (TWT) scheduling STA" to be the "target wake time (TWT) scheduling AP. And correct the definition so that it is consistent.	2017/1/9 9:42
6920	Joseph Levy	225	1 3.4	6	6	T	Y	6.06 3.4	The use of DL for Downlink was used in the 802.11ah throughout the document, but was not included in the acronym list, nor is the concept of Downlink defined anywhere. So please confirm that the way DL is used in 802.11ah is constant with the way it is used in this amendment and the definition of downlink provided in 802.11-REVmc. If it is constant with the definition in 802.11-REVmc I suggest that the definition should contain the acronym as is usually done.	Update the base line defection of downlink to contain: downlink (DL).	2017/1/9 9:42
6921	Joseph Levy	225	1 3.2	6	55	T	Y	6.55 3.2	OFDMA - currently not defined in this amendment. It is not defined in base line amendment 802.11mcD8.0. It would be best to define OFDMA prior to defining non-OFDMA.	Define OFDMA	2017/1/9 9:42
6922	Joseph Levy	225	1 3.4	7	22	G	N	7.22 3.4	The base line specification uses HE to mean: Homogenous extended in HESSID. This is confusing, given the introduction of HE as High Efficacy.	Change the Abbreviation of HESSID to be H-ESSID Note this change also be made in all places HESSID is currently used in the base line specifications. There are 42 uses of HESSID in (mc) and 13 locations in ai which need to be changed.	2017/1/9 9:42
6923	Joseph Levy	225	1 3.2	6	55	T	Y	6.55 3.2	This amendment seems to introduce the 20 MHz only HE STA in 28.3.3.6, However the term is used in several other preceding subclause, therefore there should be a definition of the term.	Define 20 MHz only HE STA: e.g. "A 20 MHz only HE STA: is a HE STA that operates with 20 MHz channel width only, in frequency bands between 1 GHz and 6 GHz. A 20 MHz only HE STA operates in the primary 20 MHz channel as a mandatory mode."	2017/1/9 9:42
6924	Joseph Levy	225	1 4.3.14a	9	7	E	N	9.07 4.3.14a	Why would you insert the HE STA clause after 4.3.12? Shouldn't it be inserted 4.2.14 VHT STA?	Insert after subclause 4.3.14	2017/1/9 9:42
6925	Joseph Levy	225	1 4.3.141	9	10	G	Y	9.10 4.3.141	The 802.11ax amendment provides new capabilities/features that warrant a more explanative introduction then simply stating a list of the "new" phy/mac features and if the features are mandatory or optional. Therefore adding descriptive text as to what the new capabilities and features of a HE STA are and what the purpose and benefits of these capabilities and features are is warranted.	Provide a useful and clear introduction to the new capabilities provided by 802.11ax features, including: 1) the benefits of the of capability (e.g. provides for MU access to lower overhead and reduce congestion in 802.11 BSSs), 2) the features of 802.11ax that will enable this capability (e.g. OFDMA or MU-MIMO), and 3) for capabilities that have multiple features supporting them what the expectation/use for the features that support the capability.	2017/1/9 9:42

6926	Joseph Levy	225	1 4.3.14.a	9	32	G	Y	9.32 4.3.14.a	The 802.11ax amendment provides new capabilities/features that warrant a more explanative introduction then simply stating a list of the "new" phy/mac features and if the features are mandatory or optional. I don't believe that clause 4 is the place for stating if a feature is optional or mandatory.	Provide a introduction to the new PHY and MAC features without stating if they are Mandatory or Optional.	2017/1/9 9:42
6927	Joseph Levy	225	1 4.3.14a	9	18	T	Y	9.18 4.3.14a	Aren't all HE non-AP STAs VHT non-AP STAs? Why must a HE non-AP STA support all VHT operating bands be and VHT non-AP STA? Wouldn't an HE non-AP STA that only supports 20, 40 and 80 MHz bandwidth also be a VHT non-AP STA? Please correct or clarify the meaning of this phrase.	Change the text to read: "An HE non-AP STA is also a VHT non-AP STA"	2017/1/9 9:42
6928	Joseph Levy	225	1 4.3.14a	9	21	T	Y	9.21 4.3.14a	The phrase: "An HE non-AP STA shall support operation in 20 MHz channel bandwidth only" does not seem to make sense as it seems to require that an HE non-AP STA is only allowed to support 20 MHz channel bandwidth, while the phrase directly above states the multiple bandwidths are allowed.	Delegate the phrase: "An HE non-AP STA shall support operation in 20 MHz channel bandwidth only" or clarify what is intended by the phrase is to support	2017/1/9 9:42
6929	Joseph Levy	225	1 4.3.14a	9	21	T	Y	9.21 4.3.14a	If the intent of the phrase: "An HE non-AP STA shall support operation in 20 MHz channel bandwidth only" is to say that a mode of operation of all HE non-AP STAs is to be able to operate as a 20 MHz only HE STA, then the phase should state that,	Replace the phrase with: All HE non-AP STAs will support operation as 20 MHz only HE STAs.	2017/1/9 9:42
6930	Joseph Levy	225	1 4.3.14a	9	26	T	Y	9.26 4.3.14a	If the intent of the phrase: "An HE non-AP STA shall support operation in 20 MHz channel bandwidth only" is to say that a mode of operation of all HE non-AP STAs is to be able to operate as a 20 MHz only HE STA, then the phase should state that,	Replace the phrase with: All HE non-AP STAs will support operation as 20 MHz only HE STAs.	2017/1/9 9:42
6931	Joseph Levy	225	1 4.3.14a	9	33	G	Y	9.33 4.3.14a	While I understand that the introduction of OFDMA is a key PHY feature for HE STAs, I don't understand why stating the mandatory support of the various RUs is necessary in the General description.	Delete the Mandatory RUs supported from this subclause.	2017/1/9 9:42
6932	Joseph Levy	225	1 4.3.14a	9	43	G	Y	9.43 4.3.14a	Why is only DL MU-MIMO support for the mandatory case the only PHY feature listed. Why aren't the other non-mandatory DL MU-MIMO features listed?	Add Option Support for DL MU-MIMO modes that are not mandatory	2017/1/9 9:42
6933	Joseph Levy	225	1 4.3.14a	9	43	G	Y	9.43 4.3.14a	Option support fir 1024-QAM seems to be an adequate description of the feature, the RU restrictions do not seem necessary as a general description.	Delete the RU limits from the PHY feature	2017/1/9 9:42
6934	Joseph Levy	225	1 4.3.14a	9	48	G	N	9.48 4.3.14a	the description of the new MAC features do not clearly state why these features were introduce, the text simply implies it. It would be clearer to state why these features are being introduced and then provide some guidance on where in the specification the details of these features can be found.	Insert a paragraph introducing the need/purpose of the new MAC features.	2017/1/9 9:42
6935	Joseph Levy	225	1 8.3.5.2.2	15	21	T	Y	15.21 8.3.5.2.2	Why does the STA_INDEX need to be added? Since the STA_INDEX and the USER_INDEX seem to be basically provide the same function and both operate using the u value to provide an index for MU users. It would seem to be simpler to extend the USER_INDEX to provide the necessary function and behavior of the STA_INDEX for HE MU PPDUs. Also note that since the User_INDEX parameter is only present for a VHT MU PPDU, it would seem that a VHT STA would be very confused by presence of a STA_INDEX as it would occupy the same location in the PHY-DAT.request as the USER_INDEX would.	remove STA_INDEX and repurpose the USER_INDEX to provide the index function for HE MU PPDUs. Also rewrite the descriptive paragraphs for USER_INDEX and STA_INDEX so that it is clear what the behavior is of the USER_INDEX when used in a VHT MU PPDU and a HE MU PPDU.	2017/1/9 9:42

6936	Joseph Levy	225	1 8.3.5.3.2	15	48	T	Y	15.48 8.3.5.3.2	Why does the STA_INDEX need to be added? Since the STA_INDEX and the USER_INDEX seem to be basically provide the same function and both operate using the u value to provide an index for MU users. It would seem to be simpler to extend the USER_INDEX to provide the necessary function for HE trigger-based PPDUs.	Replace STA_INDEX with USER_INDEX.		2017/1/9 9:42
6937	Joseph Levy	225	1 8.3.5.3.2	15	56	T	Y	15.56 8.3.5.3.2	Reuse the USER_INDEX to provide the function of the STA_INDEX	Replace the sentence with: The USER_INDEX parameter is present for an HE trigger-based PPDU and indicates the index of the user in the RXVECTOR to which the accompanying DATA octet applies; otherwise, this parameter is not present.		2017/1/9 9:42
6938	Joseph Levy	225	1 8.3.5.12	16	20	G	N	16.20 8.3.5.12	The differences between the VHT and HE channel-list element behavior seems to be very minimal should this table call out different rules for VHT and HE? It seem very redundnat specification wise to duplicate large portions of the VHT PHY clause in the HE PHY clause. Wouldn't it be more efficient to make the small additions in the HE PHY clause and reference the VHT PHY clause.	Consider removing the duplicate specifications in the VHT and HE PHY clauses.		2017/1/9 9:42
6939	Joseph Levy	225	1 8.3.5.12.3	17	13	T	Y	17.13 8.3.5.12.3	In the base specification there is a Note that is part of the first paragraph which states: "NOTE--For the VHT PHY, the timing information is omitted here and is defined in 21.3.18.5 (CCA sensitivity)." If the intent was to remove the note it should be stated clearly that the note was removed. If the note is remaining, then it should be updated to include the timing information location for the HE PHY.	Either clarify that the Note is being removed or update the Note to include the HE PHY.		2017/1/9 9:42
6940	Joseph Levy	225	1 10.2.4.2	113	15	T	Y	113.15 10.2.4.2	Why is this in addition, this should just state that The HE AP, which is a QoS AP, may ...	Remove: "In addition, an" and replace it with "The". After HE AP insert: ", which is a QoS AP,"		2017/1/9 9:42
6941	Joseph Levy	225	1			G	Y		In the definition of HE AP include that all HE APs are QoS APs.	Include that all HE APs are QoS APs, Where appropriate.		2017/1/9 9:42
6942	Joseph Levy	225	1 5	10		G	N	10.00 5	I find it hard to believe that given the significant MAC features added in this amendment that there are no changes to clause 5. Are there additions to the Security services with the additional of A-PDU fragmentation? Are there additions needed to the MSDU ordering?	Insert required changes to clause 5		2017/1/9 9:42
6943	Joseph Levy	225	1 6.3.4.2.2	11	60	E	N	11.60 6.3.4.2.2	Inserting "HE Capabilities" between "AdvertisementProtocolInfo" and "VendorSpcificInfo" while correct for the mcV8.0 is not correct if one considers the other amendments. Therefore remove "AdvertixementProtocalInfo" from the list, so that the only instructions is to insert "HE Capabilities" before "vendorSpecificInfo".	Delete: "AdvertisementProtocolInfo,"		2017/1/9 9:42
6944	Joseph Levy	225	1 6.3.6.4.2	12	33	E	N	12.33 6.3.6.4.2	The entries in this table follow the order of the primitive parameter list above, therefore the new entry in the table should be located in the proper position based on the list. The instructions to the editor should say so.	Change the instruction to the editor to read: "Insert the following entry into the unnumbered table in this subclause, so that it is located proceeding the VendorSpecificInfo primitive:"		2017/1/9 9:42
6945	Joseph Levy	225	1 6.3.8.4.2	13	1	E	N	13.01 6.3.8.4.2	The entries in this table follow the order of the primitive parameter list above, therefore the new entry in the table should be located in the proper position based on the list. The instructions to the editor should say so.	Change the instruction to the editor to read: "Insert the following entry into the unnumbered table in this subclause, so that it is located proceeding the VendorSpecificInfo primitive:"		2017/1/9 9:42
6946	Joseph Levy	225	1 6.3.11.2.2	13	35	E	N	13.35 6.3.11.2.2	The entries in this table follow the order of the primitive parameter list above, therefore the new entry in the table should be located in the proper position based on the list. The instructions to the editor should say so.	Change the instruction to the editor to read: "Insert the following entry into the unnumbered table in this subclause, so that it is located proceeding the VendorSpecificInfo primitive:"		2017/1/9 9:42
6947	Joseph Levy	225	1 6.3.27.4	13	59	E	N	13.59 6.3.27.4	Header is doubled numbered	Remove the redundant clause number		2017/1/9 9:42

6948	Joseph Levy	225	1 6.3.27.4	13	61	E	N	13.61 6.3.27.4	Header is doubled numbered	Remove the redundant clause number	2017/1/9 9:42
6949	Joseph Levy	225	1 6.3.27.4	14	7	E	N	14.07 6.3.27.4	The entries in this table follow the order of the primitive parameter list above, therefore the new entry in the table should be located in the proper position based on the list. The instructions to the editor should say so.	Change the instruction to the editor to read: "Insert the following entry into the unnumbered table in this subclause, so that it is located proceeding the VendorSpecificInfo primitive:"	2017/1/9 9:42
6950	Joseph Levy	225	1 9.3.1.9.1	34	23	T	Y	34.23 9.3.1.9.1	Changes made to the 3rd paragraph provide changes to the baseline text that while appearing to be a change do not change requirements. The baseline text should be modified in a minimal way.	Replace the first sentence with: "The RA field of the BlockAck frame that is not a Multi-STA BlockAck variant is the address of the recipient STA that requested the Block Ack.	2017/1/9 9:42
6951	Joseph Levy	225	1 9.3.1.9.1	34	23	T	Y	34.23 9.3.1.9.1	This is the frame format clause, therefore the use of the fields in the frame should not be described in this clause. The detailed use of a field in a MAC frame format should be described in the MAC clause. Therefore, remove or move to the MAC subclause the detailed requirements for the TA field in an HE-AP.	Remove or move the following text: "An HE AP that transmits a Multi-STA BlockAck frame with different values of the AID subfield in Per STA Info subfields sets the RA field to the broadcast address. An HE AP that transmits a Multi-STA BlockAck frame with a single AID subfield or with the same values of the AID subfield in Per STA Info subfields sets the RA field to the address of the recipient STA that requested the Block Ack or to the broadcast address. An HE non-AP STA transmits a Multi-STA BlockAck frame with a single AID subfield or with the same values of the AID subfield in Per STA Info subfields and sets the RA field to the TA field of the soliciting frame or the address of the recipient STA whose data/management frames are acknowledged."	2017/1/9 9:42
6952	Joseph Levy	225	1 9.4.2.46	68	28	E	N	68.28 9.4.2.46	For the Multiple BSSID element shouldn't there be a restriction on including the HE Capabilities and the HE Operations elements in the Nontransmitted BSSID Profile subelement, as there is for the HT and VHT elements?	Add the restriction to including the HE Capabilities and the HE Operations elements in the Nontransmitted BSSID Profile subelement as was done for both the HE and VHT elements in 9.4.2.46.	2017/1/9 9:42
6953	Joseph Levy	225	1 10.43.1	139	57	E	N	139.57 10.43.1	The addition of command interpretations for the case where Wake TBTT Negotiation subfield=0 and Broadcast subfield=1 is not modified text as shown but is all new text. Please correct draft so this shows a new added text.	Mark the text as new text from line 57 on page 139 thru line 21 on page 140.	2017/1/9 9:42
6954	Joseph Levy	225	1 27.7.3.1	182	28	T	Y	182.28 27.7.3.1	Saying that: A TWT scheduling STA is an HE AP, is very confusing. An AP is an entity that contains one STA and provides access to the DS via the wireless medium for associated STAs. An AP comprises a STA and a distribution DSAF. So how can a STA be an HE AP.	Rewrite this section and all related sections containing the TWT scheduling STA so that it is clear that this type of STA can only exist in an HE AP or rename the TWT scheduling STA to be a TWT scheduling HE AP or a TWT scheduling AP.	2017/1/9 9:42
6955	Joseph Levy	225	1 9.3.3.1	52	13	E	N	52.13 9.3.3.1	The Beacon frame format is 9.3.3.3 in REVmcD8.0 (and in 802.11-2016) not 9.3.3.1 as shown	Correct the subclause number to 9.3.3.1	2017/1/9 9:42
6956	Joseph Levy	225	1 9.3.3.5	52	47	E	N	52.47 9.3.3.5	The subclause header is incorrect 9.3.3.5 is not Association Request frame format it is Disassociation frame format. Hence the subclause header is numbered wrong,	Correct the subclause number to 9.3.3.6	2017/1/9 9:42
6957	Joseph Levy	225	1 9.3.3.6	53	1	E	N	53.01 9.3.3.6	The subclause header is incorrect 9.3.3.6 is not the Association Response frame format it is Association Request frame format. Hence the subclause header is numbered wrong,	Correct the subclause number to 9.3.3.7	2017/1/9 9:42
6958	Joseph Levy	225	1 9.3.3.7	53	40	E	N	53.40 9.3.3.7	The subclause header is incorrect 9.3.3.7 is not the Reassociation Response frame format it is Association Response frame format. Hence the subclause header is numbered wrong,	Correct the subclause number to 9.3.3.8	2017/1/9 9:42
6959	Joseph Levy	225	1 9.3.3.78	53	61	E	N	53.61 9.3.3.78	The subclause header is incorrect 9.3.3.8 is not the Reassociation Response frame format it is Reassociation Request frame format. Hence the subclause header is numbered wrong,	Correct the subclause number to 9.3.3.9	2017/1/9 9:42

6960	Joseph Levy	225	1 9.4.1.62	56	1	T	Y	56.01 9.4.1.62	Should there be edits to the Operating Mode field Table 9-74 and 9-75 in 9.4.1.53. Don't the Channel Width, 160/80+80 BW, Rx NSS, and RX NSS type descriptions need to be provided for the HE STA reports? Don't the HE Capabilities of STA transmitting the Operating Mode Field for the Supported Channel Width Set and Extended NSS BW Support need to be defined for the Operating Mode field?	Add the necessary descriptions for HE Capabilities and Operating Modes.	2017/1/9 9:42
6961	Joseph Levy	225	1 10.5	122	32	T	Y	122.32 10.5	Static fragmentation is a new term introduced in this amendment. Hence the use of to define the "two" types on fragmentation now in the specification effectively breaks the existing specification, unless all mentions in the baseline specification of "fragmentation" are corrected to be "static fragmentation"	Delete the insertion "With static fragmentation"	2017/1/9 9:42
6962	Joseph Levy	225	1 10.5	122	35	T	Y	122.35 10.5	Static fragmentation is a new term introduced in this amendment. Hence the use of to define the "two" types on fragmentation now in the specification effectively breaks the existing specification, unless all mentions in the baseline specification of "fragmentation" are corrected to be "static fragmentation"	Delete the insertion "static"	2017/1/9 9:42
6963	Joseph Levy	225	1 10.5	122	39	T	Y	122.39 10.5	Delete the last sentence "Unless the conditions described in 27.3.2 (Support and requirements for dynamic fragmentation) are met, static fragmentation is used." and add a paragraph defining the new feature of dynamic fragmentation.	Delete: "Unless the conditions described in 27.3.2 (Support and requirements for dynamic fragmentation) are met, static fragmentation is used." Insert a new paragraph to describe the new feature. e.g. "In addition to supporting fragmentation HE STA may also support dynamic fragmentation as described in 27.3.2 ....."	2017/1/9 9:42
6964	Joseph Levy	225	1 10.5	122	46	T	Y	122.46 10.5	Do not change this paragraph as changing it breaks the specification for all non-HE STAs. Instead add an additional paragraph providing the fragmentation limitation for HE STAs.	Remove all changes to this paragraph. If necessary insert a new paragraph that provides the length limitations and behavior of fragmentation for HE STAs.	2017/1/9 9:42
6965	Joseph Levy	225	1 10.1	127	64	T	Y	127.64 10.1	Why is it a requirement that an HE STA not send a Control Wrapper frame to another ED STA? Since most HE STAs will also be HT and VHT STAs and can process a Control Wrapper frame, why the restriction?	Remove this requirement: "An HE STA shall not send a Control Wrapper frame to another HE STA."	2017/1/9 9:42
6966	Joseph Levy	225	1 10.12	128	6	T	Y	128.06 10.12	The ability to indicate support for reception of fragmented A-MSDUs in a feature introduced in this amendment. Hence placing the requirement in the general A-MSDU operation section as if it meaningful to all STAs breaks the specification. In addition the concept of building up an A-MSDU only to then break it into fragments in several MPDUs does not make sense to me. What is the benefit?	Delete the changes to this paragraph. If there are benefits of fracturing an A-MSDU then add a separate paragraph stating that it is possible for an HE-STA to fragment an A-MSDU.	2017/1/9 9:42
6967	Joseph Levy	225	1 10.13.1	128	21	T	Y	128.21 10.13.1	Why complicate the phasing of sentence, leave it in its simple form. The concept of changing base line text to include the HE corner case where a A-MPDU contains multiple TID fields seems to be unnecessary, wouldn't it be easier to simply add a sentence or paragraph to deal with then exception for the HE case? This would yield a different resolution to the one proposed.	Change the sentence to read: "When an A-MPDU contains multiple QoS Control fields, bit 4 of these QoS Control fields shall be identical and bits 8-15 of these QoS Control fields shall be identical for MPDUs with the same the TID subfield value."	2017/1/9 9:42

6968	Joseph Levy	225	1 10.13.2	128	36	T	Y	128.36 10.13.2	The inserted sentence makes no sense as it is written. The requirement should be based on the HE Capabilities element, which requires: "If the HE STA does not include VHT Capabilities element, the Maximum A-MPDU Length Exponent subfield in HE Capabilities element combined with the Maximum A-MPDU Length Exponent subfield in HT Capabilities element indicate the maximum length of A-MPDU that the STA can Receive where EOF padding is not included in this limit." Therefore correct the requirement. Since the requirement only relates to the HE STA, I think it needs to say so.	Replace the inserted sentence: "A STA indicates in the Maximum A-MPDU Length Exponent field in its HE Capabilities element the maximum length of the AMPDU pre-EOF padding that it can receive in an HE PPDU." With: "For an HE STA the maximum A-MPDU length the STA can receive pre-EOF padding is indicated in the VHT capabilities element, or if the VHT capabilities element is not included then the maximum A-MPDU length the STA can receive pre-EOF padding is indicated by combining the Maximum A-MPDU Length Exponent subfield in HE Capabilities element combined with the Maximum A-MPDU Length Exponent subfield in HT Capabilities element."		2017/1/9 9:42
6969	Joseph Levy	225	1 10.13.2	128	41	T	Y	128.41 10.13.2	Table 9-249 (Subfields of the VHT Capabilities Information field) may also apply to HE PPDUs	Add: "... and may apply to HE PPDUs"		2017/1/9 9:42
6970	Joseph Levy	225	1 10.13.2	128	39	T	Y	128.39 10.13.2	Table 9-163 (Subfields of the A-MPDU Parameters field) may also apply to HE PPDUs	Add: "... and may apply to HE PPDUs"		2017/1/9 9:42
6971	Joseph Levy	225	1 10.13.3	128	40	T	Y	128.40 10.13.3	Table 9-229 (HE Ca[abilities element) may also apply to HE PPDUs	Add: "... and may apply to HE PPDUs"		2017/1/9 9:42
6972	Joseph Levy	225	1 10.13.3	128	58	T	Y	128.58 10.13.3	The length of an A-MPDU pre-EOF padding that an HE STA shall be capable of receiving is indicated by the Maximum A-MPDU Length Exponent subfield in the VHT capabilities element or by combining the information in the Maximum A-MPDU Length Exponent subfields in the HE and HT capabilities elements. Not as stated by the HE capabilities element alone	Correct the requirement so that the capabilities of the HE STA is correctly described, as noted in the comment.		2017/1/9 9:42
6973	Joseph Levy	225	1 10.13.3	129	6	T	Y	129.06 10.13.3	The length of an A-MPDU pre-EOF padding that an HE STA shall be capable of receiving is indicated by the Maximum A-MPDU Length Exponent subfield in the VHT capabilities element or by combining the information in the Maximum A-MPDU Length Exponent subfields in the HE and HT capabilities elements. Not as stated by the HE capabilities element alone	Correct the requirement so that the capabilities of the HE STA is correctly described, as noted in the comment.		2017/1/9 9:42
6974	Joseph Levy	225	1 10.28.3	136	31	T	Y	136.31 10.28.3	Why is this requirement in a note. I do not see a requirement anywhere in the specification for the HE RD initiator, except in this section. Hence this should either be a normative statement or should not be in the amendment.	Remove the Note. Add a normative statement if required.		2017/1/9 9:42
6975	Joseph Levy	225	1 10.28.3	136	40	T	Y	136.40 10.28.3	Why is this behavior specific to an HE STA and why can an HE non-AP STA use RD in any TXOP?	Clarify this behavior		2017/1/9 9:42
6976	Joseph Levy	225	1 9.4.2.139	68	48	E	N	68.48 9.4.2.139	Why is there a non-HE in this paragraph that appears to be legacy text?	Indicate that the "non-HE" in this text is added text or explain why it is legacy text.		2017/1/9 9:42
6977	Joseph Levy	225	1 9.4.2.139	68	50	E	N	68.50 9.4.2.139	Why is there a non-HE in this paragraph that appears to be legacy text?	Indicate that the "non-HE" in this text is added text or explain why it is legacy text.		2017/1/9 9:42
6978	Joseph Levy	225	1 10.28.3	136	50	T	Y	136.50 10.28.3	The addition of Multi-STA BlockACK to the list of frames for behavior of a non-HE RD initiator, breaks the specification because a non-HE RE initiator does not know what a Multi-STA BlockACK is as this an HE concept	Delete "Multi-STA BlockAck"		2017/1/9 9:42
6979	Joseph Levy	225	1 10.28.3	136	50	T	Y	136.50 10.28.3	Insert a requirement that an HE RD initiator shall be able to transmit a +HTC or DMG frame with the RDG/More PPDU subfield set to 1 that requires a response of a Multi-STA BlockAck frame.	Insert a requirement for A HE RD initiator, as suggested in the comment.		2017/1/9 9:42
6980	Joseph Levy	225	1 10.28.4	137	10	T	Y	137.10 10.28.4	The use of the word "while" is not appropriate. While is usually used to connote that something only occurs during a specific time, i.e. while something else is happening. It is not used to indicate alternative behavior.	delete the word "while"		2017/1/9 9:42

6981	Joseph Levy	225	1 10.28.4	137	19	T	Y	137.19 10.28.4	The use of the word "while" is not appropriate. While is usually used to connote that something only occurs during a specific time, i.e. while something else is happening. It is not used to indicate alternative behavior.	delete the word "while"	2017/1/9 9:42
6982	Joseph Levy	225	1 11.23.1	143	64	T	Y	143.64 11.23.1	Is the HE Operation element the only required element that must be present in a TDLS setup Confirm frame for HE capable STAs. Aren't the VHT or HT Operation elements also required to establish a tunneled direct-link?	Correct the requirement for which elements shall be present in a TDLS setup Confirm frame when both STAs are HE capable.	2017/1/9 9:42
6983	Joseph Levy	225	1 27.3.1	152	41	T	Y	152.41 27.3.1	There is no need to call "legacy" fragmentation "static fragmentation", it is adequate to simply refer to it as fragmentation, with the references provided.	Delete the insertion "static"	2017/1/9 9:42
6984	Joseph Levy	225	1 27.3.1	152	41	T	Y	152.41 27.3.1	Aren't there more than on fragmentation procedure? Shouldn't this be fragmentation procedures?	Replace "procedure" with procedures"	2017/1/9 9:42
6985	Joseph Levy	225	1 27.3.1	152	42	E	N	152.42 27.3.1	The sentence describing the introduction of dynamic fragmentation is poorly worded. Please consider improving the wording. Not also that "can" is a non-normative verb and hence should not be used in a normative section. The normative verb is "may".	Replace "In addition, an HE STA can support the dynamic fragmentation procedure defined in this subclause." With: "An HE STA may also support the dynamic fragmentation procedures defined in this subclause." Also it would probably improve readability of the specification if this sentence started the next paragraph.	2017/1/9 9:42
6986	Joseph Levy	225	1 27.3.1	152	48	T	Y	152.48 27.3.1	Reading this paragraph one could interpret that dynamic fragmentation suspends all fragmentation rules in 10.2.7. I don't believe that this is the intent. Clarify that dynamic fragmentation allows for several of the fragmentation rules in 10.2.7 to be ignored, not all of them.	Clarify the paragraph so that it is clear that only some fragmentation rules in 10.2.7 do not apply to HE dynamic fragmentation.	2017/1/9 9:42
6987	Joseph Levy	225	1 27.3.1	152	51	T	Y	152.51 27.3.1	It is interesting that dynamic fragmentation provides further flexibility in aggregating the data to minimize padding - but there is no reference to dynamic fragmentation in 2.7.5 (MU operation). Either provide more information in this paragraph on how dynamic fragmentation makes MU operation more efficient, or provide some information in 2.7.5 on how dynamic fragmentation could be used to make MU operation more efficient.	Remove the reference to MU operation or provide some useful explanation as to how MU operation is improved by dynamic fragmentation.	2017/1/9 9:42
6988	Joseph Levy	225	1 27.3.2	152	58	T	Y	152.58 27.3.2	The rules defined in 10.2.7 do not list any the rules listed in this paragraph. Hence the list in this paragraph is not a list of rules defined in 10.2.7 and 10.5 which are not being followed as stated in the paragraph. These all seem to be new additional rules or behaviors.	Either provide a list of the rules from 10.2.7 and 10.5 that are now being excepted or rephrase the paragraph so that it is correct.	2017/1/9 9:42
6989	Joseph Levy	225	1 27.3.2	152	55	T	Y	152.55 27.3.2	The phrase "a dynamic fragment" does not make any sense as it is used. As the fragment, dynamic or not, is always contained in a MPDU. So a dynamic fragment can not be an MPDU as stated.	Correct the sentence to so that it is a meaningful statement. As it is I'm not sure what the intended meaning of the sentence is.	2017/1/9 9:42
6990	Joseph Levy	225	1 27.3.2	152	63	T	Y	152.63 27.3.2	The statement that reception dynamic fragments is not mandatory, does not belong here. The requirement to receive an MPDU containing a dynamic fragmented payload may be optional, but that should be made clear in the PICs not here in the specification. The specification should only say that a STA may receive an MPDU that contains dynamically fragmented MSDU/A-MPDU/MMPDU. The restriction, if any, is that an HE AP should only send a MPDU containing dynamically fragmented MSDU/A-MPDU/MMPDU to a HE STA that can receive it.	Remove or correct this bulleted so that it is providing some useful information.	2017/1/9 9:42

6991 Joseph Levy	225	1 27.3.2	153	1	T	Y	153.01 27.3.2	The bulleted item "Fragmentation of A-MSDUs is permitted when supported by the recipient" does not really provide a useful requirement. It should be more specific. First, I believe that this item is only discussing dynamic fragmentation hence it should state that. Second, why is the only restricted to A-MSDUs, is there something special about A-MSDUs, if so it should be clear what is special. Lastly, "when supported by the recipient" should be defined. e.g. What element is set in the HE non-AP STA so that the HE AP knows that it can or cannot receive a MPDU with a dynamically fragmented A-MSDU.	Clarify the bulleted item so that the issues raised in the comment are satisfied. It is not clear to me what the intent of the bulleted item is.	2017/1/9 9:42
6992 Joseph Levy	225	1 27.3.2	153	3	T	Y	153.03 27.3.2	Assuming that the rule in 10.5 which is excepted is "The length of each fragment shall be an even number of octets, except for the last fragment of an MSDU or MMPDU, which may be either an even or an odd number of octets." this bulleted item should simply contain this rule as one which is being excepted.	Replace this bullet with: "The length of each fragment shall be an even number of octets, except for the last fragment of an MSDU or MMPDU, which may be either an even or an odd number of octets." If more exceptions need to be made to the rules in 10.5 and 10.2.7 the rules to be excepted should be listed as separate bullet items.	2017/1/9 9:42
6993 Joseph Levy	225	1 27.3.2	153	8	T	Y	153.08 27.3.2	If A-MSDUs are allowed to be fragmented then the rule that an A-MSDU shall be carried, without fragmentation, with in a single QoS Data frame, must also be noted as an exception. But, why anyone would want to fragment an A-MSDU is beyond me. If one is bothering to assemble an A-MSDU in the first place to improve transmission efficiently, why would one then need to fracture the A-MSDU, why not simply not build the A-MSDU and send the MDSUs.	Either, maintain the requirement that an A-MSDU be carried without fragmentation, by removing the possibility of an A-MSDU being fragmented in this section or state that the rule that an A-MSDU can not be fragmented does not apply to dynamic fragmentation.	2017/1/9 9:42
6994 Joseph Levy	225	1 27.3	152		T	Y	152.00 27.3	Why is there no mention of the No-Fragmentation field in the ADDBA Extension element?	Define the impact/status of the No-Fragmentation field in the ADDBA Extension element?	2017/1/9 9:42
6995 Joseph Levy	225	1 28.3.17.6.3	349	1	T	Y	349.01 28.3.17.6.3	.... in the primary 20 MHz channel within a period of aCCATime after the signal arrives at the receiver's antenna(s); then the receiver shall not issue a PHY-CA.indication(BUSY,{secondary}), PHYCCA.indication(BUSY,{secondary40}), PHY-CCA.indication(BUSY,{secondary80}), or PHYCCA.indication(IDLE) primitive while the threshold continues to be exceeded.	Question: this seems to restrict reporting on any other available frequency resource when the primary is busy - I know it was decided to do this in n and ac , but I thought this restriction was being lifted in HE? If this restriction was removed please up date the text so that it is clear that reporting on non-primary channels is allowed even if the primary is busy.	2017/1/9 9:42
6996 Joseph Levy	225	1			E	N		Also note there seems to be a lot of duplication of the VHT phy in the HE phy section. Given that the phys are so similar, especially in regard to CCA behavior, wouldn't it be more efficient to simply call out the differences in this phy section, after all all HE STAs are VHT STAs. - 28.3.17.6.	Reduce the duplication by properly referencing the VHT PHY section.	2017/1/9 9:42

6997	Joseph Levy	225	1 9	19		G	Y	19.00 9	There seems to be quite a lot of behavior description in the Frame format clause: 9. This is not desirable and should be removed to the appropriate PHY or MAC clause where the behavior should be described. As per the latest 802.11 editorial style guide (11-09/1024r11): "3.3 Frame formats (Clause 8) Clause 8 is reserved for describing structure (apart from statements in 8.1). Statements that describe the actions of a STA in order to determine a value for a field and any other behavioral specification should not be present in Clause 8. This requires a bit of interpretation. For example: "the Length field is set to the logarithm of the number of octets in the remainder of the frame" is acceptable. The act of	Remove all behavior description in this clause and relocated it in the proper PHY or MAC clause.		2017/1/9 9:42
6998	Joseph Levy	225	1			G	Y		Unfortunately, even with the additional time allowed for the review of this amendment and a significant time commitment on my part, I did not have enough time to review and comment on all of the clauses that warranted comment. It seemed that every clause I looked at required correction and comment. Given state of this draft it was very difficult for me to review high level technical features and their interactions, which I believe is critical for a complete technical review of the amendment. I was forced to spend most of my time trying to figure out what the technical features were and how they should be correctly described/specified. The lack of clear feature descriptions in clause 4 further hampered my ability to review and understand the goals and purpose of the new HE features. It was very difficult to understand how the HE features should work with the existing features in the	Improve the descriptions in clause 4, so that there is a useful description as to what the new features are and how they work together and with legacy features to provide improved performance. In hindsight, given the current state of the amendment it would have made more sense to do a TG review prior to sending the amendment in its current form to the WG for letter ballot. In addition it would be helpful if all of the authors of this document were familiar with the 802.11 Editorial Style Guide or if is not possible for the authors to follow the Style Guide that the editor(s) provide more in depth editing prior to submitting this amendment to WG letter ballot again. I understand that many members wish to quickly complete this amendment, but in my view it would be a mistake to lower the quality of the specification simply to speed things along. I don't see how any voter who reviewed	2017/1/9 9:42
6999	Joseph Levy	225	1 27.5.2.3	167	59	T	Y	167.59 27.5.2.3	There is a TBD in the draft. All TBD should be removed from the draft prior to WG letter ballot. Please correct this issue.	Remove the TBD and provide what behavior is expected if the STA is not associated with the AP.	2017/1/9 9:42
7000	Joseph Levy	225	1 Annex B	407		G	Y	407.00 Annex B	Annex B needs significant work as it seems to have many errors in it.	Correct the PICS so that it is clear which features are optional and which are mandatory. Also, correct the dependence of the various features.	2017/1/9 9:42
7001	Joseph Levy	225	1 B.4.3	407	26	T	Y	407.26 B.4.3	The orthogonal frequency division multiplexing (OFDM) PHY is not mandatory for STAs that support the CFHT5G PHY nor the CFTVHT PHY. Therefore remove the dependence requirement.	Delete: "CFHT5G:M" and "CFTVHT:M"	2017/1/9 9:42
7002	Joseph Levy	225	1 B.4.3	407	28	T	Y	407.28 B.4.3	What is CFHEW? This does not seem to be defined any where. Therefore either replace it with CFHE which is what I believe was intended to represent High Efficiency WLAN operation.	Delete: "CFHEW" and replace it with "CFHE".	2017/1/9 9:42
7003	Joseph Levy	225	1	407		T	Y	407.00	Replace CFHEW by CFHE throughout the appendix B, this includes	Replace "CFHEW" by "CFHE"	2017/1/9 9:42
7004	Joseph Levy	225	1 B.4.3	407	47	T	Y	407.47 B.4.3	The use of O.6 is not being used correctly. O.6 means one of all the O.6 choices needs to be chosen. e.g. in the baseline specification CFHT:O.6 corresponds to CFHT2G4 and CFHT5. This means that for CFHT PHY at least one of these options must be supported: 2.4 GHz or 5 GHz. The reuse of O.6 in regard to the CFHEW2G4 option for CFHEW does not make any sense as it needs to be a new O.<index> to choose what optional bands are supported.	Replace "CFHEW:O.6" with "CFHE:O.8" or whatever the next available index is.	2017/1/9 9:42

7005 Joseph Levy	225	1 B.4.4	408	27	T	Y	408.27 B.4.4	The way fragmentation is shown in the table, breaks the current specification, by assigning a new term Static Fragmentation that was not previously defined. Hence all legacy requirements are now broken. To fix this remove the term static fragmentation and simply add Dynamic fragmentation.	Undo the deletions and leave PC6 as it was. Introduce PC45 Dynamic fragmentation and inside the same box provide PC45.1 Dynamic fragmentations level 0, PC45.2 Dynamic fragmentation level 1, PC45.3 Dynamic fragmentation level 2. With PC45.1 being mandatory for CFHE and the other PC45.x being optional for CFHE.		2017/1/9 9:42
7006 Jouni Malinen	225	1 B.4.27.2	414	23	T	N	414.23 B.4.27.2	HEWP4.* items in PICS have self-referential prefix in the Status column. That does not make much sense ("item is mandatory if the item is supported.."). When are these items supposed to be mandatory?	Fix the predicate in HEWP4.1 .. HEWP4.5 items Status column.		2017/1/9 9:42
7007 Jouni Malinen	225	1 4.3.14a	9	21	T	N	9.21 4.3.14a	Use of "shall" in Clause 4 (General description) seems to be inconsistent with existing Clause 4 text and also most of the new text added in P802.11ax/D1.0. Isn't this supposed to be descriptive clause where "STA shall support" would more likely be written "STA supports"? Furthermore, what exactly is "shall support operation in 20 MHz channel bandwidth only" supposed to say? That the STA is not allowed to use any other channel bandwidth than 20 MHz (e.g., neither 40 MHz nor 10 MHz or smaller)? That does not sound likely, but this could be interpreted as saying so.. Or is this saying that STA shall support operation at least in a 20 MHz channel? Or something else? It would be good to be more specific on what the exact mandatory behavior is for an HE non-AP STA.	At least replace "shall support" with "supports" (or something similar) on both lines and ideally, rewrite these to clarify the intent of this description of a mandatory functionality.		2017/1/9 9:42
7008 Jouni Malinen	225	1 9.3.3	51	13	E	N	51.13 9.3.3	This applies to both lines 20 (5 9.3.3 subclause numbers in P802.11ax/D1.0 do not match IEEE Std 802.11-2016.	Update 9.3.3 subclause numbers to match IEEE Std 802.11-2016.		2017/1/9 9:42
7009 Jouni Malinen	225	1 9.4.2.1	67	29	T	N	67.29 9.4.2.1	P802.11ax/D1.0 defines multiple new elements. Only half of those have been added into Table 9-77.	Add the following Element ID 255, Element ID Extension <ANA> elements into Table 9-77: BSS Color Change Announcement element, Quiet Time Period Setup element, Quiet Time Period Request element, Quiet Time Period Response element.		2017/1/9 9:42
7010 Jouni Malinen	225	1 9.4.2.220	93	46	T	N	93.46 9.4.2.220	Figure 9-589cu shows incorrect unit for the size of the subfields within the OCW Range field: they are bits, not octets, i.e., the total size of the OCW Range field is 8 bits = 1 octet; not 8 octets.	In Figure 9-589cu, replace "Octets" with "Bits".		2017/1/9 9:42
7011 Jouni Malinen	225	1 B.4.3	407	42	T	N	407.42 B.4.3	Many of the PICS items refer to CFHEW item in the Status column. However, CFHEW is not defined anywhere.. Maybe CFHE was a typo and supposed to be that missing CFHEW instead?	Replace "CFHE" with "CFHEW" in the Item column of B.4.3 table.		2017/1/9 9:42

7012 Jouni Malinen	225	1 B.4.27.2	414	19	T	N	414.19 B.4.27.2	Number of PICS items that are being referenced in a predicate are missing the asterisk in the Item column to indicate this.	Add asterisk into the Item column for the following PICS items: CFHEW2G4, CFHEW5G, CFHEW20, CFHEW80, HEWM6.1, HEWM6.2, HEWM6.4, HEWM6.5, HEWM6.7, HEWP2.1, HEWP3.1, HEWP3.2, HEWP3.3, HEWP3.4, HEWP3.5, HEWP6.1, HEWP6.2, HEWP6.3, HEWP6.4, HEWP6.5, HEWP6.6, HEWP6.7, HEWP12.1.1, HEWP12.1.2, HEWP12.1.4, HEWP12.1.5, HEWP12.1.7, HEWP12.1.8, HEWP12.1.10, HEWP12.1.11, HEWP12.1.13, HEWP12.1.14, HEWP12.1.16, HEWP12.1.17, HEWP12.1.19, EWP12.1.20, HEWP12.1.22, HEWP12.1.23, HEWP12.2.1, HEWP12.2.3, HEWP12.2.5, HEWP12.2.7, HEWP12.2.9, HEWP12.2.11, HEWP12.2.13, HEWP12.2.15.		2017/1/9 9:42
7013 Jouni Malinen	225	1 4.3.14a	9	24	T	N	9.24 4.3.14a	The way an HE STA is being conditionally described as a VHT/HT STA based on band and whether it is a non-AP STA seems to imply that an HE AP in 2.4 GHz band is not necessarily an HT AP. If that were the case, there would be need to describe some HT STA requirements for HE AP, e.g., as far as not allowing WEP or TKIP to be used as pairwise cipher. However, based on the PICS item CFHT change (add CFHEW:M to Status), it looks like an HE AP is actually mandated to be an HT AP in the 2.4 GHz band (similarly to how an HE AP in the 5 GHz band is also a VHT AP).	Add the following item into the "In the 2.4 GHz band" list: "An HE AP is also an HT AP".		2017/1/9 9:42
7014 Ju-Hyung Son	225	1 8.3.5.3.2	15	47	E	Y	15.47 8.3.5.3.2	PHY-DATA.request is not correct.	Change from "PHY-DATA.reqest" to "PHY-DATA.indication"		2017/1/9 9:42
7015 Ju-Hyung Son	225	1 9.2.4.6.4.7	28	1	T	Y	28.01 9.2.4.6.4.7	In Table 9-18d, need to specify the meaning of the bandwidth column (20MHz, 40MHz, 80MHz, 160MHz and 80+80MHz). How a non-AP STA choose each BW column when transmitting BQR in solicited and unsolicited mode respectively?	As per comment.		2017/1/9 9:42
7016 Ju-Hyung Son	225	1 9.2.4.6.4.7	28	27	T	Y	28.27 9.2.4.6.4.7	The currrent PHY-CCA.indication primitive only provides CCA results of primary, secondary, secondary40 within Primary 80MHz. In order to support individual 20MHz CCA results within secondary40, additional PHY-CCA.indication primitives should be defined.	Please specify the additional PHY-CCA.indication primitives indicating channel availability of each 20MHz channel in secondary40 for BQR.		2017/1/9 9:42
7017 Ju-Hyung Son	225	1 9.2.4.6.4.7	28	38	T	Y	28.38 9.2.4.6.4.7	The currrent PHY-CCA.indication primitive only provides CCA results of primary, secondary, secondary40, secondary80 within Primary 160MHz(80+80MHz). In order to support individual 20MHz CCA results within secondary40 and secondary80, additional PHY-CCA.indication primitives should be defined.	Please specify the additional PHY-CCA.indication primitives indicating channel availability of each 20MHz channel in secondary40 and secondary80 for BQR.		2017/1/9 9:42
7018 Ju-Hyung Son	225	1 9.2.4.6.4.7	28	1	T	Y	28.01 9.2.4.6.4.7	When a non-AP STA transmits BQR in HE SU PPDU, BQR would be useful only if the Available Channel Bitmap indicates larger BW than the BW of the transmitted HE SU PPDU. For example, if a non-AP STA trasmits BQR in 40MHz PPDU (40MHz is idle), BQR would be useful only if the Bitmap indicates 80MHz or 160MHz channel availability.	Please clarify the BW of Available Channel Bitmap setting in unsolicited BQR.		2017/1/9 9:42

7019	Ju-Hyung Son	225	1 9.2.4.6.4.7	28	1	T	Y	28.01 9.2.4.6.4.7	How a non-AP STA chooses the type of available CH bitmap in Table 9-18d when sending BQR in HE Trigger-based PPDU? Is it based on the BW of HE Trigger-based PPDU that contains BQR? Is it based on the allocated RU for each STA in HE Trigger-based PPDU?	Please clarify the BW of Available Channel Bitmap setting in solicited BQR.	2017/1/9 9:42
7020	Ju-Hyung Son	225	1 9.2.4.6.4.8	28	60	T	Y	28.60 9.2.4.6.4.8	RDP Trigger frame is not exist	Change from "RDP Trigger frame" to "RDP"	2017/1/9 9:42
7021	Ju-Hyung Son	225	1 10.9	127	22	T	Y	127.22 10.9	the text is not only for receive operating mode	Change from "receive operating mode" to "operating mode"	2017/1/9 9:42
7022	Ju-Hyung Son	225	1 27.2.1	150	13	T	Y	150.13 27.2.1	HE MU PPDU can be transmitted by a non-AP STA. An HE AP shall not enter intra-PPDU PS when a non-AP STA transmitts UL HE MU PPDU. Therefore, an HE AP shall only enter intra-PPDU PS when it receives DL HE MU PPDU.	Change from "HE MU PPDU" to "DL HE MU PPDU"	2017/1/9 9:42
7023	Ju-Hyung Son	225	1 27.8.1	188	44	T	Y	188.44 27.8.1	It is not clear whether AP can change its operation mode with the OMI indication. In cases where AP includes OMI in multiple MPDUs in DL HE MU PPDU format, and only subset of STAs acknowledges the MPDUs, what is the AP's behavior for changing OMI settings? In baseline spec, 11.42 Notification of operating mode changes, AP/non-AP STA's behavior for operation mode change is differently described. Therefore, OMI also should clarify AP's behaviour in clear manner.	Clarify the behavior of OMI A-Control for AP and non-AP STAs clearly.	2017/1/9 9:42
7024	Ju-Hyung Son	225	1 27.8.1	188	36	T	Y	188.36 27.8.1	Does including OMI A-Control in an MPDU require change to the Ack Policy of the MPDU to immediate ack?	Change from "solicits an immediate acknowledgement" to "solicits an acknowledgement"	2017/1/9 9:42
7025	Ju-Hyung Son	225	1 27.8.1	188	45	T	Y	188.45 27.8.1	ROM is requiring "an immediate acknowledgement" in Line 36 and TOM is requiring "an acknowledgement" in Line 45. Why they require different Ack Policy for an MPDU that contains each. Please clarify the difference or harmonize the wording.	As per comment.	2017/1/9 9:42
7026	Ju-Hyung Son	225	1 27.8.2	188	57	T	Y	188.57 27.8.2	From "the immediate acknowledgement", does OMI requires a certain Ack Policy for the MPDU that contains it? Otherwise, remove "immediate".	As per comment.	2017/1/9 9:42
7027	Ju-Hyung Son	225	1 27.8.2	188	61	T	Y	188.61 27.8.2	From "the immediate acknowledgement", does OMI requires a certain Ack Policy for the MPDU that contains it? Otherwise, remove "immediate".	As per comment.	2017/1/9 9:42
7028	Ju-Hyung Son	225	1 27.8.3	189	29	T	Y	189.29 27.8.3	Why only "The Channel Width" is indicated in "NOTE" while the similar statement for Tx NSS is not in the "NOTE"?	As per comment.	2017/1/9 9:42
7029	Ju-Hyung Son	225	1 27.8.3	189	26	T	Y	189.26 27.8.3	Even though a non-AP STA indicates its max number of NSS in OMI A-Control field, the STA should use the indicated number of NSS in the soliciting Trigger frame.	Change "will use in response" to "may use in respone".	2017/1/9 9:42
7030	Ju-Hyung Son	225	1 27.8.3	189	29	T	Y	189.29 27.8.3	Even though a non-AP STA indicates its max channel width in OMI A-Control field, the STA should use the indicated channel width in the soliciting Trigger frame.	Change "will use in response" to "may use in respone".	2017/1/9 9:42
7031	Ju-Hyung Son	225	1 27.8.2	189	8	T	Y	189.08 27.8.2	What is the meaning of "After transmitting the acknowledgement frame immeidate response immediate acknowledgement" ? If OMI does not mandate the Ack Policy of the MPDU to be carried, please remove "immediate" term.	Change from "After transmitting the acknowledgement frame immeidate response immediate acknowledgement" to "After transmitting the acknowledgement frame".	2017/1/9 9:42
7032	Ju-Hyung Son	225	1 9.4.2.218.3	84	28	T	Y	84.28 9.4.2.218.3	For the current HE-SIG-B design which is designed for DL MU signalling, it is inefficient to signal full-BW UL HE MU PPDU transmission. RU allocation field is not required in full-BW UL HE MU PPDU, since SIG-A's BW subfield signals the PPDU BW and the signaling of RU allocation is not needed.	Please clarify SIG-A/B signalling method for full bandwidth (20/40/80/160(80+80) MHz) UL HE MU PPDU transmission with the minimal overhead.	2017/1/9 9:42

7033 Ju-Hyung Son	225	1 9.4.2.218.3	84	28	T	Y	84.28 9.4.2.218.3	For the current HE-SIG-B design which is designed for DL MU signalling, it is inefficient to signal partial bandwidth transmission (left or right 106tone/20MHz) of UL HE MU PPDU transmission. For example, it requires signalling of RU allocation (106, -, 106) and two User specific information fields where one user information field would be useless.	Please clarify SIG-A/B method for partial bandwidth (left/right 106-tone RU within 20MHz) UL HE MU PPDU transmission with the minimal overhead.		2017/1/9 9:42
7034 Ju-Hyung Son	225	1 27.15.2	201	28	T	Y	201.28 27.15.2	An HE non-AP STA may transmit HE MU PPDU also. Please clarify the case in this section.	Insert the following sentence in Line 28. "An HE non-AP STA may transmit an HE MU PPDU to an HE AP if it has received from the HE AP an HE Capabilities element with the UL HE MU PPDU Payload Support field equal to 1; otherwise the STA shall not trasmit HE MU PPDU to the HE AP."		2017/1/9 9:42
7035 Ju-Hyung Son	225	1 27.15.2	201	36	T	Y	201.36 27.15.2	How an HE non-AP STA can transmit HE trigger-based PPDU to a peer STA without receiving the soliciting Trigger frame?	Please clarify the case where an HE non-AP STA can transmit HE Trigger-based PPDU to a peer STA without receiving the soliciting Trigger frame. Otherwise remove the sentence "An HE non-AP STA ~ to the peer STA."		2017/1/9 9:42
7036 Ju-Hyung Son	225	1 28.1.1	209	42	T	Y	209.42 28.1.1	Channel puncturing is not a defined terminology. Please use the term "preamble puncturing" instead.	Change from "supports channel puncturing" to "supports preamble puncturing"		2017/1/9 9:42
7037 Ju-Hyung Son	225	1 28.3.17.6.4	349	7	T	Y	349.07 28.3.17.6.4	The currrent PHY-CCA.indication primitive only provides CCA results of primary, secondary, secondary40, and secondary80. In order to support BW options of current preamble puncturing mode, additional PHY-CCA.indication primitives should be defined.	Please specify the additional PHY-CCA.indication primitives for preamble puncturing.		2017/1/9 9:42
7038 Ju-Hyung Son	225	1 9.7.3	109	3	T	Y	109.03 9.7.3	As 11ax allows Multi-TID A-MPDU aggregation, QoS Data of one TID with No Ack policy may be aggregated with QoS Data of other TID with Immediate Ack policy. Please add the contents in Table 9-425.	As per comment.		2017/1/9 9:42
7039 Ju-Hyung Son	225	1 9.7.3	111	3	T	Y	111.03 9.7.3	For example in MU Cascading case, TXOP holder may transmit Ack, HT-immediate BlockAck, M-BA in an A-MPDU of data enabled no immediate response context. Please add the contents in Table 9-426.	As per comment.		2017/1/9 9:42
7040 Ju-Hyung Son	225	1 10.22.2.8	132	53	T	Y	132.53 10.22.2.8	From the dynamic fragmentation capabilities in HE STA, 11ax needs to revise exception rules that allow a STA to exceed the TXOP limit. TXOP limit exception rules should be revised for HE STAs considering dynamic fragmentation capabilities.	As per comment.		2017/1/9 9:42
7041 Ju-Hyung Son	225	1 9.3.1.23	47	48	T	Y	47.48 9.3.1.23	When a Trigger frame includes User Info fields with the AID12 field set to 0, the Padding length should be enough to cover all possible STAs that can participate. Otherwise, it would restrict the number of STAs that can participate the UL OFDMA based Random Access due to the Padding length.	Please clarify the padding length when a Trigger frame includes random acces RU.		2017/1/9 9:42
7042 Ju-Hyung Son	225	1 27.16.2	206	39	T	Y	206.39 27.16.2	When Dual Beacon is used, two kinds of Beacon frames have TBTTs respectively. Please specify BSS color change sequence when Dual Beacon is used.	As per comment.		2017/1/9 9:42
7043 Ju-Hyung Son	225	1 27.5.2.6.2	173	1	T	Y	173.01 27.5.2.6.2	Please specify UL OFDMA-based random access when a BSS is operating in Multiple BSSID mode. An HE STA in Multiple BSSID mode would receive RAPS elements and Trigger frames from its multiple BSSs in Multiple BSSID set. Please clarify how to decrement/initialize its OBO in multiple BSSID mode.	As per comment.		2017/1/9 9:42

7044	Ju-Hyung Son	225	1 9.3.1.9.7	38	6	T	Y	38.06 9.3.1.9.7	An HE STA can construct a multi-TID A-MPDU containing multiple nonzero length MPDUs with the EOF subfield set to 1 or multiple nonzero length MPDUs with the EOF subfield set to 0. Utilizing the EOF field, a multi-STA BlockAck frame can be more efficient.	As per comment	2017/1/9 9:42
7045	JUNG HOON SUH	225	1 28.1.1	209	48	G	Y	209.48 28.1.1	We need a general statement in the introduction of 11ax PHY that we have a frame with a mixed symbol length in the preamble portion and in the data portion. This is a key feature of 11ax different from the Legacy.	Insert the following statement in Line 48. The HE PHY supports the mixed OFDM symbol length in a frame where the OFDM symbol length of 3.2 usec in the preamble field portion and the symbol length of 12.8 usec excluding the Guard Interval in the data field portion are mixed.	2017/1/9 9:42
7046	JUNG HOON SUH	225	1 28.3.3.3	236	3	T	Y	236.03 28.3.3.3	Explanation on why the null subcarriers are located in each band as in the Table 28-6.	Insert the following statement in Line 3. Those null subcarriers on the edge of the band may provide the protection of the RU adjacent to the edge tones from being distorted. The extra null subcarriers located between the edge tones and the RU adjacent to the edge tones provide the protection of the RU from the edge tone distortion.	2017/1/9 9:42
7047	JUNG HOON SUH	225	1 28.3.10.8	285	56	G	Y	285.56 28.3.10.8	Add a general statement on what HE-SIG-B is for. There is a general statement for HE-SIG-A, but for HE-SIG-B, a technical detail starts immediately at the beginning of the HE-SIG-B section.	Insert the following statement in Line 56. The HE-SIG-B field provides the OFDMA resource allocation information for the scheduled STAs to look up the corresponding resources in the data portion of the frame.	2017/1/9 9:42
7048	JUNG HOON SUH	225	1 28.3.10.9	300	35	G	Y	300.35 28.3.10.9	Description on a parameter of Eq. 28-34 is missing	Add the description on what Mr,u is.	2017/1/9 9:42
7049	Junichi Iwatani	225	1 3.4	7	15	E	N	7.15 3.4	Regarding "OMI Operation mode indication", according to 27.8, OMI stands for "Operating mode indication"	Change "Operation mode indication" to "Operating mode indication"	2017/1/9 9:42
7050	Junichi Iwatani	225	1 9.2.4.6.4.2	23	59	E	N	23.59 9.2.4.6.4.2	"... and is set to the number of OFDM symbols the Data field of the HE trigger-based PPDU minus 1" This sentence is unclear.	For example, "... and is set to the number of OFDM symbols used in the Data field of the HE trigger-based PPDU minus 1"	2017/1/9 9:42
7051	Junichi Iwatani	225	1 9.2.4.6.4.3	24	31	E	N	24.31 9.2.4.6.4.3	Regarding the name "Operating Mode", in other clauses (especially 27.8 Operating mode indication), this is called "OMI A-Control field". It is not clear whether they have the same meaning. The same word (e.g., Operating mode indication(OMI)) should be used.	as in comment	2017/1/9 9:42
7052	Junichi Iwatani	225	1 9.2.4.6.4.6	27	19	E	N	27.19 9.2.4.6.4.6	"(see 26.3.13.2 (Power pre-correction)" should be "(see 28.3.14.2 (Power pre-correction))."	as in comment	2017/1/9 9:42
7053	Junichi Iwatani	225	1 9.2.4.6.4.7	27	65	E	N	27.65 9.2.4.6.4.7	"25.5.1.3" should be "27.5.1.3" (reference to DL HE MU transmission)	as in comment	2017/1/9 9:42
7054	Junichi Iwatani	225	1 9.3.1.23.1	48	41	E	N	48.41 9.3.1.23.1	"Table 8-159" is not found in Draft 1.0 and other documents.	as in comment	2017/1/9 9:42
7055	Junichi Iwatani	225	1 9.4.2.218.2	79	26	E	Y	79.26 9.4.2.218.2	Regarding "Group Addressed Multi-STA BlockAck In DL MU Support", it seems that "non-broadcast RU" should be "broadcast RU". (See 27.4.4.5, Page 162, Line 27)	as in comment	2017/1/9 9:42
7056	Junichi Iwatani	225	1 9.4.2.218.2	79	42	T	N	79.42 9.4.2.218.2	In "Table 9-262z--Subfields of the HE MAC Capabilities Information field", for "Maximum AMPDU Length Exponent", there is no definition or encoding explanation.	Add explanations	2017/1/9 9:42
7057	Junichi Iwatani	225	1 9.4.2.218.3	86	18	T	Y	86.18 9.4.2.218.3	"SRP-based SR Support" is not explained in other clauses	Add explanations in Clause 27 or 28	2017/1/9 9:42
7058	Junichi Iwatani	225	1 9.4.2.220	93	25	E	N	93.25 9.4.2.220	"Length" should be "Length"	as in comment	2017/1/9 9:42
7059	Junichi Iwatani	225	1 9.4.2.220	93	46	E	Y	93.46 9.4.2.220	For Figure 9-589cu--OCW Range field format, "Octets" should be "Bits". (The total size of OCW Range should be 8bits. See Figure 9-589ct)	as in comment	2017/1/9 9:42
7060	Junichi Iwatani	225	1 9.4.2.222	95	43	E	N	95.43 9.4.2.222	"Announce-ment" should be "Announcement"	as in comment	2017/1/9 9:42
7061	Junichi Iwatani	225	1 9.6.5	99	1	T	Y	99.01 9.6.5	There is no explanation for "L3 FRAG ADDBA Request", "L3 FRAG ADDBA Response" and "L3 FRAG DELBA". Only "L3 FRAG ADDBA Response" is used in 27.3.4.4 (Page 154, Line 41). However explanations are not enough.	Add explanations.	2017/1/9 9:42

7062	Junichi Iwatani	225	1 10.3.2.10.2	119	21	E	N	119.21 10.3.2.10.2	"A non-AP STA that is the recipient, within an HE MU PPDU, of a QoS Data frame or QoS Null frame that solicits an immediate response with Ack Policy equal to MU Ack ..." This sentence is confusing.	For example, "A non-AP STA that is the recipient, within an HE MU PPDU, of a QoS Data frame or QoS Null frame with Ack Policy equal to MU Ack that solicits an immediate response"	2017/1/9 9:42
7063	Junichi Iwatani	225	1 10.3.2.10.3	120	5	T	N	120.05 10.3.2.10.3	There is no example and figure for MultiSTA BlockAck response in OFDMA HE MU PPDU. The rule is complicated as described in 27.4.4.5 (Page 162, Line 22). Therefore an example should be added to clarify the rules. Also a reference to 27.4.4.5 should be added since additional conditions are described in 27.4.4.5.	as in comment	2017/1/9 9:42
7064	Junichi Iwatani	225	1 10.3.5	121	61	E	N	121.61 10.3.5	There is no description for "insert" or "change" for the following paragraphs.	For example, "Change the subclause as follows" should be added.	2017/1/9 9:42
7065	Junichi Iwatani	225	1 10.12	128	8	E	N	128.08 10.12	"An A-MSDU may be fragmented and each fragment transmitted within a single QoS Data frame" The sentence seems grammatically incorrect and unclear. (Does this mean "An A-MSDU may be fragmented and each fragment may be transmitted within a single QoS Data frame"?)	Fix it	2017/1/9 9:42
7066	Junichi Iwatani	225	1 10.12	128	10	E	Y	128.10 10.12	"Fragmented A-MSDU Support" should be "A-MSDU Fragmentation Support" (see 9.4.2.218.2 HE MAC Capabilities Information field, Page 79, Line 46)	as in comment	2017/1/9 9:42
7067	Junichi Iwatani	225	1 10.28.4	137	11	E	N	137.11 10.28.4	"25.10.4" should be "27.10.4"╥╫╟(A-MPDU with multiple TID)	as in comment	2017/1/9 9:42
7068	Junichi Iwatani	225	1 10.43.1	137	47	E	N	137.47 10.43.1	"tha" should be "that"	as in comment	2017/1/9 9:42
7069	Junichi Iwatani	225	1 27	149	5	G	N	149.05 27	There are only 8 figures in Clause 27. More figures should be added to clarify complicated procedures (especially for Fragmentation, Block acknowledgement and MU operation).	as in comment	2017/1/9 9:42
7070	Junichi Iwatani	225	1 27.1	149	8	G	N	149.08 27.1	In "Introduction", general explanations for HE MAC should be added first as written in 28.1 (Introduction for HE PHY)	as in comment	2017/1/9 9:42
7071	Junichi Iwatani	225	1 27.2.1	149	25	T	N	149.25 27.2.1	"... the same as the BSS color announced by the AP to which the STA is associated ..." It seems that this description is only for non-AP STAs. However, this condition (BSS color identification) should be used for APs as well. (Also in other items of this subclause.)	Clarify the conditions for an AP.	2017/1/9 9:42
7072	Junichi Iwatani	225	1 27.2.2	151	60	E	N	151.60 27.2.2	The meaning of the sentence "For example, ..." is unclear.	Clarify	2017/1/9 9:42
7073	Junichi Iwatani	225	1 27.2.3	152	13	E	Y	152.13 27.2.3	There is no definition for "HEMUEDCATimer[AC]". It seems that this is "MU EDCA Timer" described in 9.4.2.221.	Add definitions or modify the name of the parameter.	2017/1/9 9:42
7074	Junichi Iwatani	225	1 27.3.3.4	154	39	E	Y	154.39 27.3.3.4	"L3 Frag BA Request frame" and "L3 Frag BA Response" are not defined in Clause 9. ("L3 FRAG ADDBA Request" and "L3 FRAG ADDBA Request" are defined)	Modify the name or add definitions.	2017/1/9 9:42
7075	Junichi Iwatani	225	1 27.3.4.2	155	56	T	N	155.56 27.3.4.2	"Upon reception of an MPDU or S-MPDU that carries one or more dynamic fragments ..." It is unclear when an MPDU or S-MPDU carries more than one dynamic fragments. If not necessary, "or more" should be deleted.	as in comment	2017/1/9 9:42
7076	Junichi Iwatani	225	1 27.3.4.4	156	62	E	N	156.62 27.3.4.4	"module" should be "modulo"	as in comment	2017/1/9 9:42
7077	Junichi Iwatani	225	1 27.4.1	158	19	E	N	158.19 27.4.1	"MU BAR" should be "MU-BAR"	as in comment	2017/1/9 9:42
7078	Junichi Iwatani	225	1 27.4.4.1	161	37	T	N	161.37 27.4.4.1	DL MU PPDU with MU-BAR should be explained in more detail somewhere in 27.4.4. Ack policy for PPDU with MU-BAR should be clarified.	as in comment	2017/1/9 9:42
7079	Junichi Iwatani	225	1 27.4.4.2	160	54	E	N	160.54 27.4.4.2	"10.3.2.11.2 (MU acknowledgement procedure for DL MU PPDU in SU format" should be "10.3.2.10.1 (Acknowledgement procedure for DL MU PPDU in SU format)"	as in comment	2017/1/9 9:42

7080	Junichi Iwatani	225	1 27.4.4.3	161	13	E	N	161.13 27.4.4.3	"10.3.2.11.3 (MU acknowledgement procedure for HE MU PPDU in MU format)" should be "10.3.2.10.2 (Acknowledgement procedure for DL MU PPDU in MU format)"	as in comment	2017/1/9 9:42
7081	Junichi Iwatani	225	1 27.4.4.4	161	38	E	N	161.38 27.4.4.4	"10.3.2.11.4 (MU acknowledgement procedure for an UL MU transmission)" should be "10.3.2.10.3 (Acknowledgement procedure for an UL MU transmission)"	as in comment	2017/1/9 9:42
7082	Junichi Iwatani	225	1 27.4.4.4	161	56	T	N	161.56 27.4.4.4	"If the HE trigger-based PPDU carries Single MPDUs, A-MPDUs, or multi-TID A-MPDUs from more than one STA, " It seems unnatural that an HE trigger-based PPDU is from more than one STA. (Also, not "STAs"). If necessary, "HE trigger-based PPDU" should be defined for a receiver clearly. (Also for Page 162, Line 10)	Clarify or modify	2017/1/9 9:42
7083	Junichi Iwatani	225	1 27.4.4.5	162	6	E	N	162.06 27.4.4.5	"10.3.2.11.4 (MU acknowledgement procedure for an UL MU transmission)" should be "10.3.2.10.3 (Acknowledgement procedure for an UL MU transmission)"	as in comment	2017/1/9 9:42
7084	Junichi Iwatani	225	1 27.4.4.5	162	7	T	N	162.07 27.4.4.5	Regarding the format of a response in HE MU PPDU, especially for Multi-STA BA, this should be specified as OFDMA HE MU PPDU for clarification. (as described in 10.3.2.10.3, Page 120, Line 5)	as in comment	2017/1/9 9:42
7085	Junichi Iwatani	225	1 27.4.4.5	162	26	E	Y	162.26 27.4.4.5	There is no definition for "support the reception of MU Multi-STA BlockAck frame". It seems that "Group Addressed Multi-STA Block- Ack In DL MU Support" (defined in 9.4.2.218.2, Page 79, Line 21) is correct.	Fix it	2017/1/9 9:42
7086	Junichi Iwatani	225	1 27.4.4.5	162	26	E	N	162.26 27.4.4.5	"context.." should be "context."	as in comment	2017/1/9 9:42
7087	Junichi Iwatani	225	1 27.4.4.5	162	27	T	N	162.27 27.4.4.5	There is no definition for "broadcast RU"	Define or explain	2017/1/9 9:42
7088	Junichi Iwatani	225	1 27.5.1.1	162	57	E	Y	162.57 27.5.1.1	There is no field for "DL OFDMA With MIMO Support" in HE Capabilities.	Add a new field or modify the explanation	2017/1/9 9:42
7089	Junichi Iwatani	225	1 27.5.1.2	163	11	T	N	163.11 27.5.1.2	There is no definition for "broadcast RU"	Define or explain	2017/1/9 9:42
7090	Junichi Iwatani	225	1 27.5.2.2.2	166	61	E	N	166.61 27.5.2.2.2	"Type Dependent User Info field" should be "Trigger Dependent User Info field"	as in comment	2017/1/9 9:42
7091	Junichi Iwatani	225	1 27.5.2.2.2	166	62	E	N	166.62 27.5.2.2.2	"Multi-TID Support field" should be "Multi-TID Aggregation Support field" (See 9.4.2.218.2 HE MAC Capabilities Information field)	as in comment	2017/1/9 9:42
7092	Junichi Iwatani	225	1 27.5.2.2.2	166	65	E	N	166.65 27.5.2.2.2	"(Trigger frame format)).A value 0" should be "(Trigger frame format)). A value 0"	as in comment	2017/1/9 9:42
7093	Junichi Iwatani	225	1 27.5.2.2.2	167	1	E	N	167.01 27.5.2.2.2	"HE trigger-based PPDU.A value" should be "HE trigger-based PPDU. A value"	as in comment	2017/1/9 9:42
7094	Junichi Iwatani	225	1 27.5.2.2.2	167	15	T	Y	167.15 27.5.2.2.2	"The AP may assign any value defined in Table 9-25i (Preferred AC subfield encoding) in the AC Preference Level subfield in the Trigger Dependent User Info field to 1..." The meaning of this sentence is unclear. "AC Preference Level subfield" does not include the value in Table 9-25i.	Clarify	2017/1/9 9:42
7095	Junichi Iwatani	225	1 27.5.2.2.3	167	26	E	N	167.26 27.5.2.2.3	"9.22.2.7" should be "10.22.2.7"	as in comment	2017/1/9 9:42
7096	Junichi Iwatani	225	1 27.5.2.2.3	167	30	E	N	167.30 27.5.2.2.3	"9.22.2.2" should be "10.22.2.2"	as in comment	2017/1/9 9:42
7097	Junichi Iwatani	225	1 27.5.2.3	167	59	T	Y	167.59 27.5.2.3	", TBD" should be removed and the procedures should be specified.	as in comment	2017/1/9 9:42
7098	Junichi Iwatani	225	1 27.5.2.3	169	60	E	N	169.60 27.5.2.3	"MU BAR" should be "MU-BAR"	as in comment	2017/1/9 9:42
7099	Junichi Iwatani	225	1 27.5.2.3	170	7	E	N	170.07 27.5.2.3	"9-428" should be "Table 9-428"	as in comment	2017/1/9 9:42
7100	Junichi Iwatani	225	1 27.5.2.4	170	26	E	N	170.26 27.5.2.4	The explanations for the conditions of virtulal CS and NAV consideration are confusing. (Line 26-38)	Simplify explanations for clarification	2017/1/9 9:42
7101	Junichi Iwatani	225	1 27.5.2.5	171	39	E	N	171.39 27.5.2.5	"(#2190, 2191)" should be removed.	as in comment	2017/1/9 9:42
7102	Junichi Iwatani	225	1 27.5.2.5	171	41	E	N	171.41 27.5.2.5	"Table 9-XX" should be "Table 9-18c"	as in comment	2017/1/9 9:42

7103	Junichi Iwatani	225	1 27.5.2.6.2	173	10	T	Y	173.10 27.5.2.6.2	Regarding Figure 27-1--Illustration of the UL OFDMA-based random access procedure, 1) The meaning of the location of the arrows is not clear. 2) The differences between "before" and "after" the decrement is not explained and unclear. 3) Only one "SIFS" is written. This should be added to other places.	Modify Figure 27-1 for clarification.		2017/1/9 9:42
7104	Junichi Iwatani	225	1 27.5.2.6.2	173	33	T	Y	173.33 27.5.2.6.2	"it shall set the value of OCW to the OCWmin╥╟╟and shall initialize its OBO counter to a random value in the range of 0 and OCWmin." There is not enough explanations for the usage of OCW. It seems that "range of 0 and OCWmin" should be "range of 0 and OCW".	Add or modify explanations on OCW and OBO counter.		2017/1/9 9:42
7105	Junichi Iwatani	225	1 27.5.2.6.2	173	37	T	N	173.37 27.5.2.6.2	The exact timing to decrement the OBO counter is not clarified.	Clarify procedures for decrementing the OBO counter.		2017/1/9 9:42
7106	Junichi Iwatani	225	1 27.5.2.6.2	173	41	T	N	173.41 27.5.2.6.2	"decrement their nonzero OBO counters by 1" In Figure 27-1, the number of RUs is 2. Then it seems that "decrement.. by 2" is correct.	as in comment		2017/1/9 9:42
7107	Junichi Iwatani	225	1 27.5.2.6.2	173	46	E	N	173.46 27.5.2.6.2	"AID value 0If the selected" should be "AID value 0. If the selected"	as in comment		2017/1/9 9:42
7108	Junichi Iwatani	225	1 27.5.2.7	174	21	T	Y	174.21 27.5.2.7	For "NDP feedback report procedure", detailed procedures and trigger frame format should be described.	Add explanations		2017/1/9 9:42
7109	Junichi Iwatani	225	1 27.6.2	177	19	E	N	177.19 27.6.2	"Table YY-1". The numbers should be specified.	as in comment		2017/1/9 9:42
7110	Junichi Iwatani	225	1 27.6.2	178	6	E	N	178.06 27.6.2	In Figure 27-4, "UL TRIG PPDU" should be "HE trigger-based PPDU"	as in comment		2017/1/9 9:42
7111	Junichi Iwatani	225	1 27.6.3	179	9	T	N	179.09 27.6.3	"The size of the HE compressed beamforming feedback requested" is unclear.	Clarify		2017/1/9 9:42
7112	Junichi Iwatani	225	1 27.7.2	181	36	E	N	181.36 27.7.2	"trigger-based PPDU" should be "HE trigger-based PPDU"	as in comment		2017/1/9 9:42
7113	Junichi Iwatani	225	1 27.7.2	184	38	E	N	184.38 27.7.2	"Table 9.248l1" should be "Table 9-262k1" (Also in Page 184 Line 43 and Page 186 Line 28)	as in comment		2017/1/9 9:42
7114	Junichi Iwatani	225	1 27.7.3.3	186	15	E	N	186.15 27.7.3.3	"trigger-based PPDU" should be "HE trigger-based PPDU"	as in comment		2017/1/9 9:42
7115	Junichi Iwatani	225	1 27.8.3	189	15	E	N	189.15 27.8.3	"Rules for transmit operation mode (TOM) indication" should be "Rules for transmit operating mode (TOM) indication" as in ROM and other OMI descriptions. (Also in Page 188, Line 46)	as in comment		2017/1/9 9:42
7116	Junichi Iwatani	225	1 27.9.1	190	11	T	N	190.11 27.9.1	There is no definition for "SR PPDU"	Define "SR PPDU" or modify explanations		2017/1/9 9:42
7117	Junichi Iwatani	225	1 27.9.1	190	13	T	Y	190.13 27.9.1	SRP-based spatial reuse (mentioned in 28.3.10.7.2) should be explained in 27.9.1 General and a new subclause (27.9.3)	as in comment		2017/1/9 9:42
7118	Junichi Iwatani	225	1 27.9.2.1	190	36	E	N	190.36 27.9.2.1	"PHYCCARESET.request" should be "PHY-CCARESET.request"	as in comment		2017/1/9 9:42
7119	Junichi Iwatani	225	1 27.9.2.1	190	50	E	N	190.50 27.9.2.1	"SR Backoff procedure for SR delayed case." is not a complete sentence. If this is the title of a subclause, the subclause number should be added.	as in comment		2017/1/9 9:42
7120	Junichi Iwatani	225	1 27.9.2.1	190	53	E	N	190.53 27.9.2.1	"SR delay" should be "SR_Delay" (also in Line 56)	as in comment		2017/1/9 9:42
7121	Junichi Iwatani	225	1 27.9.2.1	190	56	T	N	190.56 27.9.2.1	It is unclear whether "SR Backoff procedure"(Line 50) and "existing backoff procedure"(Line 56) are the same or different procedures.	Clarify the procedures to avoid confusion.		2017/1/9 9:42
7122	Junichi Iwatani	225	1 27.9.2.2	191	7	T	Y	191.07 27.9.2.2	There is no definitions for OBSS_PDmin, OBSS_Pdmax (and OBSS_PDmin_default, OBSS_PDmax_default in Line 62)	Define them		2017/1/9 9:42
7123	Junichi Iwatani	225	1 27.9.2.2	191	7	T	Y	191.07 27.9.2.2	This formula and Figure 27-6 mean that there is no lower limit of allowable OBSS_PD level. However, the lower limit of OBSS_PD should exist and may be defined as OBSS_PDmin.	Specify the minimum value (OBSS_PDmin) for allowable OBSS_PD level.		2017/1/9 9:42
7124	Junichi Iwatani	225	1 27.9.2.2	191	7	E	N	191.07 27.9.2.2	"OBSSPDmax" and "OBSSPDmin" should be "OBSS_PDmax" and "OBSS_PDmin"	as in comment		2017/1/9 9:42
7125	Junichi Iwatani	225	1 27.9.2.2	192	3	T	Y	192.03 27.9.2.2	There is no definition for "SR mode" (also in Line 7)	Define "SR mode" or add explanations.		2017/1/9 9:42

7126 Junichi Iwatani	225	1 27.9.2.2	192	16	T	N	192.16 27.9.2.2	"If a STA regards an inter-BSS PPDU as not having been received at all using a specific OBSS_PDlevel," The procedure is unclear. It seems that this means "a) issue a PHYCCARESET. request primitive and b) not update its NAV timers based on frames carried in the PPDU" in Page 190, Line20.	For example, "If a STA regards a PPDU as an inter-BSS PPDU by using a specific OBSS_PDlevel and issues a PHYCCARESET.request primitive ...,"	2017/1/9 9:42
7127 Junichi Iwatani	225	1 27.9.2.2	192	16	E	N	192.16 27.9.2.2	"If a STA regards... once its backoff reaches zero." The meaning of the sentence is unclear.	Clarify	2017/1/9 9:42
7128 Junichi Iwatani	225	1 27.9.2.2	192	20	E	N	192.20 27.9.2.2	"UL TB PPDU" should be "HE trigger-based PPDU"	as in comment	2017/1/9 9:42
7129 Junichi Iwatani	225	1 27.9.2.2	192	22	T	Y	192.22 27.9.2.2	"The minimum OBSS_PDlevel used by the STA shall be above the received signal strength of the inter-BSS PPDU" It is unclear why the minimum OBSS_PD level (OBSS_PDmin) shall be above the received signal strength of the inter-BSS PPDU.	Clarify the reason or modify the condition	2017/1/9 9:42
7130 Junichi Iwatani	225	1 27.10.4	194	35	E	N	194.35 27.10.4	"HE ER SU PPDU" should be "HE extended range SU PPDU"	as in comment	2017/1/9 9:42
7131 Junichi Iwatani	225	1 27.16.2	206	31	T	N	206.31 27.16.2	It is necessary to clarify whether the New BSS color or Color Switch Countdown time may be changed during the advertisement of BSS Color Change Announcement.	Clarify	2017/1/9 9:42
7132 kaiying Lv	225	1 9.2.4.6.4.5	26	47	E	Y	26.47 9.2.4.6.4.5	The reference of the ACI mapping between ACI and AC is missing.	Please change the text to "The ACI High subfield indicates the ACI of the AC for which the BSR is indicated in the Queue Size High subfield. The reference of the ACI mapping between ACI and AC is defined in Table 9-136 (ACI-to-AC coding)."	2017/1/9 9:42
7133 kaiying Lv	225	1 9.3.1.9.3	36	55	T	Y	36.55 9.3.1.9.3	Change "and" to "or"	As in comment	2017/1/9 9:42
7134 kaiying Lv	225	1 9.3.1.9.7	39	51	T	Y	39.51 9.3.1.9.7	Change "and" to "or"	As in comment	2017/1/9 9:42
7135 kaiying Lv	225	1 9.3.1.23.4	50	23	E	Y	50.23 9.3.1.23.4	Change the text as follows "The MU-RTS frame format is a variant of Trigger frame format as shown in Figure 9-52c (Trigger frame).The Trigger Dependent Common Info field is not present in the MU-RTS variant Trigger frame."	As in comment	2017/1/9 9:42
7136 kaiying Lv	225	1 9.6.5.1	99	16	T	Y	99.16 9.6.5.1	Which elements are included in L3 FRAG ADDBA Request, L3 FRAG ADDBA Response or L3 FRAG DELBA?	Please Clarify it.	2017/1/9 9:42
7137 kaiying Lv	225	1 10.3.2.8a.3	117	29	T	Y	117.29 10.3.2.8a.3	The MU-RTS frame can be sent to one or more STAs by the AP with which the STAs are associated or by the AP corresponding to the transmitted BSSID.	Please change the text as follows "The MU-RTS frame is sent by the AP with which the STA is associated or by the AP corresponding to the transmitted BSSID and the value of the basic NAV is 0."	2017/1/9 9:42
7138 kaiying Lv	225	1 27.2.3	152	13	T	Y	152.13 27.2.3	When the HEMUEDCATimer[AC] is not 0, is the TXOPLimit[AC] still used as defined by EDCA Parameter Set element?	Please clarify it.	2017/1/9 9:42
7139 kaiying Lv	225	1 27.3.4.1	155	30	T	Y	155.30 27.3.4.1	Change "MSDUs" to " MSDUs or A-MSDUs when supported"	As in comment	2017/1/9 9:42
7140 kaiying Lv	225	1 10.3.2.8a.1	115	62	T	Y	115.62 10.3.2.8a.1	MU-RTS/CTS also allows an AP to protect a GCR transmission.Change to "The MU-RTS/CTS procedure allows an AP to protect an MU transmission or a GCR transmission."	As in comment	2017/1/9 9:42
7141 kaiying Lv	225	1 27.5.2.2.1	165	21	T	Y	165.21 27.5.2.2.1	How to meet the requirement of MinTrigProcTime for random access?	Please clarify it.	2017/1/9 9:42
7142 kaiying Lv	225	1 27.11.5	197	44	T	Y	197.44 27.11.5	When the MAC Duration of the HE trigger-based PPDU is 0, even if the RXVECTOR parameter TXOP_DURATION of the soliciting PPDU is set to all 1s, the TXVECTOR parameter TXOP_DURATION of the HE trigger-based PPDU can be set to 0.	Please Clarify it.	2017/1/9 9:42
7143 kaiying Lv	225	1 28.3.3.10.5	240	54	T	Y	240.54 28.3.3.10.5	If a STA finds that there is no User Info field in Trigger frame carrying the STA's AID in the Address field, the STA can still use random access RU to access the channel if there are RUs allocated for random access.	Please clarify it.	2017/1/9 9:42
7144 kaiying Lv	225	1 27.4.1	157	49	E	Y	157.49 27.4.1	Change "Multi-STA" to "Multi-STA BlockAck"	As in comment	2017/1/9 9:42

7145 kaiying Lv	225	1 27.5.2.1	164	26	E	Y	164.26 27.5.2.1	Change "Class A subfield" to "Device Class subfield" on line 26 and 27 of page 164	As in comment	2017/1/9 9:42
7146 kaiying Lv	225	1 27.5.2.3	167	59	T	Y	167.59 27.5.2.3	Miss the case of Multiple BSSID set. Please change the text to "The User Info field is addressed to a STA if the AID12 subfield is equal to the AID of the STA and the STA is associated with the AP or the TA field of the received Trigger frame with the Individual/Group bit forced to the value 0 is the same as the BSSID of any member of the Multiple BSSID Set	As in comment	2017/1/9 9:42
7147 kaiying Lv	225	1 27.5.2.3	167	65	E	Y	167.65 27.5.2.3	Please delete "–" before "Otherwise, a STA shall not send an HE trigger-based PPDU"	As in comment	2017/1/9 9:42
7148 kaiying Lv	225	1 27.5.2.3	168	27	E	Y	168.27 27.5.2.3	Change "CH_BANDWIDTHW" to "CH_BANDWIDTH"	As in comment	2017/1/9 9:42
7149 kaiying Lv	225	1 27.5.2.3	168	46	E	Y	168.46 27.5.2.3	MCS field is in User Info field. Change "the Common Info " to " User Info"	As in comment	2017/1/9 9:42
7150 kaiying Lv	225	1 27.5.2.3	168	52	E	Y	168.52 27.5.2.3	The Starting Spatial Stream subfield is in User Info field. Change "the Common Info " to " User Info"	As in comment	2017/1/9 9:42
7151 kaiying Lv	225	1 27.5.2.6.2	173	46	E	Y	173.46 27.5.2.6.2	Change "0If" to "0.If"	As in comment	2017/1/9 9:42
7152 kaiying Lv	225	1 27.5.2.6.3	174	8	T	Y	174.08 27.5.2.6.3	If a STA transmits an HE trigger-based PPDU sent by using random access RU and fails to receive the immediate acknowledgement, the STA may contend to retransmit the PPDU without using random access RU. How to update the OCW in this case?	Please clarify it.	2017/1/9 9:42
7153 kaiying Lv	225	1 27.15.2	201	33	E	Y	201.33 27.15.2	Change "HE extended range SU PPDU Payload field" to "HE ER SU PPDU Payload"	As in comment	2017/1/9 9:42
7154 kaiying Lv	225	1 27.15.2	201	38	T	Y	201.38 27.15.2	In HE Capabilities element,there is no UL MU PPDU Support field.	Please Clarify it.	2017/1/9 9:42
7155 kaiying Lv	225	1 27.4.1	158	13	E	Y	158.13 27.4.1	Change "associate" to "are associated"	As in comment	2017/1/9 9:42
7156 kaiying Lv	225	1 11.2.2.8	202	9	T	Y	202.09 11.2.2.8	When an AP sends a broadcast Multi-STA BlockAck, the broadcast Multi-STA BlockAck can not indicate the More Data Information for multi STA since the More Data subfield is in Frame Control field. Suggest to use special TID to indicate that the ACK type subfield represents More Data subfield.	Please clarify it	2017/1/9 9:42
7157 kaiying Lv	225	1 27.5.2.6.2	173	46	E	Y	173.46 27.5.2.6.2	Missing one dot.	Separate the sentence "If the selected RU....." from previous sentence.	2017/1/9 9:42
7158 kaiying Lv	225	1 10.22.2.4	130	25	E	Y	130.25 10.22.2.4	Add "or" in between "a non-VHT" and "non-HE STA"	as in comment	2017/1/9 9:42
7159 kaiying Lv	225	1			G	Y		It is not consistent within the whole draft text by saying "TA set to the transmitted BSSID" and "TA set to the MAC address of the transmitted BSSID"	Make it consistent through the draft	2017/1/9 9:42
7160 kaiying Lv	225	1 27.2.2	150	58	T	Y	150.58 27.2.2	When the trigger frame's responder failed to respond due to CS busy, the STA solicited an immediate response should also update NAV in order to avoid contending the medium.	Please clarify it	2017/1/9 9:42
7161 kaiying Lv	225	1 11.49.1	144	32	T	Y	144.32 11.49.1	BSS Color may switch to a new color due to BSS Color collision. Please clarify the operation under this situation.	As in comment	2017/1/9 9:42
7162 kaiying Lv	225	1 27.1.2	149	16	T	Y	149.16 27.1.2	Add a general condition" if BSS Color Disabled field in HE operation element is set to 0" through this subclause.	As in comment	2017/1/9 9:42
7163 kaiying Lv	225	1 27.1.2	149	43	T	Y	149.43 27.1.2	One of the conditions to take a received PPDU as an intra-BSS frame is that "The frame is a control frame that does not have a TA field and the RA matches the saved TXOP holder address for the BSS to which it is associated." Multiple BSSID set should be also considered.	Please change the text as follows: "The frame is a control frame that does not have a TA field and the RA matches the saved TXOP holder address for the BSS to which it is associated or for the BSS which is any member of the multiple BSSID set"	2017/1/9 9:42

7164	kaiying Lv	225	1 27.1.2	149	34	T	Y	149.34 27.1.2	One of the conditions to take a received PPDU as an intra-BSS frame is that "The RXVECTOR parameter PARTIAL_AID in the received VHT PPDU with the RXVECTOR parameter GROUP_ID equal to 0 is the same as the BSSID[39:47] of the AP to which the STA is associated" Multiple BSSID set should be also considered.	change to "The RXVECTOR parameter PARTIAL_AID in the received VHT PPDU with the RXVECTOR parameter GROUP_ID equal to 0 is the same as the BSSID[39:47] of the AP to which the STA is associated or the BSSID[39:47] which is any member of the multiple BSSID set"		2017/1/9 9:42
7165	kaiying Lv	225	1 27.1.2	149	50	T	Y	149.50 27.1.2	Multiple BSSID set should be considererd.	Please clarify it		2017/1/9 9:42
7166	kaiying Lv	225	1 27.11.4	196	43	T	Y	196.43 27.11.4	When BSS Color collision happens, an HE AP may switch the BSS Color to a new one.	Please change the text as follows: "shall maintain that single value of the BSS Color subfield until the HE STA transmitting an HE operation element switches to a new BSS Color"		2017/1/9 9:42
7167	kaiying Lv	225	1 27.2.2	150	27	E	Y	150.27 27.2.2	Please change "applies" to "apply"	As in comment		2017/1/9 9:42
7168	kaiying Lv	225	1 27.11.4	197	29	T	Y	197.29 27.11.4	When the BSS color changes, the the Partial BSS Color field in the HE Operation element shall be set to 0. Otherwise the value of RXVECTOR parameter PARTIAL_AID [5:8] in the received VHT PPDU with the RXVECTOR parameter GROUP_ID equal to 63 will cause confusion on detection of inter-BSS frame	Please add the following text at the end the subclause " When an HE AP changes the BSS color for the BSS that it serves, it shall set the Partial BSS Color field in the HE Operation element 0. Note: The HE AP may continue applying an AID assignment rule using the partial BSS color bits.		2017/1/9 9:42
7169	kaiying Lv	225	1 27.2.2	150	4	T	Y	150.04 27.2.2	Multiple BSSID set should also be considered.	change to "The RXVECTOR parameter PARTIAL_AID in the received VHT PPDU with the RXVECTOR parameter GROUP_ID equal to 0 is different from the BSSID[39:47] of the AP to which the STA is associated and the BSSID[39:47] which is any member of the multiple BSSID set"		2017/1/9 9:42
7170	kaiying Lv	225	1 9.4.2.200	70	27	T	Y	70.27 9.4.2.200	The Wake TBTT Negotiation subfield is set to 0 in TWT elements transmitted by a responding STA and by a scheduling STA. In table 9-262k,"Description when transmitted by a TWT scheduling STA, Wake TBTT Negotiation subfield = 1", which is conflicted with the above statement.	Please change to "Description when transmitted by a TWT scheduling STA, Wake TBTT Negotiation subfield =0."		2017/1/9 9:42
7171	kaiying Lv	225	1 27.7.2	181	42	T	Y	181.42 27.7.2	One TWT SP may include multiple TWT agreements negotiated by STAs with an AP which is any member of multiple BSSID set. Therefore a trigger frame is intended for TWT requesting STAs if it is sent by the AP to which the STAs are associated or by any member of the multiple BSSID set.	Please change the text as follows "A trigger frame is intended for one or more TWT requesting STAs if it is sent by the AP to which the STAs are associated or by any member of the multiple BSSID set. "		2017/1/9 9:42
7172	kaiying Lv	225	1 27.9.2.1	190	37	T	Y	190.37 27.9.2.1	When OBSS_PD based SR conditions are not met if the PPDU is HE SU PPDU or HE extended range SU PPDU and the RXVECTOR parameter SPATIAL_REUSE indicates SR_Delay, the STA determines that the PPDU carries a trigger frame and may continue to receive the trigger frame and obtain the values of Spatial reuses fields of Common Info field in the trigger frame to determine whether SRP-based spatial reuse conditions are met or not.	Please clarify it		2017/1/9 9:42
7173	kaiying Lv	225	1 27.9.2.1	190	42	T	Y	190.42 27.9.2.1	When OBSS_PD based SR conditions are not met if the PPDU is HE MU PPDU and the RXVECTOR parameter SPATIAL_REUSE indicates SR_Restricted, the STA determines that the PPDU carries a trigger frame and may continue to receive the trigger frame and obtain the values of Spatial reuses fields of Common Info field in the trigger frame to determine whether SRP-based spatial reuse conditions are met or not.	Please clarify it		2017/1/9 9:42
7174	kaiying Lv	225	1 27.9	190	1	T	Y	190.01 27.9	SRP-based spatial reuse operation needs to be described in details.	Please clarify it		2017/1/9 9:42

7175 kaiying Lv	225	1 27.5.2.2.1	165	35	T	Y	165.35 27.5.2.2.1	The start of the Padding subfield is identified by a User Info field that has a value of the AID equal to 0XFFF,not 2047	Change "2047" to "0XFFF"	2017/1/9 9:42
7176 kaiying Lv	225	1 27.5.2.2.2	166	5	T	Y	166.05 27.5.2.2.2	"destination AP" is confusing. Need to be clarified.	Change "destination AP" to "associated AP"	2017/1/9 9:42
7177 kaiying Lv	225	1 27.5.2.2.2	165	51	T	Y	165.51 27.5.2.2.2	It is not clear to say "STAs that intend to communicate with at least two different BSSs of the multiple BSSID set "?	Change to "The MAC address of the transmitted BSSID when dot11MultiBSSIDActivated is true and the Trigger frame is directed to STAs from at least two different BSSs of the multiple BSSID set"	2017/1/9 9:42
7178 kaiying Lv	225	1 27.2.3	152	11	G	Y	152.11 27.2.3	According to 9.3.1.23,there is "User Info field" in trigger frame,not "Per User Info field".There are many places use the incorrect name of this field.	Change as comment.	2017/1/9 9:42
7179 kaiying Lv	225	1 27.5.2.2.2	166	62	E	Y	166.62 27.5.2.2.2	There is no "Multi-TID Support field"field in HE MAC Capabilities Information field of the HE Capabilities element	Change "Multi-TID Support " to "Multi-TID Aggregation Support"	2017/1/9 9:42
7180 kaiying Lv	225	1 27.5.2.2.2	167	6	T	Y	167.06 27.5.2.2.2	According to P49,Line 1:"The value in the TID Aggregation Limit subfield in Trigger frame is less than or equal to the value indicated in the Multi-TID Aggregation Support field in the HE Capabilities element ". So if a STA indicates a nonzero value in the Multi-TID Aggregation Support field, AP should choose any value between 0 and the value that STA indicated in the Multi-TID Aggregation Support field.	Change as comment.	2017/1/9 9:42
7181 kaiying Lv	225	1 27.5.2.6.1	172	35	T	Y	172.35 27.5.2.6.1	Could BQRP variant Trigger frame be used to allocate RA RU? Since BQRP frame is the same as basic trigger frame╥╟Θ	Please clarify it	2017/1/9 9:42
7182 kaiying Lv	225	1 27.8.1	188	45	E	Y	188.45 27.8.1	ROMI solicits an immediate acknowledgement,while TOMI should also solicit an immediate acknowledgement	Change to"The OMI initiator shall indicate a change in its transmit operating mode by including the OMI A-Control field in a QoS Data or QoS Null frame that solicits an immediate acknowledgement frame and is addressed to the OMI responder as defined in 27.8.3 (Rules for transmit operation mode (TOM) indication)"	2017/1/9 9:42
7183 kaiying Lv	225	1 27.16.3	207	6	T	Y	207.06 27.16.3	Does "STA-to-STA" here has the same meaning with what is defined in 802.11-2016 "A peer-to-peer link is defined to be either a Direct Link within a QoS BSS, a TDLS, or a STA-to-STA communication in an IBSS."	Please clarify it	2017/1/9 9:42
7184 kaiying Lv	225	1 9.4.2.200	75	2	E	Y	75.02 9.4.2.200	change"TWT broadcast field"to"broadcast field"	As in comment	2017/1/9 9:42
7185 kaiying Lv	225	1 27.2.3	152	22	T	Y	152.22 27.2.3	UL MU disable operation shall be independent from switching MU/SU EDCA parameters. Otherwise, a non-AP STA may cheat to be exempt from updating its EDCA access parameters to the values contained in the MU EDCA Parameter Set element by sending the trigger-based PPDU with an OMI A-Control field containing a value of 1 in the UL MU Disable field.	Delete note 1	2017/1/9 9:42
7186 kaiying Lv	225	1 27.2.3	152	29	G	Y	152.29 27.2.3	change"HE non-AP UL MU capable STA" to" UL MU capable non-AP	Please unify it	2017/1/9 9:42
7187 kaiying Lv	225	1 27.3.3.4	154	39	E	Y	154.39 27.3.3.4	There are no definitions about the" L3 Frag BA Request frame" and " L3 Frag BA Response ".	Please change them to "L3 Frag ADDBA Request frame" and "L3 Frag ADDBA response frame"	2017/1/9 9:42
7188 kaiying Lv	225	1 27.7.2	180	44	T	Y	180.44 27.7.2	Change "otherwise it is an implicit TWT" to "otherwise it set the Trigger field to 0 to indicate it is an implicit TWT with no trigger."	As in comment	2017/1/9 9:42
7189 kaiying Lv	225	1 27.7.3.2	184	14	T	Y	184.14 27.7.3.2	Whether a TWT is implicit or not is indicated by implicit subfield in request type field. Please change "Otherwise, it shall set the Trigger field to 0 to indicate an implicit TWT." to "otherwise it shall set the Trigger field to 0 to indicate it is an implicit TWT with no trigger."	As in comment	2017/1/9 9:42
7190 kaiying Lv	225	1 27.7.3.	185	18	E	Y	185.18 27.7.3.	There is no definition about AM	Please change "AM" to "awake state"	2017/1/9 9:42
7191 kaiying Lv	225	1 9.2.4.5.6	21	2	E	Y	21.02 9.2.4.5.6	change "non-AP HE STA" to "HE non-AP STA"	As in comment	2017/1/9 9:42

7192 kaiying Lv	225	1 9.2.4.6.4.3	24	58	E	Y	24.58 9.2.4.6.4.3	add "and /or transimition" after "in reception"	As in comment	2017/1/9 9:42
7193 kaiying Lv	225	1 9.2.4.6.4.3	24	62	E	Y	24.62 9.2.4.6.4.3	add a "HE" before non-AP	As in comment	2017/1/9 9:42
7194 kaiying Lv	225	1 10.9	127	23	E	Y	127.23 10.9	Delete "receive".	As in comment	2017/1/9 9:42
7195 kaiying Lv	225	1 27.6.2	176	56	E	Y	176.56 27.6.2	There is no definition of " Received Operating Mode Indication subfield",	Please change to "OMI A-Control field"	2017/1/9 9:42
7196 kaiying Lv	225	1 27.6.2	177	26	E	Y	177.26 27.6.2	delete "notification"	As in comment	2017/1/9 9:42
7197 kaiying Lv	225	1 27.6.2	177	33	E	Y	177.33 27.6.2	delete "notification"	As in comment	2017/1/9 9:42
7198 kaiying Lv	225	1 27.8.1	188	39	E	Y	188.39 27.8.1	There is no "RX channel width subfield"	Delete "RX"	2017/1/9 9:42
7199 kaiying Lv	225	1 27.8.2	189	1	E	Y	189.01 27.8.2	delete "mode"	As in comment	2017/1/9 9:42
7200 kaiying Lv	225	1 27.8.2	189	3	E	Y	189.03 27.8.2	delete "RX"	As in comment	2017/1/9 9:42
7201 kaiying Lv	225	1 27.8.2	189	8	E	Y	189.08 27.8.2	change "After transmitting the acknowledgement frame immediate response immediate acknowledgement for" to "After transmitting the immediate acknowledgement for"	As in comment	2017/1/9 9:42
7202 kaiying Lv	225	1 27.8.3	189	29	T	Y	189.29 27.8.3	The channel bandwidth setting should be normative. Delete "note",	As in comment	2017/1/9 9:42
7203 kaiying Lv	225	1 9.4.2.219	91	51	E	Y	91.51 9.4.2.219	delete "in the"	As in comment	2017/1/9 9:42
7204 kaiying Lv	225	1 27.14.2	200	6	T	Y	200.06 27.14.2	the figure27-7 is not clear	Please re-draw it	2017/1/9 9:42
7205 kaiying Lv	225	1 9.4.1.62	57	33	E	Y	57.33 9.4.1.62	change " VHT Compressed Beamforming report" to "HE Compressed Beamforming report"	As in comment	2017/1/9 9:42
7206 kaiying Lv	225	1 9.4.1.62	57	46	T	Y	57.46 9.4.1.62	the description of the Sounding Dialog Token Number field in table 9-76a is wrong.	change it to" The sounding dialog token from the HE NDP Announcement frame soliciting feedback"	2017/1/9 9:42
7207 kaiying Lv	225	1 9.6.28.2	103	4	E	Y	103.04 9.6.28.2	change "And" to "and"	As in comment	2017/1/9 9:42
7208 kaiying Lv	225	1 9.4.2.200	71	4	T	Y	71.04 9.4.2.200	the description about " Demand TWT" is incorrect.	please clarify it	2017/1/9 9:42
7209 kaiying Lv	225	1 10.43.1	139	37	T	Y	139.37 10.43.1	The description of TWT conditions after the completion of the exchange in Table 10-19a is conflict. "An active broadcast TWT agreement is either created ...The responding STA will not create any new broadcast TWT agreement with the requester at this time"	Suggest to change to "An active broadcast TWT agreement has already exists and is using the TWT parameters identified in the response frame, including a broadcast TWT ID.The responding STA will not create any new broadcast TWT agreement with the requester at this time"	2017/1/9 9:42
7210 kaiying Lv	225	1 10.43.1	139	9	T	Y	139.09 10.43.1	The Wake TBTT Negotiation subfield is set to 0 in TWT elements transmitted by a responding STA and by a scheduling STA. In Table 10-19a, the response frame transmitted by the scheduling STA or responding STA should set Wake TBTT Negotiation subfield to 0	Suggest to change to "Accept TWT with Wake TBTT Negotiation subfield = 0 and Broadcast subfield = 1"	2017/1/9 9:42
7211 kaiying Lv	225	1 10.43.1	139	15	T	Y	139.15 10.43.1	The Wake TBTT Negotiation subfield is set to 0 in TWT elements transmitted by a responding STA and by a scheduling STA.	suggest to change to "Accept TWT with Wake TBTT Negotiation subfield = 0 and Broadcast subfield = 1"	2017/1/9 9:42
7212 kaiying Lv	225	1 10.43.1	139	22	T	Y	139.22 10.43.1	The Wake TBTT Negotiation subfield is set to 0 in TWT elements transmitted by a responding STA and by a scheduling STA. In table 10-19a, change the setting of the above field in TWT elements sent by scheduling or responding STA.	suggest to change to "Alternate TWT Wake TBTT Negotiation subfield = 0 and Broadcast subfield = 1"	2017/1/9 9:42
7213 kaiying Lv	225	1 10.43.1	140	14	T	Y	140.14 10.43.1	The Wake TBTT Negotiation subfield is set to 0 in TWT elements transmitted by a responding STA and by a scheduling STA. In table 10-19a, change the setting of the above field in TWT elements sent by scheduling or responding STA.	suggest to change to "Reject TWT with Wake TBTT Negotiation subfield = 1 and Broadcast subfield = 1"	2017/1/9 9:42
7214 kaiying Lv	225	1 10.43.1	140	23	T	Y	140.23 10.43.1	The Wake TBTT Negotiation subfield is set to 0 in TWT elements transmitted by a responding STA and by a scheduling STA. In table 10-19a, the Wake TBTT Negotiation subfield in reject TWT sent by scheduling STA should be set to 0.	suggest to change to "Reject TWT with Wake TBTT Negotiation subfield = 0 and Broadcast subfield = 1"	2017/1/9 9:42
7215 kaiying Lv	225	1 10.43.1	140	6	T	Y	140.06 10.43.1	change "TWT flow ID" to "broadcast TWT ID"	As in comment	2017/1/9 9:42
7216 Katsuo Yunoki	225	1 3.2	6	45	E	Y	6.45 3.2	It may need HE STA too for the transmitting STA.	Add "or HE STA" after VHT STA	2017/1/9 9:42
7217 Katsuo Yunoki	225	1 28.1.1	211	49	T	Y	211.49 28.1.1	UL-OFDMA is described as a mandatory feature for an HE non-AP STA here. But line 9 in page 212 seems to describe transmission of an HE MU PPDU over partial PPDU bandwidth as an option. Aren't they conflicted?	Mandatory/option of UL-OFDMA should be confirmed for an HE non-AP STA.	2017/1/9 9:42

7218 Katsuo Yunoki	225	1 28.1.1	212	9	T	Y	212.09 28.1.1	Transmission of an HE MU PPDU over partial PPDU bandwidth is described as an option for an HE non-AP STA. But line 49 in page 211 seems to describe as a mandatory feature. Aren't they conflicted?	Mandatory/option of UL-OFDMA should be confirmed for an HE non-AP STA.	2017/1/9 9:42
7219 Katsuo Yunoki	225	1 28.1.1	211	54	E	Y	211.54 28.1.1	The following sentence is not clear for me.: The maximum number of spatial streams per user the non-AP STA can receive in the DL MU-MIMO transmission shall be equal to the minimum of 4	It should be: The maximum number of spatial streams per user the non-AP STA can receive in the DL MU-MIMO transmission shall be 4	2017/1/9 9:42
7220 Katsuo Yunoki	225	1 28.3.5	249	10	E	Y	249.10 28.3.5	Connecting point of line for spatial mapping on background is wrong.	It should be corrected.	2017/1/9 9:42
7221 Katsuo Yunoki	225	1 28.3.7	256	7	G	Y	256.07 28.3.7	In the Trigger frame, HE-MCS is identified for in the User Info field. The description (line 65 in page 46) is refering to this subclause. But it isn't mentioned on Trigger frame in this subclause.	It is better to add something like the following: And also in the User Info field of Trigger frame, MCS is indicated for the HE trigger-based PPDU response for the responding STA.	2017/1/9 9:42
7222 Katsuo Yunoki	225	1 3.4	7	5	G	Y	7.05 3.4	BQRP, BSRP and RAPS should be added as abbribiations	BQRP, BSRP and RAPS should be added to Abbribiations	2017/1/9 9:42
7223 Katsuo Yunoki	225	1 9.4.2.220	93	26	E	Y	93.26 9.4.2.220	There is a spelling misstake in the Figure 9-589ct.	"Lenght" should be "Length".	2017/1/9 9:42
7224 Katsuo Yunoki	225	1 27.5.2.6.2	173	46	E	Y	173.46 27.5.2.6.2	Space between sentences is missing.	Substitute "0. If" for "0If".	2017/1/9 9:42
7225 Katsuo Yunoki	225	1 10.3.2.10.3	120	7	E	Y	120.07 10.3.2.10.3	Space between sentences is missing.	Insert " "(space) in "medium.Specifically,"	2017/1/9 9:42
7226 Katsuo Yunoki	225	1 27.5.1	162	36	T	Y	162.36 27.5.1	STA behavior after receiving MU DL PPDU should be explained. (e.g. how to respond ACK, Block ACK)	STA behavior after receiving MU DL PPDU should be explained. (e.g. how to respond ACK, Block ACK)	2017/1/9 9:42
7227 Katsuo Yunoki	225	1 27.5.2.3	167	59	G	Y	167.59 27.5.2.3	TBD is remaining.	STA behavior should be identified if it isn't associated with AP.	2017/1/9 9:42
7228 Katsuo Yunoki	225	1 3.4	7	5	G	Y	7.05 3.4	TWT should be added as abbribiation.	TWT should be added to Abbribiations	2017/1/9 9:42
7229 Kazuyuki Sakoda	225	1 27.9	190	1	T	Y	190.01 27.9	Subclause 27.9 Spatial reuse operation requires more discussion and addition of appropriate mechanisms. The aim of 802.11ax is to get higher performance in dense environment. Obviously, OBSS management is a key element to meet the goal. We are adding more than billions of new pre-HE 802.11 devices to the market per year, and need more serious consideration how to cope with non-HE OBSS issues. Also, we see non 802.11 technology in 2.4 GHz, and will probably see non 802.11 technology in 5GHz bands at the time of HE STA launch. 802.11ax spatial reuse technology shall be able to handle non-HE and non-802.11 overlapping operations in efficient way, which are missing in the D1.0.	1. Classify spatial reuse technologies into the following manner: (a) spatial reuse among non-802.11 networks, (b) spatial reuse among non-HE OBSSs, (c) spatial reuse among HE OBSSs. 2. Define adaptive CCA-ED rules as a resolution to (a). Change primary channel ED threshold for CCA to be flexible, and change supplementary channel ED threshold (mid packet detect) for CCA to be flexible. 3. Define adaptive CCA-SD rules as a resolution to (b). Change preamble detection threshold for CCA to be flexible as the currently defined minimal sensitivity is too sensitive for dense environment. Suggested text in 11-16/310r1 should be a good starting point for the rule. 4. Refine color code based CCA rules as a resolution to (c).	2017/1/9 9:42
7230 Kazuyuki Sakoda	225	1 27.9	190	1	T	Y	190.01 27.9	Transmit power control (TPC) works well to reduce OBSS interference, i.e., minimize interfere from an HE STA to others. Subclause 27.9.2.2 (Adjustment of OBSS_PD and transmit power) describes how HE STA can increase OBSS_PD level by decreasing its TX power. It is a nice incentive for STA to decrease its TX power. OBSS_PD only works with HE STAs. However, it only works with legacy STAs with limited circumstances. This means STAs cannot truely enjoy effect of 802.11ax spatial reuse until legacy BSSs and STAs are wiped out from the market. There are very large number of legacy STA installed based, and we still see large number of legacy STA (even non-VHT STA) shipment to the market.	Add new subclause under 27.9 describing spatial reuse TPC rule following the spirit of linking CCA threshold (ED-based CCA and SD-based CCA) and transmission power, as spelled out for OBSS PD.	2017/1/9 9:42

7231	Kazuyuki Sakoda	225	1 28.3.18	350	1	T	Y	350.01 28.3.18	In subclause 28.3.14.2 (Power pre-correction), sentence reads "An AP indicates in the AP Tx Power subfield of the Common Info field in Trigger frame the combined transmit power of all the transmit antennas used to transmit the Trigger frame normalized to 20 MHz bandwidth." There should be accuracy requirements for the "the combined transmit power of all the transmit antennas". However, I could not find it.	Add a suclause under 28.3.18 describing transmit power accuracy requirement for AP.	2017/1/9 9:42
7232	Kazuyuki Sakoda	225	1 27.2.1	149	46	T	Y	149.46 27.2.1	Looking through subclause 27.2.2 (updating two NAVs), there is no need to distinguish inter-BSS frame, as both inter-BSS frame and frame that cannot be identified as intra-BSS or inter-BSS are reflected to basic NAV.	Remove inter-BSS frame recognition, and clean up the description.	2017/1/9 9:42
7233	Kazuyuki Sakoda	225	1 27.2.2	151	57	T	Y	151.57 27.2.2	In subclause 27.2.2 (Updating two NAVs), a sentence reads "Maintaining two NAV is beneficial in dense deployment scenarios where a STA requires protection from frames transmitted by STAs within its BSS, i.e., intra-BSS, and avoid interference from frames transmitted by STAs in neighboring BSS, i.e., inter-BSS". I could find how to set inter-BSS NAV in D1.0. However, I could not find how the inter-BSS NAV is used to control channel access.	Add a new subclause under 27.2 describing how these 2 NAVs are used to control channel access.	2017/1/9 9:42
7234	KE YAO	225	1 28.3.10.2.1	268	2	T	Y	268.02 28.3.10.2.1	When the TXVECTOR parameter BEAM_CHANGE is 0, the cyclic shift value for the L-STF, L-LTF,L-SIG, RL-SIG, and HE-SIG-A fields should be T_{CS,HE} as specified in 28.3.10.2.2.	Change "When the TXVECTOR parameter BEAM_CHANGE is 0, the cyclic shift value for the L-STF, L-LTF, L-SIG, RL-SIG, and HE-SIG-A fields is not specified"to "When the TXVECTOR parameter BEAM_CHANGE is 0, the cyclic shift value for the L-STF, L-LTF, L-SIG, RL-SIG, and HE-SIG-A fields is T_{CS_HE} as specified in 28.3.10.2.2"	2017/1/9 9:42
7235	KE YAO	225	1 28.3.3.2	229	35	E	Y	229.35 28.3.3.2	Both "none" and "N/A" are used in table 28-2 and 28-6, though they mean the same thing.	change "none" in table 28-6 to "N/A" as in table "28-2".	2017/1/9 9:42
7236	KE YAO	225	1 28.3.10.7.2	275	34	T	Y	275.34 28.3.10.7.2	Doppler bit exits in HE-SIG-A, while how to use this bit is not specified.	A resolution to this comment will be provided.	2017/1/9 9:42
7237	KE YAO	225	1 28.3.3.5	237	57	T	Y	237.57 28.3.3.5	The supporting of 242 tones RU in secondary channels of 40/80/160/80+80 DL OFDMA implies that a 20MHz operating STA possibly needs to receive individually signaling and data over different 20MHz channels. While that's not realistic for a 20 MHz device with consideration of the very short switching time and the resulting cost.	242-tones in secondary channels shall not be allocated to 20 operating STAs in 40/80/160/80+80 DL OFDMA	2017/1/9 9:42
7238	KE YAO	225	1 28.3.3.2	232	34	T	Y	232.34 28.3.3.2	242-tone RU can be allocated to both SU and MU-MIMO, not only SU	remove 'SU'	2017/1/9 9:42
7239	KE YAO	225	1 28.3.3.2	233	26	T	Y	233.26 28.3.3.2	484-tone RU can be allocated to both SU and MU-MIMO, not only SU	remove 'SU'	2017/1/9 9:42
7240	KE YAO	225	1 28.3.3.2	234	30	T	Y	234.30 28.3.3.2	996-tone RU can be allocated to both SU and MU-MIMO, not only SU	remove 'SU'	2017/1/9 9:42
7241	KE YAO	225	1 28.3.9	264	3	E	Y	264.03 28.3.9	change SR in 'NSR' into subscript	as in comment	2017/1/9 9:42
7242	KE YAO	225	1 28.3.10.7.2	273	48	T	Y	273.48 28.3.10.7.2	rename right 106-tone RU to high 106-tone RU	refer to comment	2017/1/9 9:42
7243	KE YAO	225	1 28.3.10.7.2	274	26	T	Y	274.26 28.3.10.7.2	rename right 106-tone RU to high 106-tone RU	refer to comment	2017/1/9 9:42
7244	Kentaro Taniguchi	225	1 28.5	375	9	T	Y	375.09 28.5	The N_DBPS value for MCS0 should be N_CBPS x R = 96 x (1/2) = 48.	Change the N_DBPS value "24" to "48" in Tables 28-50.	2017/1/9 9:42
7245	Kentaro Taniguchi	225	1 28.5	382	55	T	Y	382.55 28.5	The N_DBPS value for MCS6 should be N_CBPS x R = 1836 x (3/4) = 1377.	Change the N_DBPS value "1337" to "1377" in Tables 28-65.	2017/1/9 9:42
7246	Kentaro Taniguchi	225	1 28.5	382	61	T	Y	382.61 28.5	The N_DBPS value for MCS9 should be N_CBPS x R = 2448 x (5/6) = 2040.	Change the N_DBPS value "2048" to "2040" in Tables 28-65.	2017/1/9 9:42
7247	Kiseon Ryu	225	1 27.8.2	189	1	T	Y	189.01 27.8.2	The text "If an OMI mode change is reported during a TXOP then the change should occur at least after that TXOP." is not clear whether OMI mode is changed right after the TXOP or later.	Delete "at least".	2017/1/9 9:42

7248	Kiseon Ryu	225	1 21.3.18.5.2	148	1	T	Y	148.01 21.3.18.5.2	For UL MU transmission, CCA-ED should be conducted not only for the primary 20MHz channel and secondary 20MHz/40MHz/80MHz channel but also for the non-primary 20MHz channel.	Add the following text: 21.3.18.5.2 CCA sensitivity for operating classes requiring CCA-ED Change as follows: CCA-ED shall detect a channel busy condition when the received signal strength exceeds the CCA-ED threshold as given by dot11OFDMEDThreshold for the primary 20 MHz channel, dot11OFDMEDThreshold for the secondary 20 MHz channel (if present), dot11OFDMEDThreshold + 3 dB for the secondary 40 MHz channel (if present), and dot11OFDMEDThreshold + 6 dB for the secondary 80 MHz channel (if present). The CCA-ED thresholds for the operating classes requiring CCA-ED are subject to the criteria in D.2.5. For UL MU transmission in response to a Trigger frame, CCA-ED shall detect a channel busy condition when the received signal strength	2017/1/9 9:42
7249	Kiseon Ryu	225	1 9.2.4.6.4.3	24	58	T	Y	24.58 9.2.4.6.4.3	Channel Width subfield in Operating Mode A-Control field indicates the channel width of the STA not only for ROM but also for TOM.	Modify the text as below: The Channel Width subfield indicates the operating channel width supported by the STA in transmission and reception, and is set to 0 for 20 MHz, 1 for 40 MHz, 2 for 80 MHz, and 3 for 160 MHz and 80+80 MHz.	2017/1/9 9:42
7250	Kiseon Ryu	225	1 27.5.2.5	172	10	T	Y	172.10 27.5.2.5	When a STA sends a QoS Null frame for BSR in random RU, it needs to confirm that the frame is successfully received at the AP. If it fails, the STA may perfom the retransmission procedure for random access.	Modify the text as below: An AP can also solicit one or more non-AP STAs for their BSR(s) by sending a BSRP variant Trigger frame (see 9.3.1.23 (Trigger frame format)). The non-AP STA responds (solicited BSR) as defined below: ... - The STA shall include in the HE trigger-based PPDU one or more QoS Null frames containing one or more of the following: ... - The HE STA shall not solicit an immediate response for the frames carried in the HE trigger-based PPDU (e.g., by setting the Ack Policy subfield of the frame to Normal Ack or Implicit BAR) except that it sends one or more QoS Null frames in the HE trigger-based PPDU in a random RU.	2017/1/9 9:42
7251	Kiseon Ryu	225	1 27.10.4	195	4	T	Y	195.04 27.10.4	Based on the multi-TID A-MPDU aggregation rule, a STA may not report the buffer status information for lower priority AC in an A-MPDU. QoS Null frame with BSR information should be able to be aggregated in a multi-TID A-MPDU regardless of AC priority.	As in the comment	2017/1/9 9:42
7252	Kiseon Ryu	225	1 27.5.2.2.2	166	56	T	Y	166.56 27.5.2.2.2	QoS Data frame or QoS Null frame with Ack Policy 'No Ack' can be aggregated regardless of the TID Aggregation Limit	As in the comment	2017/1/9 9:42
7253	Kiseon Ryu	225	1 10.9	127	47	T	Y	127.47 10.9	HE A-Control field can be present in the QoS Null frame.	Modify the text as below: At most one Control subfield with a given Control ID value shall be present in the A-Control field of QoS Data frame, QoS Null frame, or Management frames carried in an (A-)MPDU	2017/1/9 9:42
7254	Kiseon Ryu	225	1 27.5.2.6.2	173	64	T	Y	173.64 27.5.2.6.2	Acknowledgment procedure in response to the OFDMA random access request from unassociated STAs needs to be specified.	As in the comment	2017/1/9 9:42

7255 Kiseon Ryu	225	1 9.3.1.23.1	49	11	T	Y	49.11 9.3.1.23.1	It's not clear how to construct an A-MPDU in the HE trigger-based PPDU when the Multi-TID Aggregation Support field of the HE Capabilities element is set to 0. For that case, MPDU aggregation in an A-MPDU according to the Preferred AC subfield in the Basic Trigger frame should be clarified.	Modify the text as below: The Preferred AC subfield indicates the AC that is recommended for aggregation of MPDUs of ACs belonging to the same AC as indicated or higher priority AC(s) within a multi-TID A-MPDU sent as a response to the Trigger frame (see 9.3.1.23 (Trigger frame format)). The encoding of the Preferred AC subfield is shown in Table 9-25i (Preferred AC subfield encoding). If the TID Aggregation Limit subfield is set to 1, the MPDUs with a TID belonging to the same AC as indicated in the Preferred AC subfield should be aggregated in the A-MPDU. If the TID Aggregation Limit subfield is set to 1 and there is no MPDU with a TID belonging to the same AC as indicated in the Preferred AC subfield, MPDUs with a TID belonging to the higher priority AC may be aggregated in the A-MPDU.	2017/1/9 9:42
7256 Kwok Shum Au	225	1 9.3.1.23	46	29	E	N	46.29 9.3.1.23	The description "BW bits" is not precise.	Replace "depends on the BW bits" with "depends on the BW subfield".	2017/1/9 9:42
7257 Kwok Shum Au	225	1 9.3.1.23	47	4	E	N	47.04 9.3.1.23	The proposition between "A value" and "0" is missing.	Replace "A value 0" with "A value of 0".	2017/1/9 9:42
7258 Kwok Shum Au	225	1 9.3.1.23	47	5	E	N	47.05 9.3.1.23	There is a grammatical mistake for "is not be used".	Replace "is not be used" with "is not used".	2017/1/9 9:42
7259 Kwok Shum Au	225	1 9.3.1.23	47	35	T	Y	47.35 9.3.1.23	For the description "Values 0 to 90 maps to -100 dBm to -20 dBm", it means that there are 92 values mapping to 81 target RSSI levels. Given the resolution for the Targer RSSI subfield is 1 dB, this mapping is not correct.	Please fix the mapping by adjusting the target RSSI levels correctly.	2017/1/9 9:42
7260 Kwok Shum Au	225	1 9.3.1.23	47	47	E	N	47.47 9.3.1.23	The description "the rest bits" is not clear.	Replace "the rest bits" with "the remaining bits".	2017/1/9 9:42
7261 Kwok Shum Au	225	1 9.3.1.23	47	55	T	Y	47.55 9.3.1.23	The variable "N_{DBPS}" is not defined.	In line 60, insert the following: "N_{DBPS} is defined in Table 28-12".	2017/1/9 9:42
7262 Kwok Shum Au	225	1 9.3.1.23	47	61	E	N	47.61 9.3.1.23	Capitalization is not needed for "TF MAC Padding Duration".	In 47.61, 47.63, 47.65, 48.10, 48.12, and 48.14, replace "TF MAC Padding Duration" with "TF MAC padding duration".	2017/1/9 9:42
7263 Kwok Shum Au	225	1 9.3.1.23	48	4	T	Y	48.04 9.3.1.23	The variable "N_{DBPS,SHORT}" is not defined.	In line 10, insert the following: "N_{DBPS,SHORT} is defined in equation (28-61)".	2017/1/9 9:42
7264 Kwok Shum Au	225	1 9.3.1.23	48	17	E	N	48.17 9.3.1.23	Capitalization is not needed for "Frame".	Replace "Trigger Frame transmission" with "Trigger frame transmission".	2017/1/9 9:42
7265 Kwok Shum Au	225	1 9.3.1.23.1	48	41	G	Y	48.41 9.3.1.23.1	There is no Table 8-159.	Replace Table 8-159 with Table 9-163 (Subfields of the A-MPDU Parameters field).	2017/1/9 9:42
7266 Kwok Shum Au	225	1 9.3.1.23.2	49	54	E	N	49.54 9.3.1.23.2	The description is about a feedback report rather than a feedback report field.	In 49.54, 57.51 and 59.22, replace "HE Compressed Beamforming report" with "HE compressed beamforming report".	2017/1/9 9:42
7267 Kwok Shum Au	225	1 9.3.1.23.4	50	28	G	Y	50.28 9.3.1.23.4	The description about the TA field is not a note. It should be a main text.	Change the note to main text for the sentence "The TA field value is the address of the STA transmitting the MU-RTS frame".	2017/1/9 9:42
7268 Kwok Shum Au	225	1 9.3.1.23.4	50	40	E	N	50.40 9.3.1.23.4	The correct subfield name is "MU-MIMO LTF Mode" rather than "MU MIMO LTF Mode".	Replace "MU MIMO LTF Mode" with "MU-MIMO LTF Mode".	2017/1/9 9:42
7269 Kwok Shum Au	225	1 9.3.1.23.4	50	40	E	N	50.40 9.3.1.23.4	The correct subfield name is "Number Of HE-LTF Symbols" rather than "Number of LTF".	Replace "Number of LTFs" with "Number Of HE-LTF Symbols".	2017/1/9 9:42
7270 Kwok Shum Au	225	1 9.3.1.23.4	50	41	E	N	50.41 9.3.1.23.4	The description is about the subfields of the Common Info field.	Replace "fields are reserved" with "subfields are reserved".	2017/1/9 9:42
7271 Kwok Shum Au	225	1 9.3.1.23.4	50	41	T	Y	50.41 9.3.1.23.4	In the Common Info field, there is a Doppler subfield. There is no description here on wheher the Doppler field is reserved or set to a particular value.	Add the description about the Doppler subfield.	2017/1/9 9:42
7272 Kwok Shum Au	225	1 9.3.1.23.4	50	43	G	Y	50.43 9.3.1.23.4	The description about the Trigger Dependent Common Info field is not a note. It should be a main text.	Change the note to main text for the sentence "The Trigger Dependent Common Info field is not present in the MU-RTS frame".	2017/1/9 9:42
7273 Kwok Shum Au	225	1 9.3.1.23.4	50	57	T	Y	50.57 9.3.1.23.4	The description "primary 20 MHz/40 MHz/80 MHz" is not clear.	Replace "primary 20 MHz/40 MHz/80 MHz" with "primary 20 MHz, 40 MHz and 80 MHz channels".	2017/1/9 9:42
7274 Kwok Shum Au	225	1 9.3.1.23.4	51	12	T	Y	51.12 9.3.1.23.4	There is no "Bandwidth field" in the User Info field.	Replace "Bandwidth field" with "BW subfield".	2017/1/9 9:42
7275 Kwok Shum Au	225	1 9.3.1.23.4	51	15	G	Y	51.15 9.3.1.23.4	The description about the Trigger Dependent User Info field is not a note. It should be a main text.	Change the note to main text for the sentence "The Trigger Dependent User Info field is not present in the MU-RTS frame".	2017/1/9 9:42

7276	Kwok Shum Au	225	1 9.3.3.1	52	43	E	N	52.43 9.3.3.1	Hyphen is not needed for "present".	In 52.43, 53,36, 54.30, and 55.26, replace "pre-sent" with "present".	2017/1/9 9:42
7277	Kwok Shum Au	225	1 9.3.3.6	53	24	T	Y	53.24 9.3.3.6	There is no "TWT Requester Supported field".	In 53.24 and 54.18, replace "TWT Requester Supported field" with "TWT Requester Support field".	2017/1/9 9:42
7278	Kwok Shum Au	225	1 3.2	4	39	E	N	4.39 3.2	There is no "HE (HE) STA".	Replace "HE (HE) STA" with "HE STA".	2017/1/9 9:42
7279	Kwok Shum Au	225	1 3.2	4	53	E	N	4.53 3.2	Replace "One of the following:" with "One of the following PPDUs" for the sake of consistency with other termins in this subclause.	In 4.53 and 5.29, replace "One of the following:" with "One of the following PPDUs".	2017/1/9 9:42
7280	Kwok Shum Au	225	1 3.2	5	9	E	N	5.09 3.2	There is a duplicate "f)" at the beginning of the sentence.	Delete "f)" before "An 80 MHz ...".	2017/1/9 9:42
7281	Kwok Shum Au	225	1 3.2	5	9	E	N	5.09 3.2	The abbreviation VHT is already defined in item a).	Replace "An 80 MHz very high throughput (VHT) PPDU" with "An 80 MHz VHT PPDU".	2017/1/9 9:42
7282	Kwok Shum Au	225	1 3.2	5	13	E	N	5.13 3.2	There is a duplicate "g)" at the beginning of the sentence.	Delete "g)" before "An 80 MHz ...".	2017/1/9 9:42
7283	Kwok Shum Au	225	1 3.2	5	13	E	N	5.13 3.2	The abbreviation non-HT is already defined in item b).	Replace "An 80 MHz non-high throughput (non-HT) duplicate" with "An 80 MHz non-HT duplicate".	2017/1/9 9:42
7284	Kwok Shum Au	225	1 3.2	5	54	E	N	5.54 3.2	The abbreviation VHT is already defined in item a).	Replace "A 160 MHz very high throughput (VHT) PPDU" with "A 160 MHz VHT PPDU".	2017/1/9 9:42
7285	Kwok Shum Au	225	1 3.2	5	58	E	N	5.58 3.2	The abbreviation non-HT is already defined in item b).	Replace "A 160 MHz non-high throughput (non-HT) duplicate" with "A 160 MHz non-HT duplicate".	2017/1/9 9:42
7286	Kwok Shum Au	225	1 3.2	6	3	E	N	6.03 3.2	The opening and closing brackets are not needed.	Replace "(TXVECTOR parameter CH_BANDWIDTH equal to CBW160)" with "TXVECTOR parameter CH_BANDWIDTH equal to CBW160".	2017/1/9 9:42
7287	Kwok Shum Au	225	1 3.2	6	37	E	N	6.37 3.2	The opening and closing brackets are not needed.	Replace "(TXVECTOR parameter CH_BANDWIDTH equal to CBW80+80)" with "TXVECTOR parameter CH_BANDWIDTH equal to CBW80+80".	2017/1/9 9:42
7288	Kwok Shum Au	225	1 3.2	6	50	G	Y	6.50 3.2	The abbrevation HE stands for high efficiency, not high efficient.	Replace "high efficient (HE) dual beacon" with "high efficiency (HE) dual beacon".	2017/1/9 9:42
7289	Kwok Shum Au	225	1 3.2	6	56	E	N	6.56 3.2	The abbreviation RU is not defined in this definition yet.	Replace "242-tone RU" with "242-tone resource unit (RU)".	2017/1/9 9:42
7290	Kwok Shum Au	225	1 4.3.14a	9	21	T	Y	9.21 4.3.14a	Chapter 4 provides a general description of the wireless system.. It should be written in a declarative but not normative language. Thus, "shall" should not be appeared in the sentence.	Replace "An HE non-AP STA shall support operation in 20 MHz channel bandwidth only" with "Mandatory support for operation in 20 MHz channel bandwidth only by an HE non-AP STA".	2017/1/9 9:42
7291	Kwok Shum Au	225	1 4.3.14a	9	26	T	Y	9.26 4.3.14a	Chapter 4 provides a general description of the wireless system.. It should be written in a declarative but not normative language. Thus, "shall" should not be appeared in the sentence.	Replace "An HE non-AP STA shall support operation in 20 MHz channel bandwidth only" with "Mandatory support for operation in 20 MHz channel bandwidth only by an HE non-AP STA".	2017/1/9 9:42
7292	Kwok Shum Au	225	1 4.3.14a	9	51	E	N	9.51 4.3.14a	The fullstop is not needed.	Delete the fullstop.	2017/1/9 9:42
7293	Kwok Shum Au	225	1 4.3.14a	9	65	T	Y	9.65 4.3.14a	Chapter 4 provides a general description of the wireless system.. It should be written in a declarative but not normative language. Thus, "may" should not be appeared in the sentence.	Replace "may be set" with "is allowed to set".	2017/1/9 9:42
7294	Kwok Shum Au	225	1 6.3.3.3.2	11	41	T	Y	11.41 6.3.3.3.2	Is the service primitive "HE Operation" always present?	If "HE Operation" is not present, replace "The parameter is present if dot11HEOptionImplemented is true" with "The parameter is present if dot11HEOptionImplemented is true; otherwise, this parameter is not present".	2017/1/9 9:42
7295	Kwok Shum Au	225	1 8.3.5.2.2	15	35	E	N	15.35 8.3.5.2.2	The closing bracket is missing.	Replace "(obtained from ... parameters is present" with "(obtained from ... parameters) is present".	2017/1/9 9:42
7296	Kwok Shum Au	225	1 8.3.5.12.2	16	43	T	Y	16.43 8.3.5.12.2	Is the sentence "Indicates that the secondary 40 MHz channel is busy according to the rules specified in 21.3.18.5.4" applied to HE STA too?	If no, then change the sentence to "In a VHT STA, indicates that the secondary 40 MHz channel is busy according to the rules specified in 21.3.18.5.4".	2017/1/9 9:42
7297	Kwok Shum Au	225	1 8.3.5.12.2	16	53	T	Y	16.53 8.3.5.12.2	Is the sentence "Indicates that the secondary 80 MHz channel is busy according to the rules specified in 21.3.18.5.4" applied to HE STA too?	If no, then change the sentence to "In a VHT STA, indicates that the secondary 80 MHz channel is busy according to the rules specified in 21.3.18.5.4".	2017/1/9 9:42
7298	Kwok Shum Au	225	1 9.4.2.1.8	19	41	T	Y	19.41 9.4.2.1.8	The description "in the QoS Info field of frames it transmits" is not clear.	Replace "in the QoS Info field of frames it transmits" with "in the QoS Capability element it transmits".	2017/1/9 9:42
7299	Kwok Shum Au	225	1 9.2.4.5.4	20	46	E	N	20.46 9.2.4.5.4	The capitalization for "Trigger-based" is not needed.	Replace "an HE Trigger-based PPDU" with "an HE trigger-based PPDU".	2017/1/9 9:42

7300 Kwok Shum Au	225	1 9.2.4.6.4.2	23	60	E	N	23.60 9.2.4.6.4.2	The proposition between "the number of OFDM symbols" and "the Data field" is missing.	Replace "the number of OFDM symbols the Data field" with "the number of OFDM symbols in the Data field".	2017/1/9 9:42
7301 Kwok Shum Au	225	1 9.2.4.6.4.2	24	24	E	N	24.24 9.2.4.6.4.2	The meaning of "cannot" and "can not" can be different.	Replace "can not" with "cannot".	2017/1/9 9:42
7302 Kwok Shum Au	225	1 9.2.4.6.4.5	26	15	T	Y	26.15 9.2.4.6.4.5	There is no "AC Bitmap subfield".	In 26.15 and 26.41, replace "AC Bitmap subfield" with "ACI bitmap subfield".	2017/1/9 9:42
7303 Kwok Shum Au	225	1 9.2.4.6.4.5	26	40	T	Y	26.40 9.2.4.6.4.5	The symbol F_{Val} is defined as the value of the DL TX Power subfield in subclause 9.2.4.6.4.2.	Replace F_{Val} with another symbol to avoid double definition.	2017/1/9 9:42
7304 Kwok Shum Au	225	1 9.2.4.6.4.5	27	2	E	N	27.02 9.2.4.6.4.5	SF is a variable.	Italicize SF.	2017/1/9 9:42
7305 Kwok Shum Au	225	1 9.2.4.6.4.5	27	12	G	Y	27.12 9.2.4.6.4.5	The reference to subclause 10.9 is not appropriate.	Replace subclause 10.9 with subclause 10.13.1.	2017/1/9 9:42
7306 Kwok Shum Au	225	1 9.2.4.6.4.6	27	19	E	N	27.19 9.2.4.6.4.6	The closing bracket is missing.	Replace "(see 26.3.13.2 (Power pre-correction)" with "(see 26.3.13.2 (Power pre-correction))".	2017/1/9 9:42
7307 Kwok Shum Au	225	1 9.2.4.6.4.7	27	45	E	N	27.45 9.2.4.6.4.7	The capitalization for "Bandwidth Query Report" and "Bandwidth Query report" are not needed.	Replace "contains the Bandwidth Query Report used for Bandwidth Query report operation" with "contains the bandwidth query report used for bandwidth query report operation".	2017/1/9 9:42
7308 Kwok Shum Au	225	1 9.2.4.6.4.7	27	64	E	N	27.64 9.2.4.6.4.7	The sentence is redundant because it is already covered in lines 45-47.	Delete the sentence in lines 64-65.	2017/1/9 9:42
7309 Kwok Shum Au	225	1 9.3.1.9.1	34	10	G	Y	34.10 9.3.1.9.1	There are 7 reserved bits. In the figure, the starting bit of the Reserved field is not correct.	Replace "B6" with "B5".	2017/1/9 9:42
7310 Kwok Shum Au	225	1 9.3.1.9.3	36	28	E	N	36.28 9.3.1.9.3	The term "octets" is not needed in lines 28, 32, 36 and 40 because it is already indicated in line 26 that the unit of Block Ack Bitmap subfield length is octets.	Delete "octets" in lines 28, 32, 36 and 40.	2017/1/9 9:42
7311 Kwok Shum Au	225	1 9.3.1.9.7	38	33	T	Y	38.33 9.3.1.9.7	The description is about MU-BAR frame rather than BAR frame.	Replace "BAR frame" with "MU-BAR frame".	2017/1/9 9:42
7312 Kwok Shum Au	225	1 9.3.1.9.7	38	54	T	Y	38.54 9.3.1.9.7	The description here is about Block Ack Bitmap rather than N/A.	Replace "N/A" with "Block Ack Bitmap".	2017/1/9 9:42
7313 Kwok Shum Au	225	1 9.3.1.9.7	39	14	E	N	39.14 9.3.1.9.7	The term "octets" is not needed in lines 14, 16, 18, 20, 21, 23, 25, and 27 because it is already indicated in line 26 that the unit of Block Ack Bitmap subfield length is octets.	Delete "octets" in lines 14, 16, 18, 20, 21, 23, 25, and 27.	2017/1/9 9:42
7314 Kwok Shum Au	225	1 9.3.1.9.7	39	36	T	Y	39.36 9.3.1.9.7	For the paragraph in lines 36-46, there is no description that the Block Ack Bitmap subfield is used to indicate the receive status of up to 64, 128, 256, and 32 MSDUs and A-MSDUs.	Add description that the Block Ack Bitmap subfield is used to indicate the receive status of up to 64, 128, 256, and 32 MSDUs and A-MSDUs.	2017/1/9 9:42
7315 Kwok Shum Au	225	1 9.3.1.20	40	7	E	N	40.07 9.3.1.20	There are mutliple STA Info fields in Figure 9-51a.	Replace "multiple STA info field" with "multiple STA info fields".	2017/1/9 9:42
7316 Kwok Shum Au	225	1 9.3.1.20	41	8	E	N	41.08 9.3.1.20	There is no "Feedback Type + Ng" subfield".	Replace "Feedback Type + Ng + codebook size" with "Feedback type and Ng + codebook size".	2017/1/9 9:42
7317 Kwok Shum Au	225	1 9.3.1.20	41	19	E	N	41.19 9.3.1.20	What is "MU+Ng4"? In the previous 4 entries for 000, 001, 010 and 011, comma rather than plus sign is used. Please be consistent!	In line 19, replace "MU+Ng4" with "MU, Ng4". In line 21, replace "MU+Ng4" with "MU, Ng4". In line 25, replace "MU+Ng16" with "MU, Ng16".	2017/1/9 9:42
7318 Kwok Shum Au	225	1 9.3.1.20	41	28	E	N	41.28 9.3.1.20	The meaning of "it's" and "its" are different.	Replace "it's AID" with "its AID".	2017/1/9 9:42
7319 Kwok Shum Au	225	1 9.3.1.20	41	29	E	N	41.29 9.3.1.20	HE STA STA Info is a subfield.	Replace "HE STA Info" with "HE STA Info subfield".	2017/1/9 9:42
7320 Kwok Shum Au	225	1 9.3.1.23	41	47	E	N	41.47 9.3.1.23	Why is there an opening and a closing bracket for the RA field in Figure 9-52c?	Replace "(RA)" with "RA".	2017/1/9 9:42
7321 Kwok Shum Au	225	1 9.3.1.23	41	59	E	N	41.59 9.3.1.23	Missing space at the beginning of a sentence.	In 41.59, replace "recipient STA.If the" with "recipient STA. If the". In 41.61, replace "broadcast address.If the" with "broadcast address. If the". In 69.59, replace "otherwise.When" with "otherwise. When".	2017/1/9 9:42
7322 Kwok Shum Au	225	1 9.3.1.23	42	7	E	N	42.07 9.3.1.23	Missing space for the name of the GI And LTF Type field.	Replace "GIAnd" with "GI And".	2017/1/9 9:42
7323 Kwok Shum Au	225	1 9.3.1.23	42	28	E	N	42.28 9.3.1.23	Trigger Dependent Common Info is a subfield of the Common Info field, rather than a field.	In lines 42.28, 48.23, 49.35, 49.63, 50.43, 51.24, 51.33, and 51.65, replace "Trigger Dependent Common Info field" with "Trigger Dependent Common Info subfield".	2017/1/9 9:42
7324 Kwok Shum Au	225	1 9.3.1.23	42	28	E	N	42.28 9.3.1.23	Trigger Dependent User info is a subfield of the User Info field, rather than a field.	In lines 42.28, 48.24, 48.36, 49.36, 49.49, 49.64, 50.7, 51.15, 51.28, 51.35, 51.45, and 52.2, replace "Trigger Dependent User Info field" with "Trigger Dependent User Info subfield".	2017/1/9 9:42
7325 Kwok Shum Au	225	1 9.3.1.23	43	52	E	N	43.52 9.3.1.23	Capitalization is not needed for the word "Single Stream".	In 43.52, replace "Single" with "single". In 44.1, replace "Stream" with "stream".	2017/1/9 9:42

7326	Kwok Shum Au	225	1 9.3.1.23	44	26	E	N	44.26 9.3.1.23	The description is about the number of HE-LTF symbols rather than a field. Thus, the capitalization is not needed.	Replace "the Number of HE-LTF Symbols" with "the number of HE-LTF symbols".	2017/1/9 9:42
7327	Kwok Shum Au	225	1 9.3.1.23	45	6	E	N	45.06 9.3.1.23	A space is required between a value and its unit.	Replace "2.4GHz" with "2.4 GHz".	2017/1/9 9:42
7328	Kwok Shum Au	225	1 9.3.1.23	45	8	E	N	45.08 9.3.1.23	A noun is missing for "same value".	Replace "set to same value" with "set to the same value".	2017/1/9 9:42
7329	Kwok Shum Au	225	1 9.3.1.23	45	37	T	Y	45.37 9.3.1.23	For the sentence "User Info fields with AID = 0 shall be allocated only after User Info fields with AID not equals to 0 ...", are you referring to the value of the AID12 subfield? It is not clear,	Replace "User Info fields with AID = 0 shall be allocated only after User Info fields with AID not equals to 0 ..." with "User Info fields with zero AID12 subfield shall be allocated only after User Info fields with nonzero AID12 subfield ...".	2017/1/9 9:42
7330	Kwok Shum Au	225	1 9.3.3.6	53	24	E	N	53.24 9.3.3.6	"element" is missing for "HE Capabilities".	In 53.24 and 54.18, replace "HE Capabilities" with "HE Capabilities element".	2017/1/9 9:42
7331	Kwok Shum Au	225	1 9.3.3.6	53	26	E	N	53.26 9.3.3.6	The description is about the value of the TWT Requester Supported field and therefore, it is a number rather than a text.	In 53.26 and 54.20, replace "one" with "1".	2017/1/9 9:42
7332	Kwok Shum Au	225	1 9.3.3.8	54	19	T	Y	54.19 9.3.3.8	The description is about Reassociation Response frame, rather than Association Response frame.	Replace "Association Response frame" with "Reassociation Response frame".	2017/1/9 9:42
7333	Kwok Shum Au	225	1 9.3.3.11	55	18	T	Y	55.18 9.3.3.11	Why is "dot11HEOptionImplemented" required for the TWT element to be optionally present in Probe Response frame?	Delete "and dot11HEOptionImplemented is true".	2017/1/9 9:42
7334	Kwok Shum Au	225	1 9.4.1.62	56	3	T	Y	56.03 9.4.1.62	There is no HE Compressed Beamforming frame.	Replace "HE Compressed Beamforming frame" with "HE Compressed Beamforming And CQI frame".	2017/1/9 9:42
7335	Kwok Shum Au	225	1 9.4.1.62	57	5	E	N	57.05 9.4.1.62	"Feedback Type" is subfield.	In lines 5 and 8, replace "Feedback Type" with "Feedback Type subfield".	2017/1/9 9:42
7336	Kwok Shum Au	225	1 9.4.1.62	57	29	E	N	57.29 9.4.1.62	"Remaining Feedback Segments" is a subfield.	Replace "the field is set to" with "the subfield is set to".	2017/1/9 9:42
7337	Kwok Shum Au	225	1 9.4.1.62	57	37	E	N	57.37 9.4.1.62	"First Feedback Segment" is a subfield.	Replace "the field is set to" with "the subfield is set to".	2017/1/9 9:42
7338	Kwok Shum Au	225	1 9.4.1.62	57	47	T	Y	57.47 9.4.1.62	The description about the Sounding Dialog Token Number subfield is not correct. How is it related to the ending RU index?	Provide the correct description for the Sounding Dialog Token Number subfield.	2017/1/9 9:42
7339	Kwok Shum Au	225	1 9.4.1.62	57	52	T	Y	57.52 9.4.1.62	There is no "Channel Width" subfield in the HE MIMO Control field.	Replace "Channel Width" with "BW".	2017/1/9 9:42
7340	Kwok Shum Au	225	1 9.4.1.63	58	4	E	N	58.04 9.4.1.63	The description is about the feedback but not the field.	In 58.4, 58.6, 63.65, 64.2 and 65.12, replace "HE Compressed Beamforming and CQI feedback" with "HE compressed beamforming and CQI feedback".	2017/1/9 9:42
7341	Kwok Shum Au	225	1 9.4.1.63	58	7	E	N	58.07 9.4.1.63	"Feedback Type" is subfield.	In 58.7, 64.3 and 65.15, replace "the Feedback Type field" with "the Feedback Type subfield".	2017/1/9 9:42
7342	Kwok Shum Au	225	1 9.4.1.63	58	14	E	N	58.14 9.4.1.63	For the sentence "The explaination on how these angles are generated from the beamforming feedback matrix V is given in 19.3.12.3.6 in Table 9-67, Nc is ...", it looks strange because subclause 19.3.12.3.6 is not in Table 9-67 and there is a missing linkage between the two protions of the sentence.	Replace "The explaination on how these angles are generated from the beamforming feedback matrix V is given in 19.3.12.3.6 in Table 9-67, Nc is ..." with "The explaination on how these angles are generated from the beamforming feedback matrix V is given in 19.3.12.3.6, where Nc is ..."	2017/1/9 9:42
7343	Kwok Shum Au	225	1 9.4.1.63	58	18	E	N	58.18 9.4.1.63	"Nc index" is a subfield.	Replace "Nc Index field" with "Nc Index subfield".	2017/1/9 9:42
7344	Kwok Shum Au	225	1 9.4.1.63	58	19	E	N	58.19 9.4.1.63	"Nr index" is a subfield.	Replace "Nr Index field" with "Nr Index subfield".	2017/1/9 9:42
7345	Kwok Shum Au	225	1 9.4.1.63	58	28	G	Y	58.28 9.4.1.63	There is no equation (8-1).	Replace (8-1) with (9-1).	2017/1/9 9:42
7346	Kwok Shum Au	225	1 9.4.1.63	58	40	G	Y	58.40 9.4.1.63	Is "HE Compressed Beamforming Report information" a field? If so, rename it accordingly.	Rename "HE Compressed Beamforming Report information" as "HE Compressed Beamforming Report Information field" or "HE Compressed Beamforming Report field", and then do the global change.	2017/1/9 9:42
7347	Kwok Shum Au	225	1 9.4.1.63	59	21	E	N	59.21 9.4.1.63	The description is about the feedback matrix, rather than a field.	Replace "a single Compressed Beamforming Feedback Matrix" with "a single compressed beamforming feedback matrix".	2017/1/9 9:42
7348	Kwok Shum Au	225	1 9.4.1.63	63	32	E	N	63.32 9.4.1.63	Missing a noun.	Replace "For HE beamformee" with "For an HE beamformee".	2017/1/9 9:42
7349	Kwok Shum Au	225	1 9.4.1.64	63	54	T	Y	63.54 9.4.1.64	The name of the field is not correct.	Replace "MU Exclusive Beamforming Report field" with "HE MU Exclusive Beamforming Report field".	2017/1/9 9:42
7350	Kwok Shum Au	225	1 9.4.1.64	64	15	E	N	64.15 9.4.1.64	There is more than one subfield.	Replace "subfield" with "subfields".	2017/1/9 9:42

7351 Kwok Shum Au	225	1 9.4.1.64	64	20	E	N	64.20 9.4.1.64	Missing a proposition.	Replace "has the same structure and order Table 9-76f" with "has the same structure and order defined in Table 9-76f".	2017/1/9 9:42
7352 Kwok Shum Au	225	1 9.4.1.64	64	25	G	Y	64.25 9.4.1.64	Is "HE MU Exclusive Beamforming Report information" a field? If so, rename it accordingly.	Rename "HE MU Exclusive Beamforming Report information" as "HE MU Exclusive Beamforming Report Information field" or "HE MU Exclusive Beamforming Report field", and then do the global change.	2017/1/9 9:42
7353 Kwok Shum Au	225	1 9.4.1.65	65	21	G	Y	65.21 9.4.1.65	Is "HE CQI-only Report information" a field? If so, rename is accordingly.	Rename "HE CQI-only Report information" as "HE CQI-only Report Information field" or "HE CQI-only Report field", and then do the global change.	2017/1/9 9:42
7354 Kwok Shum Au	225	1 9.4.1.65	66	7	T	Y	66.07 9.4.1.65	The name of the subfield "Average SNR of space-time stream i for the RU index k" is not correct.	Replace "Average SNR of space-time stream i for the RU index k subfield" with "Average SNR for space-time stream i for the RU index k subfield".	2017/1/9 9:42
7355 Kwok Shum Au	225	1 9.4.1.65	66	13	T	Y	66.13 9.4.1.65	The name of the subfield "Average SNR of RU index k for space-time stream i" is not correct.	Replace "Average SNR of RU index k for space-time stream i subfield" with "Average SNR for space-time stream i for the RU index k subfield".	2017/1/9 9:42
7356 Kwok Shum Au	225	1 9.4.2.139	68	56	E	N	68.56 9.4.2.139	Capitalization is needed for the name of the HE Fragmentation Operation subfield.	In 68.56, replace "HE fragmentation Operation subfield" with "HE Fragmentation Operation subfield". In 68.57, replace "HE fragmentation operation subfield" with "HE Fragmentation Operation subfield".	2017/1/9 9:42
7357 Kwok Shum Au	225	1 9.4.2.139	68	60	T	Y	68.60 9.4.2.139	There are 4 possible values of the HE Fragmentation Operation subfield. The description from 68.60 to 69.20 summarizes the scenarios when the values are 0, 1, and 2. How about the scenario when the value is 3?	Insert the description for the scenario when the value of the HE Fragmentation Operation subfield is 3 in the ADDBA Request frame and the ADDBA Response frame.	2017/1/9 9:42
7358 Kwok Shum Au	225	1 9.4.2.200	70	27	T	Y	70.27 9.4.2.200	In 70.2-70.4, it says that "The Wake TBTT Negotiation subfield is set to 0 in the TWT elements transmitted by a responding STA and a scheduling STA". In Table 9-262k, however, there is a entry titled "Descripton when transmitted by a TWT scheduling STA, Wake TBTT Negotiation subfield = 1", which means that the Wake TBTT Negotiation subfield is allowed to set to 1 in the TWT elements transmitted by a scheduling STA. It is a contradictation.	Please clarify whether the Wake TBTT Negotiation subfield is allowed to set to 1 in the TWT elements transmitted by a scheduling STA.	2017/1/9 9:42
7359 Kwok Shum Au	225	1 9.4.2.200	73	10	E	N	73.10 9.4.2.200	Missing proposition for the sentence "Feedback can be contained is the QoS Control field ...".	In 73.10 and 73.35, replace "Feedback can be contained is the QoS Control field ..." with "Feedback can be contained in the QoS Control field ..."	2017/1/9 9:42
7360 Kwok Shum Au	225	1 9.4.2.200	73	14	G	Y	73.14 9.4.2.200	There is no subclause 25.14 for link adaptation using the HE variant HT Control field.	In 73.14 and 73.39, replace "25.14" with "27.13".	2017/1/9 9:42
7361 Kwok Shum Au	225	1 9.4.2.200	74	20	T	Y	74.20 9.4.2.200	In 74.20-74.25, it says that the Target Wake Up Time field can be set to 0, 8 octets or 2 octets. In Figure 9-589av, however, it indicated that the Target Wake Up Time field can be set to either 0 or 8 octets only.	In 69-36, replace "8 or 0" with "8, 2 or 0".	2017/1/9 9:42
7362 Kwok Shum Au	225	1 9.4.2.200	74	25	T	Y	74.25 9.4.2.200	For the sentence "When a TWT responding STA or a TWT scheduling STA with dot11TWTGroupingSupport equal to 0 transmits a TWT element to the TWT requesting STA ...", it means dot11TWTGroupingSupport is required. However, dot11TWTGroupingSupport cannot be found in this amendment (11ax D1.0), 11mc Draft 8.0 or 11ah Draft 10.0.	Add dot11TWTGroupingSupport in subclause C.3.	2017/1/9 9:42
7363 Kwok Shum Au	225	1 9.4.218.2	77	55	E	N	77.55 9.4.218.2	Maximum Number of Fragmented MSDUs is a subfield, rather than a field.	Replace "defined by this field" with "defined by this subfield".	2017/1/9 9:42
7364 Kwok Shum Au	225	1 9.4.218.2	77	57	E	N	77.57 9.4.218.2	The description is about the subfield and therefore,capitalization is needed.	Replace "the Maximum Number of Fragmented MSDUs" with "the Maximum Number of Fragmented MSDUs subfield".	2017/1/9 9:42
7365 Kwok Shum Au	225	1 9.4.218.2	78	16	E	N	78.16 9.4.218.2	There is only one remaining value.	Replace "Remaining values are reserved" with "Set to 3 for reserved".	2017/1/9 9:42

7366 Kwok Shum Au	225	1 9.4.218.2	78	27	T	Y	78.27 9.4.218.2	The name of the subfield is "HE Link Adaptation" rather than "HE Link Adaptation Capable", according to Figure 9-589ck.	Replace "HE Link Adaptation Capable" with "HE Link Adaptation".	2017/1/9 9:42
7367 Kwok Shum Au	225	1 9.4.218.2	78	41	G	Y	78.41 9.4.218.2	There is no subclause 25.4.2.	Replace 25.4.2 with 27.4.2.	2017/1/9 9:42
7368 Kwok Shum Au	225	1 9.4.218.2	78	45	E	N	78.45 9.4.218.2	UL MU Response Scheduling Support is a subfield rather than a field.	In 78.45 and 78.46, replace "field" with "subfield".	2017/1/9 9:42
7369 Kwok Shum Au	225	1 9.4.218.2	78	58	T	Y	78.58 9.4.218.2	The name of the subfield is "Broadcast TWT Support", rather than "Broadcast TWT Supported", according to Figure 9-589ck.	Replace "Broadcast TWT Supported" with "Broadcast TWT Support".	2017/1/9 9:42
7370 Kwok Shum Au	225	1 9.4.218.2	79	10	T	Y	79.10 9.4.218.2	The name of the subfield is "MU Cascading Support", rather than "MU Cascading Supported", according to Figure 9-589ck.	Replace "MU Cascading Supported" with "MU Cascading Support".	2017/1/9 9:42
7371 Kwok Shum Au	225	1 9.4.218.2	79	10	E	N	79.10 9.4.218.2	Capitalization is not needed for the description "MU Cascading sequence".	Replace "MU Cascading sequence" with "MU cascading sequence".	2017/1/9 9:42
7372 Kwok Shum Au	225	1 9.4.218.2	79	42	T	Y	79.42 9.4.218.2	There is neither description nor encoding for the Maximum A-MPDU Length Exponent subfield.	Move the two paragraphs in 80.26 to 80.54 into these two entries.	2017/1/9 9:42
7373 Kwok Shum Au	225	1 9.4.218.2	80	6	E	N	80.06 9.4.218.2	Capitalization is needed for the description about Control, Data, and Management frames.	Replace "other control, data and management frames" with "other Control, Data and Management frames".	2017/1/9 9:42
7374 Kwok Shum Au	225	1 9.4.218.2	80	11	E	N	80.11 9.4.218.2	Capitalization is not needed for the description about quiet time period.	Replace "Quiet Time Period (QTP)" with "quiet time period (QTP)".	2017/1/9 9:42
7375 Kwok Shum Au	225	1 9.4.218.2	80	29	E	N	80.29 9.4.218.2	Capitalization is not needed for the word "Receive".	In 80.29, 80.32, 80.44 and 80.48, replace "can Receive" with "can receive".	2017/1/9 9:42
7376 Kwok Shum Au	225	1 9.4.218.3	81	35	G	Y	81.35 9.4.218.3	There are 3 bits, B37, B38 and B39 for the NSTS Total For \leq 80 MHz subfeld, but it shows in the figure that there are only 2 bits.	Replace "2" with "3".	2017/1/9 9:42
7377 Kwok Shum Au	225	1 9.4.218.3	82	44	E	N	82.44 9.4.218.3	Incorrect proposition.	Replace "of" with "on".	2017/1/9 9:42
7378 Laurent Cariou	225	1 4.3.14a	9	33	T	Y	9.33 4.3.14a	the list of PHY and MAC features is incomplete	add the complete list of features	2017/1/9 9:42
7379 Laurent Cariou	225	1 9.2.4.6.4.3	24	34	T	Y	24.34 9.2.4.6.4.3	This section includes Rx and Tx operating mode indications. The spec also defines management frames to signal operating mode changes (OMN frames). For consistency, the OMN frames should be modified to include the same indications as in the Operating mode subfield of the A-control.	Define a new IE for the Tx Operating mode parameters. This IE can be added to the existing VHT Operating Mode Notification frame. The new element would be understood by an HE AP (i.e., if the OMN capability is set and the AP is HE it understands the new element).	2017/1/9 9:42
7380 Laurent Cariou	225	1 9.2.4.6.4.7	27	47	T	Y	27.47 9.2.4.6.4.7	"HE DL HE MU transmission" should be "HE DL MU transmission	Same as comment	2017/1/9 9:42
7381 Laurent Cariou	225	1 9.4.2.139	68	56	T	Y	68.56 9.4.2.139	Fragmentation level 3 should be included in the HE fragmentation operation of the ADDBA Extension element	Same as comment	2017/1/9 9:42
7382 Laurent Cariou	225	1 9.4.2.219	55	91	T	Y	55.91 9.4.2.219	TWT operation is efficient for specific types of traffic (with periodic patterns) but not for all. It is not efficient to require all STAs to apply TWT. This should be changed to a recommandation		2017/1/9 9:42
7383 Laurent Cariou	225	1 9.6.5.1	99	1	T	Y	99.01 9.6.5.1	Remove L3 FRAG ADDBA Request, response, Delba to harmonize to the solution used for fragmentation levels 1 and 2.	Same as comment	2017/1/9 9:42
7384 Laurent Cariou	225	1 9.6.29.4	105	28	T	Y	105.28 9.6.29.4	The text is confusing. It mentions a request in the response frame.	Clarify the meaning of the frames	2017/1/9 9:42
7385 Laurent Cariou	225	1 27.5.1.3	163	17	T	Y	163.17 27.5.1.3	It is not mentioned on which bandwidth the report is provided, while the bitmap depends on the bandwidth	Clarify	2017/1/9 9:42
7386 Laurent Cariou	225	1 27.5.2.7	174	24	T	Y	174.24 27.5.2.7	NDP feedback report procedure must be detailed	Provide a description of NDP feedback report procedure for the AP side and the STA side	2017/1/9 9:42
7387 Laurent Cariou	225	1 27.5.2.7	174	24	T	Y	174.24 27.5.2.7	NDP feedback report are sent in response to a trigger frame. The specification must define a new trigger type soliciting NDP feedback report from multiple STAs.	Define a new trigger type soliciting NDP feedback report	2017/1/9 9:42
7388 Laurent Cariou	225	1 27.5.2.7	174	24	T	Y	174.24 27.5.2.7	The procedure for NDP feedback report must define how the STA identifies that it can respond to the trigger frame soliciting the feedback report, and identifies the MAC and PHY parameters for the transmission of the feedback report.	Define the fields of the trigger type soliciting NDP feedback report and the associated STA procedure.	2017/1/9 9:42

7389	Laurent Cariou	225	1 27.5.2.7	174	24	T	Y	174.24 27.5.2.7	NDP feedback report is a generic mechanism that can be used for multiple types of feedback. The specification must define a way to identify the type of feedbacks that are solicited by the NDP feedback report trigger frame.	Define the fields of the trigger type soliciting NDP feedback report and the associated STA procedure.	2017/1/9 9:42
7390	Laurent Cariou	225	1 28.3.4	240	57	T	Y	240.57 28.3.4	NDP feedback report is defined as a feedback sent in response to a trigger frame without data payload. The specification must define the HE PPDU type that will carry this NDP feedback report and how the users are multiplex.	Define the HE NDP feedback report PPDU	2017/1/9 9:42
7391	Laurent Cariou	225	1 9.3.1.9.1	34	23	T	Y	34.23 9.3.1.9.1	11ax defines some solutions to improve performance when experiencing coexistence issues with BT for example. (UL MU disable bit). In the same approach, a STA experiencing packet loss due to collisions for instance because of in-device coexistence issues should be able to inform the the originator that the packet losses are due to such collisions. Based on this, the originator can adapt betterly its rate selection, which we can show improves significantly the performance.	Use a reserved bit in the BA control to signal if the PPDU that elicited the BA transmission was received with collisions (for instance due to in-device coex) or not.	2017/1/9 9:42
7392	Laurent Cariou	225	1 9.2.4.1.8	19	35	T	Y	19.35 9.2.4.1.8	A STA sending a BA should be able to set the more data bit to 1 to indicate to the originator that it has buffered traffic and would like to access the medium to transmit it (ressource request)	Modify the procedure so that any STA sending a BA to set the more data bit to 1 to indicate an UL resource request	2017/1/9 9:42
7393	Laurent Cariou	225	1 27.4.1	157	21	T	Y	157.21 27.4.1	A STA sending any BA should be able to set the more data bit to 1 to indicate to the originator that it has buffered traffic and would like to access the medium to transmit it (ressource request)	Modify the procedure so that any STA sending a BA to set the more data bit to 1 to indicate an UL resource request	2017/1/9 9:42
7394	Laurent Cariou	225	1 27.5.2.2.3	167	25	T	Y	167.25 27.5.2.2.3	Recommandations on the AP parameters (EDCA parameters and TxOP duration) to access the channel to send a trigger frame should be defined in order to ensure fairness between OBSSs	Same as comment	2017/1/9 9:42
7395	Laurent Cariou	225	1 27.7.1	179	49	T	Y	179.49 27.7.1	TWT operation is complex and defines a very long list of possible implementations and modes of operation. As such, it will be very hard to get interoperability between devices and to rely on consistent and predictable behaviors. The spec should define a limited set of modes of operation that makes more sense for 11ax use cases and define associated expected behaviors. Examples can be: individual TWT for regular traffic (voice), opportunistic power save for congested environment and bursty traffic	Same as comment	2017/1/9 9:42
7396	Laurent Cariou	225	1 27.7.1	180	15	T	Y	180.15 27.7.1	TWT is efficient only in certain environment conditions and only for some traffic types. It is therefore very unlikely that forcing TWT will be beneficial to all STAs. The TWT required bit set to 1 should therefore be a recommendation rather than a requirement. This feature was agreed at a time where Broadcast TWT was not constraining on the STA side. Now that broadcast TWT has been modified, this makes the requirement on the STA side now more stringent and should be revised. Finally, opportunistic power save has also been defined for congested environments, opportunistic power save should be part of the choices that are required by the TWT required subfield, with individual and Broadcast TWT	Replace "A STA that supports TWT and is associated with an AP from which it receives an HE Operation element whose TWT Required subfield is 1 shall either..." by "A STA that supports TWT and is associated with an AP from which it receives an HE Operation element whose TWT Required subfield is 1 should either ..." and add "participate in opportunistic power save" in the choices after the word "either".	2017/1/9 9:42
7397	Laurent Cariou	225	1 27.7.3.1	182	34	T	Y	182.34 27.7.3.1	A STA should be a TWT scheduled STA only if it negotiated a Broadcast TWT with the AP. The rules apply only to those who negotiated.	Same as comment	2017/1/9 9:42

7398 Laurent Cariou	225	1 27.7.3.2	184	14	T	Y	184.14 27.7.3.2	In a trigger-enabled SP, it is not clear if all STAs have to be triggered or not. It seems not, so the behavior of the STA and APs are not clear.	Same as comment	2017/1/9 9:42
7399 Laurent Cariou	225	1 27.7.3.2	184	52	T	Y	184.52 27.7.3.2	Description of TWT Flow Identifier subfield equal to 3 is missing	Provide description for it	2017/1/9 9:42
7400 Laurent Cariou	225	1 27.7.1	179	49	T	Y	179.49 27.7.1	Broadcast TWT is currently also used just to indicate to any STAs the point in time at which some frames will be transmitted. This is the case for the transmission of trigger frames with OFDMA random access, for the transmission of TIM elements for opportunistic power save. This should be described	Provide description for it	2017/1/9 9:42
7401 Laurent Cariou	225	1 27.7.3.1	182	28	T	Y	182.28 27.7.3.1	Broadcast TWT is currently also used just to indicate to any STAs the point in time at which some frames will be transmitted. This is the case for the transmission of trigger frames with OFDMA random access, for the transmission of TIM elements for opportunistic power save. This should be described	Provide description for it	2017/1/9 9:42
7402 Laurent Cariou	225	1 27.7.3.1	182	28	T	Y	182.28 27.7.3.1	Broadcast TWT has 2 modes of operation, one which requires negotiation (ID non equal to 0) and one which does not require negotiation (ID equal 0). This should be described. Operation with ID=0 does not require the STA to be a scheduled STA, as it is open to all associated STAs.	Provide clarification for it in this section	2017/1/9 9:42
7403 Laurent Cariou	225	1 27.7.4	187	14	T	Y	187.14 27.7.4	The spec currently defines a mode of operation where any STAs (especially STAs using legacy power save mechanisms) can send TWT info frames when going in doze state to indicate the time when they will be back in their original state (awake state). If the peer STA sets Flexible TWT Schedule Support to 1, the time when they will be back can be any time. If the peer STA sets Flexible TWT Schedule Support to 0, the time when they will be back shall coincide with a specific TWT SP. For clarity, we should define a specific section for this mode of operation, as it can be used by STAs operating only with legacy power save modes and not operating with TWT.	Define a specific section and better describe the behavior associated to the use of TWT info frames for STAs without TWT agreements.	2017/1/9 9:42
7404 Laurent Cariou	225	1 27.8.1	188	22	T	Y	188.22 27.8.1	The spec says: "An HE STA can change its operating mode setting either using the procedure described in 11.42 (Notification of operating mode changes), or the procedure described in this subclause. " The 2 procedures should be harmonized so that they provide the same capabilities (same changes of mode of operation)	Modify the notification of operating mode changes using omn frames so that the transmit operating mode changes are also supported.	2017/1/9 9:42
7405 Laurent Cariou	225	1 27.9.2.2	191	3	T	Y	191.03 27.9.2.2	Current OBSS_PD mechanism only defines operation with default parameters. In managed environments, the spec should allow APs to configure more optimaly the parameters, having in mind that those parameters shall only be used by the STAs associated with the group of APs that apply those new parameters.	Add the mechanism to allow APs from an SR group to apply new OBSS_Pdmin and max parameters, and the procedure so that those parameters can only be used if the received OBSS packet is from an OBSS that belongs to the same SR group.	2017/1/9 9:42
7406 Laurent Cariou	225	1 27.9.2.2	192	15	T	Y	192.15 27.9.2.2	The current spec defines a rule that the TxPower constraints can not be increased until the SR STA accesses the channel and ends its TxOP, even if other OBSS_PPDUs are received. This should be clarified in better wording	Same as comment	2017/1/9 9:42

7407 Laurent Cariou	225	1			T	Y		eLWA is demanding of metrics in order for APs and STAs to measure or estimate the quality of an 11ax Wi-Fi link during its operation. Estimated throughput could be enhanced to account for 11ax changes or new metrics could be defined.	Define enhanced metrics	2017/1/9 9:42
7408 Lei Huang	225	1 9.4.2.218.2	79	38	T	Y	79.38 9.4.2.218.2	"random RUs" should be changed to "random access RUs" or "RUs for random access"	as per comment	2017/1/9 9:42
7409 Lei Huang	225	1 27.5.2.6.1	172	35	T	Y	172.35 27.5.2.6.1	There is currently no rule regarding how RUs are assigned for random access in a Trigger frame by an AP. Without such a rule, it is possible that no any RUs assigned for random access in a Trigger frame are available to 20MHz operating STAs. In order for 20MHz operating STA to always get an opportunity to reach AP via random access procedure, every Trigger frame for random access shall include at least one RU for random access which is available to 20MHz operating STAs.	Add the following statement at the end of the second paragraph of section 27.5.2.6.1: "Every Trigger frame for random access transmitted by the HE AP shall include at least one RU for random access which is available to 20MHz operating STAs. In other words, every Trigger frame for random access shall contain at least one RU for random access which is in the primary 20MHz channel and unrestricted to be used for 20MHz operating STAs."	2017/1/9 9:42
7410 Lei Huang	225	1 27.5.2.6.1	172	39	T	Y	172.39 27.5.2.6.1	Currently it is optional for AP to send RAPS element. If AP does not send RAPS element, an STA does not transmit any HE trigger-based PPDU using random access RUs. This would cause unnecesary transmission delay for STA.	1. Define a default value for OCWmin and OCWmax; 2. If an HE STA does not receive the RAPS element, the HE STA shall perform UL OFDMA-based random access procedure based on the default values of OCWmin and OCWmax.	2017/1/9 9:42
7411 Lei Huang	225	1 27.5.2.6.1	172	46	T	Y	172.46 27.5.2.6.1	"Beacon or Probe Response" shall be changed to "Beacon or Probe Response frame"	as per comment	2017/1/9 9:42
7412 Lei Huang	225	1 27.5.2.6.2	173	18	T	Y	173.18 27.5.2.6.2	M-BA in Figure 27-1 is not defined in D1.0. In addition, BA could be used as an acknowledgement for HE trigger-based PPDU.	Change "Ack/M-BA" in Figure 27-1 to "Ack/BA/Multi-STA BA"	2017/1/9 9:42
7413 Lei Huang	225	1 27.5.2.6.2	173	19	E	Y	173.19 27.5.2.6.2	In Figure 27-1, "HE Trigger-based PPDU" shall be changed to "HE trigger-based PPDU"	as per comment	2017/1/9 9:42
7414 Lei Huang	225	1 27.5.2.6.2	173	27	T	Y	173.27 27.5.2.6.2	The statement "An HE AP indicates the values of OCWmin and OCWmax in the RAPS element in a Beacon or Probe Response frame for the random access operation. OCWmax is the upper limit of OCW." is redundant since there is the similar statement in Section 27.5.2.6.1 (see L38-L43 of P172).	delete "An HE AP indicates the values of OCWmin and OCWmax in the RAPS element in a Beacon or Probe Response frame for the random access operation. OCWmax is the upper limit of OCW."	2017/1/9 9:42
7415 Lei Huang	225	1 27.5.2.6.2	173	36	T	Y	173.36 27.5.2.6.2	If the OBO counter is equal to the number of RUs assigned for random access, the HE STA shall also decrement its OBO counter to zero.	Change "For an HE STA, if the OBO counter is smaller than the number of RUs assigned to AID value 0 in a Trigger frame, then the HE STA shall decrement its OBO counter to zero." to "For an HE STA, if the OBO counter is not larger than the number of RUs assigned to AID value 0 in a Trigger frame, then the HE STA shall decrement its OBO counter to zero."	2017/1/9 9:42
7416 Lei Huang	225	1 27.5.2.6.2	173	46	E	Y	173.46 27.5.2.6.2	"..AID value 0If the selected RU.." should be changed to "..AID value 0. If the selected RU.."	as per comment	2017/1/9 9:42
7417 Lei Huang	225	1 27.5.2.6.2	173	46	T	Y	173.46 27.5.2.6.2	CCA is based on individual 20MHz channel(s) and is not RU-based.	Change "If the selected RU is idle..." to "If each of one or more 20 MHz channels containing the selected RU is idle..."	2017/1/9 9:42
7418 Lei Huang	225	1 27.5.2.6.2	173	48	T	Y	173.48 27.5.2.6.2	CCA is based on individual 20MHz channel(s) and is not RU-based.	Change "If the selected RU is considered busy..." to "If each of one or more 20 MHz channels containing the selected RU is considered busy..."	2017/1/9 9:42

7419 Lei Huang	225	1 27.14.2	199	60	T	Y	199.60 27.14.2	Broadcast TWT element actually does not indicate start times for Trigger frames with random access allocations. Instead it indicates start time of broadcast TWT SP which contains Trigger frames with random access allocations.	1. Change "An HE AP may indicate one or more start times for Trigger frames with random access allocations in the broadcast TWT element that is included in the Beacon frame or a management frame ..." to "An HE AP may indicate start time for broadcast TWT SP containing Trigger frames with random access allocations in the broadcast TWT element that is included in the Beacon frame or a management frame ..." 2. Change Figure 27-7 accordingly.	2017/1/9 9:42
7420 Lei Huang	225	1 27.14.2	200	21	T	Y	200.21 27.14.2	The condition for an HE STA to enter the doze state for a trigger-enabled TWT SP is incomplete. For example, if the TWT Flow Identifier subfield in a TWT element has a value of 0, HE STA may also enter the doze state until the start of that TWT SP defined by the TWT element.	Change "An HE STA that receives a Beacon frame or a management frame containing a TWT element that has a value of 1 in the Broadcast subfield a value of 2 in the TWT Flow Identifier subfield may enter the doze state until the start of that TWT SP..." to "An HE STA that receives a Beacon frame or a management frame containing a TWT element that has a value of 1 in the Broadcast subfield, a value of 1 in the Trigger subfield, a value of either 0 or 2 in the TWT Flow Identifier subfield may enter the doze state until the start of that TWT SP..."	2017/1/9 9:42
7421 Lei Huang	225	1 27.14.2	200	24	T	Y	200.24 27.14.2	It is possible for an HE STA to enter the doze state for a trigger-enabled TWT SP in various ways. For one example, when an HE STA receives a Beacon frame or a management frame containing the TWT element with the Broadcast subfield set to 1, the Trigger subfield set to 1 and the TWT Flow Identifier subfield set to 1, namely, the trigger-based TWT SP defined by the TWT element contains no any RUs for random access, it may enter the doze state at least until the end of the TWT SP defined by the TWT element. For another example, when an HE STA receives a Beacon frame or a management frame containing the TWT element with the Broadcast subfield set to 1 and the Trigger subfield set to 0, namely, the TWT SP defined by the TWT element contains no any Trigger frame, it may enter the doze state at least until the end of the TWT SP defined by the TWT element.	Insert the following statements after the second paragraph of page 200: "An HE STA that receives a Beacon frame or a management frame containing the TWT element with the Broadcast subfield set to 1, the Trigger subfield set to 1 and the TWT Flow Identifier subfield set to 1 may enter the doze state at least until the end of the TWT SP defined by the TWT element. An HE STA that receives a Beacon frame or a management frame containing the TWT element with the Broadcast subfield set to 1 and the Trigger subfield set to 0 may enter the doze state at least until the end of the TWT SP defined by the TWT element."	2017/1/9 9:42
7422 Lei Huang	225	1 27.14.2	200	31	T	Y	200.31 27.14.2	The condition for an HE STA to enter the doze state using the value inidcated in the Cascade Indication field in a Trigger frame is incomplete. For example, if the OBO counter decrements to zero and but each of one or more 20MHz channels containing the selected RU is considered busy with the random access procedure in a Trigger frame with Cascade Indication field set to 0, the HE STA may enter the doze state immediately as well.	Change "If the OBO counter decrements to a non-zero value with the random access procedure in a Trigger frame with Cascade Indication field set to 0, it may enter the doze state immediately. If the OBO counter decrements to a non-zero value with the random access procedure in a Trigger frame with Cascade Indication field set to 1, it may remain awake for random access in the cascaded Trigger frame." to "If the OBO counter decrements to a non-zero value or if the OBO counter decrements to zero and but each of one or more 20MHz channels containing the selected RU is considered busy with the random access procedure in a Trigger frame with Cascade Indication field set to 0, it may enter the doze state immediately. If the OBO counter decrements to a non-zero value or if the OBO counter decrements to zero	2017/1/9 9:42

7423 Lei Huang	225	1 28.3.3.8.3	239	2	T	Y	239.02 28.3.3.8.3	In case of full bandwidth MU-MIMO transmission, the number of HE-SIG-B symbols is not indicated in the HE-SIG-A. Instead the number of STAs in the MU-MIMO group is indicated in the HE-SIG-A. However, in this case, a STA still needs to know the number of HE-SIG-B symbols for decoding HE-SIG-B. Therefore, it is necessary to clarify how the number of HE-SIG-B symbols is determined in case of full bandwidth MU-MIMO transmission.	Insert the following statement after the sentence "The number of STAs in the MU-MIMO group is indicated in the Number Of HE-SIG-B Symbols Or MU-MIMO Users field in HE-SIG-A." "In this case, the number of HE-SIG-B symbols can be derived according to the values of the SIGB MCS field, the SIGB DCM field and the Number Of HE-SIG-B Symbols Or MU-MIMO Users field in the HE-SIG-A field.	2017/1/9 9:42
7424 Lei Huang	225	1 28.3.10.8.5	298	20	E	Y	298.20 28.3.10.8.5	The SIGB Number of Symbols/Number of MU-MIMO Users field should be changed to the Number Of HE-SIG-B Symbols Or MU-MIMO Users field for keep consistency	as per comment	2017/1/9 9:42
7425 Lei Huang	225	1 27.5.2.6.3	174	16	T	Y	174.16 27.5.2.6.3	The retransmission procedure for random access is not clearly defined.	1. define a local MIB variable "dot11RARetryLimit",which indicates the maximum number of successive retransmission attempts. 2. Change the sentence in L52-L54 of P172 as follows: "The non-AP STA with dot11OFDMARandomAccessOptionImlemented set to true shall maintain an internal OFDMA backoff (OBO) counter and an internal random access retry (RAR) counter. 3. Change the second paragraph of 27.5.2.6.3 as follows: "If the HE trigger-based PPDU is not successfully transmitted in the randomly selected RU, the HE STA shall update its OCW to 2*OCW+1 for every retransmission, until the OCW reaches OCWmax, and shall also increment its RAR counter by one and initialize its OBO counter to a random value in the range of 0 and OCW for every retransmission. Once the OCW reaches OCWmax for successive retransmission	2017/1/9 9:42
7426 Lei Huang	225	1 27.5.2.6.2	173	56	T	Y	173.56 27.5.2.6.2	The sentence "If the HE trigger-based PPDU is successfully transmitted in the randomly selected RU, then the STA shall set its OCW to OCWmin" is redundant (see L30-L34 of P173).	remove the sentence "If the HE trigger-based PPDU is successfully transmitted in the randomly selected RU, then the STA shall set its OCW to OCWmin".	2017/1/9 9:42
7427 Lei Huang	225	1 27.5.2.6.2	174	1	T	Y	174.01 27.5.2.6.2	The condition of transmitting an HE trigger-based PPDU successfully in the randomly selected RU is not clearly defined.	1. Change L1-L5 of P174 as follows: "If a STA transmits an HE trigger-based PPDU that solicits an immediate response in a random access RU and the expected response is not received, the transmission is considered unsuccessful and the STA invokes the UL OFDMA-based random access retransmission procedure as defined in 27.5.2.6.3 (Retransmission procedure for random access). Otherwise the transmission is considered successful. 2. delete the note in L58-L60 of P173 since it has been covered by the above bulletin.	2017/1/9 9:42
7428 Lei Huang	225	1 28.1.1	209	42	T	Y	209.42 28.1.1	"channel puncturing" should be changed to "preamble puncturing"	as per comment	2017/1/9 9:42

7429	Lei Huang	225	1 28.1.1	209	57	T	Y	209.57 28.1.1	DCM can also be combined with QPSK.	change "The HE PHY data subcarriers are modulated using binary phase shift keying (BPSK), BPSK dual-carrier modulation (DCM), quadrature phase shift keying (QPSK), 16-quadrature amplitude modulation (16-QAM), 16-QAM DCM, 64-QAM, 256-QAM and 1024-QAM" to "The HE PHY data subcarriers are modulated using binary phase shift keying (BPSK), BPSK dual-carrier modulation (DCM), quadrature phase shift keying (QPSK), QPSK DCM, 16-quadrature amplitude modulation (16-QAM), 16-QAM DCM, 64-QAM, 256-QAM and 1024-QAM"	2017/1/9 9:42
7430	Lei Huang	225	1 28.3.11.5	317	34	T	Y	317.34 28.3.11.5	For a HE trigger-based PPDU, the encoder is selected by the Coding Type subfield in User Info field in a Trigger frame.	Change "The encoder is selected by the Coding field in HE-SIG-A in an HE SU PPDU or an HE extended range SU PPDU, or HE-SIG-B per-user subfield(s) in an HE MU PPDU, as defined in 28.3.10.7 (HE-SIG-A) and 28.3.10.8 (HE-SIG-B) respectively." to "The encoder is selected by the Coding field in HE-SIG-A in an HE SU PPDU or an HE extended range SU PPDU, or the Coding field in HE-SIG-B per-user subfield(s) in an HE MU PPDU, or the Coding Type subfield in User Info field in a Trigger frame, as defined in 28.3.10.7 (HE-SIG-A), 28.3.10.8 (HE-SIG-B) and 9.3.1.23 (Trigger frame format), respectively."	2017/1/9 9:42
7431	Lei Huang	225	1 28.3.11.5.1	317	63	T	Y	317.63 28.3.11.5.1	Equation (28-65) to (28-68) are also applicable to HE extended range SU PPDU	Replace "HE SU PPDU" by "HE SU PPDU or HE extended range SU PPDU' throughout whole 28.3.11.5.1	2017/1/9 9:42
7432	Lei Huang	225	1 28.3.11.5.2	318	29	T	Y	318.29 28.3.11.5.2	LDPC encoding process is applicable to HE extended range SU PPDU as well	Change "For an HE SU PPDU using LDPC coding to encode the Data field,..." to "For an HE SU PPDU or HE extended range SU PPDU to encode the Data field..."	2017/1/9 9:42
7433	Lei Huang	225	1 28.3.11.2	314	20	T	Y	314.20 28.3.11.2	Strictly speaking, the PSDU contains pre-FEC MAC pad bits.	Change "When BCC encoding is used, the Data field shall consist of the SERVICE field, the PSDU, the tail bits, the post-FEC padding bits and the packet extension. When LDPC encoding is used, the Data field shall consist of the SERVICE field, the PSDU, the post-FEC padding bits and the packet extension." to "When BCC encoding is used, the Data field shall consist of the SERVICE field, the PSDU, the pre-FEC PHY pad bits, the tail bits, the post-FEC padding bits and the packet extension. When LDPC encoding is used, the Data field shall consist of the SERVICE field, the PSDU, the pre-FEC PHY pad bits, the post-FEC padding bits and the packet extension…"	2017/1/9 9:42
7434	Lei Huang	225	1 28.3.11.5.1	318	19	T	Y	318.19 28.3.11.5.1	Equation (28-68) is not necessary. Similar to N_DBPS,LAST, we can just say that N_CBPS,LAST = N_CBPS,LAST,init, which is defined by (28-62).	1. Change "The number of coded bits per symbol in the last OFDM symbol(s) of an HE SU PPDU is given by Equation (28-68). " to "The number of coded bits per symbol in the last OFDM symbol(s) of an HE SU PPDU is N_CBPS,LAST= N_CBPS,LAST,init." 2. delete equation (28-68).	2017/1/9 9:42

7435 Lei Huang	225	1 28.3.11.5.2	318	31	T	Y	318.31 28.3.11.5.2	Strictly speaking, the PSDU contains pre-FEC MAC pad bits.	Change "all bits in the Data field including the scrambled SERVICE, PSDU, and pre-FEC pad bits are encoded" to "all bits in the Data field including the scrambled SERVICE, PSDU, and pre-FEC PHY pad bits are encoded"	2017/1/9 9:42
7436 Lei Huang	225	1 28.3.11.2	315	14	T	Y	315.14 28.3.11.2	Figure 28-29 seems to be applicable to LDPC only since no tail bits are added after FEC.	Change the FEC block to the LDPC FEC block in Figure 28-29	2017/1/9 9:42
7437 Lei Huang	225	1 28.3.11.5.2	318	34	T	Y	318.34 28.3.11.5.2	Equation (20-35) should be changed to Equation (19-35).	As per comment	2017/1/9 9:42
7438 Lei Huang	225	1 28.3.11.5.2	318	47	T	Y	318.47 28.3.11.5.2	Equation (20-36) should be changed to Equation (19-36).	As per comment	2017/1/9 9:42
7439 Lei Huang	225	1 28.3.11.5.4	319	56	T	Y	319.56 28.3.11.5.4	Currently, for an HE MU PPDU, the user with the longest encoded packet duration is derived by Equation (28-77), which requires computing the initial pre-FEC padding factor value and the initial number of OFDM symbol for each user. Actually,a simpler method can be used for this purpose. In more details, first compute initial number of OFDM symbols for each user, and then determine a subset of users which have maximum initial number of OFDM symbols. After that, compute the initial pre-FEC padding factor value only for each user in the subset. Then the user with the longest encoded packet duration is just the user which has maximum initial pre-FEC padding factor among the users in the subset. In other words, compared with the current method, the proposed method does not require computing the initial pre-FEC padding factor values for users which are not in the	Change the method for deriving the user with the longest encoded packet duration as per comment.	2017/1/9 9:42
7440 Lei Huang	225	1 28.3.11.5.4	320	58	T	Y	320.58 28.3.11.5.4	In Equation (28-83), N_CBPS,last,u should be changed to N_CBPS,short,u	As per comment	2017/1/9 9:42
7441 Lei Huang	225	1 28.3.11.5.4	321	30	T	Y	321.30 28.3.11.5.4	a_init=4 should be changed to a=4	As per comment	2017/1/9 9:42
7442 Lei Huang	225	1 28.3.14.2	341	48	T	Y	341.48 28.3.14.2	Due to STA's minimum/maximum transmit power limit, the actual received signal power at AP for an HE trigger-based PPDU may be higher or lower than the target RSSI. For example, for one STA which is located very closed to AP, the received signal power at AP may be much higher than the target RSSI due to the STA's minimum transmit power limit. For one STA which is located far away from the AP, the received signal power at AP may be much lower than the target RSSI due to the STA's maximum transmit power limit. As a result, the received signal power at AP could differ significantly among STAs, which results in severe MUI (multi-user interference). This problem becomes even more severe in case of OFDMA based random access, since AP has no knowledge about which STA will be transmitting at a random access RU.	Insert the following statement after L48 of P341: "An STA should not transmit its HE trigger-based PPDU when the estimated received signal power at AP is much larger than the target RSSI."	2017/1/9 9:42
7443 Lei Huang	225	1 3.2	4	39	E	Y	4.39 3.2	delete "(HE)" from "a HE (HE) STA"	As per comment	2017/1/9 9:42
7444 Lei Huang	225	1 3.2	4	41	T	Y	4.41 3.2	The following 40MHz mask PPDUs is missing: A 40 MHz HE PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW40) transmitted using the 40 MHz transmit spectral mask defined in Clause 28 (High Efficiency (HE) PHY specification).	As per comment	2017/1/9 9:42
7445 Lei Huang	225	1 3.2	4	56	E	Y	4.56 3.2	"using the 80 MHZ transmit spectral mask" should be changed to "transmitted using the 80MHz transmit spectral mask.	As per comment	2017/1/9 9:42
7446 Lei Huang	225	1 3.2	4	60	E	Y	4.60 3.2	"using the 80 MHZ transmit spectral mask" should be changed to "transmitted using the 80MHz transmit spectral mask.	As per comment	2017/1/9 9:42

7447	Lei Huang	225	1 3.2	4	64	E	Y	4.64 3.2	"using the 80 MHZ transmit spectral mask" should be changed to "transmitted using the 80MHz transmit spectral mask.	As per comment	2017/1/9 9:42
7448	Lei Huang	225	1 3.2	5	2	E	Y	5.02 3.2	"using the 80 MHZ transmit spectral mask" should be changed to "transmitted using the 80MHz transmit spectral mask.	As per comment	2017/1/9 9:42
7449	Lei Huang	225	1 3.2	5	6	E	Y	5.06 3.2	"using the 80 MHZ transmit spectral mask" should be changed to "transmitted using the 80MHz transmit spectral mask.	As per comment	2017/1/9 9:42
7450	Lei Huang	225	1 3.2	5	9	E	Y	5.09 3.2	1) delete the duplicated "f); 2)"using the 80 MHZ transmit spectral mask" should be changed to "transmitted using the 80MHz transmit spectral mask.	As per comment	2017/1/9 9:42
7451	Lei Huang	225	1 3.2	5	13	E	Y	5.13 3.2	1) delete the duplicated "g); 2)"using the 80 MHZ transmit spectral mask" should be changed to "transmitted using the 80MHz transmit spectral mask.	As per comment	2017/1/9 9:42
7452	Lei Huang	225	1 3.2	5	31	E	Y	5.31 3.2	"using the 160 MHZ transmit spectral mask" should be changed to "transmitted using the 160MHz transmit spectral mask.	As per comment	2017/1/9 9:42
7453	Lei Huang	225	1 3.2	5	35	E	Y	5.35 3.2	"using the 160 MHZ transmit spectral mask" should be changed to "transmitted using the 160MHz transmit spectral mask.	As per comment	2017/1/9 9:42
7454	Lei Huang	225	1 3.2	5	39	E	Y	5.39 3.2	"using the 160 MHZ transmit spectral mask" should be changed to "transmitted using the 160MHz transmit spectral mask.	As per comment	2017/1/9 9:42
7455	Lei Huang	225	1 3.2	5	43	E	Y	5.43 3.2	"using the 160 MHZ transmit spectral mask" should be changed to "transmitted using the 160MHz transmit spectral mask.	As per comment	2017/1/9 9:42
7456	Lei Huang	225	1 3.2	5	51	E	Y	5.51 3.2	"using the 160 MHZ transmit spectral mask" should be changed to "transmitted using the 160MHz transmit spectral mask.	As per comment	2017/1/9 9:42
7457	Lei Huang	225	1 3.2	5	55	E	Y	5.55 3.2	"using the 160 MHZ transmit spectral mask" should be changed to "transmitted using the 160MHz transmit spectral mask.	As per comment	2017/1/9 9:42
7458	Lei Huang	225	1 3.2	5	59	E	Y	5.59 3.2	"using the 160 MHZ transmit spectral mask" should be changed to "transmitted using the 160MHz transmit spectral mask.	As per comment	2017/1/9 9:42
7459	Lei Huang	225	1 3.2	6	11	E	Y	6.11 3.2	"using the 80+80 MHZ transmit spectral mask" should be changed to "transmitted using the 80+80MHz transmit spectral mask.	As per comment	2017/1/9 9:42
7460	Lei Huang	225	1 3.2	6	15	E	Y	6.15 3.2	"using the 80+80 MHZ transmit spectral mask" should be changed to "transmitted using the 80+80MHz transmit spectral mask.	As per comment	2017/1/9 9:42
7461	Lei Huang	225	1 3.2	6	19	E	Y	6.19 3.2	"using the 80+80 MHZ transmit spectral mask" should be changed to "transmitted using the 80+80MHz transmit spectral mask.	As per comment	2017/1/9 9:42
7462	Lei Huang	225	1 3.2	6	23	E	Y	6.23 3.2	"using the 80+80 MHZ transmit spectral mask" should be changed to "transmitted using the 80+80MHz transmit spectral mask.	As per comment	2017/1/9 9:42
7463	Lei Huang	225	1 3.2	6	27	E	Y	6.27 3.2	"using the 80+80 MHZ transmit spectral mask" should be changed to "transmitted using the 80+80MHz transmit spectral mask.	As per comment	2017/1/9 9:42
7464	Lei Huang	225	1 4.3.14a	9	38	T	Y	9.38 4.3.14a	"80+80MHz channel" is missing.	Change "Mandatory support for 26-, 52-, 106-, 242-, 484-, 996- and 2x996-tone RUs in a 160 MHz channel" to "Mandatory support for 26-, 52-, 106-, 242-, 484-, 996- and 2x996-tone RUs in a 80+80 MHz or 160 MHz channel"	2017/1/9 9:42

7465	Lei Huang	225	1 4.3.14a	9	42	T	Y	9.42 4.3.14a	1024 QAM is also applicable to 2*996-tone RU.	Change "Optional support for 1024-QAM on 242-, 484- and 996-tone RUs" to "Optional support for 1024-QAM on 242-, 484-, 996- and 2*996-tone RUs"	2017/1/9 9:42
7466	Lei Huang	225	1 4.3.14a	9	53	T	Y	9.53 4.3.14a	Dynamic fragmentation level 0 means no support for dynamic fragmentation. It is not true to claim that VHT STAs do not support dynamic fragmentation level 0.	Change "Mandatory support for dynamic fragmentation level 0" to "Optional support for dynamic fragmentation levels 1, 2 and 3"	2017/1/9 9:42
7467	Lei Huang	225	1 4.3.14a	9	56	T	Y	9.56 4.3.14a	"target wake up time" should be changed to "target wake time"	As per comment	2017/1/9 9:42
7468	Lei Huang	225	1 4.3.14a	9	58	T	Y	9.58 4.3.14a	"OFDMA-based random access" should be changed to "UL OFDMA-based random access"	As per comment	2017/1/9 9:42
7469	Lei Huang	225	1 6.3.3.3.2	11	26	T	Y	11.26 6.3.3.3.2	The description on HE Capabilities is inaccurate and incomplete, which should be similar to VHT Capabilities	Replace the Description on HE Capabilities by "The values from the HE Capabilities element. The parameter is present if dot11HEOptionImplemented is true and an HE Capabilities element was present in the Probe Response or Beacon frame from which the BSSDescription was determined. The parameter is not present otherwise."	2017/1/9 9:42
7470	Lei Huang	225	1 6.3.3.3.2	11	35	T	Y	11.35 6.3.3.3.2	The description on HE Operation is inaccurate and incomplete, which should be similar to VHT Operation	Replace the Description on HE Operation by "The values from the HE Operation element. The parameter is present if dot11HEOptionImplemented is true and an HE Operation element was present in the Probe Response or Beacon frame from which the BSSDescription was determined. The parameter is not present otherwise."	2017/1/9 9:42
7471	Lei Huang	225	1 9.2.4.6.4.1	23	37	T	Y	23.37 9.2.4.6.4.1	The content for Control ID value of 6 is missing in Table 9-18a.	Add "See 9.2.4.6.4.8 (Reverse direction protocol (RDP))" for Control ID value of 6.	2017/1/9 9:42
7472	Lei Huang	225	1 9.2.4.6.4.7	28	53	T	Y	28.53 9.2.4.6.4.7	"Figure 8-1" and "Figure 8-2" in section 8.3.5.12.2 cannot be found. Please provide the correct reference.	As per comment	2017/1/9 9:42
7473	Lei Huang	225	1 9.2.4.6.4.8	28	60	T	Y	28.60 9.2.4.6.4.8	"RDP Trigger frame" should be changed to "RDP Control subfield".	As per comment	2017/1/9 9:42
7474	Lei Huang	225	1 9.3.1.9.1	34	10	T	Y	34.10 9.3.1.9.1	"B6" in Figure 9-33 should be changed back to "B5" .	As per comment	2017/1/9 9:42
7475	Lei Huang	225	1 9.3.1.9.7	38	54	T	Y	38.54 9.3.1.9.7	The second row under the column "Presence of optional subfields in the Per STA Info field" corresponding to Ack Type = 1 and TID = 15 should be changed from "N/A" to "Block Ack Bitmap"	As per comment	2017/1/9 9:42
7476	Lei Huang	225	1 9.3.1.20	40	7	E	Y	40.07 9.3.1.20	"multiple STA info field" should be changed to "multiple STA Info fields"	As per comment	2017/1/9 9:42
7477	Lei Huang	225	1 9.3.1.20	40	25	E	Y	40.25 9.3.1.20	"STA Info subfield" should be changed to "STA Info field"	1. Change "The format of the STA Info subfield in an HE NDP Announcement Frame is defined in Figure 9-51b (STA Info subfield format in an HE NDP Announcement frame)." to "The format of the STA Info field in an HE NDP Announcement Frame is defined in Figure 9-51b (STA Info field format in an HE NDP Announcement frame)." 2. replace the title of Figure 9-51b by "STA Info field format in an HE NDP Announcement frame"	2017/1/9 9:42
7478	Lei Huang	225	1 9.3.1.20	41	8	T	Y	41.08 9.3.1.20	"Feedback Type+Ng+codebook size" should be changed to "Feedback Type And Ng + Codebook Size" since Table 9-26a shows the joint encoding for two subfields instead of three subfields.	As per comment	2017/1/9 9:42
7479	Lei Huang	225	1 9.3.1.20	41	19	T	Y	41.19 9.3.1.20	It is better to change "MU+Ng4" to "MU, Ng=4" and change "MU+Ng16" to "MU, Ng=16" in Table 9-25a	As per comment	2017/1/9 9:42
7480	Lei Huang	225	1 9.3.1.20	41	12	T	Y	41.12 9.3.1.20	It is better to change "Ng4" to "Ng=4" and change "Ng16" to "Ng=16" in Table 9-25a	As per comment	2017/1/9 9:42

7481 Lei Huang	225	1 9.3.1.20	41	28	T	Y	41.28 9.3.1.20	There is no HE STA Info field. It is better to change "in the HE STA Info" to "in an STA Info field of the HE NDP Announcement frame"	As per comment	2017/1/9 9:42
7482 Lei Huang	225	1 9.3.1.23	41	47	T	Y	41.47 9.3.1.23	"(RA)" should be changed to "RA".	As per comment	2017/1/9 9:42
7483 Lei Huang	225	1 9.3.1.23	44	23	T	Y	44.23 9.3.1.23	"Table 22-13" should be changed to "Table 21-13".	As per comment	2017/1/9 9:42
7484 Lei Huang	225	1 9.3.1.23	44	27	T	Y	44.27 9.3.1.23	The HE-SIG-A field of an HE trigger-based PPDU does not contain the Number Of HE-LTF Symbols field. "Table 28-18 (HE-SIG-A field of an HE trigger-based PPDU)" should be changed to "Table 28-17 (HE-SIG-A field of an HE MU PPDU)".	As per comment	2017/1/9 9:42
7485 Lei Huang	225	1 9.3.1.23	44	22	T	Y	44.22 9.3.1.23	The description on relation between the number of HE-LTF symbols and the total number of space-time streams is confusing	Replacing "The number of HE-LTF symbols is a function of the total number of space-time streams. For non-OFDMA PPDUs, the encoding of the Number Of HE-LTF Symbols subfield is defined in Table 22-13. For OFDMA PPDUs, the number of HE-LTFs is greater than or equal to the maximum across RUs of the total number of space time streams. The encoding of the Number Of HE-LTF Symbols subfield is the same as the Number of HE-LTF Symbols in HE-SIG-A2, which is defined in Table 28-18 (HE-SIG-A field of an HE trigger-based PPDU)." by "The number of HE-LTF symbols is a function of N_STS,total as shown in Table 21-13. For a non-OFDMA PPDU, N_STS,total is the total number of space-time streams; while for an OFDMA PPDU, N_STS,total is the maximum of the total number of space time streams per RU. The encoding	2017/1/9 9:42
7486 Lei Huang	225	1 9.3.1.23	45	4	T	Y	45.04 9.3.1.23	80+80MHz is missing.	Replacing "For 160 MHz four SR fields for each 40 MHz" by "For 80+80 MHz or 160 MHz four SR fields for each 40 MHz"	2017/1/9 9:42
7487 Lei Huang	225	1 9.3.1.23	47	15	T	Y	47.15 9.3.1.23	There is no description about the Starting Spatial Stream subfield and the Number of Spatial Streams subfield in the SS Alocation subfield	Add the following description after Figure 9-52f: "The Starting Spatial Stream subfield indicates the stream index of the first spatial stream of the HE trigger-based PPDU response of the STA identified by the AID12 subfield. The Number of Spatial Streams subfield indicates the number of spatial streams of the HE trigger-based PPDU response of the STA identified by the AID12 subfield	2017/1/9 9:42
7488 Lei Huang	225	1 9.3.1.23	48	5	T	Y	48.05 9.3.1.23	M_PAD is defined in the same manner in both (9-ax1) and (9-ax2).	delete the definition of M_PAD under (9-ax2)	2017/1/9 9:42
7489 Lei Huang	225	1 9.3.1.23	48	17	E	Y	48.17 9.3.1.23	"Trigger Frame" should be changed to "Trigger frame"	As per comment	2017/1/9 9:42
7490 Lei Huang	225	1 9.3.1.23.4	50	59	T	Y	50.59 9.3.1.23.4	The description "The mapping of B19-B13 to RU Allocation subfield follows the RU index in Table 28-3 (Subcarrier indices for RUs in a 20 MHz HE PPDU) in an increasing order." is not complete and accurate.	replacing "The mapping of B19-B13 to RU Allocation subfield follows the RU index in Table 28-3 (Subcarrier indices for RUs in a 20 MHz HE PPDU) in an increasing order." by "For a 20 MHz PPDU, the mapping of B19-B13 to RU allocation follows the RU index in Table 28-3 (Subcarrier indices for RUs in a 20 MHz HE PPDU) in an increasing order. For a 40 MHz PPDU, the mapping of B19-B13 to RU allocation follows the RU index in Table 28-4 (Subcarrier indices for RUs in a 40 MHz HE PPDU) in an increasing order. For an 80 MHz, 160 MHz and 80+80 MHz PPDU, the mapping of B19-B13 to RU allocation follows the RU index in Table 28-5 (Subcarrier indices for RUs in an 80 MHz HE PPDU) in an increasing order."	2017/1/9 9:42
7491 Lei Huang	225	1 9.4.1.62	56	21	E	Y	56.21 9.4.1.62	"the HE MIMO Control Fields" should be changed to "the HE MIMO Control field"	As per comment	2017/1/9 9:42

7492 Lei Huang	225	1 9.4.1.62	56	12	T	Y	56.12 9.4.1.62	In HE MIMO Control field of HE Compressed Beamforming And CQI frame, Ng, Feedback Type and Codebook Information are separately encoded and 4-bit is required. However, in the HE NDP Annoucement frame, Ng, Feedback Type and Codebook Information are jointly encoded and only 3-bit is required. For consistency, it is better to use a unified method for encoding Ng, Feedback Type and Codebook information in both sounding related frames. In other words, in HE MIMO Control field, 3-bit joint encoding of Ng, Feedback Type and Codebook Information should be used, and thus there is one more reserved bit in HE MIMO Control field.	As per comment		2017/1/9 9:42
7493 Lei Huang	225	1 9.4.1.62	56	3	T	Y	56.03 9.4.1.62	The reference is incorrect.	Replacing "The HE MIMO Control field is included in every HE Compressed Beamforming frame (see 9.4.1.63 (HE Compressed Beamforming Report field))." by "The HE MIMO Control field is included in every HE Compressed Beamforming And CQI frame (see 9.6.28.2 HE Compressed Beamforming And CQI frame format).		2017/1/9 9:42
7494 Lei Huang	225	1 9.4.1.62	57	21	T	Y	57.21 9.4.1.62	"VHT Compressed Beamforming frame" should be changed to "HE Compressed Beamforming And CQI frame".	As per comment		2017/1/9 9:42
7495 Lei Huang	225	1 9.4.1.62	57	34	T	Y	57.34 9.4.1.62	"VHT Compressed Beamforming Report field" should be changed to "HE Compressed Beamforming Report field".	As per comment		2017/1/9 9:42
7496 Lei Huang	225	1 9.4.1.62	57	46	T	Y	57.46 9.4.1.62	The description on Sounding Dialog Token Number is incorrect.	Please fix it.		2017/1/9 9:42
7497 Lei Huang	225	1 9.4.1.62	57	51	T	Y	57.51 9.4.1.62	HE Compressed Beamforming frame should be changed to "HE Compressed Beamforming And CQI frame".	As per comment		2017/1/9 9:42
7498 Lei Huang	225	1 10.3.2.10.2	119	25	T	Y	119.25 10.3.2.10.2	"UL MU Response Scheduling A-Control field" should be changed to "UL MU Response Scheduling Control subfield".	As per comment		2017/1/9 9:42
7499 Lei Huang	225	1 10.28.3	136	31	T	Y	136.31 10.28.3	"RDP A-Control field" should be changed to "RDP Control subfield".	As per comment		2017/1/9 9:42
7500 Lei Huang	225	1 28.5	372	57	T	Y	372.57 28.5	"non-OFDMA 160MHz and 80+80MHz" should be changed to "2*996-tone RU and non-OFDMA 160MHz and 80+80MHz".	As per comment		2017/1/9 9:42
7501 Lei Huang	225	1 28.5	372	63	T	Y	372.63 28.5	DCM stands for dual carrier modulation, not dual subcarrier modulation.	Change "Dual sub-carrier modulation (DCM)" to "Dual carrier modulation (DCM)"		2017/1/9 9:42
7502 Lei Huang	225	1 28.5	401	4	T	Y	401.04 28.5	In the title of Table 28-95, "HE-MCSs for optional non-OFDMA 160 MHz and 80+80 MHz" should be changed to "HE-MCSs for optional 2*996-tone RU and optional non-OFDMA 160MHz and 80+80MHz". Do the same thing for the title of Table 28-96 to Table 28-102.	As per comment		2017/1/9 9:42
7503 Lei Huang	225	1 28.3.3.1	228	17	T	Y	228.17 28.3.3.1	The reference is incorrect. The difference between OFDM and OFMA is illustrated in Figure 28-1, not Table 28-15.	Please fix it.		2017/1/9 9:42
7504 Lei Huang	225	1 28.3.3.2	229	5	E	Y	229.05 28.3.3.2	"...484-tone RU and 996-tone RU and 2*996-tone RU" should be changed to "...484-tone RU, 996-tone RU and 2*996-tone RU".	As per comment		2017/1/9 9:42
7505 Lei Huang	225	1 28.3.3.2	235	26	T	Y	235.26 28.3.3.2	There is lack of the description on 2*996-tone RU.	Add the following description on 2*996-tone RU: "A 2*996-tone RU consists of two 996-tone RUs, each located at each half of the PPDU bandwidth for 160 MHz and 80+80 MHz HE PPDU formats."		2017/1/9 9:42
7506 Lei Huang	225	1 28.3.3.5	237	18	T	Y	237.18 28.3.3.5	The reference is incorrect. The 20MHz-only HE STA is described in 28.3.3.6, not 28.3.9	Please fix it.		2017/1/9 9:42

7507	Lei Huang	225	1 27.8	188	26	T	Y	188.26 27.8	Throughout 27.8, "OMI A-Control field" should be changed to "OM Control subfield"	As per comment	2017/1/9 9:42
7508	Lei Huang	225	1 28.3.3.5	237	19	T	Y	237.19 28.3.3.5	"ROM" should be changed to "OMI"	As per comment	2017/1/9 9:42
7509	Lei Huang	225	1 28.3.3.8.3	239	18	T	Y	239.18 28.3.3.8.3	Throughout the whole paragragh, it is better to change "beamformee group" to "MU-MIMO group" for keeping consistency.	As per comment	2017/1/9 9:42
7510	Lei Huang	225	1 28.3.3.8.3	239	22	T	Y	239.22 28.3.3.8.3	What does a multiplexing information lookup table means? Further clarification is required.	Replacing "From a multiplexing information lookup table for Nuser,r, the ordered number of spatial streams for all members in the beamformee group in RU r, NSS,r,u, u = 1, ..., Nuser,r, is obtained." by "From the spatial configuration fields of user specific blocks for RU r and Nuser,r, the ordered number of spatial streams for all members in the MU-MIMO group in RU r, NSS,r,u, u = 1, ..., Nuser,r, is obtained."	2017/1/9 9:42
7511	Lei Huang	225	1 28.3.3.10.5	240	52	T	Y	240.52 28.3.3.10.5	The User Info field of the Trigger frame does not contain Address field. The AID12 field is used instead.	Changing "Address field" to "the AID12 field" in L52 and L54 of P240	2017/1/9 9:42
7512	Lei Huang	225	1 28.3.6.7	252	34	T	Y	252.34 28.3.6.7	Throughout 28.3.6.7, "Common Block field" should be changed to "Common field"	As per comment	2017/1/9 9:42
7513	Lei Huang	225	1 28.3.6.7	252	49	T	Y	252.49 28.3.6.7	The construction procedure of HE-SIG-B is not correct. Notice that there are two HE-SIG-B content channels. The HE-SIG-B symbols from the first HE-SIG-B content channel are duplicated over every odd numbered 20 MHz of the channel bandwidth while the HE-SIG-B symbols from the second HE-SIG-B content channel are duplicated over every even numbered 20 MHz of the channel bandwidth.	Please fix it.	2017/1/9 9:42
7514	Lei Huang	225	1 28.3.7	256	7	T	Y	256.07 28.3.7	For an HE trigger-based PPDU, the HE-MCS is carried in a User Info field of the Trigger frame soliciting the HE trigger-based PPDU.	Changing "For an HE trigger-based PPDU, it is carried in the User Info fields of the Trigger frame." to "For an HE trigger-based PPDU, it is carried in a User Info field of the Trigger frame soliciting the HE trigger-based PPDU."	2017/1/9 9:42
7515	Lei Huang	225	1 28.3.9	263	7	T	Y	263.07 28.3.9	"where N_HE-SIG-B is the number of OFDM symbols in the HE-SIG-B field" is redundant since N_HE-SIG-B has been defined in the previous page (see L15 of P262)	remove "where N_HE-SIG-B is the number of OFDM symbols in the HE-SIG-B field"	2017/1/9 9:42
7516	Lei Huang	225	1 28.3.11.5.4	321	18	T	Y	321.18 28.3.11.5.4	"N_DBPS.LAST.u = N_DBPS.LAST.init.u" should be changed to "N_DBPS.last.u = N_DBPS.last.init.u".	as per comment	2017/1/9 9:42
7517	Lei Huang	225	1 28.3.11.5.4	321	47	T	Y	321.47 28.3.11.5.4	"a_init" should be changed to "a"	as per comment	2017/1/9 9:42
7518	Lei Huang	225	1 28.3.15.3	344	22	T	Y	344.22 28.3.15.3	The reference for CQI-only feedback is incorrect.	change "9.4.1.64" to "9.4.1.65".	2017/1/9 9:42
7519	Lei Huang	225	1 28.3.12	337	27	T	Y	337.27 28.3.12	The third paragraph of clause 28.3.12 only involves packet extension for HE SU PPDU or HE extended range SU PPDU.	change "For an HE PPDU,..." to "For an HE SU PPDU or HE extended range SU PPDU,..."	2017/1/9 9:42
7520	Lei Huang	225	1 28.3.12	338	50	T	Y	338.50 28.3.12	The HE preamble is inclusive of RL-SIG and HE-SIG-A.	1. T_RL-SIG and T_HE-SIG-A should be removed from (28-114) as well as the equation of N_SYM following (28-114) 2. Update T_HE-PREAMBLE by including T_RL-SIG and T_HE-SIG-A	2017/1/9 9:42

7521	Lei Huang	225	1 28.3.12	339	3	T	Y	339.03 28.3.12	In 28.3.10.7.2, it has been mentioned that HE-SIG-A includes Pre-FEC Padding Factor subfield and PE Disambiguity subfield. In 9.3.1.23, it has also been mentioned that The Packet Extension subfield of the Common Info field indicates the packet extension duration of the trigger-based PPDU response. The first two bits indicate the pre-FEC padding factor and the third bit indicates the PE-Disambiguity. Therefore, the description in L3 to L17 of P339 including Table 28-38 is unnecessary.	1. remove Editor's Note in L1 of P339; 2. remove the description in L3 to L17 including Table 28-38.		2017/1/9 9:42
7522	Lei Huang	225	1 28.3.12	340	13	T	Y	340.13 28.3.12	For an HE extended range SU PPDU, the HE-SIG-A duration is represented by T_HE-SIG-A-R only	remove T_HE-SIG-A from T_HE-PREAMBLE for an HE extended range SU PPDU		2017/1/9 9:42
7523	Lei Huang	225	1 28.3.12	340	19	T	Y	340.19 28.3.12	HE-SIG-A field does not include the Packet Extension subfield	change "b_PE-Disambiguity is PE Disambiguity subfield in the Packet Extension subfield of the HE-SIG-A field" to "b_PE-Disambiguity is PE Disambiguity subfield of the HE-SIG-A field		2017/1/9 9:42
7524	Lei Huang	225	1 9.3.1.23	44	56	T	Y	44.56 9.3.1.23	Regarding packet extension, HE-SIG-A includes 2-bit pre-FEC padding factor subfield and 1-bit PE disambiguity subfield. However, the Trigger frame includes 3-bit packet extension subfield. For keeping consistency, it is better to split 3-bit packet extension subfield in the Trigger frame into a 2-bit pre-FEC padding factor subfield and 1-bit PE disambiguity subfield.	as per comment		2017/1/9 9:42
7525	Leonardo Lanante	225	1 9.4.2.220	93	37	T	N	93.37 9.4.2.220	The Value of OCW, OCWmin and OCWmax was directly based from CW, CWmax, and CWmin from EDCA. But due to the difference between OFDMA random access and DCF, the current equations for OCW, OCWmax and OCWmin are not optimal. Specifically, the current draft allows STAs to pick a zero OCW when the minimum OCW should be one to reflect the fact that it needs to wait for a TF to send a frame..	Redefine the equations for OCWmax, OCWmin and OCW . I have a prepared contribution for this.		2017/1/9 9:42
7526	Leonardo Lanante	225	1 9.3.1.9.7	37	51	T	N	37.51 9.3.1.9.7	AIDs for unassociated STAs are still undefined.	Allow the AP to provide AIDs for unassociated STAs and make them eligible for scheduled OFDMA transmission.		2017/1/9 9:42
7527	Li-Hsiang Sun	225	1 10.3.2.3.7	114	32	T	Y	114.32 10.3.2.3.7	HE PPDU with 'all 1' in TXOP_DURATION should still have EIFS protection if only preamble is decoded by 3rd party STA. Clause 27.11.5 specifies conditions that it can be set to 'all 1' so it is a valid parameter	changed 'if a valid TXOP_DURATION parameter' to 'if there is duration information for NAV setting indicated in the TXOP_DURATION parameter'		2017/1/9 9:42
7528	Li-Hsiang Sun	225	1 10.3.2.4	115	32	T	Y	115.32 10.3.2.4	The next paragraph in 802.11-2016 states "In non-DMG BSS NAVTimeout period is equal to (2 x aSIFSTime) + (CTS_Time) + aRxPHYStartDelay + (2 x aSlotTime). The "CTS_Time" shall be calculated using the length of the CTS frame and the data rate at which the RTS frame used for the most recent NAV update was received.". This paragraph should be updated for 11ax as CTS responding to MU-RTS are sent with a constant CTS_Time	Add the 802.11-2016 paragraph in comment, and add "In case of responding to MU-RTS, CTS_Time is calculated using 6Mbps data rate in non-HT format"		2017/1/9 9:42
7529	Li-Hsiang Sun	225	1 10.3.2.10.3	121	1	T	Y	121.01 10.3.2.10.3	10.7.6.1 in 802.11-2016 states "The following rules determine whether a Control frame is carried in a non-HT, HT or VHT PPDU: ... Otherwise, the Control frame shall be carried in a non-HT PPDU ..." However, the case of MBA in Fig. 10-12c transmitted in HT, VHT, or HE PPDU are not covered	Add 10.7.6.1 in 802.11-2016 to ax draft, and revise the condition to avoid contradiction with baseline text.		2017/1/9 9:42

7530	Li-Hsiang Sun	225	1 10.3.5	122	11	T	Y	122.11 10.3.5	How to set attribute to enable duration based RTS but also disable length-based RTS? Currently disableing length based RTS by setting dot11RTSThreshold to larger than maximum PSDU, also disables the duration-based RTS, based on this sentence	In p122.11 Removes "If dot11RTSThreshold is larger than the maximum PSDU length, all PSDUs shall be delivered without RTS/CTS exchange" Add in clause C.3 dot11RTSThreshold OBJECT-TYPE, but remove "Setting this attribute to be larger than the maximum PSDU size has the effect of turning off the RTS/CTS handshake for frames of Data or Management type transmitted by this STA"	2017/1/9 9:42
7531	Li-Hsiang Sun	225	1 10.9	127	18	E	Y	127.18 10.9	The paragraph misses some newly introduced control ID	add description for value of 6	2017/1/9 9:42
7532	Li-Hsiang Sun	225	1 10.28.3	136	50	T	Y	136.50 10.28.3	How would a non-HE STA expect a response of MBA?	removes "Multi-STA BlockAck"	2017/1/9 9:42
7533	Li-Hsiang Sun	225	1 10.28.4	137	10	T	Y	137.10 10.28.4	If the RD initiator sends a multi-TID AMPDU with RDG=1, how does the RD responder determine the primary AC? In 10.9, it says "The HT Control field of all MPDUs containing the HT Control field aggregated in the same A-MPDU shall be set to the same value.", so it is difficult to determine which AC granted the RDG	Clarify "the same AC" means the lowest AC in case of a multi-TID AMPDU from RD initiator	2017/1/9 9:42
7534	Li-Hsiang Sun	225	1 27.4.3	159	34	T	Y	159.34 27.4.3	If the negotiated buffer size is within [1, 64], not only it satisfies the 1st bullet, it also satisfies all following bullets, so it can use a length 256 bitmap	Change in p159.36 [1, 256] to [65, 256] Change in p159.43 [1,128] to [65, 128] Change in p159.45 [1.256] to [129,256]	2017/1/9 9:42
7535	Li-Hsiang Sun	225	1 27.3.4.2	155	56	T	Y	155.56 27.3.4.2	How does an MPDU or S-MPDU carry more than 1 dynamic fragments?	removes "or more"	2017/1/9 9:42
7536	Li-Hsiang Sun	225	1 9.4.2.218.2	79	42	T	Y	79.42 9.4.2.218.2	Maximum A-MPDU Length Exponent definition and encoding are missing	moves p80.26~39 to the table	2017/1/9 9:42
7537	Li-Hsiang Sun	225	1 9.7.1	106	32	T	Y	106.32 9.7.1	The EOF field description does not take into account of ack-enabled Multi-TID A-MPDU, in which EOF could be set to 1 but not for padding and not for S-MPDU as described in the table	add 'Set to 1 in the MPDU delimiter of a multi-TID A-MPDU as described in 27.0.4' before 'Set to 0 otherwise'	2017/1/9 9:42
7538	Li-Hsiang Sun	225	1 10.2.7 (not exist)	113	22	T	Y	113.22 10.2.7 (not exist)	10.2.7 of 802.11-2016 specifies that 'an MSDU is transmitted using an HT-immediate or HT-delayed block ack agreement or when the MSDU or MMPDU is carried in an A-MPDU that does not contain a VHT single MPDU, in which case the MSDU or MMPDU is transmitted without fragmentation.'. The block ack agreement used in 11ax is considered HT-immediate BA agreement. This clause in baseline contradicts with dynamic fragementation	add 10.2.7 of 802.11-2016 to the ax draft and revise the condition in comment to allow dynamic fragmentation	2017/1/9 9:42
7539	Li-Hsiang Sun	225	1 27.3.3.4	154	41	T	Y	154.41 27.3.3.4	The level 3 dynamic fragmentation currently has its own BA action frame for BA agreement negotiation, unlike level 1 and 2 that uses ADDBA extention of the existing BA action frame. It should be consolidated using the same mechanism as in level 1 and 2	Revise the description and ADDBA extension to include level-3 negotiation	2017/1/9 9:42
7540	Li-Hsiang Sun	225	1 27.3.4.3	156	6	T	Y	156.06 27.3.4.3	The description misses the case that the receiver responding to a ack-enabled multi-TID A-MPDU	In L6 and L42, add 'A Multi-STA Block Ack when the receiived fragment is contained in a multi-TID A-MPDU that solicits an immediate response'	2017/1/9 9:42
7541	Li-Hsiang Sun	225	1 27.3.4.3	156	10	T	Y	156.10 27.3.4.3	It is not clear why MBA is tied to responding to soliciting S-MPDU carried in trigger-based PPDU. It could be sent as in Figure 10-12b using ack frame. In addition, MBA could be sent in UL as an ack to a DL-Multi-TID A-MPDU	In L 10 and L 46, remove "that contains the acknowledgement for the soliciting S-MPDU carried in an HE trigger-based PPDU"	2017/1/9 9:42
7542	Li-Hsiang Sun	225	1 27.10.3	193	19	T	Y	193.19 27.10.3	The sentence 'The STA shall not add an A-MPDU subframe with EOF equal to 0 after any A-MPDU subframe with EOF set to 1' is not correct because ack-enabled multi-TID A-MPDU could have EOF set to 1, followed by A-MPDU subframes from another TID	change to "The STA shall not add an A-MPDU subframe with EOF equal to 0 after any A-MPDU subframe with EOF set to 1 and MPDU Length field >0'	2017/1/9 9:42

7543 Li-Hsiang Sun	225	1 27.10.4	194	24	E	Y	194.24 27.10.4	This requirement is a duplicate of the requirement described in P195.16	remove the paragraph	2017/1/9 9:42
7544 Li-Hsiang Sun	225	1 27.3.4.1	155	52	T	Y	155.52 27.3.4.1	The capability of rx fragmentation level is not necessarily the same as what level of fragmentation preferred to tx. There should be a requirement that in ADDBA response frame the value of HE Fragmentation Operation subfield should not be greater than the value of HE Fragmentation Operation subfield in the ADDBA Request frame	add 'The value of HE Fragmentation Operation subfield in ADDBA Response frame shall not be greater than the value of HE Fragmentation Operation subfield in the ADDBA Request frame	2017/1/9 9:42
7545 Li-Hsiang Sun	225	1 27.5.2.6.2	173	33	T	Y	173.33 27.5.2.6.2	Is a new attempt to use UL OFDMA random access after a successful UL OFDMA based random acces transmission, considered 'Initial HE triggered-based PPDU transmission' in L30? If yes, what happens if the OBO counter is not 0 when new attempt starts, should OBO counter still needs to be re-initialized as described in L 33?	describe whether a new attempt to use UL OFDMA should use the residual OBO counter values, or re-initialize it.	2017/1/9 9:42
7546 Li-Hsiang Sun	225	1 27.5.2.6.2	173	62	T	Y	173.62 27.5.2.6.2	It is not clear how STA without AID could participate the UL MU ack procedure in 10.3.2.10.3.	describe specifically how STA without AID acquires its ack following the procedure in 10.3.2.10.3, when there are multiple acks to multiple STA without AID	2017/1/9 9:42
7547 Lisa Ward	225	1 28.3.18.1	353	52	T	N	353.52 28.3.18.1	Not all 11ax signal analyzer solutions are capable of the current RBW (25 kHz) and VBW (kHz) settings and we'd like to recommend 30 khz RBW and 10 kHz VBW .. Since, the 11ax settings are based on scaling the settings of the legacy spectral mask, I tried to research the reasons behind the legacy 11a 100 KHz RBW and 30 KHz VBW settings in order to determine if there was some specific importance in those settings but was unable to find anything in the archived documents on the 802.11 website. Since I can find no specific reasons for the 100K and 30 KHz settings in legacy OFDM PHY, I can see no real value to setting the 11ax RBW and VBW requirements based on perfect scaling of them.	Change: Measurements shall be made using a 25 kHz resolution bandwidth and a 7.5 kHz video bandwidth. to: Measurements shall be made using a 30 kHz resolution bandwidth and a 10 kHz video bandwidth.	2017/1/9 9:42
7548 Lisa Ward	225	1 28.3.18.4.4	357	38	E	N	357.38 28.3.18.4.4	Consistent terminology? In table 28-11 for tone allocation related constants in OFDMA, it states that NST=NSD+NSP where NST is the total number of subcarriers per RU, NSD is the total number of complex data numbers per RU, and NSP is the number of pilot subcarriers. However, in equations 28-122 and 28-124 NST is defined as the total number of data tones of occupied RU. I wonder if for consistency/clarity, either the term NSD should be used OR change the NST definition in eq 28-122 and 28-124 to be defined as total number of subcarriers in occupied RU.	Change NST to NSD in equations 28-122 and 28-124 or change NST definitions in those equations to total number of subcarriers in used RU.	2017/1/9 9:42
7549 Lisa Ward	225	1 28.3.18.2	354	47	E	N	354.47 28.3.18.2	typo in subcarrier index in table 28-44, it says +3 to +3441 for the 80 MHz subcarrier indices. Suggest changing 3441 to 344	Change +3441 to +344	2017/1/9 9:42

7550	Lisa Ward	225	1 27.4.4.5	162	23	E	N	162.23 27.4.4.5	Missing word in following sentence or perhaps a type? & also a typo --too many '.' after 'context' : The AP may respond with group addressed Multi-STA BlockAck frame(s) in an HE MU PPDU if the receivers of group-addressed Multi-STA BlockAck frame announce the support the reception of MU Multi-STA BlockAck frame. The Ack Type field shall be set according to the acknowledgement context..	Change to "The AP may respond with group addressed Multi-STA BlockAck frame(s) in an HE MU PPDU if the receivers of group-addressed Multi-STA BlockAck frame announce they support the reception of MU Multi-STA BlockAck frame. The Ack Type field shall be set according to the acknowledgement context." OR "The AP may respond with group addressed Multi-STA BlockAck frame(s) in an HE MU PPDU if the receivers of group-addressed Multi-STA BlockAck frame announce the support of the reception of MU Multi-STA BlockAck frame. The Ack Type field shall be set according to the acknowledgement context."	2017/1/9 9:42
7551	Liwen Chu	225	1 9.4.2.200	74	4	E	Y	74.04 9.4.2.200	Change to "In a TWT element transmitted by a TWT requesting or scheduled STA, the TWT wake interval is equal to the average time that the TWT requesting STA or TWT scheduled STA expects to elapse between successive TWT SPs."	As in comment	2017/1/9 9:42
7552	Liwen Chu	225	1 27.6.2	176	23	T	Y	176.23 27.6.2	Remove "to the STA" from the sentence	As in comment	2017/1/9 9:42
7553	Liwen Chu	225	1 9.4.2.200	74	55	E	Y	74.55 9.4.2.200	temorary primary channel?	As in comment	2017/1/9 9:42
7554	Liwen Chu	225	1 9.4.2.218.2	78	50	T	Y	78.50 9.4.2.218.2	STA is the transmitter of A-BSR. It is not necessary to indicate whether a STA can transmit A-BSR.	As in comment	2017/1/9 9:42
7555	Liwen Chu	225	1 9.4.2.218.2	79	21	T	Y	79.21 9.4.2.218.2	There is no such thing of non-broadcast RU for group-addressed frame	Remove the capability bit	2017/1/9 9:42
7556	Liwen Chu	225	1 9.4.2.218.2	79	42	T	Y	79.42 9.4.2.218.2	The definition of "Maximum AMPDU Length Exponent" field is missing.	Add the definition.	2017/1/9 9:42
7557	Liwen Chu	225	1 9.4.2.218.3	79	42	T	Y	79.42 9.4.2.218.3	It is not necessary to add Dual Band Support in HE PHY Capabilities Information field. If it is 1, what does it mean and what is the purpose of it?	Remove Dual Band Support from the field.	2017/1/9 9:42
7558	Liwen Chu	225	1 9.4.2.218.3	83	22	T	Y	83.22 9.4.2.218.3	It is not necessary for a transmitter to announce its transmitting capability of a feature to the receiver.	Change the definition per the comment	2017/1/9 9:42
7559	Liwen Chu	225	1 9.4.2.218.3	83	34	T	Y	83.34 9.4.2.218.3	It is not necessary for a transmitter to announce its transmitting capability of a feature to the receiver.	Change the definition per the comment	2017/1/9 9:42
7560	Liwen Chu	225	1 9.4.2.218.4	86	60	T	Y	86.60 9.4.2.218.4	This is no such thing of Channel Bandwidth Set field	Use the defined field.	2017/1/9 9:42
7561	Liwen Chu	225	1 9.4.2.219	91	39	T	Y	91.39 9.4.2.219	This paragraph should be removed since the following paragraph replaces it.	As in comment	2017/1/9 9:42
7562	Liwen Chu	225	1 9.4.2.221	94	53	T	Y	94.53 9.4.2.221	"except that a value 0 of the AIFSN field indicates that the AIFS is equal to the value of the MU EDCA Timer " This is ok for the first backoff per MU EDCA parameters after being triggered. The normative text doesn't say for the following backoff after scheduled by Trigger MU EDCA timer is set to the value of MU EDCA Timer.	Clarify the text and harmonize the normative behavior with the text here.	2017/1/9 9:42
7563	Liwen Chu	225	1 9.4.2.224	96	53	T	Y	96.53 9.4.2.224	The start time of SP per PPDU TX time is not good because of the retransmission of the frame: the receiver can't discard the duplicated frame. It is simpler to replace the offset field with a start timer field.	As in comment	2017/1/9 9:42
7564	Liwen Chu	225	1 9.7.1	107	1	T	Y	107.01 9.7.1	Change "VHT PPDU" to "VHT and HE PPDU"	As in comment	2017/1/9 9:42
7565	Liwen Chu	225	1 9.7.1	107	13	T	Y	107.13 9.7.1	Change the note to "NOTE--The format of the MPDU Length field maintains a common encoding structure for both HE, VHT and HT PPDUs. For HT PPDUs, only the MPDU Length Low subfield is used, while for VHT and HE PPDUs, both subfields are used."	As in comment	2017/1/9 9:42

7566	Liwen Chu	225	1 9.7.1	110	53	T	Y	110.53 9.7.1	Change to "One or more Trigger frames where the Trigger Type field is Basic Trigger, MU-BAR,or BSRP." to "One or more Trigger frames where the Trigger Type field is Basic Trigger, MU-BAR, or BSRP, or BQRP." Change to "Basic Trigger frame or BSRP Trigger frame only when AP transmits the A-MPDU" to "Basic Trigger frame, or BSRP Trigger frame or BQRP Trigger frame only when AP transmits the A-MPDU"	As in comment	2017/1/9 9:42
7567	Liwen Chu	225	1 10.3.2.4	114	51	T	Y	114.51 10.3.2.4	"If the STA is an HE STA, the STA is a TXOP holder, and the frame is solicited by the STA, then the STA shall not update its NAV." If the STA is a TXOP holder, the STA will never update the NAV per the received PPDU from the TXOP resopnder. This is true for 11a/b/g/n/ac STA, and is also true for HE STA. The reason is that the received Duration will not be larger than the NAV timer value.	Remove the sentence	2017/1/9 9:42
7568	Liwen Chu	225	1 10.3.2.4	114	49	T	Y	114.49 10.3.2.4	"If the STA is an HE STA and the STA is solicited for an immediate response by the PPDU carrying the received frame, the STA shall not update its NAV." This is not needed since the solicited STA is the receiver of the soliciting frame which is similar to NDPA in 11ac.	Remove the sentence	2017/1/9 9:42
7569	Liwen Chu	225	1 10.3.2.8a.3	117	29	T	Y	117.29 10.3.2.8a.3	"The MU-RTS frame is sent by the AP with which the STA is associated and the value of the basic NAV is 0" carrier sensing bullet already cover the text after and. The text before and is not necessary since the MU-RTS is always from the associated STA.	Removing the bullet	2017/1/9 9:42
7570	Liwen Chu	225	1 9.2.4.6.4.7	27	63	T	Y	27.63 9.2.4.6.4.7	Change "assist HE DL HE MU transmission" to "assist HE DL and UL HE MU transmission"	As in comment	2017/1/9 9:42
7571	Liwen Chu	225	1 27.5.1.3	163	16	T	Y	163.16 27.5.1.3	The channel query can be used by both UL and DL MU. Move the subclause outside of DL MU subclause and change the title accordingly.	As in comment	2017/1/9 9:42
7572	Liwen Chu	225	1 27.5.1.3	163	46	T	Y	163.46 27.5.1.3	Add management frame after QoS Null, QoS Data frames	As in comment	2017/1/9 9:42
7573	Liwen Chu	225	1 9.4.2.218.3	86	11	T	Y	86.11 9.4.2.218.3	It is atrange that DL MU on partial BW is defined only for RX side but UL MU on partial BW is defined for both TX and RX sides.	Harmonize the definiition.	2017/1/9 9:42
7574	Liwen Chu	225	1 27.5.2.1	164	24	T	Y	164.24 27.5.2.1	Class A and B should also apply to UL MU also.	Change the text per the comment.	2017/1/9 9:42
7575	Liwen Chu	225	1 27.5.2.4	170	26	T	Y	170.26 27.5.2.4	Here the virtual carrier sensing is not needed if the responding are Ack/BA and the length is less than 418. However CS Required is set to 0 when the length is less than 418 and the responding from all STAs are Ack/BA.	harmonize them	2017/1/9 9:42
7576	Liwen Chu	225	1 27.16	204	56	T	Y	204.56 27.16	It seems a 20MHz HE STA doesn't need to implement VHT features. For sure HE devices in 2.4GHz band don't need to implement VHT features.	Change the text per the comment.	2017/1/9 9:42
7577	Liwen Chu	225	1 27.16	205	1	T	Y	205.01 27.16	The whole paragraph can't be true in 5GHz and 2.4GHz bands.	change the text.	2017/1/9 9:42
7578	Liwen Chu	225	1 27.16	205	18	T	Y	205.18 27.16	2.4GHz band is missing.	Change the text per the comment.	2017/1/9 9:42
7579	Liwen Chu	225	1 27.16	205	24	T	Y	205.24 27.16	"Channel Center Frequency Segment 2" is missing. Add it.	As in comment	2017/1/9 9:42
7580	Liwen Chu	225	1 27.16	205	37	T	Y	205.37 27.16	"Channel Center Frequency Segment 2" is missing. Add it.	As in comment	2017/1/9 9:42
7581	Liwen Chu	225	1 27.15.2	201	36	T	Y	201.36 27.15.2	change the paragraph to "An HE non-AP STA may transmit an HE MU PPDU to a peer STA if it has received from the peer STA an HE Capabilities element with the UL MU PPDU Support field equal to 1; otherwise the STA shall not transmit an HE MU PPDU to the peer STA"	As in comment	2017/1/9 9:42

7582	Liwen Chu	225	1 27.15.2	201	44	T	Y	201.44 27.15.2	Two issues here: 1), HE TRIG PPDU in STBC shouldn't use HE TRIG PPDU since HE TRIG PPDU is only from STA to AP. As a TXOP holder, AP can send wantever PPDU it wants to use. This also contradicts with the following bullet. So HE TRIG PPDU should be removed from the bullet. 2, HE MU PPDU should be added to the bullet.	As in comment	2017/1/9 9:42
7583	Liwen Chu	225	1 27.15.2	201	53	T	Y	201.53 27.15.2	This bullet should be removed since there is no support of transmiting FTM in various HE PPDU formats.	As in comment	2017/1/9 9:42
7584	Liwen Chu	225	1 27.15.3	202	21	T	Y	202.21 27.15.3	"and BW shall be 20 MHz" should be removed from the bullet since responding BW rules already cover this.	As in comment	2017/1/9 9:42
7585	Liwen Chu	225	1 27.15.3	202	30	T	Y	202.30 27.15.3	Change "When the Supported HE-MCS and NSS set of the receiving STA or STAs is not known, the transmitting STA shall transmit using a <HE-MCS, NSS> tuple in the basic HE-MCS and NSS set." to "When the Supported HE-MCS and NSS set of the receiving STA or STAs is not known, the transmitting STA shall transmit using a <HE-MCS, NSS> tuple in the basic HE-MCS and NSS set if basic HE MCS and NSS set is not idle, otherwise the transmitting STA shall transmit using a <HE-MCS, NSS> tuple in the mandatory HE-MCS and NSS set"	As in comment	2017/1/9 9:42
7586	Liwen Chu	225	1 27.15.3	202	33	T	Y	202.33 27.15.3	The text is ambiguous since the protection levels are different per the environment.	Delete the last sentence and add the related text to protection subclause if necessaey.	2017/1/9 9:42
7587	Liwen Chu	225	1 27.15.4.1	203	9	T	Y	203.09 27.15.4.1	There is no such thing of Supported HE-MCS and NSS Set field.	Use the correct name.	2017/1/9 9:42
7588	Liwen Chu	225	1 27.15.4.1	203	14	T	Y	203.14 27.15.4.1	There is no such thing of Rx HE-MCS Map subfield	Use the correct name.	2017/1/9 9:42
7589	Liwen Chu	225	1 27.15.4.2	203	35	T	Y	203.35 27.15.4.2	There is no such thing of Supported HE-MCS and NSS Set field.	Use the correct name.	2017/1/9 9:42
7590	Liwen Chu	225	1 27.15.4.2	203	40	T	Y	203.40 27.15.4.2	There is no such thing of Tx HE-MCS Map subfield	Use the correct name.	2017/1/9 9:42
7591	Liwen Chu	225	1 27.15.4.2	203	54	T	Y	203.54 27.15.4.2	Change "should" to "shall"	As in comment	2017/1/9 9:42
7592	Liwen Chu	225	1 27.15.4.2	203	61	T	Y	203.61 27.15.4.2	Change "should" to "shall"	As in comment	2017/1/9 9:42
7593	Liwen Chu	225	1 27.14.3.1	200	39	T	Y	200.39 27.14.3.1	The following behavior should be added: the AP shall send DL PPDU to STA or trigger UL transmission from STA if the STA has its bit in TIM element being set to 1.	As in comment	2017/1/9 9:42
7594	Liwen Chu	225	1 27.14.3.1	200	62	T	Y	200.62 27.14.3.1	The bahavior is too restrict. When the AP has only DL PPDUs to be transmitted to a STA in TWT broadcast SP and all the buffered frames are discarded, the AP doesn't need to set the bit for the STA in TIM element to 1 in the following TWT SP.	As in comment	2017/1/9 9:42
7595	Liwen Chu	225	1 27.14.3.1	200	45	T	Y	200.45 27.14.3.1	What is the type of the TWT SP?	Clarify it.	2017/1/9 9:42
7596	Liwen Chu	225	1 27.14.3.1	200	49	T	Y	200.49 27.14.3.1	Change "At the beginning of these periodic TWT SPs," to "At the beginning of these periodic TWT SPs with the TWT flow identifier field set to 3,"	As in comment	2017/1/9 9:42
7597	Liwen Chu	225	1 27.14.3.1	200	60	T	Y	200.60 27.14.3.1	What is the type of the TWT SP?	Clarify it.	2017/1/9 9:42
7598	Liwen Chu	225	1 9.4.2.200	73	4	T	Y	73.04 9.4.2.200	Add Ack/BA as the responding frame from scheduled STA. It makes no sense to only do sounding without data frame transmission.	As in comment	2017/1/9 9:42
7599	Liwen Chu	225	1 9.4.2.200	73	30	T	Y	73.30 9.4.2.200	Add Ack/BA as the responding frame from scheduled STA. It makes no sense to only do sounding without data frame transmission.	As in comment	2017/1/9 9:42
7600	Liwen Chu	225	1 9.4.2.200	72	53	T	Y	72.53 9.4.2.200	Add the following restriction "The AP doesn't transmit a TIM frame or a FILS discovery frame including a TIM element at the beginning of the TWT SP."	As in comment	2017/1/9 9:42

7601	Liwen Chu	225	1 27.14.2	200	28	T	Y	200.28 27.14.2	Clarify the following behavior: In a TWT SP whose Broadcast subfield is 1 and TWT Flow Identifier subfield is 2, can a Trigger frame with no contention RU be transmitted? If the answer is yes, can Trigger frame that has no allocated contention RU follow Trigger frame which has Cascade Indication field set to 0 and has conttention RU?	Clarify it.	2017/1/9 9:42
7602	Liwen Chu	225	1 27.14.1	199	11	T	Y	199.11 27.14.1	Add the following intra-PPDU power save rules: if a PPDU is from OBSS, the STA can desicard the frame until the end of the PPDU.	As in comment	2017/1/9 9:42
7603	Liwen Chu	225	1 27.12	198	50	T	Y	198.50 27.12	There is no such thing as dot11PPEThresholdsMappingTable.	Clarify it.	2017/1/9 9:42
7604	Liwen Chu	225	1 27.11.4	197	25	T	Y	197.25 27.11.4	Add the following text: "an non-AP STA should use A1, A2, A3 fields for SR decision"	As in comment	2017/1/9 9:42
7605	Liwen Chu	225	1 27.10.4	193	44	T	Y	193.44 27.10.4	Change the text to "An HE transmitter shall not aggregate MPDU that asks for Ack in a multiple-TID A-MPDU to the HE recipient unless the HE transmitter received the recipient's HE Capabilities element with Ack Enabled Multi-TID A-MPDU Support subfield being set to 1"	As in comment	2017/1/9 9:42
7606	Liwen Chu	225	1 27.10.4	194	19	T	Y	194.19 27.10.4	It is not clear whether Action frame accounts for a TID.	Clarify it.	2017/1/9 9:42
7607	Liwen Chu	225	1 27.10.4	194	40	T	Y	194.40 27.10.4	"When any of the buffers is empty" is not right since this means when the buffer of one TID related to the primary AC is empty.	Change to "when the buffers of all TIDs related to the primay AC are empty."	2017/1/9 9:42
7608	Liwen Chu	225	1 27.10.4	194	51	T	Y	194.51 27.10.4	The paragraph at L51 is similar to the paragraph at L24. One of them should be removed.	As in comment	2017/1/9 9:42
7609	Liwen Chu	225	1 27.10.4	195	15	T	Y	195.15 27.10.4	The paragraph at P195 L15 is similar to the paragraph at P194 L24. One of them should be removed.	As in comment	2017/1/9 9:42
7610	Liwen Chu	225	1 27.9.2.1	190	51	T	Y	190.51 27.9.2.1	This is not a sentence.	Delete it.	2017/1/9 9:42
7611	Liwen Chu	225	1 27.9.2.1	190	53	T	Y	190.53 27.9.2.1	Change "SR delay entry" to SR_Delay	As in comment	2017/1/9 9:42
7612	Liwen Chu	225	1 27.9.2.2	192	22	T	Y	192.22 27.9.2.2	The sentence is wrong. Here is an example, suppose the STA which sets OBSS PD level to -76 dbm, it receives the signal strength of inter-BSS PPDU is -72dbm, and the STA set NAV and assumes medium busy. Per "The minimum OBSS_PDlevel used by the STA shall be above the received signal strength of the inter-BSS PPDU, which means that the maximum TXPWRmax shall be calculated with OBSS_PDlevel equal to the received signal strength of the inter-BSS PPDU, with Equation (27-1).", the OBSS PD level is changed to -72dbm and TX Power is changed to TX Power Ref- (-72+82).	Update the sentence or deletre it.	2017/1/9 9:42
7613	Liwen Chu	225	1 27.8.1	188	29	T	Y	188.29 27.8.1	Why management frmae is not mentioned here?	Add management frame.	2017/1/9 9:42
7614	Liwen Chu	225	1 27.8.2	189	8	T	Y	189.08 27.8.2	The meaning of the following sentence is not clear "After transmitting the acknowledgement frame immediate response immediate acknowledgement for the frame containing the OMI A-Control field, the OMI responder may transmit subsequent SU PPDUs or MU PPDUs that are addressed to the OMI initiator."	Clarify it.	2017/1/9 9:42
7615	Liwen Chu	225	1 27.8.1	188	48	T	Y	188.48 27.8.1	The following behavior should be added: a ROM intiator shall not transmit ROMI to a STA that doesn't support the receiption of A-Control with ROMI.	As in comment	2017/1/9 9:42
7616	Liwen Chu	225	1 27.8.3	189	18	T	Y	189.18 27.8.3	Before sending TOMI, the initiator should make sure that the responder can receive OMI Control. Arguablly in this case the reponder can always receive the OMI Control since the responder is always AP. But the sentence is not clear that the responder is always an AP.	Change the sentence to "An OMI initiator that is a non-AP STA may indicate changes in its transmit parameters by sending a frame that contains the OMI A-Control field to the OMI responder which is an AP."	2017/1/9 9:42

7617	Liwen Chu	225	1 27.8	188	17	T	Y	188.17 27.8	NSS behavior is not harmonized with HE Capabilities element.	Change the nomative behavior to make them consistent.	2017/1/9 9:42
7618	Liwen Chu	225	1 27.7.1	179	54	T	Y	179.54 27.7.1	Add the following sentence: "An HE STA can negotiate broasdcast TWT values, as defined in 10.43 (Target wake time (TWT)), subject to the additional rules and restrictions that are defined in 27.7.3 (broadcastTWT agreements)."	As in comment	2017/1/9 9:42
7619	Liwen Chu	225	1 27.7.1	179	66	T	Y	179.66 27.7.1	Change the text to "STAs need not be made aware of the TWT values of other STAs or that a TWT service period (SP) can be used to exchange frames with other STAs."	As in comment	2017/1/9 9:42
7620	Liwen Chu	225	1 27.7.2	180	31	T	Y	180.31 27.7.2	Change "If the TWT responding STA is an AP then it may set the Responder PM Mode subfield to 1 only if all non-AP STAs, which are associated to it, indicate support of TWT in the role of a TWT requester" to "If the TWT responding STA is an AP then it may set the Responder PM Mode subfield to 1 only if all non-AP STAs, which are associated to it, indicate support of TWT in the role of a TWT requester and the AP announces the TWT Required subfield to 1 in its HE Operation element"	As in comment	2017/1/9 9:42
7621	Liwen Chu	225	1 27.7.2	180	48	T	Y	180.48 27.7.2	20MHz operation can be indicated by OMI, operation mode management frame. It is not necessary to add another method.	Change "May set the TWT Channel subfield in the TWT element it transmits to a value that corresponds to the primary channel of the BSS to indicate a 20 MHz operation; otherwise it shall set it to 0" to "Shall set the TWT Channel subfield in the TWT element it transmits to 0"	2017/1/9 9:42
7622	Liwen Chu	225	1 27.7.2	181	4	T	Y	181.04 27.7.2	This is not necessary for the following reasons: 1, TWT Information can do this. 2, TWT Information provide accurate behavior, something can be done something can't be done. 3, with unsolicited TWT response, anything can be done which is bad.	Remove "An HE AP may send an unsolicited TWT response frame with the Trigger subfield equal to 1 to an HE non-AP STA that has set the TWT Requester Support subfield to 1 in the HE Capabilities elements that it transmits to the AP."	2017/1/9 9:42
7623	Liwen Chu	225	1 27.7.2	181	13	T	Y	181.13 27.7.2	"(for both implicit TWT and trigger-enabled TWT)" should be "(for both non trigger-enabled TWT and trigger-emabled TWT)"	As in comment	2017/1/9 9:42
7624	Liwen Chu	225	1 27.7.2	181	19	T	Y	181.19 27.7.2	With these rules, a trigger-enabled TWT allows DL MU with Trigger/A-Control trigger + UL MU acknowledgement only frame exchange. But DL MU +BA/Ack+BAR+BA frame exchange is disallowed.	Allow DL MU +BA/Ack+BAR+BA frame exchange in Trigger-enabled TWT. The simple way is to define trigger-enabled TWT as the STA's transmission is always triggered/solicited by AP's transmission.	2017/1/9 9:42
7625	Liwen Chu	225	1 27.7.2	181	22	T	Y	181.22 27.7.2	"The TWT responding STA that intends to transmit additional Trigger frames during a trigger-enabled TWT SP shall set the Cascade Indication field of the Trigger frame to 1 to indicate that it will transmit another Trigger frame within the same TWT SP. The TWT responding STA shall set the Cascade Indication field to 0 when the Trigger frame is the last Trigger frame of the TWT SP or when the Trigger frame is sent outside of a TWT SP." The sentences are not in line with the behavior of STA's definiiton about the last Trigger frame to a STA.	Harmonize them.	2017/1/9 9:42
7626	Liwen Chu	225	1 27.7.2	182	6	T	Y	182.06 27.7.2	The behavior of a STA which is scheduled by Trigger with Cascade Indicate being 0 is not defined.	Add the following text:"The finishing of frame exchange solicted by a Trigger frame with the Cascade Indication field equal to 0 that is intended to the STA and does not allocate any random RU during an unannounced TWT"	2017/1/9 9:42

7627	Liwen Chu	225	1 27.7.3.1	182	28	T	Y	182.28 27.7.3.1	Change to "A TWT scheduling STA is an HE AP with dot11TWTOptionActivated equal to true that includes Broadcast TWT Support being set to 1 in HE Capabilities element and optionally a broadcast TWT element in the Beacon frame, and follows the rules described in 27.7.3.2 (Rules for TWT scheduling STA).". The reason for this is that since STA and AP can negotiate broadcast TWT. At the begining of BSS operation, the AP may not include broadcast TWT in Beacon.	As in comment	2017/1/9 9:42
7628	Liwen Chu	225	1 27.7.3.1	182	39	T	Y	182.39 27.7.3.1	A STA can both have individual TWT and broadcast TWT. So the following bullet should be deleted: "Has not negotiated any implicit TWT agreement with the HE AP as described in 27.7.2 (Individual TWT agreements)."	As in comment	2017/1/9 9:42
7629	Liwen Chu	225	1 27.7.3.2	184	11	T	Y	184.11 27.7.3.2	"Alternate TWT when the periodic TWT is being modified" This should be removed since TWT Information provide better solution.	As in comment	2017/1/9 9:42
7630	Liwen Chu	225	1 27.7.3.2	184	14	T	Y	184.14 27.7.3.2	Change "it shall set the Trigger field to 0 to indicate an implicit TWT." to "it shall set the Trigger field to 0 to indicate an non Trigger-enabled TWT."	As in comment	2017/1/9 9:42
7631	Liwen Chu	225	1 27.7.3.2	184	42	T	Y	184.42 27.7.3.2	It should be TWT scheduled STA here. For TWT scheduling STA, there is no restriction about the types of frames to be transmitted.	As in comment	2017/1/9 9:42
7632	Liwen Chu	225	1 27.7.3.2	184	42	T	Y	184.42 27.7.3.2	For Flow ID 3, whether random RU can be allocated in UL MU is missing. Add it.	As in comment	2017/1/9 9:42
7633	Liwen Chu	225	1 27.7.3.3	185	38	T	Y	185.38 27.7.3.3	Whether a scheduled STA can do transmission is decided by the MU EDCA parameters. No additional rules are needed.	Change the text per the comment.	2017/1/9 9:42
7634	Liwen Chu	225	1 27.7.3.3	185	42	T	Y	185.42 27.7.3.3	"A TWT scheduled STA that is in PS mode may go to doze state after receiving the Beacon frame and shall be in the awake state at a broadcast TWT start time during which the STA intends to exchange frames with the TWT scheduling STA." This is not harmonized with AP's trigger rules: in a btoadcast TWT SP, AP should schedule the STAs that negotiate the TWT SP with it.	Harmonize them.	2017/1/9 9:42
7635	Liwen Chu	225	1 27.7.3.4	185	42	T	Y	185.42 27.7.3.4	The behavior of the scheduling AP is not complete. Add the following rule: an AP shall not incude Per STA Info of a STA in a TWT SP which is announced in a Beacon whose TBTT is not the STA's wake TBTT.	As in comment	2017/1/9 9:42
7636	Liwen Chu	225	1 27.7.4	187	12	T	Y	187.12 27.7.4	This should not be mandatory at the receiving side.	Change the reception of it to be optional	2017/1/9 9:42
7637	Liwen Chu	225	1 27.6.2	176	26	T	Y	176.26 27.6.2	"otherwise it shall be set to the MAC address of the STA whose AID is included in the STA Info field" This is not true. Otherwise HE sounding can't be used in IBSS, MBSS.	modify it to allow HE sounding in IBSS, MBSS.	2017/1/9 9:42
7638	Liwen Chu	225	1 27.6.2	177	19	T	Y	177.19 27.6.2	Replace YY-1 with realreference.	As in comment	2017/1/9 9:42
7639	Liwen Chu	225	1 27.6.2	177	30	T	Y	177.30 27.6.2	CCFS 2 is not in VHT Operation Information field which needs to be used to decide maxmum 26-tone RU. Include CCFS 2.	As in comment	2017/1/9 9:42
7640	Liwen Chu	225	1 27.6.2	178	22	T	Y	178.22 27.6.2	Change "shall compute the HE compressed beamforming feedback after receiving the HE NDP" to "shall compute the HE compressed beamforming feedback per NDPA's requirement (Feedback Type + Ng + codebook size) after receiving the HE NDP"	As in comment	2017/1/9 9:42

7641	Liwen Chu	225	1 27.6	176	1	T	Y	176.01 27.6	Sounding feedback segmentation rules are missing from the draft. Add them.	As in comment	2017/1/9 9:42
7642	Liwen Chu	225	1 27.5.1.1	162	52	T	Y	162.52 27.5.1.1	A-MPDU in HE DL MU PPDU doesn't use the rules in 27.10.3. Padding rules for A-MPDU in VHT PPDU is used.	As in comment	2017/1/9 9:42
7643	Liwen Chu	225	1 27.5.1.1	162	56	T	Y	162.56 27.5.1.1	Paragraph at L56 is duplicated with the paragraph at L44.	Remove the paragraph at L44	2017/1/9 9:42
7644	Liwen Chu	225	1 27.5.2.2.1	165	21	T	Y	165.21 27.5.2.2.1	This requirement must be true to the last Trigger frame in A-MPDU. Change the text accordingly.	As in comment	2017/1/9 9:42
7645	Liwen Chu	225	1 27.5.2.2.2	166	56	T	Y	166.56 27.5.2.2.2	This paragraph is duplicated with the rules in multi-TID A-MPDU subclause. Delete it.	As in comment	2017/1/9 9:42
7646	Liwen Chu	225	1 27.5.2.2.2	167	6	T	Y	167.06 27.5.2.2.2	It shouldn't be any value from 0 to 7. The value should be less than the STA's maximal TC levels being announced.	As in comment	2017/1/9 9:42
7647	Liwen Chu	225	1 27.5.1	162	36	T	Y	162.36 27.5.1	The rules about when the DL MU frame exchange is successful is missing from the draft.	Add the related rules.	2017/1/9 9:42
7648	Liwen Chu	225	1 27.5.2.3	167	54	T	Y	167.54 27.5.2.3	Add random OFDMA here	As in comment	2017/1/9 9:42
7649	Liwen Chu	225	1 27.5.2.3	169	50	T	Y	169.50 27.5.2.3	MAC padding of A-MPDU in HE TRIG PPDU should be in subcaluse 27	Change the padding subclause.	2017/1/9 9:42
7650	Liwen Chu	225	1 27.5.2.4	170	37	T	Y	170.37 27.5.2.4	"both of the NAVs are considered" Clarify when both NAVs are considered for UL MU transmission.	As in comment	2017/1/9 9:42
7651	Liwen Chu	225	1 27.5.2.6.1	172	35	T	Y	172.35 27.5.2.6.1	It seems reasonable to add BQRP here.	As in comment	2017/1/9 9:42
7652	Liwen Chu	225	1 27.5.2.6.1	173	48	T	Y	173.48 27.5.2.6.1	"If the selected RU is considered busy as a result of either physical or virtual carrier sensing, then the HE STA shall not transmit its HE trigger-based PPDU in the randomly selected RU and it randomly selects any one of the RUs that are assigned to AID value 0 in the subsequent Trigger frame." This violates backoff basic assumption and may create high collision. Change it to "If the selected RU is considered busy as a result of either physical or virtual carrier sensing, then the HE STA shall not transmit its HE trigger-based PPDU in the randomly selected RU and it start another backoff by doubling its CW"	As in comment	2017/1/9 9:42
7653	Liwen Chu	225	1 27.4.1	157	28	T	Y	157.28 27.4.1	This is also applicable to IBSS and MBSS case.	As in comment	2017/1/9 9:42
7654	Liwen Chu	225	1 27.4.1	157	36	T	Y	157.36 27.4.1	Change to "An HE AP may send a Multi-STA BlockAck frame in response to an HE trigger-based PPDU"	As in comment	2017/1/9 9:42
7655	Liwen Chu	225	1 27.4.2	158	53	T	Y	158.53 27.4.2	Change supporting 32 bit capability field to supporting bitmap optimization capability. If a STA does not announce supporting bitmap optimization capability, another STA can't send bitmap 32 to it, bitmap 32/64 to it when 128 bitmap is negotiated, bitmap 32/64/128 to it when 256 bitmap is negotiated.	As in comment	2017/1/9 9:42
7656	Liwen Chu	225	1 27.4.4.1	160	39	T	Y	160.39 27.4.4.1	MU-BAR Trigger is not allowed to be aggregated in A-MPDU. This is like BAR is not allowed to be aggregated in A-MPDU	As in comment	2017/1/9 9:42
7657	Liwen Chu	225	1 27.4.4.5	162	22	T	Y	162.22 27.4.4.5	Since broadcast RU is used to carry group-addressed M-BA. It is mandatory supported by all STAs. Reqrite the paragraph.	As in comment	2017/1/9 9:42
7658	Liwen Chu	225	1 27.3.3.3	154	7	T	Y	154.07 27.3.3.3	Change "...that are not sent under a block ack.." to "...that are sent under a block ack...".	As in comment	2017/1/9 9:42
7659	Liwen Chu	225	1 27.2.1	149	16	T	Y	149.16 27.2.1	The priority of partial AID is missing. Add it.	As in comment	2017/1/9 9:42
7660	Liwen Chu	225	1 27.2.1	152	15	T	Y	152.15 27.2.1	Change "for all the ACs from which QoS Data frames were transmitted in the HE trigger-based PPDU" to "for all the ACs from which QoS Data frames were transmitted successfully in the HE trigger-based PPDU"	As in comment	2017/1/9 9:42
7661	Liwen Chu	225	1 11.49	144	27	T	Y	144.27 11.49	Move the content in 11.49 to subclause 27	As in comment	2017/1/9 9:42

7662 Liwen Chu	225	1 10.3.2.4	114	52	T	Y	114.52 10.3.2.4	"If the STA is an HE STA, the STA is a TXOP holder, and the frame is solicited by the STA, then the STA shall not update its NAV." This sentence is not needed since in 11baseline, a TXOP holder will not update its NAV. Delete it.	As in comment	2017/1/9 9:42
7663 Liwen Chu	225	1 10.3.2.8a.3	117	5	T	Y	117.05 10.3.2.8a.3	Add the folowing text: if the AP detects idle medium, the AP may send CF-End frame before backoff.	As in comment	2017/1/9 9:42
7664 Liwen Chu	225	1 10.3.2.10.1	118	37	T	Y	118.37 10.3.2.10.1	Update Figure 10-11 through removing Ack from the PPDU solicited by BAR	As in comment	2017/1/9 9:42
7665 Liwen Chu	225	1 10.3.2.10.3	120	1	T	Y	120.01 10.3.2.10.3	Change "an AP may send either multiple BlockAck frames (or Ack frames) in an HE MU PPDU, or a Multi-STA BlockAck frame (see 27.4 (Block acknowledgement)). Multi-STA BlockAck frame transmissions are allowed in a non-HT Duplicate PPDU, HT PPDU, VHT PPDU, HE SU PPDU, HE extended range SU PPDU and OFDMA HE MU PPDU." to "an AP may send either multiple BlockAck frames (or Ack frames) in an HE MU PPDU, or a Multi-STA BlockAck frame (see 27.4 (Block acknowledgement)). Multi-STA BlockAck frame transmissions are allowed in a non-HT Duplicate PPDU, HT PPDU, VHT PPDU, HE SU PPDU, HE extended range SU PPDU and OFDMA HE MU PPDU where each multi-STA BlockAck frame is in a broadcast RU."	As in comment	2017/1/9 9:42
7666 Liwen Chu	225	1 10.9	126	43	T	Y	126.43 10.9	The paragraph started with "If the HT variant HT Control field is present in an MPDU, the DEI subfield provides information on the drop eligibility of the..." is missing. Add it back.	As in comment	2017/1/9 9:42
7667 Liwen Chu	225	1 10.22.2.5	130	44	T	Y	130.44 10.22.2.5	Add MU puncturing mode here.	As in comment	2017/1/9 9:42
7668 Liwen Chu	225	1 10.22.2.7	132	1	T	Y	132.01 10.22.2.7	The bullet at L1 should be separated to two cases, DL MU + UL MU acknowledgement, Trigger + UL MU acknowledgement.	As in comment	2017/1/9 9:42
7669 Liwen Chu	225	1 10.22.2.7	131	51	T	Y	131.51 10.22.2.7	HE MU sounding is missing fron the frame exchange sequence. Add it.	As in comment	2017/1/9 9:42
7670 Liwen Chu	225	1 10.22.2.8	133	15	T	Y	133.15 10.22.2.8	Add HE sounding subclause	As in comment	2017/1/9 9:42
7671 Lochan Verma	225	1 9.3.1.23	44	57	T	N	44.57 9.3.1.23	The sentence "first two bits indicate the pre-FEC padding factor and third bit indicates the PE-Disambiguity" is confusing since endianess is not stated.	The bits B34-B35 indicate the pre-FEC padding factor and the bit B36 indicates the PE-disambiguity	2017/1/9 9:42
7672 Lochan Verma	225	1 28.3.12	338	41	T	N	338.41 28.3.12	The sentence "The first two bits in the packet extension subfield indicate the pre-FEC padding factor and the thir bit indicates the PE-disambiguity" does not belong here. Further, if it is retained, the language needs improvement	Delete the sentence.	2017/1/9 9:42
7673 Lochan Verma	225	1 28.3.12	338	59	T	N	338.59 28.3.12	"b_{PE-Disambiguity} is B2 of the Packet Extension subfield of the Common Info field in the Trigger frame" is inaccurate	Replace with "b_{PE-Disambiguity} corresponds to the bit B36 in the Trigger frame"	2017/1/9 9:42
7674 Lochan Verma	225	1 28.3.12	339	8	T	N	339.08 28.3.12	Delete Table 28-38 and its references since the "Packet Extension field in HE-SIG-A" does not exist. In lieu we have "pre-FEC padding factor" and "PE Disambiguity" fields in HE-SIG-A.	refer to comment	2017/1/9 9:42

7675	Lochan Verma	225	1 28.3.12	339	1	T	N	339.01 28.3.12	Remove Editor's Note	One method to resolve Editor's comment is as follows. Delete lines 1 - 18. Edit line 20: "The Pre-FEC Padding Factor in HE-SIG-A is encoded as shown in Table 28-39 (Pre-FEC Padding Factor subfield encoding)." Edit line 40: "The PE-Disambiguity subfield in HE-SIG shall be set to 1 if the condition in Equation (28-115) is met, otherwise it shall be set to 0."	2017/1/9 9:42
7676	Lochan Verma	225	1 28.3.12	338	50	T	N	338.50 28.3.12	Define "m" in the Equation 28-114	refer to comment	2017/1/9 9:42
7677	Lochan Verma	225	1 9.3.1.23	44	50	T	N	44.50 9.3.1.23	"Values 0 - 61 maps to -20 dBm to 40 dBm" is inaccurate in Table 9-25e.	"Values 0 - 60 maps to -20 dBm to 40 dBm"	2017/1/9 9:42
7678	Lochan Verma	225	1 28.3.14.2	341	63	T	N	341.63 28.3.14.2	Reference to MSB bit of the UL Headroom subfield can be clarified further by referring to the exact bit location.	Replace "Note that the MSB bit of the UL Headroom subfield being set to 1 indicates that the STA is transmitting the HE trigger-based PPDU at its minimum Tx^{STA}_{pwr} for the assigned MCS" with "that the bit B5 of the UL Headroom subfield being set to 1 indicates that the STA is transmitting the HE trigger-based PPDU at its minimum Tx^{STA}_{pwr} for the assigned MCS	2017/1/9 9:42
7679	Lochan Verma	225	1 28.3.10.7	274	17	T	N	274.17 28.3.10.7	Specify that values 2-3 are reserved (Table 281-16)	For an HE extended range SU PPDU "Values 2 and 3 are reserved"	2017/1/9 9:42
7680	Lochan Verma	225	1 28.2.2	221	15	T	N	221.15 28.2.2	define in spec meaning of "right" 106-tone RU	refer to comment	2017/1/9 9:42
7681	Lochan Verma	225	1 9.4.1.63	60	53	E	N	60.53 9.4.1.63	In Table 9-76c the 20 MHz (S,E) FB tone corresponding to RU index 8 in the last column of the table is missing	Please refer to 11-16-0836/r1, Table YY-1.	2017/1/9 9:42
7682	Lochan Verma	225	1 9.4.1.63	62	7	E	N	62.07 9.4.1.63	In Table 9-76d the 20 MHz (S,E) FB tone corresponding to RU index 0 in the last column are incorrect.	Please refer to 11-16-836/r1, Table YY-2.	2017/1/9 9:42
7683	Lochan Verma	225	1 9.4.1.63	62	25	E	N	62.25 9.4.1.63	In Table 9-76d the 20 MHz (S,E) FB tone corresponding to RU index 8 in the last column of the table is missing	Please refer to 11-16-0836/r1, Table YY-2.	2017/1/9 9:42
7684	Lochan Verma	225	1 9.4.2.218.3	84	56	T	N	84.56 9.4.2.218.3	Beamformee STS for <= 80' and 'NSTS total for <= 80 MHz' capabilities should be combined into one capability. They mean the same thing since Nsts,total = beamformee STS value	Delete 'Nsts Total for <= 80 MHz'	2017/1/9 9:42
7685	Lochan Verma	225	1 9.4.2.218.3	84	56	T	N	84.56 9.4.2.218.3	Beamformee STS for > 80' and 'NSTS total for > 80 MHz' capabilities should be combined into one capability. They mean the same thing since Nsts,total = beamformee STS value	Delete 'Nsts Total for > 80 MHz'	2017/1/9 9:42
7686	Lochan Verma	225	1 27.6.3	179	1	E	N	179.01 27.6.3	Rules for segmented feedback in HE sounding is missing text from 11-16-773/r4, which was motioned and accepted (CR Motion 95, Aug 2016)	See comment	2017/1/9 9:42
7687	Lochan Verma	225	1 28.3.11.9	327	14	T	N	327.14 28.3.11.9	There is a typo here missing something in the sentence. After "frequency diversity for a", should point out what kind of RU it is here (a 26-, 52, 106-, 242-, 484-, or 996-tone RU).	Refer to comment	2017/1/9 9:42
7688	Lochan Verma	225	1 27.5.1.1	162	46	T	N	162.46 27.5.1.1	Downlink MU-MIMO on Partial Bandwidth Rx' is no HE Capability	Replace with ""An AP shall not transmit to a STA an HE MU PPDU with HE-SIG-B assigning MU-MIMO RU in an DL OFDMA PPDU when the RU does not span the entire PPDU bandwidth, to a STA from which it has not received an HE Capabilities element with DL MU-MIMO on Partial Bandwidth subfield set to 1". "	2017/1/9 9:42
7689	Lochan Verma	225	1 27.5.1.1	162	56	T	N	162.56 27.5.1.1	DL OFDMA With MIMO Support is no capability in HE capabilities	Delete lines 56-59.	2017/1/9 9:42

7690	MARC EMMELMANN	225	1 0	0	0	G	Y	0.00 0	The current amendment to the standard has been produced by a process which was subject to dominance. Technical content contained in the draft has been produced by an interest group external to IEEE 802.11. Produced technical content has been voted into the draft under a process which was subject to "dominance" as concluded by the IEEE 802.11 / EC investigation. Technical content requires a 75% approval to be included in the draft. Several votes conducted to include technical submissions in the draft were conducted while the process was dominated by members of the external interest group. Even though companies having had participated in the interest group have declared that they would no longer participate in the interest group, the established state is that the technical content of the	Apply the special measures to all subsequent votes on the TGax amendment; especially the working group voter pool and any subsequent voter pools should be subject to special measures.	2017/1/9 9:42
7691	Mark Hamilton	225	1 1	1	1	E	Y	1.01 1	11ah D10.0 includes the following editorial instruction: Change "[a] VHT Single MPDU" to "[an] S-MPDU" throughout the baseline draft. This needs to be applied to the baseline quoted text in 11ax.	Change "[a] VHT Single MPDU" to "[an] S-MPDU" throughout the draft	2017/1/9 9:42
7692	Mark Hamilton	225	1 3.2	3	35	E	N	3.35 3.2	For native speakers, the phrase is "a high" (not "an high").	Change "an high" to "a high". Also at P6L42.	2017/1/9 9:42
7693	Mark Hamilton	225	1 3.2	6	53	T	Y	6.53 3.2	The phrases "HE PPDU", "HE BSS", "HE MU/SU PPDU" and "HE-MCS" are used in the text, similarly to the equivalent VHT/HT phrases. These terms should be well-defined.	Define "HE PPDU", similar to HT PPDU and VHT PPDU. Same for "BSS", "MU PPDU", "SU PPDU", "extended range SU PPDU", "trigger-based PPDU", and "MCS".	2017/1/9 9:42
7694	Mark Hamilton	225	1 3.2	6	58	T	Y	6.58 3.2	Define OFDMA (we only have "non-OFDMA")	Add a defintion for OFDMA: Orthogonal Frequency Division Multiple Access (OFDMA): An OFDM-based multiple access scheme where different subsets of subcarriers are allocated to different users of the channel, allowing simultaneous data transmission to or from several users of the channel.	2017/1/9 9:42
7695	Mark Hamilton	225	1 3.2	6	58	T	Y	6.58 3.2	Add a definition of RU	Add a defintition of RU: Resource Unit (RU): A group of subcarriers used within OFDMA to allocate subchannels to users of the channel.	2017/1/9 9:42
7696	Mark Hamilton	225	1 4.3	9	7	E	Y	9.07 4.3	Clause 4 introduction for HE makes more sense after VHT (4.3.14). Maybe that is what's meant?	Change "4.3.12" to "4.3.14"	2017/1/9 9:42
7697	Mark Hamilton	225	1 4.3.14a	9	20	T	Y	9.20 4.3.14a	Combination of "shall support operation ... only" is confusing. It shall only support such operation?	Reword to clarify the relation of "shall support" and "only". Suggest something like "shall support operation in a mode with only 20 MHz channel bandwidth". (If this use of "mode" isn't yet another problem.)	2017/1/9 9:42
7698	Mark Hamilton	225	1 4.3.14a	9	12	T	Y	9.12 4.3.14a	Why say HE works between 1 GHz and 6 GHz, and then only describe 5 GHz and 2.4 GHz operation, and relation to VHT and HT? If HE only works in those bands, just say so.	Change "frequency bands between 1 GHz and 6 GHz" to "the 2.4 GHz and 5 GHz frequency bands".	2017/1/9 9:42
7699	Mark Hamilton	225	1 4.3.14a	9	18	T	Y	9.18 4.3.14a	A VHT STA only optionally supports 160 MHz or 80+80 MHz. Likewise for HE. So, an HE non-AP STA that does not support 160 MHz or does not support 80+80 MHz, is not "also a VHT non-AP STA"?	Reword to relfect intent. Since the requiremnent for bandwidth operation seem to be the same for HE and VHT, perhaps just leave this list of operating modes as "when not operating in 20 MHz-only bandwidth"	2017/1/9 9:42
7700	Mark Hamilton	225	1 4.3.14a	9	24	T	Y	9.24 4.3.14a	An HE AP in 2.4 GHz should also be an HT AP	Add "An HE AP is also an HT AP"	2017/1/9 9:42
7701	Mark Hamilton	225	1 4.3.14a	9	29	T	Y	9.29 4.3.14a	These features are not present in an HT AP, either.	Delete "non-AP". Same thing on P9L48.	2017/1/9 9:42
7702	Mark Hamilton	225	1 4.3.14a	9	52	T	Y	9.52 4.3.14a	What is "dynamic fragmentation level 0"? (The PICS has no reference for it, either)	Clarify what is meant by "dynamic fragmentation level 0", probably in 27.3.2, and put in the reference in the PICS	2017/1/9 9:42
7703	Mark Hamilton	225	1 4.3.14a	9	65	T	Y	9.65 4.3.14a	This statement is not intended to be normative, but a declaration that the normative capability is specified later in the text	Change "may" to "can"	2017/1/9 9:42

7704	Mark Hamilton	225	1 6.3.3.3.2	11	26	T	Y	11.26 6.3.3.3.2	HE Capabilities and HE Operation values are only present if they were present in a matching Probe Reponse or Beacon for the this BSSDesciptor.	Add, in the Description column, similar language to that in 802.11-2016 for HT Capabilities and VHT Capabilities, to both the HE Capabilities and HE Operation rows.	2017/1/9 9:42
7705	Mark Hamilton	225	1 6.3.4.2.4	12	14	T	Y	12.14 6.3.4.2.4	MLME-JOIN needs to check for unsupported HE-MCS in the Basic HE-MCS and NSS Set.	Add a change to 6.3.4.2.4, to add a paragraph after the similar VHT paragraph: "If the MLME of an HE STA receives an MLME-JOIN.request primitive with a SelectedBSS parameter containing a Basic HE-MCS And NSS Set field in the HE Operation parameter that contains any unsupported <HE-MCS, NSS> tuple, the MLME response in the resulting MLME-JOIN.confirm primitive shall contain a ResultCode parameter that is not set to the value SUCCESS." Same thing in 6.3.11.2.4.	2017/1/9 9:42
7706	Mark Hamilton	225	1 6.3.27	13	58	T	Y	13.58 6.3.27	MLME-DLS.confirm needs HE Capabilities, like MLME-DLS.indication.	Add HE Capabilities parameter and row to MLME-DLS.confirm, similar to the baseline for HT/VHT Capabilities for this primitive.	2017/1/9 9:42
7707	Mark Hamilton	225	1 8.3.5.2.2	15	34	T	Y	15.34 8.3.5.2.2	How is STA_INDEX different from USER_INDEX?	Remove the new parameter. Merge the reference to Table 28-1 into the existing text for USER_INDEX on condition of an HE MU PPDU.	2017/1/9 9:42
7708	Mark Hamilton	225	1 9.2.4.1.8	19	40	T	Y	19.40 9.2.4.1.8	Bad use of "can". This does not appear to be a declarative statement that this is defined elsewhere, but rather a future potential statement.	Change "can" to "might". Same thing at P19L49.	2017/1/9 9:42
7709	Mark Hamilton	225	1 9.2.4.5.4	20	44	T	Y	20.44 9.2.4.5.4	Ambiguous addition. Also, unnecessary behavioral text.	Presumably, the two paragraphs before the insertion are for the cases when the frame is not carried in a DL HE MU PPDU. So, add "For a frame not carried in a DL HE MU PPDU, and ..." to the beginning of both paragraphs. Reword the added text, following the colon, to "An immediate response in an HE Trigger-based PPDU is expected." Delete the following sentence completely, as this is behavior described in clause 10.	2017/1/9 9:42
7710	Mark Hamilton	225	1 9.2.4.5.6	21	2	T	Y	21.02 9.2.4.5.6	Addition causes ambiguity. A sentence is added that starts "A non-AP HE STA uses ...". Is this intended to be in addition to how other STAs use it, or an exclusive (exhaustive) list of the STAs that use it? (There is no other text saying how other STAs use it, hence the confusion caused.)	Add text describing which other STAs (HE APs, non-HE STAs, etc.?) use this subfield, and what they are indicating, if it is different from what a non-AP HE STA is indicating.	2017/1/9 9:42
7711	Mark Hamilton	225	1 9.2.4.5.6	21	6	T	Y	21.06 9.2.4.5.6	Poor change of "might" to "can". "Can" is discouraged, because it causes potential confusion. Generally, agreed (per Style Guide) that 'can' is used when there is a normative statement giving the option, that is made elsewhere, and the text with 'can' is referencing that statement. That is not the case here. 'Might' is the better choice, as this is a possible future action that a device could take, without any normative text for the stuation.	Revert the change from 'might' to 'can', so the baseline text ('might') remains unchanged.	2017/1/9 9:42
7712	Mark Hamilton	225	1 9.2.4.5.6	21	13	T	Y	21.13 9.2.4.5.6	Why overload the meaning of this subfield, for HE versus non-HE transmitters? This reaults in receivers that are compatible with both HE and pre-HE peers to process the field values differently depending on the source's capabilities (which are potentially non-obvious from the frame itself.)	Remove the HE versus non-HE distinction.	2017/1/9 9:42
7713	Mark Hamilton	225	1 9.2.4.6.4.1	22	60	T	Y	22.60 9.2.4.6.4.1	Unnecessary constraint. If a Control subfield with Control ID equal to 0 (UL MU response scheduling) is present, then the entire Aggregated Control field is filled, so "first" is meaningless.	Delete the sentence "The Control subfield with Control ID subfield equal to 0, if present, is fhte first subfield of the sequence.	2017/1/9 9:42
7714	Mark Hamilton	225	1 9.2.4.6.4.1	22	60	T	Y	22.60 9.2.4.6.4.1	There is no clear constraint that all the Control subfields must have total length of 26 bits or less.	Add a sentence, "The total length of all Control subfields contained in the Aggregate Control subfield must be 26 bits or less."	2017/1/9 9:42

7715 Mark Hamilton	225	1 9.2.4.6.2	24	24	T	Y	24.24 9.2.4.6.2	Can refers to normative permission, not appropriate in this note	Change "can not satisfy" to "is unable to satisfy"	2017/1/9 9:42
7716 Mark Hamilton	225	1 9.2.4.6.4.3	24	54	T	Y	24.54 9.2.4.6.4.3	Can refers to normative permission, not appropriate here	Change "can receive" to "is capable of receiving"	2017/1/9 9:42
7717 Mark Hamilton	225	1 9.2.4.6.4.3	25	1	T	Y	25.01 9.2.4.6.4.3	Can refers to normative permission, not appropriate here	Change "can transmit to "is capable of transmitting	2017/1/9 9:42
7718 Mark Hamilton	225	1 9.2.4.6.4.4	25	28	E	Y	25.28 9.2.4.6.4.4	For everyone's sanity, but a hyphen in all occurances of "HE MCS"	Replace "HE MCS" with "HE-MCS" throughout	2017/1/9 9:42
7719 Mark Hamilton	225	1 9.2.4.6.4.5	27	9	T	Y	27.09 9.2.4.6.4.5	This is a normative permission. In clause 9, state it declaratively.	Change "can remain" to "optionally remains"	2017/1/9 9:42
7720 Mark Hamilton	225	1 9.2.4.6.4.7	28	53	T	Y	28.53 9.2.4.6.4.7	Use of "may" in a NOTE	Change "may" to "might"	2017/1/9 9:42
7721 Mark Hamilton	225	1 9.2.4.7.1	29	57	T	Y	29.57 9.2.4.7.1	Also reference HE Capabilities Information field, which has further MPDU length info (Length Exponent)	Add Table 9-262z to the "see also" in the HE PPDU column	2017/1/9 9:42
7722 Mark Hamilton	225	1 9.2.4.7.1	30	25	E	Y	30.25 9.2.4.7.1	Reference should be to HE PHY characteristics table	Change reference from Table 21-29 to Table 28-46, in HE PPDU column	2017/1/9 9:42
7723 Mark Hamilton	225	1 9.2.5.2	30	65	E	N	30.65 9.2.5.2	Add to the editing instructions to renumber after the insertion	Add "... and renumber appropriately" to the editing instructions.	2017/1/9 9:42
7724 Mark Hamilton	225	1 9.2.5.2	31	33	T	Y	31.33 9.2.5.2	Requirement is too vague. How many "multiple BlockAck frames, Ack frames" should be accounted for?	Specify the requirement in sufficient detail to be implementable/testable.	2017/1/9 9:42
7725 Mark Hamilton	225	1 9.3.1.8.2	33	54	E	Y	33.54 9.3.1.8.2	Modification to obsolete text. Subclause 9.3.1.8.2 is marked as obsolete in 802.11-2016.	Remove this change.	2017/1/9 9:42
7726 Mark Hamilton	225	1 9.3.1.9.1	34	23	T	Y	34.23 9.3.1.9.1	The implication of adding "or the address of the recipient STA..." is that this is not always the transmitter of the soliciting frame. If that is the case (there is a different possibility for transmitter and recipient), that case needs to be clarified. Also, "the recipient STA whose data/management frames are acknowledged" is confusing.	Delete after the "or", or clarify when this other alternative is supposed to be used. Reword the end of the sentence to clarify the STA being referenced. (STAs don't "own" frames, so "whose" is confusing. Perhaps it is the STA that transmitted the frames being acknowledged?) Same thing at P34L33 (for the HE non-AP STA).	2017/1/9 9:42
7727 Mark Hamilton	225	1 9.3.1.9.1	34	25	E	N	34.25 9.3.1.9.1	Suggest a new paragraph for the Multi-STA Block Ack case	Start a new paragraph at the first occurance of "An HE AP that transmits"	2017/1/9 9:42
7728 Mark Hamilton	225	1 9.3.1.9.1	34	27	T	Y	34.27 9.3.1.9.1	AID is not a subfield of the Multi-STA BlockAck frame, Per STA Info is the subfield.	Change "AID" to "Per STA Info". ("An HE AP that transmits a Multi-STA BlockAck frame with a single _Per STA Info_ subfield set the RA field ...") Same thing in the next setence, for the HE non-AP STA.	2017/1/9 9:42
7729 Mark Hamilton	225	1 9.3.1.9.1	34	28	E	Y	34.28 9.3.1.9.1	Clarification	Add "all", to clarify that "the same value of the AID subfield in all Per STA Info subfields" is required. (Also, make "values" singular.) Same thing for the non-AP stentence, following.	2017/1/9 9:42
7730 Mark Hamilton	225	1 9.3.1.9.1	34	30	E	N	34.30 9.3.1.9.1	Clarification and simplification.	Change sentence to "Since an HE non-AP STA always transmits ..., it sets the RA field to the TA field ..."	2017/1/9 9:42
7731 Mark Hamilton	225	1 9.3.1.9.1	35	50	T	Y	35.50 9.3.1.9.1	The baseline text that talks about the "GCR field" in subclause 9.3.1.9.1 (802.11-2016 P678L3) will need to be updated, since the subfield has been removed.	TGak has not made its modifications to this text either. Appropriate, and building/matching changes will need to be worked out.	2017/1/9 9:42
7732 Mark Hamilton	225	1 9.3.1.9.3	36	36	T	Y	36.36 9.3.1.9.3	Ambigous use of "can only". Use declarative verbs in clause 9.	Reword this NOTE: "A Compressed ... is not sent to an ... whose ... is not 3." Same thing at P39L30.	2017/1/9 9:42
7733 Mark Hamilton	225	1 9.3.1.9.7	37	23	T	Y	37.23 9.3.1.9.7	There appears to be no such terms as "multi-STA multi-TID" or "multi-STA single TID"	Delete "multi-TID, and multi-STA single TID"	2017/1/9 9:42
7734 Mark Hamilton	225	1 9.3.1.9.7	37	46	T	Y	37.46 9.3.1.9.7	Per STA Info is a poor choice of name, since this subfield can be repeated more than once for a given STA.	Change 'Per STA Info' subfield name to 'Per AID TID Info' subfield. Change the first subfield within this subfield from 'Per AID TID Info' to 'AID TID Info', since there is only one of these per 'Per AID TID Info', and it provides the AID and TID information for that 'Per AID TID' pair.	2017/1/9 9:42
7735 Mark Hamilton	225	1 9.3.1.9.7	37	59	T	Y	37.59 9.3.1.9.7	AIDs are 14 bits. The AID subfield here is a truncated AID.	Change "the AID" to "the 11 least significant bits of the AID"	2017/1/9 9:42
7736 Mark Hamilton	225	1 9.3.1.9.7	38	4	T	Y	38.04 9.3.1.9.7	This is a normative statement, and shouldn't be a NOTE.	Change text to normal (normative) text instead of a NOTE.	2017/1/9 9:42

7737	Mark Hamilton	225	1 9.3.1.9.7	38	15	T	Y	38.15 9.3.1.9.7	Circular definition of BASSC subfield format. The sentence says, "When B0 of the Fragment Number subfield of the Block Ack Starting Sequence Control subfield is 0, the Block Ack Starting Sequence Control subfield is as defined in Figure 9-28." But, without knowing the format of hte BASSC subfield (if it is defined per Figure 9-28 or not), the receiver can't find B0 of the Fragment Number subfield.	Add a paragraph, before the sentence at P39L1: "The Block Ack Starting Sequence Control subfield format, if present, is as defined in Figure 9-28. " Change the start of the paragraph at P38L36, to: "When B0 of the Fragment Number subfield of the Block Ack Starting Sequence Control subfield is 0, the Block Ack Bitmap subfield of the BA Information field conatins an 8-octet, 16-octet, 32-octet or 4-octet bitmap subfield depending on B2-B1 of the Fragment Number subfield ..."	2017/1/9 9:42
7738	Mark Hamilton	225	1 9.3.1.20	40	22	T	Y	40.22 9.3.1.20	If the previously reserved bits in the Sounding Dialog Token field are to be used to distinguish between a VHT NDP Announcement and an HE NDP Announcement, that should be stated explicitly, with appropriate changes to Figure 9-50 and related text.	Add text, a generic VHT/HE NDP Announcement frame format (with "variable" sized STA Info field), and an updated Figure 9-50, indicating a new use for B1 of the Sounding Dialog Token field, as the VHT/HE identifier, that distinguishes these two formats of the STA Info field. Delete the paragraph at P40L22, instead putting this concept earlier in the subclause (near Figure 9-50). Move the baseline text and Figure 9-49 to follow this new text, explicitly for the VHT/HE field set to 0 case. Replace the first sentence at P40L6 with something like "When the VHT/HE field is set to 1, the VHT/HE NDP Announcement frame format is shown in Figure 9-51a."	2017/1/9 9:42
7739	Mark Hamilton	225	1 9.3.1.20	40	39	T	Y	40.39 9.3.1.20	No description of the AID11 subfield.	Insert paragraph: "The AID11 subfield contains the least significant 11 bits of the AID of the STA expected to process this STA Info subfield. The AID11 subfield is equal to zero if the STA is an AP, mesh STA, or a member of an IBSS."	2017/1/9 9:42
7740	Mark Hamilton	225	1 9.3.1.20	41	8	T	Y	41.08 9.3.1.20	Use of "+" for natural language "and" is a poor choice. It can be confused with addition. Also, which bits in the column relate to which subfield is unclear	Change the column heading to "Feedback Type And Ng, and Codebook Size subfield values". Either split the column into two, to indicate which bits are which subfield, or provide a bit mapping hint similar to "B25, B26, B28".	2017/1/9 9:42
7741	Mark Hamilton	225	1 9.3.1.20	41	28	T	Y	41.28 9.3.1.20	How does the Disambiguation subfield prevent this? There is no explanation anywhere I can find.	Add a description (here, or perhaps better in clause 10 or 27) of how this mechanism works.	2017/1/9 9:42
7742	Mark Hamilton	225	1 9.3.1.23	42	26	T	Y	42.26 9.3.1.23	"can" is not appropriate for a normative permission. Use declarative verbs in clause 9.	Change "can include an optional ... and optional ..." to "optionally includes a ... and ..."	2017/1/9 9:42
7743	Mark Hamilton	225	1 9.3.1.23	43	2	T	Y	43.02 9.3.1.23	Use 'shall' for normative requirements.	Change "are required to" to "shall"	2017/1/9 9:42
7744	Mark Hamilton	225	1 9.3.1.23	43	5	T	Y	43.05 9.3.1.23	Use normative verbs to state requirements (or non-requirements)	Change "are not required to consider" to "may ignore"	2017/1/9 9:42
7745	Mark Hamilton	225	1 9.3.1.23	45	36	T	Y	45.36 9.3.1.23	This sentence is confusing. Also, there is no need to say that all User Info fields come before the Padding, that is part of the format per Figure 9-52c.	Reword: "All User Info fields with AID12 not equal to zero appear before any User Info fields with AID12 equal to zero."	2017/1/9 9:42
7746	Mark Hamilton	225	1 9.3.1.23	47	44	T	Y	47.44 9.3.1.23	The Padding field appears to always be "present", just potentially zero length, per Equation 9-ax1. But this text assumes it is non-zero length, but not always present.	Align the text and the Equation. Suggest to remove the "0" case from the Equation, as that allows the text to talk about the special AID without a lot of wording to special-case the zero length padding case.	2017/1/9 9:42
7747	Mark Hamilton	225	1 9.3.1.23	47	46	T	Y	47.46 9.3.1.23	"STAID" here is probably referring to the AID12 subfield of the User Info field. That should be more clear. Also, the Padding field doesn't have any such subfields, so it needs to be explained that this parsed is as if there were a User Info field starting here, so the parser knows it has hit the Padding. Also, per Equation 9-ax1 and 9-ax2, the Padding field is always 2 or 4 octets.	Change "STAID[11:0]" to "AID12". Reword this and the preceeding sentences as, "The Padding field of the Trigger frame, if present, is 2 or 4 octets. The Padding field starts with 0xFFF in the first 12 bits, thus corresponding to a User Info field with the special value of 0xFFF in the AID12 field, and the rest of the bits of the Padding field are all set to one."	2017/1/9 9:42
7748	Mark Hamilton	225	1 9.3.1.23	47	56	T	Y	47.56 9.3.1.23	Math equation is a little messed up.	Add a multiplication glyph between N_DBPS and m_PAD.	2017/1/9 9:42

7749	Mark Hamilton	225	1 9.3.1.23	48	4	T	Y	48.04 9.3.1.23	Math equation is a little messed up. What is "SHORT"?	Replace the comma with a multiplication glyph between N_DBPS and m_PAD. Delete "SHORT" (or explain what it means).	2017/1/9 9:42
7750	Mark Hamilton	225	1 9.3.1.23.1	48	60	T	Y	48.60 9.3.1.23.1	Can refers to normative permission, not appropriate here	Change "can be aggregated by a STA" to "the STA supports aggregating"	2017/1/9 9:42
7751	Mark Hamilton	225	1 9.3.1.23.1	48	64	T	Y	48.64 9.3.1.23.1	This is a normative statement, and shouldn't be a NOTE.	Change text to normal (normative) text instead of a NOTE.	2017/1/9 9:42
7752	Mark Hamilton	225	1 9.3.1.23.4	50	28	E	Y	50.28 9.3.1.23.4	Starting at P50L28 through P51L16 (with exception of the two NOTES about the Trigger Dependent fields) is duplicative of text in 9.3.1.23, for all Trigger frames.	Delete the text from P50L28 to P51L16, except for the two NOTES about Trigger Dependent fields. (These should be NOTEs, as covered by a separate comment.)	2017/1/9 9:42
7753	Mark Hamilton	225	1 9.3.1.23.4	50	43	T	Y	50.43 9.3.1.23.4	The NOTES in 9.3.1.23.4 about the Trigger Dependent fields (both are not present) is normative text, and should not be NOTEs.	Change the text at P50L43 and P51L15 to normal (normative) text instead of NOTEs.	2017/1/9 9:42
7754	Mark Hamilton	225	1 9.3.3.6	53	20	T	Y	53.20 9.3.3.6	Association Request doesn't have a TWT element, according to 9.3.3.5.	Either remove this condition from Association Response, or add TWT element to Assocation Request. Same thing for Reassociation Request/Response.	2017/1/9 9:42
7755	Mark Hamilton	225	1 9.4.1.11	55	54	E	Y	55.54 9.4.1.11	Reference error - Quiet Time Period Action frame is in subclause 9.6.29.	Change clause reference for Quiet Time Period Action frame to 9.6.29.	2017/1/9 9:42
7756	Mark Hamilton	225	1 9.4.1.63	58	25	T	Y	58.25 9.4.1.63	This looks like a definitive, normative requirement.	Change "may take" to "takes"	2017/1/9 9:42
7757	Mark Hamilton	225	1 9.4.2.3	67	44	T	Y	67.44 9.4.2.3	Draft 11ak is using values 125 and 124.	Change "125" to "123"	2017/1/9 9:42
7758	Mark Hamilton	225	1 9.4.2.27	68	19	T	Y	68.19 9.4.2.27	"A STA" is non-specific, but this information is for _this_ STA	Change "A STA" to "The STA" in both occurrances.	2017/1/9 9:42
7759	Mark Hamilton	225	1 9.4.2.218.2	77	55	T	Y	77.55 9.4.2.218.2	Can refers to normative permission, not appropriate here	Change "can be concurrently received by a STA" to "the STA is capable of receiving concurrently"	2017/1/9 9:42
7760	Mark Hamilton	225	1 9.4.2.218.2	77	39	T	Y	77.39 9.4.2.218.2	"a STA" is non-specific, but this information is for _this_ STA	Change "a STA" to "the STA" throughout this subclause (3 occurrances)	2017/1/9 9:42
7761	Mark Hamilton	225	1 9.4.2.218.2	78	21	T	Y	78.21 9.4.2.218.2	Can refers to normative permission, not appropriate here	Change "can aggregate" to "is capable of aggregating"	2017/1/9 9:42
7762	Mark Hamilton	225	1 9.4.2.218.2	78	19	E	Y	78.19 9.4.2.218.2	Potentially confusing language. Reword	Change the Encoding description to "Set to 1 less than the number of TIDs of QoS Data frames that an HE STA is capable of aggregating in a multi-TID A-MPDU."	2017/1/9 9:42
7763	Mark Hamilton	225	1 9.4.2.218.2	78	31	T	Y	78.31 9.4.2.218.2	Can refers to normative permission, not appropriate here	Change "can" to "is capable of"	2017/1/9 9:42
7764	Mark Hamilton	225	1 9.4.2.218.2	78	13	T	Y	78.13 9.4.2.218.2	Clarify what "additional time needed to process" means.	Change the Definition column entry to: "Indicates the amount of time needed from the end of the User Info field with an AID indicating this STA until the end of the PPDU that contains a Trigger frame, for the STA to be able to process a received Trigger frame."	2017/1/9 9:42
7765	Mark Hamilton	225	1 9.4.2.218.2	79	16	E	N	79.16 9.4.2.218.2	Unnecessary confusion caused by "can"	Change "can solicit" to "solicits"	2017/1/9 9:42
7766	Mark Hamilton	225	1 9.4.2.218.2	80	28	T	Y	80.28 9.4.2.218.2	Can refers to normative permission, not appropriate here	Change "can Receive" to "is capable of receiving". Same thing in next sentence, and two similar sentences in the next paragraph.	2017/1/9 9:42
7767	Mark Hamilton	225	1 9.4.2.218.2	80	36	T	Y	80.36 9.4.2.218.2	"is" for normative requirement	Change "is 7" to "is set to 7"	2017/1/9 9:42
7768	Mark Hamilton	225	1 9.4.2.218.3	84	50	T	Y	84.50 9.4.2.218.3	Can refers to normative permission, not appropriate here	Change "can receive" to "is capable of receiving", in both the Definition and Encoding cells.	2017/1/9 9:42
7769	Mark Hamilton	225	1 9.4.2.218.3	84	56	T	Y	84.56 9.4.2.218.3	Can refers to normative permission, not appropriate here	Chane "can be sent to the STA" to "the STA is capable of receiving"	2017/1/9 9:42
7770	Mark Hamilton	225	1 9.4.2.218.3	84	58	T	Y	84.58 9.4.2.218.3	Can refers to normative permission, not appropriate here	Change "can receive" to "is capable of receiving"	2017/1/9 9:42
7771	Mark Hamilton	225	1 9.4.2.218.3	85	6	T	Y	85.06 9.4.2.218.3	Can refers to normative permission, not appropriate here	Change "can receive" to "is capable of receiving", in both the Definition and Encoding cells.	2017/1/9 9:42
7772	Mark Hamilton	225	1 9.4.2.218.3	85	13	T	Y	85.13 9.4.2.218.3	Can refers to normative permission, not appropriate here	Chane "can be sent to the STA" to "the STA is capable of receiving"	2017/1/9 9:42
7773	Mark Hamilton	225	1 9.4.2.218.3	85	15	T	Y	85.15 9.4.2.218.3	Can refers to normative permission, not appropriate here	Change "can receive" to "is capable of receiving"	2017/1/9 9:42
7774	Mark Hamilton	225	1 9.4.2.219	91	64	T	Y	91.64 9.4.2.219	Use 'shall' for normative requirements.	Change "must" to "shall"	2017/1/9 9:42
7775	Mark Hamilton	225	1 9.4.2.219	92	2	T	Y	92.02 9.4.2.219	Redundant text, with behavioral statements, that should not be in clause 9.	Delete this description of behavior (that is already in 11.49.1), and replace with "See 11.49.1."	2017/1/9 9:42
7776	Mark Hamilton	225	1 9.4.2.222	95	43	T	Y	95.43 9.4.2.222	This is a normative permission. In clause 9, state it declaratively.	Change "can be included" to "is optionally included"	2017/1/9 9:42
7777	Mark Hamilton	225	1 9.4.2.223	96	22	T	Y	96.22 9.4.2.223	What does "the HE STA support it can transmit frames" mean?	Clarify. Same thing in 9.4.2.224 and 9.4.2.225.	2017/1/9 9:42

7778	Mark Hamilton	225	1 9.7.3	110	58	E	Y	110.58 9.7.3	Reword to clarify declarative intent of this NOTE.	Reword NOTE 2 to: "It is optional for an AP including a Trigger frame and Block frame to include QoS Data in that A-MPDU." Same thing at P111L32.	2017/1/9 9:42
7779	Mark Hamilton	225	1 10.3.1	113	51	T	Y	113.51 10.3.1	Use proper normative verbs	Change "This mechanism requires STAs to" to When this mechanism is enabled, STAs shall"	2017/1/9 9:42
7780	Mark Hamilton	225	1 10.3.2.10.1	119	7	E	Y	119.07 10.3.2.10.1	Text does not match baseline	Change "Single MPDU" to "VHT single MPDU". (Note capitalization.) (Or, "S-MPDU", per instructions in 11ah.)	2017/1/9 9:42
7781	Mark Hamilton	225	1 10.3.5	122	13	T	Y	122.13 10.3.5	Is this "non-requirement" stated somewhere?	Add to the NOTE a reference to where this is stated normatively.	2017/1/9 9:42
7782	Mark Hamilton	225	1 10.5	122	40	T	Y	122.40 10.5	Use proper normative verbs	Change "is" to "shall be"	2017/1/9 9:42
7783	Mark Hamilton	225	1 10.7	122	52	T	Y	122.52 10.7	Rate selection rules are needed for new HE-MCS options.	New rules, or clarity about applicability of existing rules, is needed for all transmissions that can use the new HE-MCS rates, throughout subclause 10.7.	2017/1/9 9:42
7784	Mark Hamilton	225	1 10.7.6.5.2	123	38	T	Y	123.38 10.7.6.5.2	Why is this only for APs?	Change "An AP that transmits" to "A STA that transmits"	2017/1/9 9:42
7785	Mark Hamilton	225	1 10.7.6.5.2	123	33	T	Y	123.33 10.7.6.5.2	How does this relate to the rest of the (baseline) text? If Multi-STA is unique (and it might be, because there isn't a single "previous frame"), then clarify in the existing text that it applies to BlockAck excpet Multi-STA BlockAck.	Clarify throughout 10.7.6.5 baseline text, where the rules are different for HE, or for new frame types introduced in 11ax (like Multi-STA BlockAck). Especially consider 10.7.6.5.1's limitations on the scope of the new 10.7.6.5.2 text in 11ax draft.	2017/1/9 9:42
7786	Mark Hamilton	225	1 10.24.10.3	134	40	T	Y	134.40 10.24.10.3	There is no "User Identifier" subfield in an MU-BAR frame.	Change "User Identifier" to "AID12". Change "set to the AID" to "set to the least significant 12 bits of the AID".	2017/1/9 9:42
7787	Mark Hamilton	225	1 10.24.10.3	135	53	T	Y	135.53 10.24.10.3	AID12 fields hold only a truncation of AIDs	Change "AID12 fields set to AIDs" to "AID12 fields set to the 12 least significant bits of AIDs"	2017/1/9 9:42
7788	Mark Hamilton	225	1 11.3.5.3	143	49	T	Y	143.49 11.3.5.3	Need to add basic HE-MCS to the association rules in 11.3.5.3	Add a bullet after bullet (h), "The SME shall refuse an association request from an HE STA that does not support all of the <HE-MCS, NSS> tuples indicated by the Basic HE-MCS And NSS Set field of the HE Operation parameter in the MLME-START.request primitive." Same thing in 11.3.5.5. Similarly in 11.4.2.	2017/1/9 9:42
7789	Mark Hamilton	225	1 11.49.1	144	39	T	Y	144.39 11.49.1	To make the AID12 field (in Trigger frames, etc) unique, and the values 0 and 0xFFF in the least significant 12 bits of AID have special meaning, there are more AID assignment rules.	Change title of subclause to "AID assignment rules". Add paragraph that states that the assigned AID may not have 0 or 0xFFF in the least significant 12 bits. Add a paragraph that says the AID must be unique in the least significant 11 bits (to make Tigger and HE ND Announcement work). Or, just say AIDs must be allocated between 1 and 2045 (2046 is also a special value for an unallocated/unused RU). This needs to have an exception for MultiBSSID also, though.	2017/1/9 9:42
7790	Mark Hamilton	225	1 17.3.9.10	145	63	T	Y	145.63 17.3.9.10	Confusing sentence. Doesn't seem necessary.	Delete the sentence "This requirement does not include round trip delay."	2017/1/9 9:42
7791	Mark Hamilton	225	1 17.3.9.10	145	64	T	Y	145.64 17.3.9.10	This sentence should be a NOTE, as it is not adding normative requirements	Change the sentence starting "This requirement is the same ..." to be a NOTE.	2017/1/9 9:42
7792	Mark Hamilton	225	1 27.1	149	10	T	Y	149.10 27.1	What does "are banned" mean?	Replace with "An HE STA shall not support HCCA or TSPECs."	2017/1/9 9:42
7793	Mark Hamilton	225	1 27.1	149	10	T	Y	149.10 27.1	Backward compatibility problems around TSPEC. Since an HE STA is also a VHT STA (per 4.3.14a), to disallow any use of TSPEC by an HE STA means that any peer pre-HE (VHT or older STA) that sends a TSPEC in to the HE STA will get indeterminate and incompatible results.	Clarify the expected behavior for an HE STA when in peer communication with a pre-HE STA, when TSPEC use is attempted.	2017/1/9 9:42
7794	Mark Hamilton	225	1 27.2.2	150	27	T	Y	150.27 27.2.2	Use proper normative verbs	Change this paragraph to, "An HE STA maintaining two NAVs shall fulfil the requirements in 10.3.2.1 (CS mechanism). For such a STA, when both the NAV timers are 0, the virtual CS indication shall be idle; if one or both of the NAV timers is nonzero, the virtual CS indication shall be busy."	2017/1/9 9:42

7795	Mark Hamilton	225	1 27.2.3	152	11	T	Y	152.11 27.2.3	Trigger frame User Info fields only have AID12, not full AIDs.	Change "with the AID of the STA" to "with AID12 matching the least significant 12 bits of the AID of the STA"	2017/1/9 9:42
7796	Mark Hamilton	225	1 27.3.1	152	41	T	Y	152.41 27.3.1	Use proper normative verbs	Change these sentences to, "An HE STA shall support the ... In addition, an HE STA may support the ..."	2017/1/9 9:42
7797	Mark Hamilton	225	1 27.3.1	152	45	T	Y	152.45 27.3.1	U	Change "can" to "may". Same thing at P157L21, and P158L1.	2017/1/9 9:42
7798	Mark Hamilton	225	1 27.3.2	153	3	T	Y	153.03 27.3.2	Use proper normative verbs	Change "The length of each framgement is not required to be equal" to "The length of each fragment may differ"	2017/1/9 9:42
7799	Mark Hamilton	225	1 27.4.1	157	33	T	Y	157.33 27.4.1	This sentence could use some re-wording clarification. However, the concept is already stated in 10.7.6.5.2, anyway - except that sentence says "An AP that ..." which seems overly limiting.	At P123L38 change "An AP that transmits" to "A STA that transmits"	2017/1/9 9:42
7800	Mark Hamilton	225	1 27.4.1	157	36	T	Y	157.36 27.4.1	This sentence implies that any STA that gets an HE trigger-based PPDU can always send a Multi-STA Block Ack. But, the sentence at P157L49 implies that only some HE STAs will support Multi-STA BlockAck. These are inconsistent. Is there anything preventing an AP from sening a Multi-STA BlockAck to a STA that doesn't support it? Also, PICS is blank for this, so unclear if support is Mandatory or not.	If Multi-STA support is optional, where is it indicated (only "All ACK Support" and "Group Addressed Multi-STA Block-Ack In DL MU Support" is currently in the HE Capabilities)? Text needs to be added to clarify that it is optional. The PICS entry is blank, and should indicate Optional.	2017/1/9 9:42
7801	Mark Hamilton	225	1 27.4.3	159	29	T	Y	159.29 27.4.3	Clarify that these bitmap lengths are in bits.	Add "in bits" after "The Block Ack Subfield length" at the start of this sentence.	2017/1/9 9:42
7802	Mark Hamilton	225	1 27.4.3	159	53	T	Y	159.53 27.4.3	Why is there a special case for support of a 32-bit BlockAck Bitmap in a Multi-STA BlockAck?	Delete this paragraph. Also delete this item from the HE Capabilities element in subclause 9.4.218.2.	2017/1/9 9:42
7803	Mark Hamilton	225	1 27.4.3	160	3	T	Y	160.03 27.4.3	Use proper normative verbs	Change "can be used by" to "is supported by"	2017/1/9 9:42
7804	Mark Hamilton	225	1 27.4.3	160	21	T	Y	160.21 27.4.3	Unclear reference, using "it", and vague requirements using "are" (and "may be"?).	Reword this paragraph, to be clear about actors, and use 'shall' as appropriate.	2017/1/9 9:42
7805	Mark Hamilton	225	1 27.4.4.1	160	31	T	Y	160.31 27.4.4.1	Use proper normative verbs	Change "can" to "shall"	2017/1/9 9:42
7806	Mark Hamilton	225	1 27.4.4.4	161	42	E	Y	161.42 27.4.4.4	In this context, the phrase 'sngle MPDU" is just a general use of the English word "single", not a technical term	Change "Single MPDU" to "single MPDU"	2017/1/9 9:42
7807	Mark Hamilton	225	1 27.5.1.3	163	19	T	Y	163.19 27.5.1.3	Use proper normative verbs	Change "delivers" to "shall deliver"	2017/1/9 9:42
7808	Mark Hamilton	225	1 27.5.1.3	163	21	T	Y	163.21 27.5.1.3	Use proper normative verbs	Change "can" to "may". Same thing at P163L35, P164L47, P167L2, P171L12, P171L52, P174L36.	2017/1/9 9:42
7809	Mark Hamilton	225	1 27.5.2.2.1	164	46	T	Y	164.46 27.5.2.2.1	AID12 only has the least significant 12 bits of the AID	Change "AID of the STA" to "12 least significant bits of the AID of the STA"	2017/1/9 9:42
7810	Mark Hamilton	225	1 27.5.2.21	165	24	E	Y	165.24 27.5.2.21	Wording fix	Change "and" to "to" to match the "from".	2017/1/9 9:42
7811	Mark Hamilton	225	1 27.5.2.2.1	165	26	E	Y	165.26 27.5.2.2.1	The subfield name is missing "Duration". Called "field" on line 27.	Add "Duration" at the end of the subfield name on lines 26 and 27. Change "field" to "subfield" on line 27.	2017/1/9 9:42
7812	Mark Hamilton	225	1 27.5.2.2.1	165	26	T	Y	165.26 27.5.2.2.1	This sentence is inconsistent with the next paragraph, and the previous sentence. The only rule we need, is for the AP to protect each non-AP STA's requested time. No need for a maximumizing function.	Delete this sentence.	2017/1/9 9:42
7813	Mark Hamilton	225	1 27.5.2.2.1	165	35	E	Y	165.35 27.5.2.2.1	NOTE 1 is not relevant here. Plus, this concept is clearly stated in 9.3.1.23, and duplication leads to trouble.	Delete NOTE 1	2017/1/9 9:42
7814	Mark Hamilton	225	1 27.5.2.3	167	57	T	Y	167.57 27.5.2.3	AID12 is equal to the least significant 12 bits of the AID	Change "AID12 subfield is equal to the AID" to "AID12 subfield is equal to the 12 least significant bits of the AID"	2017/1/9 9:42
7815	Mark Hamilton	225	1 27.5.2.3	169	30	T	Y	169.30 27.5.2.3	Use proper normative verbs	Change "is not required" to "is optional".	2017/1/9 9:42
7816	Mark Hamilton	225	1 27.5.2.3	169	57	T	Y	169.57 27.5.2.3	Clarify 'required'.	Change "required type" to "type requested by the Trigger frame". Same thing at P170L2.	2017/1/9 9:42
7817	Mark Hamilton	225	1 27.5.2.5	171	56	T	Y	171.56 27.5.2.5	AID12 is equal to the least significant 12 bits of the AID	Change "the STA's AID" to "the 12 least significant bits of the STA's AID". Same thing at P181L43, P184L1. Similarly "recipient's AID" to "12 least significant bits of the reipcient's AID" at P181L44.	2017/1/9 9:42
7818	Mark Hamilton	225	1 27.6.2	176	27	T	Y	176.27 27.6.2	AID in HE NDP Announcement is only the lower 11 bits of the AID	Change "the STA whose AID is" to "the STA whose least significant 11 bits of AID are"	2017/1/9 9:42

7819	Mark Hamilton	225	1 27.6.2	177	55	T	Y	177.55 27.6.2	AID in HE NDP Announcement is only the lower 11 bits of the AID	Change "the HE beamformee's AID" to "the least significant 11 bits of the HE beamformee's AID". Same thing at P178L21, P178L25.	2017/1/9 9:42
7820	Mark Hamilton	225	1 27.7.2	181	2	T	Y	181.02 27.7.2	Use proper normative verbs	Change "shall not be required to" to "may optionally"	2017/1/9 9:42
7821	Mark Hamilton	225	1 27.7.2	181	28	T	Y	181.28 27.7.2	Use proper normative verbs	Change "is not required to" to might optionally". Same thing at P184L25.	2017/1/9 9:42
7822	Mark Hamilton	225	1 27.7.3.3	186	8	T	Y	186.08 27.7.3.3	AID12 is equal to the least significant 12 bits of the AID	Change "AID" to "12 least significant bits of the AID". Same thing at P186L22, P189L51, P189L55.	2017/1/9 9:42
7823	Mark Hamilton	225	1 27.9.2.1	190	24	T	Y	190.24 27.9.2.1	Inconsistency in basic NAV operation. At P150L36, P151L1 and P151L28, a frame (matching the other criteria) that is "cannot be identified as intra-BSS or inter-BSS" will update the basic NAV. But at P190L24, does not include the "cannot be determined" case.	Add "or cannot be identified as intra-BSS or inter-BSS" to the first bullet.	2017/1/9 9:42
7824	Mark Hamilton	225	1 28.1.1	211	64	T	Y	211.64 28.1.1	It says, "... except if the non-AP STA is 20 MHz-only capable", which is not a well-defined term. Per the PICS (and the top of page 210), all HE non-AP STAs are 20 MHz-only "capable" (it is 'M'). I think in this clause it means doing 20 MHz-only operation. (Or, is that called "20 MHz operation", or a "20 MHz operating STA" - see 28.3.3.5?)	Change "20 MHz-only capable" to "a 20 MHz-only STA", at P212L1, and throughout page 212. Clarify (due to the statement at P210L1 that all HE non-AP STAs are inclusive of 20 MHz-only STAs), that the bullets at P212L1, P212L13 and P212L25 when they say "are not applicable/supported" don't mean that all HE non-AP STAs don't apply/suport these.	2017/1/9 9:42
7825	Mark Hamilton	225	1 28.2.2	223	40	E	Y	223.40 28.2.2	Improper use of 'might'. By convention, the statements in the TXVECTOR/RXVECTOR tables are declarative, and reference normative statements elsewhere. Modify to not use 'might', and keep the reference.	Change "might be" to "are"	2017/1/9 9:42
7826	Mark Hamilton	225	1 28.3.3.1	228	16	E	Y	228.16 28.3.3.1	Incorrect cross-reference	Reference should be to Figure 28-1, not Table 28-15.	2017/1/9 9:42
7827	Mark Hamilton	225	1 28.3.3.6	238	3	T	Y	238.03 28.3.3.6	The term "20-MHz only" (and variants) is very confusing. The lack of clear terminology and normative statements in this subclause (and 28.3.3.5) isn't helping.	Rewrite this subclause, using clearly normative words ('shall', etc.) and clarify if this is a capability, a mode of operation, or a limitation of the implementation, and if it is static for the instantiation of the STA. (I think it is static)	2017/1/9 9:42
7828	Mark Hamilton	225	1 28.3.10.7.1	272	57	E	Y	272.57 28.3.10.7.1	Don't make this look like a specification requirement, it is a necessity.	Change "required" to "necessary"	2017/1/9 9:42
7829	Mark Hamilton	225	1 28.3.10.7.2	273	11	T	Y	273.11 28.3.10.7.2	Why list the bits explicitly, and also the "Number of bits" column?	Delete the Number of bits column from Table 28-16. Same thing for Tables 28-17, 28-18, 28-22, and 28-23.	2017/1/9 9:42
7830	Mark Hamilton	225	1 28.3.14.1	340	51	E	Y	340.51 28.3.14.1	Don't make this look like a specification requirement, it is a necessity.	Change "it requires" to "it is necessary to have", and change "by" to "completed by" on the next line.	2017/1/9 9:42
7831	Mark Hamilton	225	1 28.3.14.1	340	55	E	Y	340.55 28.3.14.1	Don't make this look like a specification requirement, it is a necessity.	Change "required" to "necessary"	2017/1/9 9:42
7832	Mark Hamilton	225	1 28.3.14.3	342	59	T	Y	342.59 28.3.14.3	Confusing sentence. Doesn't seem necessary.	Delete the sentence "This requirement does not include round trip delay."	2017/1/9 9:42
7833	Mark Hamilton	225	1 28.3.17.3	346	63	T	Y	346.63 28.3.17.3	Use proper normative verbs	Change sentence to, "If the regulatory domain permits a 160 MHz band plan, then the STA shall be measured for adjacent channel rejection for 160 MHz operation, otherwise such measurement is optional." Similarly for nonadjacent channel, at P347L47.	2017/1/9 9:42
7834	Mark Hamilton	225	1 28.3.17.6.2	348	3	T	Y	348.03 28.3.17.6.2	Sentence is out of place ("also", in addition to what?), and redundant with the following text.	Delete the first setence of 28.3.17.6.2.	2017/1/9 9:42
7835	Mark Hamilton	225	1 28.3.18.1	350	17	T	Y	350.17 28.3.18.1	Is this "non-requirement" stated somewhere?	Add to the NOTE a reference to where this is stated normatively.	2017/1/9 9:42
7836	Mark Hamilton	225	1 28.3.18.2	355	1	T	Y	355.01 28.3.18.2	Use proper normative verbs	Change "requirements apply" to "requirements shall apply". Same thing at P355L44.	2017/1/9 9:42
7837	Mark Hamilton	225	1 B.4.3	407	60	E	Y	407.60 B.4.3	What is "CFIndSTA"? Probably meant "CFIndepSTA".	Change all "CFIndSTA" to "CFIndepSTA" in the PICS	2017/1/9 9:42
7838	Mark RISON	225	1 9.4.2.1	67	19	E	Y	67.19 9.4.2.1	"9.4.2.214" is a stale xref	Change to "9.4.2.219"	2017/1/9 9:42
7839	Mark RISON	225	1			G	Y		Many cross-references are not logically cross-references, and many of those are stale	Make all subclause/figure/table cross-references actual logical cross-references (i.e. clickable)	2017/1/9 9:42

7840	Mark RISON	225	1 27.6.2	176	14	T	Y	176.14 27.6.2	There should be a mechanism to allow an HE BFer to poll for missed segments. It is not clear whether a BRP frame can be used in the SU case, and the BRP variant Trigger frame cannot be used in the MU case as it is preceded by an NDP that will take precedence	Allow Beamforming Report Poll frames to be used to solicit SU retransmission of missed segments (cf. 10.34.5.3). Define a new Trigger frame variant to solicit MU retransmission of missed segments (without a preceding NDP+NDPA). Delete the Feedback Segment Retransmission Bitmap from the Trigger Dependent User Info field of the Beamforming Report Poll variant Trigger frame (leaving it blank); this is the field needed for the new Trigger frame variant to solicit retransmission of missing segments	2017/1/9 9:42
7841	Mark RISON	225	1 27.2.1	149	51	T	Y	149.51 27.2.1	A frame without BSS_COLOR that is part of a Multiple BSSID Set but is not the BSSID of the AP to which the STA is associated will be identified as both infra-BSS (line 27) and inter-BSS (line 51). This does not appear to be the intention (line 58), and is not resolved by giving priority to MAC address decisions (page 150 line 15).	Either: i) Expand the precedence rule on (page 150 line 15) so that the intra-BSS designation takes priority over the inter-BSS designation, -or- ii) Gate the inter-BSS BSSID check (page 149 line 51) on the AP not being a member of a Multiple BSSID Set.	2017/1/9 9:42
7842	Mark RISON	225	1 27.2.2	150	57	E	Y	150.57 27.2.2	"The STA is not solicited an immediate response" is non-grammatical and does not make sense.	Change the bullet to "An immediate response is not solicited from the STA by the PPDU carrying the frame".	2017/1/9 9:42
7843	Mark RISON	225	1 27.2.2	151	5	E	Y	151.05 27.2.2	"The STA is not solicited an immediate response" is non-grammatical and does not make sense.	Change the bullet to "An immediate response is not solicited from the STA by the PPDU carrying the frame".	2017/1/9 9:42
7844	Mark RISON	225	1 27.2.2	151	50	T	Y	151.50 27.2.2	Reference is made to additional conditions that may set or reset the NAV in 10.4.3.3, but it is not explicit whether this applies to the intra-BSS NAV, the basic NAV, or both.	Specify that: i) The NAV updated from the CDPMaxDuration or CFPDurRemaining value is selected based on the intra-BSS or inter-BSS designation of the received Beacon or Probe Response frame. Ii) The NAV is reset in response to CF-End or CF-End +CF-Ack frames as specified in 10.22.2.9.	2017/1/9 9:42
7845	Mark RISON	225	1 27.5.2.3	167	59	T	Y	167.59 27.5.2.3	The behaviour if the STA is not associated with the AP is "TBD".	Delete the final sentence of the first bullet; if the STA is not associated with the AP then it should not send an HE trigger-based PPDU and hence is handled by the final bullet (line 64).	2017/1/9 9:42
7846	Mark RISON	225	1 26.1.1	209	50	E	Y	209.50 26.1.1	LTF should be HE-LTF	Change "LTF" to "HE-LTF"	2017/1/9 9:42
7847	Mark RISON	225	1 26.1.1	210	11	E	Y	210.11 26.1.1	Binary Convolutional Coding should be Binary Convolutional Code	Change "coding" to "code"	2017/1/9 9:42
7848	Mark RISON	225	1 26.1.1	210	27	E	Y	210.27 26.1.1	LDPC coding should be LDPC code	Change "coding" to "code"	2017/1/9 9:42
7849	Mark RISON	225	1 26.1.1	210	8	G	Y	210.08 26.1.1	Reception of HE extended range SU PPDU should be optional	Move it to the optional list below	2017/1/9 9:42
7850	Mark RISON	225	1 28.3.3.1	228	52	G	Y	228.52 28.3.3.1	Allocating different transmit powers to different subchannels may violate transmit spectrum flatness requirement	Add a NOTE to that effect	2017/1/9 9:42
7851	Mark RISON	225	1 28.3.3.2	230	6	G	Y	230.06 28.3.3.2	For Table 28-3 to 28-5, a note should be added explaining that the most negative indices refer to the lowest frequency.	As it says in the comment	2017/1/9 9:42
7852	Mark RISON	225	1 28.3.3.4	236	34	T	Y	236.34 28.3.3.4	What about 2x HE-LTF case, is it always present?	Clarify	2017/1/9 9:42
7853	Mark RISON	225	1 28.3.3.4	236	34	T	Y	236.34 28.3.3.4	It is desirable to always transmit pilot subcarrier even if the RU the pilot subcarriers belonging to is not allocated.	Add "Pilot subcarriers shall be transmitted even if the RU a pilot subcarrier belongs to is not allocated"	2017/1/9 9:42
7854	Mark RISON	225	1 28.3.3.8.3	239	17	E	Y	239.17 28.3.3.8.3	What does "information of each RU" refer to? And what does "RU" refer to?	Clarify. Also add RU to 3.4	2017/1/9 9:42
7855	Mark RISON	225	1 28.3.5	247	9	E	Y	247.09 28.3.5	In Figure 28-15, each user's processing, CSD is included; is CSD per user procesing or per PPDU? If it is per PPDU, during per user processing, the frequency/spatial allcoation is not done and how the CSD can be carried out without frequency/spatial information?	Move CSD to outside per-user	2017/1/9 9:42
7856	Mark RISON	225	1 28.3.6.11.1	255	31	E	Y	255.31 28.3.6.11.1	It would be easier for description purpose to move CSD operation outside per user processing; as CSD operation needs global information, such as spatial and frequency allocation.	As it says in the comment	2017/1/9 9:42
7857	Mark RISON	225	1 28.3.10.8.3	288	56	E	Y	288.56 28.3.10.8.3	The section title Time domain encoding is confusing	Use a better title	2017/1/9 9:42

7858	Mark RISON	225	1 28.3.10.8.2	286	34	E	Y	286.34 28.3.10.8.2	Need a formal description of how the bits from common block and multiple user blocks are cascaded and mapped before modulation and loaded to data sub-carriers	As it says in the comment	2017/1/9 9:42
7859	Mark RISON	225	1 28.3.10.8.5	294	22	E	Y	294.22 28.3.10.8.5	Is this illustration for one content channel?	Add "for one content channel" to the caption for Figure 28-25	2017/1/9 9:42
7860	Mark RISON	225	1 28.3.10.10	301	18	G	Y	301.18 28.3.10.10	Does the frequency portion corresponding to RUs not allocated to any user carry HE-LTF symbol?	Clarify	2017/1/9 9:42
7861	Mark RISON	225	1 27.10.4	193	40	E	Y	193.40 27.10.4	Terminology differs from description of HE Capabilities element given in 9.4.2.218.2	Change "Ack Enabled Multi-TID A-MPDU Support" to "Ack-Enabled Multi-TID Aggregation Support"	2017/1/9 9:42
7862	Mark RISON	225	1 27.10.4	193	44	E	Y	193.44 27.10.4	Terminology differs from description of HE Capabilities element given in 9.4.2.218.2	Change "Ack Enabled Multi-TID A-MPDU Support" to "Ack-Enabled Multi-TID Aggregation Support"	2017/1/9 9:42
7863	Mark RISON	225	1 27.10.4	193	49	T	Y	193.49 27.10.4	Setting EOF to 1 in this manner is inconsistent with the statement "set to 0 otherwise" in first row of Table 9-422	Remove from 27.10.4 all mentions of EOF	2017/1/9 9:42
7864	Mark RISON	225	1 27.10.4	193	49	T	Y	193.49 27.10.4	Setting EOF to 1 in this manner conveys no additional information and is unnecessary	Remove from 27.10.4 all mentions of EOF	2017/1/9 9:42
7865	Mark RISON	225	1 9.2.4.6.4.5	25	54	T	Y	25.54 9.2.4.6.4.5	"Each bit of the bitmap is set to 1 to indicate that the buffer status of the AC, which ACI is identified by the location of the bit in the ACI Bitmap subfield, is reported and set to 0 otherwise." is not true. For example, 26.27 indicates that the status of 8 TIDs is being reported even if all bits in the bitmap are 0	After "is reported" add "in the ACI Bitmap subfield"	2017/1/9 9:42
7866	Mark RISON	225	1 9.2.4.5.6	21	19	T	Y	21.19 9.2.4.5.6	"If a QoS Data frame is fragmented" -- MPDUs cannot be fragmented. Also at 21.21, 27.7, 27.10	Change the cited text to "If an MSDU/A-MSDU/MMPDU is fragmented" in each case	2017/1/9 9:42
7867	Mark RISON	225	1 9.2.4.6.4.5	27	3	T	Y	27.03 9.2.4.6.4.5	It is not clear what "the present (A-)MPDU" is	Change the cited text to "the (A-)MPDU containing the BSR"	2017/1/9 9:42
7868	Mark RISON	225	1 9.2.4.5.6	21	13	T	Y	21.13 9.2.4.5.6	It is not clear what "the present (A-)MPDU" is	Change the cited text to "the (A-)MPDU containing the Queue Size subfield"	2017/1/9 9:42
7869	Mark RISON	225	1 9.2.4.5.6	21	3	T	Y	21.03 9.2.4.5.6	It is not clear that the Queue Size is a form of BSR (the wording in 27.5.2.5 indicates this is to be seen as an "implicit BSR")	At the end of the sentence inserted at the cited location, add "; this is an implicit BSR"	2017/1/9 9:42
7870	Mark RISON	225	1 9.4.2.219	91	62	T	Y	91.62 9.4.2.219	"which enables the use of RTS/CTS except for values 0 and 1023" -- 0 enables RTS/CTS too	Delete "0 and" in the cited text; also delete the following " The value 0 indicates that RTS/CTS must be used for all frame exchanges." since this follows from the specification of the use of this field	2017/1/9 9:42
7871	Mark RISON	225	1 9.4.2.219	91	63	E	Y	91.63 9.4.2.219	"must" is not a standard modal verb	Change "must be" to "is" at the cited location	2017/1/9 9:42
7872	Mark RISON	225	1 10.3.5	121	61	T	Y	121.61 10.3.5	There are several issues with duration-based RTS threshold: 10.3.1 suggests this applies to the AP too 10.3.2.4a doesn't have any actual normative behavioural specification (and misses "HE" before "duration-based") 10.3.5 has a NOTE that seems normative 10.3.1 says that this is driven by dot11DurationRTSThreshold, but nothing ties this to the value in the HE Duration Based RTS Threshold field in the HE Operation element C.3 talks of "receiving duration-based RTS threshold notification frame" but there is no such frame C.3 says "TxOP" C.3 says "should be" but 10.3.5 says "shall" C.3 refers to the undefined concept "transmission or TXOP" C.3 has broken grammar	Change 10.3.1 to say the mechanism only applies to non-AP STAs (APs continue to use dot11RTSThreshold) Delete 10.3.2.4a Promote the first NOTE in 10.3.5 to a non-NOTE Add wording in 10.3.1 to say that dot11DurationRTSThreshold is updated whenever an HE non-AP STA receives an HE Operation element from an AP to which it is associated Change C.3 422.31 to talk of receiving an HE Operation element from an AP to which an HE non-AP STA is associated Change "TxOP" to "TXOP" in C.3 Delete "Value zero means the RTS should be always used for TxOP transmission." in C.3 Delete "transmission or" at 422.35 Add "The" at the start of the sentence at 422.38, and a full stop at the end	2017/1/9 9:42
7873	Mark RISON	225	1 10.3.5	121	63	T	Y	121.63 10.3.5	dot11RTSThreshold should be used for EDCA as well as DCF, as for dot11DurationRTSThreshold	Add "or EDCA" after "DCF" at the cited location	2017/1/9 9:42
7874	Mark RISON	225	1			G	Y		New amendment style is a bad idea. It means you need to look in multiple places to find what the requirements really are	Use traditional style, i.e. incorporate 802.11ax into 802.11 baseline text, by merging Clause 27 into Clauses 10 and 11	2017/1/9 9:42
7875	Mark RISON	225	1 9.2.4.6.4.4	25	8	E	Y	25.08 9.2.4.6.4.4	"9.31.4 (Link adaptation using the HE variant HT Control field))" is a broken reference	Refer to 27.13 instead	2017/1/9 9:42

7876	Mark RISON	225	1 9.4.2.200	73	14	E	Y	73.14 9.4.2.200	"25.14 (Link adaptation using the HE variant HT Control field)" is a broken reference	Refer to 27.13 instead	2017/1/9 9:42
7877	Mark RISON	225	1 9.4.2.200	73	39	E	Y	73.39 9.4.2.200	"25.14 (Link adaptation using the HE variant HT Control field)" is a broken reference	Refer to 27.13 instead	2017/1/9 9:42
7878	Mark RISON	225	1 10.9	126	26	E	Y	126.26 10.9	"10.31.4 (Link adaptation using the HE variant HT Control field))" is a broken reference	Refer to 27.13 instead	2017/1/9 9:42
7879	Mark RISON	225	1 9.4.2.218.2	76	42	E	Y	76.42 9.4.2.218.2	The figure says "HE Link Adaptation", the text at 78.26 says "HE Link Adaptation Capable"	Change both locations to "HE Link Adaptation Supported"	2017/1/9 9:42
7880	Mark RISON	225	1 B.4	411	29	T	Y	411.29 B.4	BQR and RDP A-Controls are missing	Add rows HEWM4.6/7 for them	2017/1/9 9:42
7881	Mark RISON	225	1 10.22.2.8	133	17	T	Y	133.17 10.22.2.8	Link adaptation is also described in 27.13	Add "and 27.13" after "10.31"	2017/1/9 9:42
7882	Mark RISON	225	1 9.4.2.218.2	78	31	T	Y	78.31 9.4.2.218.2	Solicited HE MFB/MRQ is not described	Delete "Set to 3 (Both) if the STA can provide HE MFB in response to HE MRQ and if the STA provides unsolicited HE MFB."	2017/1/9 9:42
7883	Mark RISON	225	1 9.2.4.6.4.1	22	48	E	Y	22.48 9.2.4.6.4.1	The field is "Aggregated Control" not "Aggregate Control"	Change "Aggregate" to "Aggregated" at the cited location	2017/1/9 9:42
7884	Mark RISON	225	1			E	Y		The things in an Aggregated Control subfield are Control subfields, not A-Control subfields	Delete "A-" in "UL MU Response Scheduling A-Control subfield", "BQR A-Control subfield", "BSR A-Control subfield" throughout Delete "A-" and add "sub" before "field" in "BSR A-Control field", "OMI A-Control field", "BQR A-Control field", "UL MU Response Scheduling A-Control field", "RDP A-Control field" throughout	2017/1/9 9:42
7885	Mark RISON	225	1 10.9	127	52	T	Y	127.52 10.9	An HE STA that receives an A-Control field shall ignore the remainder of the A-Control field that follows a Control ID subfield whose value is not recognized or is not supported by the STA." -- this is a interop/forward-compatibility disaster waiting to happen	Change to "An HE STA that receives an A-Control field shall ignore a Control field with a Control ID subfield whose value is not recognized or is not supported by the STA."	2017/1/9 9:42
7886	Mark RISON	225	1 10.9	127	44	T	Y	127.44 10.9	"If an A-Control field is present in a frame then it shall contain at least one Control subfield, and the Control subfield shall be present in the A-Control field only if it is supported by the receiving STA" -- this does not cover A-Controls in multicast frames	Add "(s)" after "STA"	2017/1/9 9:42
7887	Mark RISON	225	1 9.2.4.6.4.6	27	14	T	Y	27.14 9.2.4.6.4.6	There is no behavioural MAC specification of UL power headroom Control subfields	Move the text at the end of 28.3.14.2 to a new subclause in 27	2017/1/9 9:42
7888	Mark RISON	225	1 9.2.4.6.4.4	25	5	T	Y	25.05 9.2.4.6.4.4	There is no behavioural MAC specification of HE link adaptation Control subfields	Change 27.13 to refer to the HE link adaptation Control subfield	2017/1/9 9:42
7889	Mark RISON	225	1 27.8.1	188	24	E	Y	188.24 27.8.1	The Control subfield is called Operating Mode not Operating Mode Indication	Change "Operating mode indication (OMI)" to "Operating Mode (OM) indication" at the cited location and change OMI to OM throughout	2017/1/9 9:42
7890	Mark RISON	225	1 27.8.1	188	29	T	Y	188.29 27.8.1	Is dot11OMIOptionImplemented for tx, rx or both?	Change the para at the cited location to "If dot11OMIOptionImplemented is true, an HE STA may send a QoS Data or QoS Null frame that contains the OMI A-Control field to indicate a change in its receive and/or transmit operating parameters and shall support the reception of the OMI A-Control field. If dot11OMIOptionImplemented is false, an HE STA shall not send a QoS Data or QoS Null frame that contains the OMI A-Control field and shall ignore the OMI A-Control field if received. An HE AP shall set dot11OMIOptionImplemented to true." At 421.28 change "generating" to "transmitting and receiving" and change "the station" to "the non-AP STA"	2017/1/9 9:42
7891	Mark RISON	225	1 27.13	198	60	T	Y	198.60 27.13	This just has a statement on how to set the HE MCS subfield. Everything else is missing (setting of caps for solicited, unsolicited, expected behaviour at TX and at RX, etc.)	Add all the missing LA/MFB detail	2017/1/9 9:42
7892	Mark RISON	225	1			T	Y		"legacy preamble" is ambiguous because HE builds on top of more than one existing PHY	Change "legacy preamble" to "OFDM/ERP PPDU preamble" throughout	2017/1/9 9:42

7893	Mark RISON	225	1			T	Y		"right 106-tone RU" is not defined, nor is "left 106-tone RU"	Change "right 106-tone RU" to "highest-frequency 106-tone RU" throughout Change "left 106-tone RU" to "lowest-frequency 106-tone RU" throughout	2017/1/9 9:42
7894	Mark RISON	225	1 9.4.2.3	67	50	T	Y	67.50 9.4.2.3	Should make it clear that an AP must not include the 126 membership selector (VHT) if it wants to allow 20-MHz-only HE STAs	Add a "NOTE---To allow association of 20 MHz-only STAs, an HE AP omits the VHT PHY BSS membership selector and only includes the HT PHY and HE PHY membership selectors."	2017/1/9 9:42
7895	Mark RISON	225	1			E	Y		Multi-STA BlockAcks are very badly named, as they are also used in single-STA contexts	Change "Multi-STA BlockAck" to "Extended BlockAck" throughout	2017/1/9 9:42
7896	Mark RISON	225	1			G	Y		UL MU-MIMO should be optional	Make UL MU-MIMO optional rather than mandatory	2017/1/9 9:42
7897	Mark RISON	225	1 9.3.1.20	40	7	E	Y	40.07 9.3.1.20	"STA info" is wrong	Change to "STA Info"	2017/1/9 9:42
7898	Mark RISON	225	1 9.3.1.20	40	7	E	Y	40.07 9.3.1.20	"STA info element" is doubly wrong	Change to "STA Info field"	2017/1/9 9:42
7899	Mark RISON	225	1 9.3.1.20	41	28	E	Y	41.28 9.3.1.20	"it's" is wrong	Change to "its"	2017/1/9 9:42
7900	Mark RISON	225	1 9.3.1.20	40	5	T	Y	40.05 9.3.1.20	"The frame format of the HE NDP Announcement frame with multiple STA info field is shown in Figure 9-51a" implies there's a different format without multiple STA Info fields	Delete "with multiple STA info field" (sic)	2017/1/9 9:42
7901	Mark RISON	225	1 9.3.1.20	41	28	T	Y	41.28 9.3.1.20	"The Disambiguation subfield is set to 1 to prevent a VHT STA from wrongly determining it's AID in the HE STA Info." is not clear (and grammatically wrong)	Change to "The Disambiguation subfield is set to 1. NOTE---A VHT STA interprets this as a STA Info field with an invalid AID."	2017/1/9 9:42
7902	Mark RISON	225	1 9.3.1.20	40	6	T	Y	40.06 9.3.1.20	The format/contents of the RA, TA and Sounding Dialog Token fields in an HE NDPA is not specified	Change the para at line 22 to: "The RA, TA and Sounding Dialog Token fields are set as in a VHT NDP Announcement frame, except that bit 1 of the Sounding Dialog Token field is set to 1."	2017/1/9 9:42
7903	Mark RISON	225	1 9.3.1.20	41	9	T	Y	41.09 9.3.1.20	Showing "Feedback Type + Ng + codebook size" is a recipe for interop problems	Show the information in three columns, one for b25 of the STA Info, one for b26 and one for b28	2017/1/9 9:42
7904	Mark RISON	225	1 9.3.1.20	40	53	T	Y	40.53 9.3.1.20	"indicates the first 26-tone RU" - how exactly? Does it start from 0 or from 1? What does 0/1 indicate? This is not clear	Append ", where tone 0 is the lowest-frequency tone,"	2017/1/9 9:42
7905	Mark RISON	225	1 9.2.5.2	31	52	T	Y	31.52 9.2.5.2	Need to account for HE beamforming too	After "VHT NDP," add "HE NDP,"	2017/1/9 9:42
7906	Mark RISON	225	1 10.22.2.7	132	4	T	Y	132.04 10.22.2.7	Need to account for HE beamforming too	Add a para "an HE NDP Announcement frame followed after SIFS by an HE NDP followed after SIFS by a PPDU containing one or more HE Compressed Beamforming frames, or" and a para " an HE NDP Announcement frame followed after SIFS by an HE NDP followed after SIFS by a BRP Trigger frame followed after SIFS by a PPDU containing one or more HE Compressed Beamforming frames, or"	2017/1/9 9:42
7907	Mark RISON	225	1 27.9.2.1	190	50	E	Y	190.50 27.9.2.1	"SR Backoff procedure for SR delayed case." is not a sentence	Delete the full stop and make into a subclause heading (27.9.2.2)	2017/1/9 9:42
7908	Mark RISON	225	1 27.9.2.1	190	52	T	Y	190.52 27.9.2.1	"carrying the SR delay entry" -- it is not clear what is meant by carrying an entry	Change to "not indicating SR_Disallowed"; also at lines 55 and 56	2017/1/9 9:42
7909	Mark RISON	225	1			E	Y		"SR Disallowed" is missing an underscore at 179.27 (also wrong case), 274.6, 276.40, 279.13, 279.35, 280.17, 280.41	Change to "SR_Disallowed" at the cited locations	2017/1/9 9:42
7910	Mark RISON	225	1 27.11.6	198	29	T	Y	198.29 27.11.6	"to SR_Delay entry" -- it is not clear what is meant by setting to an entry	Change to "to a value other than SR_Disallowed"	2017/1/9 9:42
7911	Mark RISON	225	1			T	Y		There is no definition of "SR_Delay" (it can be any number from 1 to 15)	At 190.37 change "indicates SR_Delay" to "does not indicate SR_Disallowed" and at 274.12 change "Set to SR_Delay" to "Set to a value other than SR_Disallowed"	2017/1/9 9:42
7912	Mark RISON	225	1 4.3.14a	9	65	E	Y	9.65 4.3.14a	"The Trigger frames schedule may be set between the non-AP STA and the AP using TWT operation." -- missing apostrophe	Add an apostrophe after "frames"	2017/1/9 9:42
7913	Mark RISON	225	1 9.3.1.23	42	59	T	Y	42.59 9.3.1.23	"If the Cascade Indication subfield is 1, then a subsequent Trigger frame as defined in 27.7 (TWT operation) and in 27.14.2 (Power save with UL OFDMA-based random access) follows the current Trigger frame. " -- these xrefs look wrong	Fix the xrefs to the two subclauses that discuss the subsequent Trigger frames	2017/1/9 9:42

7914	Mark RISON	225	1 9.3.3.6	53	17	T	Y	53.17 9.3.3.6	The deletion has lost the "otherwise not present" case	Add a para "Otherwise, the TWT element is not present." at the end of the cell	2017/1/9 9:42
7915	Mark RISON	225	1 9.3.3.6	53	19	T	Y	53.19 9.3.3.6	The change is not compatible with existing implementations that do not include a TWT element in the assoc rsp even though dot11TWT is true and there was a TWT element in the assoc req	Add "optionally" before "present". Ditto Table 9-32	2017/1/9 9:42
7916	Mark RISON	225	1 9.3.3.6	53	19	T	Y	53.19 9.3.3.6	The change is not compatible with existing implementations that do not include a TWT element in the assoc rsp even though dot11TWT is true and there was a TWT element in the assoc req	Do not make any change in this cell. Ditto Table 9-32	2017/1/9 9:42
7917	Mark RISON	225	1 9.3.3.11	55	18	E	Y	55.18 9.3.3.11	Broken grammar	Change "is true" to "are true"	2017/1/9 9:42
7918	Mark RISON	225	1 9.4.2.6	67	60	E	Y	67.60 9.4.2.6	The field names are not referred to correctly	Change to "DTIM Count field" and "DTIM Period field"	2017/1/9 9:42
7919	Mark RISON	225	1 9.4.2.6	68	1	T	Y	68.01 9.4.2.6	" the AP does not intend to transmit to the STA or to trigger the STA for an UL MU transmission" -- triggering is done by transmitting to the STA	Delete "or trigger the STA for an UL MU transmission"	2017/1/9 9:42
7920	Mark RISON	225	1 9.4.2.27	68	19	T	Y	68.19 9.4.2.27	The change is not compatible with existing implementations that do not set the bit even though dot11TWT is true	Add "and dot11HEOptionImplemented is true"	2017/1/9 9:42
7921	Mark RISON	225	1 9.4.2.27	68	23	T	Y	68.23 9.4.2.27	This bit serves no purpose as it is always the same as the one immediately above it	Delete this row, and delete "Requester" twice at line 19	2017/1/9 9:42
7922	Mark RISON	225	1 9.4.2.200	69	63	T	Y	69.63 9.4.2.200	"The Wake TBTT Negotiation subfield indicates" -- how exactly does it indicate this?	Add similar sentences to the "The Broadcast field is 1 to indicate that the TWT SP(s) defined by the TWT element are associated with broadcast TWT(s). The Broadcast field is 0, otherwise." above	2017/1/9 9:42
7923	Mark RISON	225	1 9.4.2.200	72	37	T	Y	72.37 9.4.2.200	" the TWT Flow Identifier subfield contains a value that indicates recommendations on the types of frames that are transmitted by scheduled STAs during the broadcast TWT SP, encoded according to Table 9-262k1" -- but that table discusses both the scheduling STA and scheduled STA	Delete "scheduled"	2017/1/9 9:42
7924	Mark RISON	225	1 9.4.2.200	70	27	T	Y	70.27 9.4.2.200	"Description when transmitted by a TWT scheduling STA, Wake TBTT Negotiation subfield = 1" is incompatible with " The Wake TBTT Negotiation subfield is set to 0 in TWT elements transmitted by a responding STA and by a scheduling STA." at line 2 above	Change "1" to "0"	2017/1/9 9:42
7925	Mark RISON	225	1 9.4.2.200	70	27	T	Y	70.27 9.4.2.200	Descriptions of the other four cases (requesting/responding when Wake TBTT Negotiation Subfield = 1 and scheduling/scheduled when = 0) are missing	Delete ", Wake TBTT Negotiation subfield = [0/1]" in each cell (4 deletions)	2017/1/9 9:42
7926	Mark RISON	225	1 9.4.2.200	70	43	E	Y	70.43 9.4.2.200	Spurious asterisk	Delete the asterisk	2017/1/9 9:42
7927	Mark RISON	225	1 9.4.2.200	71	30	T	Y	71.30 9.4.2.200	There can be no TWT request to accept since a scheduled STA cannot make a request (see 70.35)	Change the cell to "N/A"	2017/1/9 9:42
7928	Mark RISON	225	1 9.4.2.200	71	33	E	Y	71.33 9.4.2.200	It says "(See" in the 4th column	Change to "(see"	2017/1/9 9:42
7929	Mark RISON	225	1 9.4.2.200	73	22	T	Y	73.22 9.4.2.200	"There are no restrictions on the frames transmitted by the schedul- ing STA of the broadcast TWT SP." -- but the scheduling STA is the AP, so the next para does introduce restrictions	Delete the cited text; also at line 49. Also fix at line 56 to only refer to the scheduled STA	2017/1/9 9:42
7930	Mark RISON	225	1 9.4.2.200	73	9	T	Y	73.09 9.4.2.200	"Feedback can be contained is the QoS Control field or in the HE variant HT Control field of the frame, " -- a PS-Poll cannot carry either	At line 8 and line 33 change "PS-Poll and QoS Null frames" to "QoS Null frames and PS-Poll frames contained in Control Wrapper frames"	2017/1/9 9:42
7931	Mark RISON	225	1 9.4.2.200	73	45	E	Y	73.45 9.4.2.200	There are 3 instances of "(Re-)Association" in the document	Change each to "(Re)Association"	2017/1/9 9:42
7932	Mark RISON	225	1 9.4.2.200	73	58	E	Y	73.58 9.4.2.200	There are 2 instances of "FILS discovery frame" in the document	Change each to "FILS Discovery frame"	2017/1/9 9:42
7933	Mark RISON	225	1 9.3.1.9.7	38	50	E	Y	38.50 9.3.1.9.7	There are 3 instances of "Action Ack frame" in the document	Change each to "Action frame"	2017/1/9 9:42
7934	Mark RISON	225	1 9.3.1.9.7	38	4	T	Y	38.04 9.3.1.9.7	"NOTE--When a Multi-STA BlockAck frame is used to acknowledge a management frame, the TID value is set to 15." -- according to e.g. Table 9-24b this is only the case for Action frames	Delete this NOTE	2017/1/9 9:42
7935	Mark RISON	225	1 9.3.1.9.7	38	53	E	Y	38.53 9.3.1.9.7	"N/A" is not the name of a subfield	Change to "Block Ack Bitmap"	2017/1/9 9:42

7936	Mark RISON	225	1 9.3.1.9.7	38	39	E	Y	38.39 9.3.1.9.7	"N/A" in the third column is not the name of a subfield	Change to "Block Ack Starting Sequence Control and Block Ack Bitmap" in the third column at lines 39, 41 and 49	2017/1/9 9:42
7937	Mark RISON	225	1 9.7.1	106	32	T	Y	106.32 9.7.1	"Set to 1 in an A-MPDU subframe that has 0 in the MPDU Length field and that is used to pad the A-MPDU in a VHT or HE PPDU as described in 10.13.6 (A-MPDU padding for VHT PPDU). Set to 1 in the MPDU delimiter of a S-MPDU as described in 10.13.7 (Setting the EOF field of the MPDU delimiter). Set to 0 otherwise." -- it can also be set to 1 in a multi-TID A-MPDU	Before the last sentence add "Can be set to 1 in the MPDU delimiter of one or more MPDUs in a multi-TID A-MPDU as described in 27.10.4."	2017/1/9 9:42
7938	Mark RISON	225	1 27.4.4.1	160	34	T	Y	160.34 27.4.4.1	"in an A-MPDU or multi-TID A-MPDU" -- a multi-TID A-MPDU is an A-MPDU	Delete "or multi-TID A-MPDU"	2017/1/9 9:42
7939	Mark RISON	225	1 27.4.4.1	160	34	T	Y	160.34 27.4.4.1	"when these frames are carried in an A-MPDU or multi-TID A-MPDU" -- it can do so even if they are not (e.g. using the Ack Policy in an MPDU sent in an 11abg PPDU)	Delete the cited text	2017/1/9 9:42
7940	Mark RISON	225	1 27.10.4	193	32	T	Y	193.32 27.10.4	There are 5 instances of "nonzero length MPDU delimiter". All MPDU delimiters have non-zero length (they all have a length of 4 octets)	Change each instance to "MPDU delimiter with the MPDU Length subfield not equal to 0"	2017/1/9 9:42
7941	Mark RISON	225	1 27.10.4	193	50	T	Y	193.50 27.10.4	" if the QoS Data frame or Action frame solicits an immediate Ack frame." -- as indicated at line 61, it does not solicit an Ack frame, it solicits a MSBA frame	Change to "[...] that solicits an Ack indication in a Multi-STA Block Ack frame"	2017/1/9 9:42
7942	Mark RISON	225	1 27.10.4	193	56	T	Y	193.56 27.10.4	" that solicits BlockAck" -- this is unclear	Change to "[...] that solicits a BlockAck indication in a Multi-STA Block Ack frame"	2017/1/9 9:42
7943	Mark RISON	225	1 27.10.4	193	53	T	Y	193.53 27.10.4	"A multi-TID A-MPDU may contain multiple noncontiguous nonzero length MPDU delimiters with EOF subfield equal to 1, one for each TID that solicits Ack and/or multiple noncontiguous nonzero length MPDU delimiters with EOF subfield equal to 0, one for each TID that solicits BlockAck." -- this is extremely unclear (and some aspects seem wrong, e.g. there can be more than one per TID for the BA case)	Change to "A multi-TID A-MPDU may contain multiple nonzero length MPDU delimiters with EOF subfield equal to 1, but no more than one for each TID. A multi-TID A-MPDU may contain multiple nonzero length MPDU delimiters with EOF subfield equal to 0. NOTE---The MPDUs may be in any order, irrespective of their TID and the EOF subfield of their delimiter."	2017/1/9 9:42
7944	Mark RISON	225	1 27.10.4	193	58	T	Y	193.58 27.10.4	"that receives a multi-TID A-MPDU" -- it is not clear how such an A-MPDU is identified	Change to "that receives an A-MPDU with more than one MPDU delimiter with the EOF subfield equal to 1 and the MPDU Length subfield not equal to 0, or with MPDUs from more than one TID, or with both Management and Data frames"	2017/1/9 9:42
7945	Mark RISON	225	1 27.10.4	194	14	T	Y	194.14 27.10.4	"An HE STA may aggregate in a multi-TID A-MPDU QoS Data frames with multiple TIDs as defined in Table 9-425 (A-MPDU contents in the data enabled immediate response context) or Table 9-426 (A-MPDU contents in the data enabled no immediate response context)." duplicates "An HE STA shall construct a multi-TID A-MPDU as defined in 9.7" above	Delete the (first) cited text	2017/1/9 9:42
7946	Mark RISON	225	1 27.10.4	194	31	E	Y	194.31 27.10.4	It says "TXOP limit" twice	Add "the" before the cited text at line 31 and line 32	2017/1/9 9:42
7947	Mark RISON	225	1 27.10.4	194	1	T	Y	194.01 27.10.4	"One Per STA Info field indicating a BlockAck for each TID of a successfully received MPDU that solicits a response that is preceded by a nonzero length MPDU delimiter whose EOF is 0 (TID value equals that of the QoS Data frame)." -- this is unclear in the case where there is more than one such frame per TID	Change to "One Per STA Info field indicating a BlockAck for each TID present in the successfully received MPDUs that solicited a response that is preceded by a nonzero length MPDU delimiter whose EOF is 0 (TID value equals that of the QoS Data frame)."	2017/1/9 9:42
7948	Mark RISON	225	1 27.10.4	193	50	T	Y	193.50 27.10.4	" if the QoS Data frame or Action frame solicits an immediate Ack frame." -- it is not clear what the condition is	Add a "NOTE---A QoS Data frame solicits an immediate non-block acknowledgement if the Ack Policy is Normal Ack or Implicit Block Ack Request and the TID does not correspond to a block ack agreement. An Action frame always solicits an immediate acknowledgement."	2017/1/9 9:42

7949	Mark RISON	225	1 27.10.4	193	56	T	Y	193.56 27.10.4	"that solicits BlockAck" -- it is not clear what the condition is	Add a "NOTE---A QoS Data frame solicits an immediate block acknowledgement if the Ack Policy is Normal Ack or Implicit Block Ack Request and the TID corresponds to a block ack agreement."	2017/1/9 9:42
7950	Mark RISON	225	1 27.10.4	193	47	T	Y	193.47 27.10.4	There is no need for this overloading of the EOF field	Replace lines 193.47 to 194.4 with: An HE STA shall construct a multi-TID A-MPDU as defined in 9.7 (Aggregate MPDU (A-MPDU)) and 10.13 (A-MPDU operation) except that there may be QoS Data frames with different TIDs in the A-MPDU (but no more than one per TID if not sent under a block ack agreement) and there may be an Action frame in the A-MPDU. An HE STA that receives a multi-TID A-MPDU shall respond with a Multi-STA BlockAck frame that contains (see 27.4 (Block acknowledgement)) one Per STA Info field per TID of the successfully received MPDUs and also one Per STA Info field if an Action frame was successfully received, where: - For MPDUs sent under a	2017/1/9 9:42
7951	Mark RISON	225	1 9.3.1.9.7	37	23	E	Y	37.23 9.3.1.9.7	"The format defined below is used for multi-STA multi-TID, and multi-STA single TID BlockAck variant." -- there is no such thing as a "multi-STA single TID BlockAck variant	Change to "The format defined below is used for both multi-TID and single-TID multi-STA operation."	2017/1/9 9:42
7952	Mark RISON	225	1 9.3.1.9.7	37	23	E	Y	37.23 9.3.1.9.7	"The format defined below is used for multi-STA multi-TID, and multi-STA single TID BlockAck variant." -- it's also used for single-STA multi-TID operation	Change to "The format defined below is used for both multi-TID and single-TID multi-STA operation, and for multi-TID single-STA operation."	2017/1/9 9:42
7953	Mark RISON	225	1			E	Y		We don't include representation details in field names	Delete "M1" throughout (in "Highest NSS Supported M1" and "NSS M1")	2017/1/9 9:42
7954	Mark RISON	225	1 9.3.1.23	48	17	T	Y	48.17 9.3.1.23	"STBC is disallowed for Trigger Frame transmission." is behaviour, not format	Move to 27.15.2 (and lowercase "frame")	2017/1/9 9:42
7955	Mark RISON	225	1 9.3.1.23	47	44	E	Y	47.44 9.3.1.23	" The Padding field of the Trigger frame, if present, is an integer number of octets >= 2: Padding field starts with special STAID[11:0] as 0xFFF and the rest bits of the Padding field are all set to one. 0xFFF is reserved as the special value to indicate the start of the MAC padding. The length of the Padding field is in units of octets and is set as defined in the following formulas" -- "starts with special STAID[11:0] as 0xFFF" is meaningless and "0xFFF is reserved as the special value to indicate the start of the MAC padding." is not normative and "The length of the Padding field is in units of octets" is meaningless	Change to "The Padding field, if present, is at least 2 octets long and contains all-ones. NOTE---This field starts like a User Info field with AID12 equal to 4095, which is reserved."	2017/1/9 9:42
7956	Mark RISON	225	1 9.3.1.23	48	4	T	Y	48.04 9.3.1.23	"N_DBPS,SHORT" is not defined	Give a xref to Equation (28-61)	2017/1/9 9:42
7957	Mark RISON	225	1 28.3.11.5.4	320	14	E	Y	320.14 28.3.11.5.4	"N_DBPS,short" is not defined	Change to "N_DBPS,SHORT" at 320.14 and 321.22	2017/1/9 9:42
7958	Mark RISON	225	1 9.3.1.23	47	55	T	Y	47.55 9.3.1.23	"N_DBPS" is not defined	Give a xref to some equation or table in Clause 28	2017/1/9 9:42
7959	Mark RISON	225	1 27.6.2	177	38	T	Y	177.38 27.6.2	It is not clear how missed segments are requested in the SU PPDU case. The problem is that the only way to do this is to send a BRP variant Trigger, but such a trigger would be preceded by an NDPA with only one STA Info, which would confuse the beamformee	Add a "NOTE---If an HE beamformer does not successfully receive all feedback segments from the HE beamformee, it cannot use a Beamforming Report Poll variant Trigger frame unless it has another HE beamformee to poll. In this case it can only repeat the entire sequence."	2017/1/9 9:42
7960	Mark RISON	225	1 27.5.2.5	171	40	E	Y	171.40 27.5.2.5	Invalid xref	Change "XX" to "18c"	2017/1/9 9:42

7961	Mark RISON	225	1 11.1.3.10	141	37	T	Y	141.37 11.1.3.10	For dual beacons to work w.r.t. both non-HE STAs and distant HE STAs, group-addressed traffic needs to be sent twice, once after each of the beacon types	After "When Beacon frames are transmitted in two PHY formats, the HE AP shall transmit Beacon frames in non-HE format and in HE_EXT_SU format." add "The HE AP shall transmit buffered non-GCR-SP group addressed BUs twice, once immediately after each of these Beacon frames, when they are DTIM Beacons frames (see 11.2.3.4)." Also add a bit to HE Operation to indicate which kind of beacon it is (cf. STBC Beacon in 802.11-2016 page 953)	2017/1/9 9:42
7962	Mark RISON	225	1 27.10.4	193	49	T	Y	193.49 27.10.4	In an A-MPDU containing multiple MPDUs of different TID, each with EOF = 1, it is unclear whether each of these MPDUs is to be treated as a VHT Single MPDU	At the end of the sentence add "(these frames are treated as S-MPDUs)"	2017/1/9 9:42
7963	Mark RISON	225	1 10.43.1	137	58	E	Y	137.58 10.43.1	Table uses terms first STA and second STA whilst the text uses the terms requesting station and responding station	In the table, change "first STA" to "requesting STA" throughout, and "second STA" to "responding STA" throughout	2017/1/9 9:42
7964	Mark RISON	225	1 10.43.1	138	33	E	Y	138.33 10.43.1	Non-IEEE terminology	Change "The requesting STA can send a new request with any set of TWT parameters and the responder might entertain the creation of an individual TWT agreement using those parameters." to "The requesting STA may send a new request considering the alternative parameters." Ditto at 139.29	2017/1/9 9:42
7965	Mark RISON	225	1 27.4.3	159	32	E	Y	159.32 27.4.3	In the buffer size lists the previous is a subset of the subsequent item making the bitmap widrth rules contradictory	Change, in this order of appearance, "within [1, 64]" to "less than 65" "within [1, 256]" to "more than 64" "within [1, 64]" to "less than 65" "within [1, 128]" to "between 65 and 128" "within [1, 256]" to "more than 128"	2017/1/9 9:42
7966	Mark RISON	225	1 27.4.3	160	14	E	Y	160.14 27.4.3	10.24.7 should be updated us use the term BitmapLength. Even without that, this note is more than informative.	Modify 10.24.7. to use BitmapLength and BitmapLength - 1 rather than the magic numbers 63 and 64, and in one place state that for non-HE STAs BitmapLength is 64. Then here state that BitmapLength is whatever bitmap length results from the rules in this subclause.	2017/1/9 9:42
7967	Mark RISON	225	1 27.4.3	160	17	T	Y	160.17 27.4.3	The length is also limited by this UL RU duration	Add this and any other limitations	2017/1/9 9:42
7968	Mark RISON	225	1 27.5.2.1	163	19	T	Y	163.19 27.5.2.1	This is normative, not just informative	Change "Non-AP STAs transmit their response frames using HE trigger-based PPDU format, in either UL OFDMA, UL MU-MIMO, or both, except when the Trigger frame is of type MU-RTS, in which case the response (CTS) is sent in a non-HT PPDU format (see 10.3.2.8a (MU-RTS/CTS procedure))." to "Non-AP STAs shall transmit their response frames using HE trigger-based PPDU format, in either UL OFDMA, UL MU-MIMO, or both, except when the Trigger frame is of type MU-RTS, in which case the response (CTS) shall be sent in a non-HT PPDU format (see 10.3.2.8a (MU-RTS/CTS procedure))."	2017/1/9 9:42

7969	Mark RISON	225	1 27.5.2.1	164	19	E	Y	164.19 27.5.2.1	Inconsistent use of STA, AP and HE AP for procedures that appear to be AP specific procedures	Change "A STA shall not transmit a Trigger frame assigning an MU-MIMO RU in an UL OFDMA PPDU when the RU does not span that entire PPDU bandwidth to a STA from which it has not received an HE Capabilities element with B23 of the UL MU subfield of the HE PHY Capabilities Information field set to 1. A STA shall not transmit a Trigger frame soliciting a full bandwidth UL MU-MIMO HE trigger-based PPDU from a STA from which it has not received an HE Capabilities element with B22 of the UL MU subfield of the HE PHY Capabilities Information field set to 1. " to "An HE AP shall not transmit a Trigger frame assigning an MU-MIMO RU in an UL OFDMA PPDU when the RU does not span that entire PPDU bandwidth to a STA from which it has not received an HE Capabilities	2017/1/9 9:42
7970	Mark RISON	225	1 27.8.1	188	29	T	Y	188.29 27.8.1	No mention of support of OMI A-Control in receiver	Change "If dot11OMIOptionImplemented is true, an HE STA may send a QoS Data or QoS Null frame that contains the OMI A-Control field to indicate a change in its receive and/or transmit operating parameters." to "If dot11OMIOptionImplemented is true, an HE STA may send to a STA that indicated OMI A-Control support in its HE Capabilities element a QoS Data or QoS Null frame that contains the OMI A-Control field to indicate a change in its receive and/or transmit operating parameters."	2017/1/9 9:42
7971	Mark RISON	225	1 27.10.3	193	19	T	Y	193.19 27.10.3	Constraint on EOF not reverting to 0 after 1 inconsistent with 27.10.4	Remove setting EOF for Ack policy in 27.10.4	2017/1/9 9:42
7972	Mark RISON	225	1 27.6.2	176	21	T	Y	176.21 27.6.2	"If an HE AP does not receive an HE Capabilities element with the Rx Control Frame To MultiBSS subfield in the HE MAC Capabilities Information field equal to 1 from a STA, the HE AP shall not send a NDP Announcement frame whose destination STAs associate with more than one APs to the STA." is not clear ("APs to the STA" is especially confusing, as is "associate with more than one AP"). Also wrong pronoun before "NDP" and plurality for "APs"	Change to "If an HE AP does not receive from a STA an HE Capabilities element with the Rx Control Frame To MultiBSS subfield in the HE MAC Capabilities Information field equal to 1, the HE AP shall not send to the STA an NDP Announcement frame whose destination STAs are associated with more than one BSS."	2017/1/9 9:42
7973	Mark RISON	225	1 26.5.2.3	168	17	T	Y	168.17 26.5.2.3	There is an issue if this length is shorter than the CBR that we generated, because 27.6.3 says we can't always fragment CBRs	Add at 168.19 a "NOTE---It is not always possible to fragment HE compressed beamforming feedback (see 27.6.3). If the length is insufficient to contain the HE compressed beamforming feedback requested by a Beamforming Report Poll variant Trigger frame, no feedback is sent."	2017/1/9 9:42
7974	Mark RISON	225	1 27.5.2.5	171	50	T	Y	171.50 27.5.2.5	If the queue size of both fields is a non-255 value the values need to be consistent	Append to the NOTE "If neither is 255, the values ought to be consistent (e.g. if the latter refers to the same TID as the former, the value ought to be the same)."	2017/1/9 9:42
7975	Mark RISON	225	1 10.3.2.8a.2	117	10	T	Y	117.10 10.3.2.8a.2	It is not clear whether an MU-RTS can be carried in a VHT MU PPDU	Add "VHT or" before "HE" at the cited location	2017/1/9 9:42
7976	Mark RISON	225	1 10.3.2.8a.3	118	30	T	Y	118.30 10.3.2.8a.3	In the example shown in Figure 10-9c, if STA2 does not respond with a CTS, it is not clear whether the AP is permitted to transmit using both primary and secondary 20MHz channels	At the end of 10.3.2.8a.2 add a para "The transmitter of an MU-RTS frame shall not subsequently transmit during the TXOP in any 20 MHz channel for which it did not receive a CTS frame."	2017/1/9 9:42
7977	Mark RISON	225	1 11.1.3.10	141	39	T	Y	141.39 11.1.3.10	"The Beacon frame transmitted in non-HE PPDU format has TBTT at the TSF value 0." is unclear	Change to "Time 0 is defined to be a TBTT for the Beacon frame transmitted in non-HE PPDU format (see 11.1.3.2)."	2017/1/9 9:42

7978	Mark RISON	225	1 11.1.3.10	141	44	T	Y	141.44	11.1.3.10	"The Beacon frame transmitted in HE extended range SU PPDU has TBTT at the TSF value 0 plus the TBTT offset which value is a half of the value of the Beacon Interval field of the Beacon frame sent in non-HE format." is unclear	Change to "The TBTT for the Beacon frame transmitted in HE extended range SU PPDU format shall be offset by half of a beacon interval from the TBTT of the Beacon frame transmitted in non-HE PPDU format."	2017/1/9 9:42
7979	Mark RISON	225	1 11.1.3.10	141	50	T	Y	141.50	11.1.3.10	"The non-HE format and HE EXT_SU PPDU format Beacon frames may contain different set of elements." is far too loose	Change to "Except for the setting of the TIM field and TSF field, all other fields inside the Beacon frame transmitted in HE extended range SU PPDU format shall be identical to the Beacon frame transmitted in non-HE PPDU format." At 141.41 delete "as indicated in the Beacon frame transmitted in non-HE PPDU format" and change "Beacon interval" to "beacon interval". At 141.48 delete "as indicated in the Beacon frame transmitted in the HE extended range SU PPDU."	2017/1/9 9:42
7980	Massinissa Lalam	225	1 3.4	7		E	Y	7.00	3.4	Please consider adding the BSR acronym in subclause 3.4	As in comment.	2017/1/9 9:42
7981	Massinissa Lalam	225	1 3.4	7		E	Y	7.00	3.4	Please consider adding the BQR acronym in subclause 3.4	As in comment.	2017/1/9 9:42
7982	Massinissa Lalam	225	1 3.4	7		E	Y	7.00	3.4	Please consider adding the BSRP acronym in subclause 3.4	As in comment.	2017/1/9 9:42
7983	Massinissa Lalam	225	1 3.4	7		E	Y	7.00	3.4	Please consider adding the BQRP acronym in subclause 3.4	As in comment.	2017/1/9 9:42
7984	Massinissa Lalam	225	1 9.4.2.218.3	83	26	E	Y	83.26	9.4.2.218.3	In Table 9-262aa, check font size for B17 definition	As in comment.	2017/1/9 9:42
7985	Massinissa Lalam	225	1 9.4.2.218.3	82	45	E	Y	82.45	9.4.2.218.3	In Table 9-262aa, add extra line between each Bxx definition for the Preamble Puncturing Rx row	As in comment.	2017/1/9 9:42
7986	Massinissa Lalam	225	1 9.4.2.218.3	83	40	T	Y	83.40	9.4.2.218.3	The "Doppler procedure" is not defined in this draft. Either add its definition or referred to its definition if it is already defined in another amendment.	As in comment.	2017/1/9 9:42
7987	Massinissa Lalam	225	1 9.4.2.218.3	84	6	E	Y	84.06	9.4.2.218.3	In Table 9-262aa, replace "support of Tx" with "support of transmission" in the DCM encoding at Tx and Rx row	As in comment.	2017/1/9 9:42
7988	Massinissa Lalam	225	1 9.4.2.218.3	84	33	E	Y	84.33	9.4.2.218.3	In Table 9-262aa, check font size of "Set to 1 if sent by an HE AP with support for 4 or more spatial streams" in the SU Beamformer row	As in comment.	2017/1/9 9:42
7989	Massinissa Lalam	225	1 9.4.2.218.3	85	48	E	Y	85.48	9.4.2.218.3	In Table 9-262aa, add extra line between each Bxx definition for the Tx Beamforming Feedback With Trigger Frame row,	As in comment.	2017/1/9 9:42
7990	Massinissa Lalam	225	1 3.4	7		E	Y	7.00	3.4	Please consider adding the PPE acronym in subclause 3.4	As in comment.	2017/1/9 9:42
7991	Massinissa Lalam	225	1 3.4	7		E	Y	7.00	3.4	Please consider adding the PE (Packet Extension) acronym in subclause 3.4	As in comment.	2017/1/9 9:42
7992	Massinissa Lalam	225	1 3.4	7		E	Y	7.00	3.4	Please consider adding the SRP acronym in subclause 3.4	As in comment.	2017/1/9 9:42
7993	Massinissa Lalam	225	1 9.4.2.218.4	87	56	T	Y	87.56	9.4.2.218.4	How can a STA know the size of the "Tx Rx HE MCS Support field" since Tx BW Bitmap and Rx BW Bitmap may not be present as they are "beyond Highest MCS Supported filed" in case all of their bits are equal to zero? Indeed, the sentence "If all of the bits of the Tx BW Bitmap subfield and all of the bits of the Rx BW Bitmap subfield are zero, then none of the subfields of the Tx Rx HE MCS Support field beyond Highest MCS Supported need to be present." implies that the Tx Rx HE MCS Support field can have a size as low as 6 bits. In my opinion the "Tx BW Bitmap" and "Rx BW bitmap" should always be present to maintain a minimum of a 2 bytes field (coherent with Figure 9-589c)), extended by one byte each time a bit is at 1 Tx BW Bitmap and Rx BW Bitmap. Therefore, the begining of the next subfield 'PPE Thresholds (optional)" can also be uniquely defined.	Please consider revision. For instance, replacing the whole paragraph with "If all of the bits of the Tx BW Bitmap subfield and all of the bits of the Rx BW Bitmap subfield are zero, then none of the subfields of the Tx Rx HE MCS Support field beyond Rx BW Bitmap are present."	2017/1/9 9:42

7994	Massinissa Lalam	225	1 9.4.2.218.5	88	64	T	Y	88.64 9.4.2.218.5	What does "RU allocation index 0" means? Please give a definition of "RU allocation index".	As in comment.	2017/1/9 9:42
7995	Massinissa Lalam	225	1 9.4.2.219	92	7	T	Y	92.07 9.4.2.219	The whole paragraph about the "nontransmitted BSSID", "Nontransmitted BSSID", "transmitted BSSID" and "Transmitted BSSID" is really confusing. Please consider revision since one can not easily make the distinction all the terms use (some times with capital letter, some without).	As in comment.	2017/1/9 9:42
7996	Massinissa Lalam	225	1 9.4.2.219	92	19	T	Y	92.19 9.4.2.219	It is not clear if the BSS Color Disabled set to 1 is a recommendation or an action that non-AP STAs associated to the AP shall perform (i.e. disabling BSS colos)	Replace "The BSS Color Disabled subfield indicates whether the transmitting AP recommends the ..." with "The BSS Color Disabled subfield indicates whether the transmitting AP commands the ..." if the intent is to have a mandatory behavior. Otherwise, replace in the next sentence "An HE AP sets the BSS Color Disabled subfield to 1 if the HE AP decides to disable ..." with "An HE AP sets the BSS Color Disabled subfield to 1 if the HE AP recommends to disable ...".	2017/1/9 9:42
7997	Massinissa Lalam	225	1 9.4.2.219	92	36	T	Y	92.36 9.4.2.219	It seems to me that the Dual Beacon subfield does not "indicate" the TBTT offset of the Beacon frame in HE extended range SU PPDU format. This offset is fixed and defined in subclause 11.1.3.10.	Delete the sentence "The Dual Beacon subfield also indicates the TBTT offset of Beacon frame in HE extended range SU PPDU in 11.1.3.10 (Beacon generation in an HE BSS)." Add the sentence "The TBTT offset of Beacon frame in HE extended range SU PPDU is defined in 11.1.3.10 (Beacon generation in an HE BSS)." after "The subfield is set to 1 if the HE AP transmits beacons in an HE extended range SU PPDU and a non-HE PPDU.".	2017/1/9 9:42
7998	Massinissa Lalam	225	1 9.4.2.219	93	10	T	Y	93.10 9.4.2.219	Is VHT Operation Information field necessary for HE AP operating in the 5 GHz band? Since an HE STA is also a VHT STA in the 5 GHz band, does it make sense to repeat these 3 bytes? Especially since it is more than likely that a VHT Operation Element will also be present in a 5 GHz AP for backward compatibility reason. The only interest seems to be in the 2,4 GHz band where VHT is not defined.	Consider deleting "VHT Operation Information" from the "HE Operation" element if the "VHT Operation" is also present in the frame carrying the "HE Operation" element. The sentence "The VHT Operation Information field is present in the HE Operation element only if no VHT Operation element is present in the same management frame carrying the HE Operation element." should be placed before "The structure of the VHT Operation Information field is defined in Figure 9-564 (VHT Operation Information field) and its subfields are defined in Table 9-252 (VHT Operation Information subfields)". Figure 9-589cq should also be changed with the size of VHT Operation Information being 0 or 3 octets instead of 3.	2017/1/9 9:42
7999	Massinissa Lalam	225	1 9.4.2.220	93	26	E	Y	93.26 9.4.2.220	Replace "Lenght" with "Length" in Figure 9-589ct	As in comment.	2017/1/9 9:42
8000	Massinissa Lalam	225	1 3.2	3	47	E	N	3.47 3.2	I think that in the sentence "Clause 21 (Very High Throughput (VHT) PHY specification(11ac))", the "(11ac)" part should be deleted. However, I admit that this is more a comment for a possible rev md than 11ax, unless we want to align also the sentence "Clause 28 (High Efficiency (HE) PHY specification)", by adding "Clause 28 (High Efficiency (HE) PHY specification(11ax))", But I do not favor this option. My preference would be to take the opportunity to delete this extra text if possible.	If within the scope/perimeter of the 11ax WG, please replace "Clause 21 (Very High Throughput (VHT) PHY specification(11ac))" with "Clause 21 (Very High Throughput (VHT) PHY specification".	2017/1/9 9:42
8001	Massinissa Lalam	225	1 3.2	4	26	E	Y	4.26 3.2	The "j)" subsection should be underligned as it basically introduces HE40 PPDU.	Please underlign the whole "j)" bullet sentence.	2017/1/9 9:42
8002	Massinissa Lalam	225	1 3.2	4	27	E	Y	4.27 3.2	In the "j)" subsection, "Clause 26" should be replaced with "Clause 28".	As in comment.	2017/1/9 9:42
8003	Massinissa Lalam	225	1 3.2	4	53	E	Y	4.53 3.2	Add "PPDUs" at the end of the sentence "One of the following" to be aligned with the "40 MHz mask ..." subsection.	Replace "One of the following:" with "One of the following PPDUs:".	2017/1/9 9:42

8004	Massinissa Lalam	225	1 3.2	4	57	E	Y	4.57 3.2	In the "a)" subsection, terminate the sentence with point (.).	As in comment.		2017/1/9 9:42
8005	Massinissa Lalam	225	1 3.2	4	61	E	Y	4.61 3.2	In the "b)" subsection, terminate the sentence with point (.).	As in comment.		2017/1/9 9:42
8006	Massinissa Lalam	225	1 3.2	4	65	E	Y	4.65 3.2	In the "c)" subsection, terminate the sentence with point (.).	As in comment.		2017/1/9 9:42
8007	Massinissa Lalam	225	1 3.2	5	4	E	Y	5.04 3.2	In the "d)" subsection, terminate the sentence with point (.).	As in comment.		2017/1/9 9:42
8008	Massinissa Lalam	225	1 3.2	5	9	E	Y	5.09 3.2	Delete the extra "f)" added at the begining of the sentence.	As in comment.		2017/1/9 9:42
8009	Massinissa Lalam	225	1 3.2	5	10	E	Y	5.10 3.2	Delete the extra "g)" added at the begining of the sentence.	As in comment.		2017/1/9 9:42
8010	Massinissa Lalam	225	1 3.2	5	28	E	Y	5.28 3.2	Add "PPDUs" at the end of the sentence "One of the following" to be aligned with the "40 MHz mask ..." subsection.	Replace "One of the following:" with "One of the following PPDUs:".		2017/1/9 9:42
8011	Massinissa Lalam	225	1 3.2	5	26	E	Y	5.26 3.2	Terminate all subsections (from "a)" to "h)") with a point (.).	As in comment.		2017/1/9 9:42
8012	Massinissa Lalam	225	1 3.2	6	8	E	Y	6.08 3.2	Add "PPDUs" at the end of the sentence "One of the following" to be aligned with the "40 MHz mask ..." subsection.	Replace "One of the following:" with "One of the following PPDUs:".		2017/1/9 9:42
8013	Massinissa Lalam	225	1 3.2	6	6	E	Y	6.06 3.2	Terminate all subsections (from "a)" to "e)") with a point (.).	As in comment.		2017/1/9 9:42
8014	Massinissa Lalam	225	1 4.3.14a	9	25	T	Y	9.25 4.3.14a	I would have thought that in the 2.4GHz band an HE AP would also be an HT AP for at least two reasons 1) backward compatibility reason dictated by the PAR, 2) since an HE non-AP STA is also an HT non-AP STA.	Please replace "- An HE non-AP STA is also an HT non-AP STA" with "- An HE STA is also an HT STA".		2017/1/9 9:42
8015	Massinissa Lalam	225	1 9.2.4.5.6	21	6	E	N	21.06 9.2.4.5.6	Replace "can" with "may".	As in comment.		2017/1/9 9:42
8016	Massinissa Lalam	225	1 9.3.1.8.1	33	43	E	Y	33.43 9.3.1.8.1	The sentence "Change the 4th paragraph as follows:" should be in italic (+bold).	As in comment.		2017/1/9 9:42
8017	Massinissa Lalam	225	1 9.3.1.9.3	36	13	E	Y	36.13 9.3.1.9.3	Please precise where the Fragment Number subfield comes from. For instance, replace "The Fragment Number subfield is set as defined in Table 9-24a" with "The Fragment Number subfield of the Block Ack Starting Sequence Control subfield is set as defined in Table 9-24a".	As in comment.		2017/1/9 9:42
8018	Massinissa Lalam	225	1 9.3.1.9.7	38	13	E	Y	38.13 9.3.1.9.7	"Ack Type subfield" is used through all the subclause. Please stay consistent and replace "The Ack Type field is not set to 1 when responding to a BlockAckReq frame or an MU-BAR frame." with "The Ack Type subfield is not set to 1 when responding to a BlockAckReq frame or an MU-BAR frame."	As in comment.		2017/1/9 9:42
8019	Massinissa Lalam	225	1 9.3.1.23	42	7	E	Y	42.07 9.3.1.23	In Figure 9-52d, add a space between "GI" and "And" in the "GIAnd LTF Type" subfield (B20-B21).	As in comment.		2017/1/9 9:42
8020	Massinissa Lalam	225	1 9.1.3.23	41	34	E	Y	41.34 9.1.3.23	In this subclause, we have for the subfields description of the Common Info field for instance: "The CS Required subfield is ...", "The BW subfield indicates ...", and "The GI And LTF Type subfield of the Common Info field indicates ...", "The MU-MIMO LTF Mode subfield of the Common Info field". Either add "of the Common Info field" each time a subfield description of the Common Info field is missing it (e.g. Cascade Indication, CS Required, BW, Spatial Reuse, Doppler, HE-SIG-A Reserved) or delete it each time it appears in a subfield description of the Common Info field to stay consistent. I do prefer the first option though (more precise).	As in comment.		2017/1/9 9:42
8021	Massinissa Lalam	225	1 9.1.3.23	44	50	E	Y	44.50 9.1.3.23	In table 9-25e, correct the description when AP Tx Power subfield value is between 0 and 60. Replace "Values 0 to 61 maps to -20 dBm to 40 dBm" with "Values 0 to 60 maps to -20 dBm to 40 dBm".	As in comment.		2017/1/9 9:42

8022	Massinissa Lalam	225	1 9.1.3.23	45	11	T	Y	45.11 9.1.3.23	The "high doppler mode of transmission" is not clearly defined in the draft. What is the criteria to consider it "high" or not? What are the consequences for the STA? Also through all the document the "Doppler procedure" is also mentionned in relation with this Doppler bit, but no clear link is established between this procedure and this mode of transmission. Please clarify.	Please, add clarifications on what the "high doppler mode transmission" is and what are the consequences of it for a STA.		2017/1/9 9:42
8023	Massinissa Lalam	225	1 9.1.3.23	47	46	G	N	47.46 9.1.3.23	So the special STAID[11:0] is in fact AID12 with the value 0xFFF? I think that it should be more clearly stated that the padding is in fact a special User Info Field with AID12 subfiled being equal to 0xFFF, the rest being filed with ones. At least, one could replace "starts with special STAID[11:0] as" with "starts with special AID12 subfield as".	As in comment.		2017/1/9 9:42
8024	Massinissa Lalam	225	1 9.2.4.6.4.1	24	34	E	Y	24.34 9.2.4.6.4.1	Please consider replacing "Operation Mode" with "Operating Mode Indication (OMI)" in Table 9-18a (and subsequent clause 9.2.4.6.4.3) to make the link with the "OMI A-Control Support" field the HE MAC capabilities Table 9-262z more obvious for the reader (like it is done for BSR and BQR).	As in comment.		2017/1/9 9:42
8025	Massinissa Lalam	225	1 9.3.1.23.3	49	62	E	Y	49.62 9.3.1.23.3	For consistency with previous trigger frame variants description, the first sentence should be "If the Trigger frame is a MU-BAR variant, the Trigger Dependent Common Info field is not present and the Trigger Dependent User Info field is defined in Figure 9-52i (Trigger Dependent User Info field for the MU-BAR variant).".	As in comment.		2017/1/9 9:42
8026	Massinissa Lalam	225	1 9.3.1.23.4	50	22	E	Y	50.22 9.3.1.23.4	For consistency with previous trigger frame variants description, the first sentence should be "If the Trigger frame is a MU-RTS variant, the Trigger Dependent Common Info field is not present and the Trigger Dependent User Info field is not present". The two NOTEs (pg50,ln43 and pg51,ln15) can be deleted.	As in comment.		2017/1/9 9:42
8027	Massinissa Lalam	225	1 9.3.1.23.4	50	22	E	Y	50.22 9.3.1.23.4	In general, the presentation of this subclause should be aligned with the previous trigger frame variant presentations. If specific values are set for given subfields (Common or User) then it is worth mentioning them, but lines 22, 31, 46 are useless in my opinion (or by default covered by the parent subclause 9.3.1.23).	As in comment.		2017/1/9 9:42
8028	Massinissa Lalam	225	1 9.3.1.23.5	51	17	E	Y	51.17 9.3.1.23.5	Replace the subclause title "BSRP variant" with "Buffer Status Report Poll variant" to stay consitent with the BQRP subclause title and the Table 9-25a.	As in comment.		2017/1/9 9:42
8029	Massinissa Lalam	225	1 9.3.1.23.5	51	20	E	Y	51.20 9.3.1.23.5	For consistency with previous trigger frame variants description, this whole subclause should read "If the Trigger frame is a Buffer Status Report Poll (BSRP) variant, the Trigger Dependent Common Info field is not present and the Trigger Dependent User Info field is not present.".	As in comment.		2017/1/9 9:42
8030	Massinissa Lalam	225	1 9.3.1.23.6	51	33	E	Y	51.33 9.3.1.23.6	For consistency with previous trigger frame variants description, the first sentence should be "If the Trigger frame is a GCR MU-BAR variant, the Trigger Dependent Common Info field is defined in Figure 9-52j (Trigger Dependent Common Info field for the GCR MU-BAR variant) and the Trigger Dependent User Info field is not present.".	As in comment.		2017/1/9 9:42

8031	Massinissa Lalam	225	1 9.3.1.23.7	51	60	E	Y	51.60 9.3.1.23.7	For consistency with previous trigger frame variants description, the first three sentences of this subclause could be replaced with "If the Trigger frame is a Bandwidth Query Report Poll (BQRP) variant, the Trigger Dependent Common Info field is not present and the Trigger Dependent User Info field is not present.".	As in comment.	2017/1/9 9:42
8032	Massinissa Lalam	225	1 9.3.1.23.7	52	5	E	Y	52.05 9.3.1.23.7	Replace "The CS Required subfield is set to 1." with "The CS Required subfield of the Common Info field is set to 1."	As in comment.	2017/1/9 9:42
8033	Massinissa Lalam	225	1 3.4	7		E	Y	7.00 3.4	Please consider adding the RAPS (Random Access Parameter Set) acronym to the subclause 3.4	As in comment.	2017/1/9 9:42
8034	Massinissa Lalam	225	1 9.3.3.11	55	24	E	N	55.24 9.3.3.11	In Table 9-34, check the horizontal line width between row 95 and 96, It should be thinner.	As in comment.	2017/1/9 9:42
8035	Massinissa Lalam	225	1 9.4.1.62	56	9	E	N	56.09 9.4.1.62	In Figure 9-121a, consider spliting the row (B0-B39) in two rows (e.g. B0-B11, and B12-B39) to avoid overlapping and stick within the page margins.	As in comment.	2017/1/9 9:42
8036	Massinissa Lalam	225	1 9.4.1.62	57	21	T	Y	57.21 9.4.1.62	In Table 9-76a, the Remaining Feedback Segments description is not clear. In particular the way the split is done between 1 and 6 and 1 and 7 for the remaining feedback segments of a segmented reports. It is clear that for the last feedback segment (or unsegmented feedback) this subfield will have the value 0. However, for the first feedback fragment in case of segmented feedback, the only possible value to be set is 7 since this precision ("Set to a value between 1 and 6 for a feedback segment that is neither the first nor the last of a segmented report.") forbids other values. Please clarify the description as it is confusing right now.	As in comment.	2017/1/9 9:42
8037	Massinissa Lalam	225	1 9.4.1.62	57	51	T	Y	57.51 9.4.1.62	What does the sentence "In an HE Compressed Beamforming frame not carrying all or part of an HE Compressed Beamforming report" means? In such case, what information does the HE Compressed Beamforming report carry? Please clarify the use case when this can happen or reference it to a correct subclause in the Draft if this 0 information feedback transmission use case is already covered.	As in comment.	2017/1/9 9:42
8038	Massinissa Lalam	225	1 9.4.2.218.2	77	22	E	Y	77.22 9.4.2.218.2	In Table 9-262z describing the HE MAC capabilities, some times "HE STA", " is used, some times only "STA". Since this table only addresses HE-capable device, I don't think that it is necessary to add "HE". Anyway please uniform the table by consistently using either {"HE STA", "HE non-AP STA", "HE AP"} or {"STA", "non-AP STA", "AP}.	As in comment.	2017/1/9 9:42

8039	Massinissa Lalam	225	1 9.4.2.218.2	78	78	E	N	78.78 9.4.2.218.2	In Table 9-262z, use a consistent definition for the support of a specific Control ID subfield value in an HE variant HT Control field. For instance the definition associated to the support of Control ID = 0 (UL MU response scheduling,pg78,ln43), Control ID = 2 (HE Link adaptation, pg78,ln27) and Control ID = 3 (Buffer Status Report,pg78,ln49) do not follow the same format. I would prefer to stick with something equivalent to the first definition format provided for HE link adaptation support, i.e., "Indicates whether the STA supports <Control ID Meaning from Table 9-18a> using the HE variant HT Control field". This gives - For HE Link Adaptation Capable pg78,ln27: "Indicates whether the STA supports HE link adaptation using the HE variant HT Control field." - For UL MU Response Scheduling Support,pg78,ln43: "Indicates whether the non-AP	As in comment.			2017/1/9 9:42
8040	Massinissa Lalam	225	1 9.4.2.218.2	79	28	E	N	79.28 9.4.2.218.2	Consider replacing "OMI A-Control Support" with "A-OMI Support" to stay consistent with "A-BSR Support" and "A-BQR Support" subfields	As in comment.		2017/1/9 9:42
8041	Massinissa Lalam	225	1 9.4.2.218.2	79	42	T	Y	79.42 9.4.2.218.2	In Table 9-262z, the row for "Maximum AMPDU Length Exponent" is empty. Please fill it.	As in comment.		2017/1/9 9:42
8042	Massinissa Lalam	225	1 3.4	7		E	Y	7.00 3.4	Please consider adding the QTP acronym in subclause 3.4	As in comment.		2017/1/9 9:42
8043	Massinissa Lalam	225	1 9.4.2.220	93	60	E	Y	93.60 9.4.2.220	Replace "EOCW_max" with "EOCWmax"	As in comment.		2017/1/9 9:42
8044	Massinissa Lalam	225	1 9.4.2.224	96	38	E	Y	96.38 9.4.2.224	In Figure 9-589da, replace "Vender" with "Vendor".	As in comment.		2017/1/9 9:42
8045	Massinissa Lalam	225	1 9.4.2.225	97	16	E	Y	97.16 9.4.2.225	In Figure 9-589db, replace "Vender" with "Vendor".	As in comment.		2017/1/9 9:42
8046	Massinissa Lalam	225	1 27.2.1	149		E	Y	149.00 27.2.1	Please terminate sentences with a point(.) when one is missing. Many bullet points in this subclause are not correctly terminated.	As in comment.		2017/1/9 9:42
8047	Massinissa Lalam	225	1 27.2.1	150	16	E	Y	150.16 27.2.1	Delete extra space added after before the point (.) in the sentence "If the received frame satisfies both intra-BSS and inter-BSS conditions, the decision made by using the MAC address takes precedence over the decision made by using the RXVECTOR parameter BSS_COLOR .".	As in comment.		2017/1/9 9:42
8048	Massinissa Lalam	225	1 27.2.2	150		E	Y	150.00 27.2.2	Please terminate sentences with a point(.) when one is missing. Many bullet points in this subclause are not correctly terminated.	As in comment.		2017/1/9 9:42
8049	Massinissa Lalam	225	1 27.3.4.1	155	21	E	Y	155.21 27.3.4.1	Replace "Set to 3 if the STA supports reception of dynamic fragments following the procedure defined in 227.3.3.4 (Level 3 dynamic fragmentation)" with "Set to 3 if the STA supports reception of dynamic fragments following the procedure defined in 27.3.3.4 (Level 3 dynamic fragmentation)"	As in comment.		2017/1/9 9:42
8050	Massinissa Lalam	225	1 27.4.1	157	36	T	Y	157.36 27.4.1	I was under the impression that only an HE AP is the recipient of an HE trigger-based PPDU, meaning that "An HE STA may send a Multi-STA BlockAck frame in response to an HE trigger-based PPDU." should be replaced by "An HE AP may send a Multi-STA BlockAck frame in response to an HE trigger-based PPDU."	As in comment.		2017/1/9 9:42

8051	Massinissa Lalam	225	1 27.4.1	157	28	E	Y	157.28	27.4.1	Delete sentence "An HE non-AP STA that sends a Multi-STA BlockAck frame shall set the AID subfield in the Per STA Info field of the Multi-STA BlockAck frame to 0 and the RA field to the BSSID when the intended receiver of the frame is the AP." and add the sentence after "An HE non-AP STA shall transmit a Multi-STA BlockAck frame with a single AID subfield or with the same values of the AID subfield in Per STA Info subfields and shall set the RA field to the address of the recipient STA that requested the Block Ack frame. In case the intended recipient STA is the AP the HE non-AP STA is associated to, the AID is set to 0 and the RA field is set to the BSSID of the AP."	As in comment.	2017/1/9 9:42
8052	Massinissa Lalam	225	1 27.4.1	157	48	E	Y	157.48	27.4.1	Replace "An HE STA that supports Multi-STA BlockAck shall examine each received Multi-STA sent by an STA ..." with "An HE STA that supports Multi-STA BlockAck shall examine each received Multi-STA BlockAck frames sent by an STA ...". otherwise define what a "Multi-STA" is.	As in comment.	2017/1/9 9:42
8053	Massinissa Lalam	225	1 27.5.1.1	162	58	T	Y	162.58	27.5.1.1	There is no "DL OFDMA With MIMO Support" field defined in the HE Capabilities element subclause 9.4.2.218. Either add this field if missing or refer to the correct one(s). So far the intent of the sentence is not really clear for me to decide to which already existing fields of the HE Capabilities element to refer. Does the sentence refer to a DL OFDMA transmission plus DL MU-MIMO on some RUs, or just DL OFDMA with more than one spatial streams on some RUs?	As in comment.	2017/1/9 9:42
8054	Massinissa Lalam	225	1 27			G	N		27	On the whole clause, "HE STA", "HE non-AP STA", "HE AP", "STA", "non-AP STA", "AP" are used. Since this clause only applies to HE STA, should we drop the "HE" prefix or should we ensure that it is always present?	Use either "HE STA", "HE non-AP STA", "HE AP" or "STA", "non-AP STA", "AP" on the whole clause.	2017/1/9 9:42
8055	Massinissa Lalam	225	1 28			G	N		28	On the whole clause, "HE STA", "HE non-AP STA", "HE AP", "STA", "non-AP STA", "AP" are used. Since this clause only applies to HE STA, should we drop the "HE" prefix or should we ensure that it is always present?	Use either "HE STA", "HE non-AP STA", "HE AP" or "STA", "non-AP STA", "AP" on the whole clause.	2017/1/9 9:42
8056	Massinissa Lalam	225	1 27.5.2.2.1	164	46	E	Y	164.46	27.5.2.2.1	Remove the extra point(.) in "For recipient STAs that are associated with the AP, the User Info field is addressed to a recipient STA if the value of the AID12 subfield of the User Info field is equal to the AID of the STA or to 0 (indicating a random access allocation).."	As in comment.	2017/1/9 9:42
8057	Massinissa Lalam	225	1 27.5.2.2.2	166	22	T	Y	166.22	27.5.2.2.2	In "Spatial Reuse is set to SR_Disallowed", the value "SR_Disallowed" is not defined. Please add a definition or clearly state that "Spatial Reuse is set to 0 (SR disallow)" if same meaning as Table 28-19 is meant.	As in comment.	2017/1/9 9:42
8058	Massinissa Lalam	225	1 27.5.2.2.3	167	34	T	N	167.34	27.5.2.2.3	The sentence "An AP may use any AC for sending a PPDU that contains only Trigger frames." allows an AP to use the voice AC to "preempt" the medium, event if it knows, through reporting for instance, that the addressed STAs only have background traffic to transmit. In my opinion, we should at least recommend for data traffic that if the AP knows the AC categories of the buffered traffic of the addressed STAs, it should use the lowest AC reported for sending a PPDU that contains such Trigger frame.	As in comment.	2017/1/9 9:42

8059	Massinissa Lalam	225	1 27.5.2.3	167	65	E	Y	167.65 27.5.2.3	"-- Otherwise, a STA shall not send an HE trigger-based PPDU" should not be a bullet point. Remove the sentence from the bullet list.	As in comment.	2017/1/9 9:42
8060	Massinissa Lalam	225	1 27.5.2.3	169	18	T	Y	169.18 27.5.2.3	In "-- SPATIAL_REUSE shall be set to the value indicating SR_Disallowed", the parameter "SR_Disallowed" is not defined in the Draft. please define it or rephrase if based on Table Table 28-19, e.g. ""-- SPATIAL_REUSE shall be set to 0 (SR disallow)".	As in comment.	2017/1/9 9:42
8061	Massinissa Lalam	225	1 27.5.2.4	170	26	T	Y	170.26 27.5.2.4	From the text, it seems that a STA that is sollicited by a trigger frame for an UL transmission will not consider a NAV set by intra-BSS, i.e. by a STA from the same BSS ... is it really the wanted behavior? If so, then "If one or both of the NAVs are considered and the considered NAV's counter is nonzero" only refers to the inter-BSS NAV and should be rephrased accordingly.	As in comment.	2017/1/9 9:42
8062	Massinissa Lalam	225	1 3.4	7		E	Y	7.00 3.4	Please consider adding the RA (Random Access) acronym in subclause 3.4	As in comment.	2017/1/9 9:42
8063	Massinissa Lalam	225	1 27.5.2.6.1	172	28	E	Y	172.28 27.5.2.6.1	Replace "A STA shall set the UL OFDMA RA Support subfield in the HE Capabilities element to 1 if it supports UL OFDMA-based random access and set it 0, otherwise." with "A STA shall set the UL OFDMA RA Support subfield in the HE Capabilities element to 1 if it supports UL OFDMA-based random access and set it to 0, otherwise.".	As in comment.	2017/1/9 9:42
8064	Massinissa Lalam	225	1 27.5.2.6.2	173	45	E	Y	173.45 27.5.2.6.2	Separate the two sentences by adding a point(.) followed by a blank space. Ie replace "For an HE STA, if the OBO counter is 0 or if the OBO counter decrements to 0, then the STA randomly selects one of the RUs assigned to AID value 0If ..." with ""For an HE STA, if the OBO counter is 0 or if the OBO counter decrements to 0, then the STA randomly selects one of the RUs assigned to AID value 0. If ..."	As in comment.	2017/1/9 9:42
8065	Massinissa Lalam	225	1 27.5.2.6.3	174	12	E	Y	174.12 27.5.2.6.3	Delete the sentence "This subclause defines the retransmission procedure that a STA may follow using random access." as it brings no addtional information not already conveyed.	As in comment.	2017/1/9 9:42
8066	Massinissa Lalam	225	1 27.6.4	179	28	T	Y	179.28 27.6.4	In "-- SPATIAL_REUSE set to SR disallowed", what is "SR disallowed"? Please define it or rephrase if based on Table Table 28-19, e.g. "-- SPATIAL_REUSE set to 0 (SR disallow)".	As in comment.	2017/1/9 9:42
8067	Massinissa Lalam	225	1 27.7.1	180	180	T	Y	181.80 27.7.1	I'm still missing the technical contributions which demonstrate the benefit of having the TWT operation mandatory at an HE AP in a dense deployment context (using the agreed 11ax simulation scenarios for instance). So far, I do not have any technical evidence of why "An HE AP shall set the TWT Responder Support subfields of the Extended Capabilities element and HE Capabilities element to 1.". Please delete this sentence or give sufficient justification of why it should be this way.	As in comment.	2017/1/9 9:42

8068	Massinissa Lalam	225	1 27.9.1	190	11	T	Y	190.11 27.9.1	An "SR PPDU" is not defined in the draft. Please consider replacing "When the conditions specified in 27.9 (Spatial reuse operation) are met that allow the transmission of an SR PPDU, an HE STA may transmit an SR PPDU to either an HE STA or a non-HE STA." with "When the conditions specified in 27.9 (Spatial reuse operation) are met that allow the transmission of a PPDU, an HE STA may transmit this PPDU, defined as Spatial Reuse (SR) PPDU, to either an HE STA or a non-HE STA."	As in comment.		2017/1/9 9:42
8069	Massinissa Lalam	225	1 27.9.2.1	190		T	Y	190.00 27.9.2.1	"SR_Delay" and "SR_Restricted" values are not defined in this subclause. Please define them.	As in comment.		2017/1/9 9:42
8070	Massinissa Lalam	225	1 27.9.2.1	190	50	E	Y	190.50 27.9.2.1	"SR Backoff procedure for SR delayed case." seems out of place. Is it a new subclause? Is so, create the corresponding subclause (and adjust the subsequent subclause numbers).	As in comment.		2017/1/9 9:42
8071	Massinissa Lalam	225	1 27.9.2.2	191		E	N	191.00 27.9.2.2	Quality of Figure 27-6 should really be improved.	As in comment.		2017/1/9 9:42
8072	Massinissa Lalam	225	1 27.9.2.2	191		T	Y	191.00 27.9.2.2	Shouldn't TXPWRref be dependent from the band (even the channel based on the local regulation)? please clarify if it is the case or not.	As in comment.		2017/1/9 9:42
8073	Massinissa Lalam	225	1 27.9.2.2	191		T	Y	191.00 27.9.2.2	While obvious, I think that it should be stated that OBSS_PDmin is lower or equal to OBSS_PDmax.	As in comment.		2017/1/9 9:42
8074	Massinissa Lalam	225	1 27.9.2.2	192	19	T	Y	192.19 27.9.2.2	What is an "including UL TB PPDU" ? I think that "HE trigger-based PPDU" is what is meant.	As in comment.		2017/1/9 9:42
8075	Massinissa Lalam	225	1 27.14.2	200		E	Y	200.00 27.14.2	Increase the size of Figure 27-7. It is barely readable.	As in comment.		2017/1/9 9:42
8076	Massinissa Lalam	225	1 3.4	7		E	Y	7.00 3.4	Please consider adding the QTP (Quiet Time Period) acronym in subclause 3.4	As in comment.		2017/1/9 9:42
8077	Massinissa Lalam	225	1 28.3.3.1	228	17	E	Y	228.17 28.3.3.1	Wrong reference. Replace "Table 28-15 (CH_BANDWIDTH and for pre-HE modulated fields)" with "Figure 28-1--Illustration of OFDM and OFDMA concepts".	As in comment.		2017/1/9 9:42
8078	Massinissa Lalam	225	1 28.3.3.2	229	14	T	Y	229.14 28.3.3.2	How is the AP "advised" ? This requirement should be mandatory in my opinion with something like "NOTE--If a HE non-AP STA does not respond with a 26-tone RU in HE trigger-based PPDU in a DFS channel, then AP shall trigger with no less than 52-tone RU for the same HE non-AP STA in the next HE trigger-based PPDU transmission."	As in comment.		2017/1/9 9:42
8079	Massinissa Lalam	225	1 28.3.10.7.2	275	33	T	Y	275.33 28.3.10.7.2	In Table 28-16, the "Doppler mode" is not defined in the standard. Please add a definition and to what does it correspond?	As in comment.		2017/1/9 9:42
8080	Massinissa Lalam	225	1 28.3.10.7.4	285		E	Y	285.00 28.3.10.7.4	In Figure 28-19, lots of "HE-SIG-" fields are present, please adjust the box size for a complete viewing of the fileds.	As in comment.		2017/1/9 9:42
8081	Massinissa Lalam	225	1 28.3.11.9	325		E	Y	325.00 28.3.11.9	The bits mapped for each 1024-QAM symbol are barely readable. Consider increasing the size for each quadrant (Figure 28-30 to 33).	As in comment.		2017/1/9 9:42
8082	Massinissa Lalam	225	1 B	407		E	Y	407.00 B	In Annex B "HEW" is still used, while it has been decided at the begining of TGax to go with "HE" instead. Please replace "High Efficiency WLAN (HEW) operation" with "High Efficiency (HE) operation" for consistency with the other clauses. Also replaced any "HEW" found in this annex with "HE".	As in comment.		2017/1/9 9:42
8083	Matthew Fischer	225	1 9.4.2.218.2	76	31	T	Y	76.31 9.4.2.218.2	TWT support bits exist in both HE CAP IE and Ext CAP IE - the bits only need to appear in one location	Eliminate the TWT support bits from the HE CAP IE while keeping those in the EXT CAP IE. Adjust references appropriately.		2017/1/9 9:42
8084	Matthew Fischer	225	1 10.43.1	139	9	T	Y	139.09 10.43.1	It feels like the TWT request command could appear in the initiating box as well for this row	Change "Demand TWT" to "Request or Demand TWT"		2017/1/9 9:42

8085	Matthew Fischer	225	1 27.8.3	189	39	T	Y	189.39 27.8.3	Language is not quite correct	Change "all variants" to "any variant"	2017/1/9 9:42
8086	Matthew Fischer	225	1 27.7.3.3	185	42	T	Y	185.42 27.7.3.3	The language here is a bit unclear - in particular, pay attention to the "shall" clause and the associated modifier "which the STA intends": A TWT scheduled STA that is in PS mode may go to doze state after receiving the Beacon frame and shall be in the awake state at a broadcast TWT start time during which the STA intends to exchange frames with the TWT scheduling STA. - the problem here is that the AP cannot predict whether a STA is going to be awake or not, because the AP does not know of the STA's intentions. So this is not helpful language. Either change the shall to a should, or remove the qualifier and require the STA to be awake for all TWT SP associated with a Broadcast TWT that it has joined.	Remove the qualifier or modify it so that the STA is required to be awake for all TWT SP associated with a Broadcast TWT that it has joined. If a STA has not joined the Broadcast TWT with this TWTID, then it does not have to be awake. Also, there will remain the option for a STA to be able to sleep through some BTWT SPs because it can always signal suspend and resume with the TWT Info frames.	2017/1/9 9:42
8087	Matthew Fischer	225	1 27.9	190	1	T	Y	190.01 27.9	SRP is incomplete - need a control on the ACK response to an SR transmission - if the DATA frame was transmitted under SRP conditions, then the ACK should also obey the SRP conditions - but the ACK transmitter needs to know if the DATA frame was transmitted under SRP conditions because for a non-SRP generated DATA frame, the ACK has no conditions, and we do not want to impose new conditions on ACKing that were not in the baseline, except for the new case of a DATA frame sent under SRP conditions	Add a way for an SR transmitter using SRP to indicate to the recipient that its ACK must be conditionalized on SRP conditions - use A-control to tell the recipient that the DATA frame was transmitted under SRP conditions	2017/1/9 9:42
8088	Matthew Fischer	225	1 27.9	190	1	T	Y	190.01 27.9	SRP is incomplete - backoff after meeting SRP conditions is not described - this is needed to avoid multiple STAs accepting an SRP condition and then all transmitting at the same time and creating a collision	Describe the backoff mechanism when SRP condition is met	2017/1/9 9:42
8089	Matthew Fischer	225	1 27.7.3.3	185	57	T	Y	185.57 27.7.3.3	In a couple of places, the wrong term is used - where "responding STA" is mentioned	At L58, change "responding STA" to "scheduled STA" and at L62, change "responding STA" to "scheduling STA" - also the sentence on L62 that begins with "reception of a frame" is a separate paragraph, but it should probably be item 3) in the list of items just above itself	2017/1/9 9:42
8090	Matthew Fischer	225	1 27.7.3.3	185	45	T	Y	185.45 27.7.3.3	If a STA is awake for more than one TWT SP, because either at the start or in the middle of an initial TWT SP, an overlap occurs, then the STA should be required to be awake until all TWT SP in which it participates have terminated. Note the complication here of identifying the particular TWT SP to which a terminanation notice belongs - i.e. if a scheduled STA receives an EOSP, is that valid or all TWT SP in which it participates, or is it only valid for one of them and if so, which one of them?	As one option, add a new paragraph to follow the paragraph that begins at P185L42 and its associated bullet items as follows: A scheduled STA that participates in more than one Broadcast TWT SP shall remain in the wake state during any time that is part of any of the TWT SP in which it participates unless a termination has occured for each of the TWT SPs that is currently active. Or maybe: A scheduled STA that participates in more than one Broadcast TWT SP may switch to doze state only when a termination event has occured for all currently acitve TWT SPs in which it participates.	2017/1/9 9:42
8091	Matthew Fischer	225	1 27.9.2.1	190	39	T	Y	190.39 27.9.2.1	What about the ACK that is transmitted in response to the SR PPDU? Does it have to obey any OBSS_PD transmit power rules?	Add a restriction on the tx power of the response transmitter, such that the tx power has to be limited to whatever tx power is "in force" where "in force" means that if a STA has discarded an OBSS PPDU using OBSS_PD and is counting backoff before transmitting an SR PPDU, then that tx power is "in force" for the duration of the OBSS PPDU that was discarded and if a reception occurs before the backoff countdown expires, then the response to that reception is restricted in its transmit power.	2017/1/9 9:42

8092	Matthew Fischer	225	1 27.9.1	190	3	T	Y	190.03 27.9.1	What about the response transmission to a PPDU that was transmitted due to a spatial reuse opportunity? That response transmission should be restricted, such that it too, must ensure that it will not interfere with an ongoing exchange, using whatever SR technique is avilable at the response transmitter STA, with a preference for SRP if enabled and a fallback to OBSS_PD if SRP is not enabled. Since a normal response is allowed to ignore all CCA indications, the responder needs to be able to tell the difference between a normal eliciting PPDU/MPDU and one an eliciting PPDU that was transmitted using SR of some sort.	Provide an indication within MPDUs of whether the MPDU was transmitted during an SR opportunity or not, and add a restriction on the response transmission to that SR PPDU transmission such that the response must examine the medium condition before responding and obey transmit power restrictions that might be in force due to ongoing SR conditions, e.g. OBSS_PD based transmit power restriction. Expect a submission that details such changes.	2017/1/9 9:42
8093	Matthew Fischer	225	1 28.3.10.7.2	273	29	T	Y	273.29 28.3.10.7.2	The UL/DL bit is set according to the UPLINK_FLAG parameter of the TXVECTOR - shouldn't the language in this subclause mention the TXVECTOR UPLINK_FLAG parameter? I think that this comment applies to a lot of the TXVECTOR values. I have not yet checked the RXVECTOR, but there probably needs to be something done there as well. A quick check of previous amendment PHY subclauses shows that no one has really done it this way, but it does feel like this suggested coupling of the TXVECTOR values and the SIG field values is the way that things should have been done all along.	Reword all of the TX and RX SIG field descriptions so that they are related directly to TXVECTOR and RXVECTOR items, where appropriate.	2017/1/9 9:42
8094	Matthew Fischer	225	1 27.9	190	1	T	Y	190.01 27.9	The MAC operation of the SRP mechanism is not described.	Provide a description of the MAC protocol for the SRP spatial reuse parameter. Expect a submission detailing a set of proposed changes.	2017/1/9 9:42
8095	Matthew Fischer	225	1 10.3.2.8a.2	117	5	T	Y	117.05 10.3.2.8a.2	There might be more than one recipient of an MU-RTS.	Change "sent by the receipient of the MU-RTS frame" to "sent by any recipient of the MU-RTS frame"	2017/1/9 9:42
8096	Matthew Fischer	225	1 10.3.2.8a.2	117	10	T	Y	117.10 10.3.2.8a.2	Why is the MU-RTS not allowed to be sent in an HE PPDU? There is no sense to having such a restriction.	Remove the cited line which disallows MU-RTS from being sent using an HE PPDU format.	2017/1/9 9:42
8097	Matthew Fischer	225	1 27.7.2	180	26	T	Y	180.26 27.7.2	The TWT negotiation process can be improved. Specifically, if a timeslot bitmap were added to the process then a STA could more concisely indicate its preferred TWT SP times and it could observe the allocated TWT SP times of OBSS neighbors and request time slots that avoid those times.	Add a time slot bitmap to allow simpler negotation of TWT SP times and to allow a simple method of determining when OBSS interference is more likely. Expect a submission detailing some changes.	2017/1/9 9:42
8098	Matthew Fischer	225	1 27	149	5	T	Y	149.05 27	Add a mechanism to set the transmit power per direction per link in order to achieve an increase in performance due to improved receiver design since the original EVM specification was written.	Add a mechanism to set the transmit power per direction per link in order to achieve an increase in performance due to improved receiver design since the original EVM specification was written. Expect a submission detailing some changes.	2017/1/9 9:42
8099	Matthew Fischer	225	1 10.7.6	123	29	T	Y	123.29 10.7.6	Due to power differences and other considerations, a situation can arise when the transmitter of a response frame using the standard required response MCS value is employing an MCS that will not work for the link because of the asymmetry, e.g. tx power asymmetry. Allow a STA to dictate the response PPDU MCS to avoid this problem.	Allow the transmitter of a response eliciting MPDU to include an indication of an appropriate MCS for the response MPDU. Expect a submission detailing some changes.	2017/1/9 9:42

8100	Matthew Fischer	225	1 9.4.1.62	56	10	T	Y	56.10 9.4.1.62	Transmit beamformer is sometimes inclined to modify a steering vector that is fed back by the beamformee, and that is often ok, but sometimes, the beamfomee needs to ensure that the beamformer does not alter the vector - so add a Vector Sanctity indication in the HE MIMO control field and describe its use, i.e. somewhere within 27.6 where TXBF for HE specifics appear	Add a bit "Vector Sanctity" to the HE MIMO Control field and a support bit to indicate support for the bit, and add a description of the use of the bit in 10.32 - also consider expanding its use backwards to VHT - expect a submission with detailed changes	2017/1/9 9:42
8101	Matthew Fischer	225	1 27.9.2	190	14	T	Y	190.14 27.9.2	OBSS_PD effect on secondary channel level sensing has not been described - if the OBSS PD level changes, do the secondary channel thresholds also need to change?	Address the issue of non-primary sensing levels if the OBSS_PD level changes - if there is no relationship with non-primary sensing levels, at least add a note indicating this so that it is explicitly stated somewhere.	2017/1/9 9:42
8102	Matthew Fischer	225	1 27.9.2.1	190	36	T	Y	190.36 27.9.2.1	The sentence here really does not provide any interesting functionality. At the end of the PPDU, the PHY is in a reset state anyway and the medium condition reverts to idle unless ED is active, which really does not matter in this case.	Provide additional text to justify the inclusion of this normative behavioral statement or delete it.	2017/1/9 9:42
8103	Matthew Fischer	225	1 27.9.2	190	14	T	Y	190.14 27.9.2	There is no definitive statement regarding the priority of the SRP condition vs the OBSS_PD condition	Add a normative behavioral statement that indicates that if a STA has enabled SRP and and SRP condition is in effect, then this overrides OBSS_PD conditions.	2017/1/9 9:42
8104	Matthew Fischer	225	1 27.9.2.2	191	3	T	Y	191.03 27.9.2.2	If the OBSS_PD is at a certain level and an OBSS PPDU is discarded based on that level, then is there any requirement of the STA that discarded that PPDU to hold its transmit power at or below the value associated with the OBSS_PD level that it used to discard the PPDU, for the duration of the discarded PPDU?	Add text to clarify any rules regarding holding TX power at a certain level for a duration related to the duration of a discarded PPDU.	2017/1/9 9:42
8105	Matthew Fischer	225	1 27.11.6	198	34	T	Y	198.34 27.11.6	What is the meaning of SR_RESTRICTED? The few references to this value do not make any sense. If the intent was to limit the SR transmission to the duration of the PPDU on top of which the SR transmission occurs, then there should be a general rule.	Remove SR_RESTRICTED and add text that says: SRP transmissions are always restricted to the duration of the discarded/ignored PPDU and OBSS_PD SR transmissions are not restricted in any way.	2017/1/9 9:42
8106	Matthew Fischer	225	1 9.4.2.218.5	90	25	T	Y	90.25 9.4.2.218.5	A minor error in the rules written in the table for PPET8 and PPET16	In table 9-262ad - PPET8 and PPET16 encoding, change "x greater than equal to PPET16" to "x greater than or equal to PPET16"	2017/1/9 9:42
8107	Matthew Fischer	225	1 9.4.2.218.5	90	7	T	Y	90.07 9.4.2.218.5	The text describing a relationship between PPET8 and PPET16 is not quite correct.	Change "The value for each PPET8 for NSSn for RUm is always less than the value of PPET16 for NSSn for RUm." to "The value for each PPET8 for NSSn for RUm is always less than the value of PPET16 for NSSn for Rum, except when PPET8 = 7."	2017/1/9 9:42
8108	Matthew Fischer	225	1 27.7.3.1	182	27	T	Y	182.27 27.7.3.1	Broadcast TWT - a non-AP STA that is participating in Broadcast TWT will wake for TWT SPs and then check trigger frames to see if the STA is identified in a trigger. If there is more than one trigger for an SP, the STA will wake for multiple triggers and by the end of the SP, it is possible that the STA has not been identified and therefore, has wasted power checking each trigger. It would be more efficient for power consumption if the STA had a clue as to whether any trigger in the SP was going to identify it.	Add a TIM of some sort to be associated with each Broadcast TWT so that a participating STA can wake at the beacon and read the TWT-TIM to see if it should be waking for any of the triggers associated with this broadcast TWT within this beacon interval. The TIM could also be included at the start of each TWT SP, say, within a beacon-like frame, e.g. measurement pilot frame or something else.	2017/1/9 9:42

8109	Matthew Fischer	225	1 27.7.4	188	11	T	Y	188.11 27.7.4	TWT Information frame use is supposed to allow changes to Broadcast TWT operation, e.g. suspend, resume, skip, but the TWT Info field TWT ID is 3 bits and the TWT IE Broadcast TWT ID field is 8 bits - is there a 3 bit limit on the ID values for broadcast TWT? Even if there were such a limit, the TWT info frame does not distinguish between Broadcast and Individual TWT ID values - one might decide to use the RA of the TWT info frame to identify when the TWT ID is referring to BCAST TWT vs Individual TWT - but none of this is spelled out in the draft.	Either make some explicit rules about the RA and TWT ID field values and a limit on Broadcast TWT ID values in the TWT IE, or add a few bits to the TWT Info field definition to allow differentiation of Broadcast vs Individual TWT in that field	2017/1/9 9:42
8110	Matthew Fischer	225	1 27.5.2.3	169	17	T	Y	169.17 27.5.2.3	There is no language describing what a recipient is required to do or not do when it sees the value SR_DISALLOWED in a received PPDU and of intra or inter-BSS, etc. Such language is required, plus it is unclear whether the value applies to OBSS_PD SR or SRP SR or both. There is no language to differentiate the SR field in the MAC trigger frame common info field vs the PHY SIGA SR field.	Provide language to indicate what a recipient does when SR_DISALLOWED is received in a PPDU - does it apply to OBSS_PD or SRP or both? What about Intra vs Inter-BSS?	2017/1/9 9:42
8111	Matthew Fischer	225	1 27.9.2	190	17	T	Y	190.17 27.9.2	The utility of OBSS PD seems most beneficial to scenarios where the intra-BSS SINRs are generally higher than inter-BSS SINRs. Identifying when a STA is operating within such a scenario would greatly improve the performance of OBSS PD. Add a mechanism to allow a STA to identify when OBSS PD would provide benefit, such as providing a list of OBSSs that meet the condition of inter-BSS SINR << intra-BSS SINR	Define the concept of a spatial reuse group that identifies OBSSs that meet the condition inter-BSS SINR << intra-BSS SINR and provide a means for disseminating this information. Expect a submission	2017/1/9 9:42
8112	Matthew Fischer	225	1 9.3.1.23	44	60	T	Y	44.60 9.3.1.23	The description of the Spatial Reuse field is poorly written. For example, the description does not indicate which portions of a 40, 80 or 160 MHz channel are affected by which pieces of the SR field; The description is unclear about which fields are identical to which fields in the case of 40 and 80 MHz; There is no information about which BW is the BW of reference for the words "For 20 MHz one SR field" etc.; The current descripton talks about "SR field 1", "SR field 2" but nowhere is there a picture or even a sentence defining what these are.	Clarify the problems highlighted in the comment.	2017/1/9 9:42
8113	Matthew Fischer	225	1 9.3.1.9.7	38	35	T	Y	38.35 9.3.1.9.7	There is no explicit language anywhere stating what the allowed responses to UL OFDMA VHT Single are - I assume, without any explicit language, that both ACK and MBA are allowed	Clarify - even if the comment is correct, at least add a note pointing this out to avoid the possibility that an AP responds with ACK and a non-AP STA refuses it.	2017/1/9 9:42
8114	Matthew Fischer	225	1 9.3.1.23	41	36	T	Y	41.36 9.3.1.23	Discontiguous resource allocations are possible, but it is not clear how this is done - does an AP deliver in a trigger, multiple UL user info fields for a single AID to deliver multiple discontiguous RU s to that STA? Or does it have new encodings that indicate discontiguous tones? And if multiple RUs are possible, can they be contiguous and how does that differ from a single one that spans the same tones as more than one combined? And when a STA has discontiguous RU allocations, does it treat them as a single allocation for the purpose of interleaving, for example?	Provide clear instructions as to AP and STA behavior when invoking the multiple RU allocation option.	2017/1/9 9:42
8115	Matthew Fischer	225	1 28.3.10.8.5	295	6	T	Y	295.06 28.3.10.8.5	SIG B does not currently specify a means for indicating multiple RU allocations to a single STA.	Specify a means for indicating multiple RU allocations to a single STA within the SIGB, for example, by allowing the AID of a single STA to appear multiple times within the SIGB fields.	2017/1/9 9:42

8116 Matthew Fischer	225	1 28.3.3.2	229	1	T	Y	229.01 28.3.3.2	Add a PHY mode to support the transmission and reception of a preamble punctured non-HT DUP	As stated in the comment	2017/1/9 9:42
8117 Matthew Fischer	225	1 9.3.1.23	46	10	T	Y	46.10 9.3.1.23	non-HT format response to a trigger frame (e.g. CTS in response to MU-RTS) currently uses RU allocation information from the trigger that is aligned with HE tone mapping, but the CTS in non-HT format does not use HE tone mapping. Add some language in the draft that instructs the MU-RTS transmitter as to what tones to specify in order to generate the correct CTS response on the correct tone plan, and also language for the trigger recipient to ensure that the correct transmission is elicited.	As stated in the comment	2017/1/9 9:42
8118 Matthew Fischer	225	1 28.3.10.7.2	274	6	T	Y	274.06 28.3.10.7.2	The Spatial Reuse field says that there are values SR_DISALLOWED and SR_DELAY and 14 other values and points to 27.9.2.1 General (within OBSS_PD Spatial Reuse) and to what should be 27.11.6 Setting TXVECTOR parameters for an HE PPDU SPATIAL_REUSE - but the table 28-19 Spatial Reuse subfield encoding indicates only SR_DISALLOW, 14 numerical values and one reserved value. The table and the text in the various subclauses need to be reconciled.	As stated in the comment	2017/1/9 9:42
8119 Matthew Fischer	225	1 9.4.2.218.2	76	47	T	Y	76.47 9.4.2.218.2	B24 Group Addressed Multi-STA BlockAck In DL MU Support is indicated as being 4 bits in width, but it is probably only 1 bit in width	Change width of 4 bits to width of 1 bits in the diagram for the MAC Capabilities field for B24	2017/1/9 9:42
8120 Matthew Fischer	225	1 9.4.2.218.2	78	13	T	Y	78.13 9.4.2.218.2	Multi-TID aggregation support - this bit is not well described - is this the number of TIDs that the STA supports on the receive side? If so, state it explicilty.	Indicate that the level of Multi-TID support signaled is on the receive side.	2017/1/9 9:42
8121 Matthew Fischer	225	1 9.4.2.218.2	83	34	T	Y	83.34 9.4.2.218.2	Within more than one row in the "encoding" column of the table for MAC Capabilities, there are multiple statements of "if supported" and the implied reference of the implied "what" is the information in the second column, but the second column in many instances describes multiple different features that are optionally supported, so confusion is quite possible as to which bit indicates what - sure, the bit numbers appear in both columns to allow some sort of association, but really, this is pretty lazy wording. You only have to write the information out once and then it is done for all future revisions. Just write out what must be supported for each of these bits explicitly in the third column.	As stated in the comment	2017/1/9 9:42
8122 Matthew Fischer	225	1 27.4.3	159	45	T	Y	159.45 27.4.3	Size of the MBA response bitmap can be chosen by the MBA transmitter without constraint, so the STA that elicits the MBA cannot predict the duration of MBA - this is probably only a problem for SU PPDU eliciting frame because the MU PPDU includes a trigger for response which includes a duration value - maybe also for MU eliciting frame if for example, the MU PPDU has only one response required - e.g. the MU PPDU is to two STA and one STA has noACK MPDUs.	Need to define a way to constrain the MBA response (e.g. the bitmap length in particular) so that DUR times are predictable. Maybe simply include a restriction that the resopnse shall not exceed the DUR field value of the eliciting PPDU. See also 27.4.4.2 DL MU PPDU soliciting an SU PPDU response which probably needs some new language.	2017/1/9 9:42

8123	Matthew Fischer	225	1 9.4.2.200	70	3	T	Y	70.03 9.4.2.200	The following text was not updated when the table of TWT commands and responses was updated for broadcast TWT negotiation: "The Wake TBTT Negotiation subfield is set to 0 in TWT elements transmitted by a responding STA and by a scheduling STA." Missing definition for requesting and responding STA cases.	Delete the cited line and change "The Wake TBTT Negotiation subfield indicates that the scheduled STA transmitting the TWT element is indicating a value for the next wake TBTT for a broadcast TWT" to "The Wake TBTT Negotiation subfield indicates that a scheduled STA transmitting the TWT element is indicating a requested value for the next wake TBTT for a broadcast TWT and a scheduling STA transmitting the element is indicating the next wake TBTT for the broadcast TWT. The Wake TBTT Negotiation subfield is set to 0 by TWT Requesting and TWT Responding STAs."		2017/1/9 9:42
8124	Matthew Fischer	225	1 9.4.2.200	69	36	T	Y	69.36 9.4.2.200	figure 9-589av was not correctly updated to reflect changes made during CR that created D1.0 - Broadcast TWT changes allow a value of 2 octets for the Target Wake Time field, and this is not reflected in the TWT element diagram (9-589av) octet count label for the field	Change the number of octets in the figure for the Target Wake Time field to be 8 or 2 or 0.		2017/1/9 9:42
8125	Matthew Fischer	225	1 27.7.3.4	186	44	T	Y	186.44 27.7.3.4	Description is missing for value of Target Wake Time field	Add another bullet item as follows: "The value requested for the next wake TBTT in the Target Wake Time field" Also change the text on P69		2017/1/9 9:42
8126	Matthew Fischer	225	1 27.7.3.4	186	54	T	Y	186.54 27.7.3.4	Is it really the wake TBTT or is it the next broadcast TWT SP start time?	Clarify, possibly changing the text as suggested by the comment.		2017/1/9 9:42
8127	Matthew Fischer	225	1 9.4.2.200	70	34	T	Y	70.34 9.4.2.200	The table entry for the first row for column wake tbtt negotiation is NA, but at P139 the text says that this box should not have NA value - also see P186L40 which does not mention REQUEST	Make a decision - either do or do not allow request command by scheduled STA for Broadcast TWT - fix the different references so that they do not conflict.		2017/1/9 9:42
8128	Matthew Fischer	225	1 9.4.2.200	69	59	T	Y	69.59 9.4.2.200	Can a non-AP STA send more than one broadcast TWT parameter set in a TWT IE, for example, if it wants to join more than one broadcast TWT?	Clarify and add explicit language with the answer		2017/1/9 9:42
8129	Matthew Fischer	225	1 10.43.1	137	56	T	Y	137.56 10.43.1	Table 10-19a does not include any case where the scheduled STA includes Broadcast=1, so is it disallowed, and if so, shouldn't there be an explicit statement somewhere, instead of this implicit one	Clarify and add explicit language with the answer		2017/1/9 9:42
8130	Matthew Fischer	225	1 27.7.3.2	184	54	T	Y	184.54 27.7.3.2	The exact meanings of some of the fields in the TWT element are not well described when comparing the cases of Broadcast TWT negotiation vs Broadcast TWT SP announcement.	Clarify the difference between a TWT element that is part of a broadcast TWT negotiation vs a Broadcast TWT announcement, probably need to emphasize the difference in the RA of the MPDU that contains the element plus point out the difference in the meaning of the TWT Wake Interval field for the two cases. (i.e. the TWT Wake Interval is used during negotiation to identify non-AP STA wake times and it is used during Broadcast TWT announcements to indicate the separation between successive Broadcast TWT SP start times.		2017/1/9 9:42
8131	Matthew Fischer	225	1 9.4.2.200	70	34	T	Y	70.34 9.4.2.200	Too many of the entries for column "Description when transmitted by a TWT scheduling STA, Wake TBTT Negotiation subfield = 1" have "NA" - according to Table 10-19a–TWT setup exchange command interpretation, there should be more entries with something other than NA here.	Reconcile the table in 9.4.2.200 TWT element with Table 10-19a–TWT setup exchange command interpretation - noting that Table 10-19a is the more correct one.		2017/1/9 9:42
8132	Matthew Fischer	225	1 27.7.3.2	184	38	T	Y	184.38 27.7.3.2	Table reference is incorrect	Change 9-248l1 to 9.262kl maybe?		2017/1/9 9:42
8133	Matthew Fischer	225	1 9.2.4.6.4.5	26	15	T	Y	26.15 9.2.4.6.4.5	Wrong acronym - AC should be ACI	change AC Bitmap subfield to ACI Bitmap subfield		2017/1/9 9:42
8134	Matthew Fischer	225	1 9.4.2.219	91	39	T	Y	91.39 9.4.2.219	There are two differing descriptions of the meaning of the value 0 for BSS color - merge them or delete one or somehow reconcile them.	There are two differing descriptions of the meaning of the value 0 for BSS color - merge them or delete one or somehow reconcile them.		2017/1/9 9:42

8135	Matthew Fischer	225	1 27.10.4	193	58	T	Y	193.58 27.10.4	How does the recipient know whether the received PPDU was a multi-TID AMPDU or a single TID AMPDU? If some of the delimiters are bad, the recipient could mistake a multi-TID AMPDU for a single AMPDU.	Make the response always the same - i.e. it is always an MBA, even if the recipient thinks it was a single TID AMPDU.	2017/1/9 9:42
8136	Matthew Fischer	225	1 27.10.4	193	50	T	Y	193.50 27.10.4	The use of the word "solicits" here is interesting, because a few lines later, it says that the response shall be MBA, so is it really soliciting an immediate ACK, or is it soliciting an MBA? Does it depend on what the contents of the AMPDU were? i.e. single VHT vs Multi-TID, etc?	Make the language consistent.	2017/1/9 9:42
8137	Matthew Fischer	225	1 9.4.2.27	68	23	T	Y	68.23 9.4.2.27	There are good reasons to allow unsolicited TXBF FB.	Add a capability bit that indicates that an AP supports the receipt of unsolicited FB.	2017/1/9 9:42
8138	Matthew Fischer	225	1 9.7	105	50	T	Y	105.50 9.7	Is there a rule that says that the presence or absence of optional MAC header fields must be consistent within a TID within an AMPDU? How about across TIDs?	Clarify.	2017/1/9 9:42
8139	Matthew Fischer	225	1 10.3.2.4	114	48	T	Y	114.48 10.3.2.4	Referring to: If the STA is not an HE STA and the received frame's RA is equal to the STA's own MAC address, the STA shall not update its NAV. If the STA is an HE STA and the STA is solicited for an immediate response by the PPDU carrying the received frame, the STA shall not update its NAV. If the STA is an HE STA, the STA is a TXOP holder, and the frame is solicited by the STA, then the STA shall not update its NAV. Further, when the received frame is a DMG CTS frame and its TA is equal to the STA's own MAC address, the STA shall not update its NAV. For all other received frames the STA shall update its NAV when the received Duration is greater than the STA's current NAV value. Consider the case: The receiving STA is an HE	Not certain	2017/1/9 9:42
8140	Matthew Fischer	225	1 27.5.2.2.1	164	47	T	Y	164.47 27.5.2.2.1	Random Access UL OFDMA for unassociated STAs is mentioned here, but how does such a STA recognize the DL OFDMA response? Such a STA needs some sort of AID value to identify its DL RU allocation - the text refers me to 27.5.2.6 but there is nothing here mentioning what to do for unassociated STA, while over in 27.5.2.3, there is a TBD in a sentence that refers to unassociated STA	Define the rules for unassociated STA operation within UL OFDMA Random Access	2017/1/9 9:42
8141	Matthew Fischer	225	1 27.5.2.6.2	173	1	T	Y	173.01 27.5.2.6.2	A more efficient random access FB mechanism should be defined.	Change to a feedback mechanism that uses an HTF like sequence with small tone allocations mapped to AID values to allow at least binary feedback indication or even multiple bit FB indication (e.g. I have UL data, I request DL data, etc.)	2017/1/9 9:42
8142	Matthew Fischer	225	1 27.5.2.6.2	173	1	T	Y	173.01 27.5.2.6.2	The name here and in many places in the document is just "random access" while in other places it is UL OFDMA random access - the second form is clear and unambiguous, but the first form can be confused with normal EDCA random access or DCF random access and should not be used to avoid such confusion.	Define a new name for the UL OFDMA random access process and use it consistently, an acronym is good because it shortens the language and makes for a very convenient name. How about HORA = HE OFDMA Random Access	2017/1/9 9:42

8143	Matthew Fischer	225	1 27.7.3.1	182	39	T	Y	182.39 27.7.3.1	Currently, a STA that signs up for individual TWT is no longer considered a participant in any broadcast TWT. Think about the possibility of changing this now that a STA can perform an explicit sign up for Broadcast TWT. I.e. before the ability to sign up for BTWT existed, a STA that signed up for iTWT was assumed to no longer participate in bTWT, but if a STA can sign up for bTWT, then there is no reason to not allow it to do so.	Modify the cited sentence to state that a STA that has at least one active iTWT is automatically excluded from all bTWT except for those bTWT for which the STA explicitly signs up to participate. Also note that if the STA reverts to no iTWT any longer, then it is again automatically assumed to participate in all broadcast TWT - or maybe, if it has signed up for at least one bTWT, then it forsakes all others not explicitly signed up for which it is	2017/1/9 9:42
8144	Matthew Fischer	225	1 9.42.200	59	36	T	Y	59.36 9.42.200	The TWT Channel should be 0 or 1 because for bTWT, the TWT channel is not present	Change the TWT Channel octet count in figure 9-589av TWT element format to read "0 or 1" instead of "1"	2017/1/9 9:42
8145	Matthew Fischer	225	1 27.7.3.4	187	8	T	Y	187.08 27.7.3.4	The teardown process is a bit difficult for bTWT - theTWT teardown action frame contains a flow identifier field which is currently defined as having only 3 bits, but bTWT can have an ID of up to 8 bits in the TWT IE	Either limit the bTWT ID field to 7 bits and in the flow id field of the twt teardown action frame use one bit of the flow field as a broadcast identifier OR do not use the teardown procedure for bTWT teardown, but instead, use command reject in either direction	2017/1/9 9:42
8146	Michael Montemurro	225	1 10.3.2.4	114	65	T	Y	114.65 10.3.2.4	What does "is not all 1s" mean? I assume you mean all bits in the field are "not all set to 1".	Reword the condition to be more precise. For instance, you could say if all bits included in the field are not set to 1.	2017/1/9 9:42
8147	Michael Montemurro	225	1 10.9	127	19	T	Y	127.19 10.9	What does it mean to "expects an HE trigger-based"	Re-word the condition to be more precise.	2017/1/9 9:42
8148	Michael Montemurro	225	1 27.2.2	151	10	T	Y	151.10 27.2.2	What does "is not all 1s" mean? I assume you mean all bits in the field are "not all set to 1".	Reword the condition to be more precise. For instance, you could say if all bits included in the field are not set to 1. Same issue with 151.26 (and potentially other areas).	2017/1/9 9:42
8149	Michael Montemurro	225	1 27.3.3.1	153	13	T	Y	153.13 27.3.3.1	Could there be a brief description on the differences between Level 1,2, and 3, dynamic fragmentation in the "General " clause?	Give the reader some additional information that describies why there are three levels of fragmenation and what distiguishes each level.	2017/1/9 9:42
8150	Michael Montemurro	225	1 27.4.1	158	10	T	Y	158.10 27.4.1	"If an HE AP does not receive an HE Capabilities element with the Rx Control Frame To MultiBSS set to 1 from a STA," doesn't make sense.	Change "To MultieBSS" to "To MultiBSS bit" at cited location and 158.17.	2017/1/9 9:42
8151	Michael Montemurro	225	1 27.5.2.3	167	42	T	Y	167.42 27.5.2.3	"STA behavior" doesn't provide much context for this subclause. Is it really TX rules?	Update the title of the clause to be something more specicic than "STA behavior"	2017/1/9 9:42
8152	Michael Montemurro	225	1 27.5.2.6.2	173	25	T	Y	173.25 27.5.2.6.2	The overall procedure shown in Figure 27-1 is not really described very well. Its not clear to the reader.	Add an explanation in the paragraphe that introduces Figure 27-1	2017/1/9 9:42
8153	Michael Montemurro	225	1 27.7.3.1	183	25	T	Y	183.25 27.7.3.1	The overall procedure shown in Figure 27-5 is not really described very well. Its not clear to the reader.	Add an explanation in the paragraphe that introduces Figure 27-5	2017/1/9 9:42
8154	Michael Montemurro	225	1 27.7.3.4	186	33	T	Y	186.33 27.7.3.4	The use of listen interval in the contect of TWT is ambiguous because there is already a Listen Interval field defined in the IEEE 802.11 base standard.	Reword the TWT procedure descriptions to use alternaive wording for "listen interval:	2017/1/9 9:42
8155	Ming Gan	225	1 28.3.10.8.4	293	8	T	Y	293.08 28.3.10.8.4	y2y1y0 is not only used for 106-tone RU+cbut also for 242,484,996-tone RUs.	clarify the explaination of y2y1y0	2017/1/9 9:42
8156	Ming Gan	225	1 27.5.2.3	167	59	T	Y	167.59 27.5.2.3	When the unassociated STA receives a trigger frame with random access RU, the behavior of this STA is not defined	Define a precedure of association setup through OFDMA random access	2017/1/9 9:42
8157	Ming Gan	225	1 9.36.1.9.7	38	4	T	Y	38.04 9.36.1.9.7	Now Multi-STA BlockAck can not be used to acknowledge the association request frame because of unassociated STA is not assigned an AID	define a common special AID for all the unassociated STAs such that they can parse the M-BA frame correctly	2017/1/9 9:42
8158	Ming Gan	225	1 27.3.3.4	154	39	T	Y	154.39 27.3.3.4	L3 frag BA request/ response indications are located in block ack action field (see page 99, line 1) , however Level 2 and Level 1 operation subfields are located in ADDBA extension element (see page 68, line 37)	suggest to remove the HE fragmentation operation subfield in the ADDBA capabilities field, and then put level 1 and level 2 indications into the block ack action field.	2017/1/9 9:42
8159	Ming Gan	225	1 9.4.2.218.2	77	38	T	Y	77.38 9.4.2.218.2	Level 2 and level 3 supports to fragment A-MSDU according to the section 27.3	add description for A-MSDU	2017/1/9 9:42
8160	Ming Gan	225	1 27.3.3.4	154	60	T	Y	154.60 27.3.3.4	Level 3 supports to fragment MMPDU, however, there is not description for MMPDU. Actually, it appeared in draft D0.3~D0.5	add the following description at the end of this sentence: and up to one dynamic fragment of an MMPDUin an A-MPDU	2017/1/9 9:42
8161	Ming Gan	225	1 28.3.5	247	44	T	Y	247.44 28.3.5	There is transmission block diagram for HE downlink MU-MIMO, however, it lacks of transmission block diagram for HE uplink MU-MIMO	It is not clear to transmit Uplink MU-MIMO. Add a transmission block diagram	2017/1/9 9:42

8162	Ming Gan	225	1 9.2.4.6.4.6	29	19	T	Y	29.19 9.2.4.6.4.6		See 26.3.13.2 (Power pre-correction), the reference is wrong	change 26.3.13.2 to 28.3.14.2	2017/1/9 9:42
8163	Ming Gan	225	1 27.10.4	194	45	T	Y	194.45 27.10.4		Only AC of higher priority compared with primary AC is allowed to be aggregated in Multi-TID A-MPDU, however, when the queue of this kind of AC is empty, low priority AC can not help to further improve performance.	Add one rule to allow low priority AC to be aggregated in Multi-TID A-MPDU. Suggestion: when the the queue of AC of higher priority with repsect to primary AC is empty, AC of lower priority with repsect to primary AC can be aggregated in one Multi-TID A-MPDU.	2017/1/9 9:42
8164	Ming Gan	225	1 10.43.1	137	47	E	Y	137.47 10.43.1		Demand TWT indicates tha the transmitting STA will accept only the indicated TWT parameters for a TWT agreeement. One typo on "tha"	correct it to "that"	2017/1/9 9:42
8165	Ming Gan	225	1 9.4.2	67	1	T	Y	67.01 9.4.2		BSS load element provides the channel utilization such that the unassociated STA can choose the proper AP┤+ε and extended BSS load element further provides the the spatial stream underutilization given the busy channel such that unassociated STA with MU-MIMO capability can choose the proper AP. Now 11ax introduce a OFDMA, there is the probability of frequence underutilization given the busy channel.	Define a HE BSS load element considering frequency utilization such to help unassociated STA to choose a best AP	2017/1/9 9:42
8166	Ming Gan	225	1 9.3.123.3	50	17	T	Y	50.17 9.3.123.3		MU-BAR frame is not only used for single TID per STA, but also for multiple TIDs per STA. Howerver, it is uesd for multiple TIDs per STA, there are a lot of redudancy, such as "Per TID info" of 2 bytes in BAR info field. Each TID require one "Per TID info" subfield . Instead, using TID bitmap of 1 byte per STA, not "Per TID info" subfield Per TID Per STA, can save lots of byes. We also see an example of GCR MU-BAR frame, it is separated from MU-BAR frame to save the overhead.	Define a new variant for Multi-TID MU-BAR frame like GCR MU-BAR frame. Using TID bitmap of 1 byte in Multi-TID MU-BAR frame to short the whole frame.	2017/1/9 9:42
8167	Ming Gan	225	1 27.5.1.3	163	23	T	Y	163.23 27.5.1.3		"explicitly deliver BQRs in any frame sent to the AP", what is "any frame". It is not clear. Actually it requires this frame contains A-control field.	change "any frame" to "any frame which contains A-Control field"	2017/1/9 9:42
8168	Ming Gan	225	1 27.5.1.3	163	21	T	Y	163.21 27.5.1.3		"implicititly" and "explicitly" seem redudant. Non-AP STA always carries available channle bitmap in the A-Control field in these two modes	delete "implicititly" and "explicitly"	2017/1/9 9:42
8169	Ming Gan	225	1 28.3.10.8.3	289	36	T	Y	289.36 28.3.10.8.3		The big Gamma_M(k) in the equation 28-20 is the phase rotation value, but it does not specify the value for the pilot subcarriers although phase rotation is not done on the pilot subcarriers.	as the proposed in the comment	2017/1/9 9:42
8170	Noel Stott	225	1 4.3.14a	9	21	G	N	9.21 4.3.14a		The term "only" implies that the HE non-AP STA can only support 20MHz operation. It would be nice if the HE non-AP STA could support operation in more than 20MHz channel bandwidths.	"An HE non-AP STA shall support operation in 20 MHz channel bandwidth."	2017/1/9 9:42
8171	Osama Aboulmagd	225	1 3.4	7	1	G	Y	7.01 3.4		The abberviation list seems to be incomplete	add missing abbreviations, e.g. MU-BAR, A-BQR, BQRP, etc. Additionaly S-MPDU is not defined. I think it is the VHT Single PPDU. As much as I can search it is not defined in 802.11-2016. Need to be added in this draft.	2017/1/9 9:42
8172	Osama Aboulmagd	225	1 17.5.2.3	167	59	G	Y	167.59 17.5.2.3		There is one occurance of "TBD" on page 167	TBD has to be either deleted or resolvced	2017/1/9 9:42
8173	Osama Aboulmagd	225	1 4.3.14a	9	19	T	Y	9.19 4.3.14a		Support of 160 and 80+80 MHz is not required for the an HE non-AP STA to be a VHT STA since they are optional features.	delete 160 MHz and 80+80 MHz. Add a line to include the optional support for 160 and 80+80 MHz.	2017/1/9 9:42
8174	Osama Aboulmagd	225	1 9.2.4.5.4	20	43	T	Y	20.43 9.2.4.5.4	8590	The new HE rule added to Table 9-9, how would a receipient return a multi-STA BA in response to a DL HE MU PPDU? Additionally it is not clear what type of the trigger frame is used to return the response. There is MU ACK trigger frame type.	clarify	2017/1/9 9:42

8175	Osama Aboulmagd	225	1 9.2.4.6.1	21	62	T	Y	21.62 9.2.4.6.1	The rule at the end of page 21, "The VHT subfield is set to 1 and the HE subfield is set to 0 to indicate VHT variant...". Actually a VHT device wouldn't care what the value of the so called "HE subfield" is since it is a reserved bit. Therefore it seems to me that any VHT device will always interpret the HT control field as a VHT variant as long as VHT field is set to 1.	need to define precisely the behaviour of a VHT device in this case, espcially when bit 0 and bit 1 are set to 1 and 1. Does this rle requires changing VHT devices already deployed?	2017/1/9 9:42
8176	Osama Aboulmagd	225	1 9.2.4.6.4	22		T	Y	22.00 9.2.4.6.4	A-Control needs to be defined	as in comment	2017/1/9 9:42
8177	Osama Aboulmagd	225	1 9.2.4.6.4.2	23	51	T	Y	23.51 9.2.4.6.4.2	It is not clear what variant of the trigger frame carries an immediate ack? Is it the baic trigger variant?	indicate the variant trigger frame explicitly	2017/1/9 9:42
8178	Osama Aboulmagd	225	1 9.2.4.6.4.3	24	59	T	Y	24.59 9.2.4.6.4.3	does the channel width field in the Operating Mode indicates an operating channel at less or equal the indicated BW? E.g. when the Channel Width is set to 1, does it indicate less or equal 40 MHz	CLARIFY	2017/1/9 9:42
8179	Osama Aboulmagd	225	1 9.2.4.6.4.5	26	22	T	Y	26.22 9.2.4.6.4.5	BSR is really very confusing. The UP bits are mapped to AC. The same TID field is used to either indicate the UP or the TSID. I can understand the ACI Bitmap. Hoever the delta TID are very confusing. What function does this field provide? UP doesn't have TID associated with it.	clarify the use of TID	2017/1/9 9:42
8180	Osama Aboulmagd	225	1 9.2.4.6.4.5	25	31	T	Y	25.31 9.2.4.6.4.5	BSR operation is redundant and is covered by biggybacking the buffer size using the Queue Size field of the QoS Control field	Given the efficiency of using piggybacing to communicate buffer status and the apparent complexity of the BSR operation as defined in this clause, the proposal is to delete this part.	2017/1/9 9:42
8181	Osama Aboulmagd	225	1 9.2.4.6.4.5	26	50	T	Y	26.50 9.2.4.6.4.5	SF needs to be included in the abbreviation clause, if it is not already there	as in comment	2017/1/9 9:42
8182	Osama Aboulmagd	225	1 9.2.4.6.4.7	28	8	T	Y	28.08 9.2.4.6.4.7	In table 9-18d, what does it mean "channel is available"? Does it mean the STA is capable of receiving PPDU at the specified BW? Or does it mean the channel was sensed to be free using carrier sensing?	clarify	2017/1/9 9:42
8183	Osama Aboulmagd	225	1 9.2.4.6.4.7	27	42	T	Y	27.42 9.2.4.6.4.7	The operation of the BQR is not clear as described later in the draft. Does this operation intended to replace the dynamic BW operation in VHT?	clarify	2017/1/9 9:42
8184	Osama Aboulmagd	225	1 9.2.4.6.4.7	28	8	T	Y	28.08 9.2.4.6.4.7	The channel indications in table 9-18d, is there a relationship to primary and secondary channels? The language is all over the place.	clarify	2017/1/9 9:42
8185	Osama Aboulmagd	225	1 9.2.4.6.4.8	28	60	T	Y	28.60 9.2.4.6.4.8	What an RDP Trigger frame is? It doesn't seem to be defined	Define if needed	2017/1/9 9:42
8186	Osama Aboulmagd	225	1 9.3.1.9.7	37	23	T	Y	37.23 9.3.1.9.7	The language, "multi-STA multi-TID and multi-STA single TID" is very awakward. Additionally there is no BA variant having this name.	I suggest using something like, "Multi-STA BA varaint for single or multiple TID". I am sure the Editor will come up with better wording :-)	2017/1/9 9:42
8187	Osama Aboulmagd	225	1 9.3.1.9.7	38	35	T	Y	38.35 9.3.1.9.7	I am wondering what is the value of using multi-STA BA variant to aknowledge a single MPDU or VHT Single MPDU. Is there any gain compared to using the normal ACK frame?	Clarify	2017/1/9 9:42
8188	Osama Aboulmagd	225	1 9.3.1.20	40	22	T	Y	40.22 9.3.1.20	B0 and B1 of the sounding dialog token in VHT are reserved. Does this mean a VHT device always set those two bits to 0? Would it be possible for a VHT device to set B0 or B1 or both to 1? Is it an implementation issue.	if a VHT device sets B1 to 1 for any reason, what would be the behavior of an HE device? Clarify	2017/1/9 9:42
8189	Osama Aboulmagd	225	1 9.3.1.23.1	49	15	T	Y	49.15 9.3.1.23.1	Can someone please translate the paragraph starting at line 11 on page 49 and ending at line 15 of the same page? For example what does, "the AC that is recommeneded for aggregation of MPDUs of Acs belonging to the same AC..." Acs belonging to the same AC!!!!	as in comment	2017/1/9 9:42
8190	Osama Aboulmagd	225	1 9.3.1.23.1	49	6	T	Y	49.06 9.3.1.23.1	AC Preference level seems to be useless. Wouldn't Preferred AC be sufficient?	delete AC Preference level	2017/1/9 9:42
8191	Osama Aboulmagd	225	1 9.3.1.23.5	51	17	T	Y	51.17 9.3.1.23.5	BSRP needs to be added to the abbreviations	as in comment	2017/1/9 9:42

8192	Osama Aboulmagd	225	1 9.3.1.23.5	51	22	T	Y	51.22	9.3.1.23.5		How the Common Info field and the User Info field are relevant to Buffer Status Report Poll. I'd have expceted some parameters relevant to the BSR, e.g. AC, TID, etc.	clarify	2017/1/9 9:42
8193	Osama Aboulmagd	225	1 9.3.1.23.5	51	33	T	Y	51.33	9.3.1.23.5		what does "Trigger Dependnet " mean?	explain	2017/1/9 9:42
8194	Osama Aboulmagd	225	1 9.3.3.1	52	38	T	Y	52.38	9.3.3.1		RAPS needs to be added to the abbreviations Clause	as in comment	2017/1/9 9:42
8195	Osama Aboulmagd	225	1 9.4.2.200	69	22	E	Y	69.22	9.4.2.200		there may be a numbering issue. 9.4.2.200 in 11ah is assigned to TSF Timer Accuracy element. May need to change the numbering for TWT element	as in comment.	2017/1/9 9:42
8196	Osama Aboulmagd	225	1 9.4.2.200	69	30	T	Y	69.30	9.4.2.200		Comparing the IE in Figure 9-589av to the one in 11ah draft, it seems that this TWT element is a new element by adding Broadcast TWT ID. The question is; is this a new IE? If not then I don't understand what format is now used for ah	clarify	2017/1/9 9:42
8197	Osama Aboulmagd	225	1 9.4.2.200	69	30	T	Y	69.30	9.4.2.200		There are sub-fields in the TWT IE having variable length. When repeating for each TWT parameter, how the information can be decoded given the variabe length of some of the sub-fields?	Clarify	2017/1/9 9:42
8198	Osama Aboulmagd	225	1 9.4.2.200	70	50	T	Y	70.50	9.4.2.200	8591	The terms Scheduling STA and Scheduled STA need to be defined	as in comment	2017/1/9 9:42
8199	Osama Aboulmagd	225	1 9.4.2.200	72	36	T	Y	72.36	9.4.2.200		The term broadcast TWT SP needs to be defined	as in comment	2017/1/9 9:42
8200	Osama Aboulmagd	225	1 9.4.2.200	72	47	T	Y	72.47	9.4.2.200		Table 9-262k1 seems to be totally arbitrary and is not based on any rationale. Perhaps some explanation is in order.	either provide a rationale for the different restrictions or simply delete the table. My preference is to delete the table.	2017/1/9 9:42
8201	Osama Aboulmagd	225	1 9.4.2.221	94	1	T	Y	94.01	9.4.2.221		what MU EDCA parameter set is used for. It seems tat the only new parameter is the MUEDCA Timer. The rest of the parameters are the same as in EDCA Parameter set.	Needs clarification to see how useful this nes IE is	2017/1/9 9:42
8202	Osama Aboulmagd	225	1 9.4.2.223	95	55	E	Y	95.55	9.4.2.223		STA-2-STA	change "2" to "to"	2017/1/9 9:42
8203	Osama Aboulmagd	225	1 9.4.2.223	95	54	T	Y	95.54	9.4.2.223		What does "improve probability" mean? Improve with respect to what?	explain or delete	2017/1/9 9:42
8204	Osama Aboulmagd	225	1 9.4.2.223	96	23	T	Y	96.23	9.4.2.223		what role does "Vendor Specific Service Identifier" do?	clarify	2017/1/9 9:42
8205	Osama Aboulmagd	225	1 9.4.2.224	96	31	T	Y	96.31	9.4.2.224		why there is a need to define a "periodic sequence" of quiet elements?	clarify	2017/1/9 9:42
8206	Osama Aboulmagd	225	1 9.4.2.223	95	48	T	Y	95.48	9.4.2.223		Is there a field in the HE Capability element to indicate support for this feature? If not then I believe it needs to be added.	as in comment	2017/1/9 9:42
8207	Osama Aboulmagd	225	1 10.2	113	4	T	Y	113.04	10.2		The 802.11ax amendment introduces MU transmissions which is not supported by any of the control functions in Figure 10-1 of the 802.11-2016. There is a need to introduce a ne MU access function and add to the Figure.	as in comment.	2017/1/9 9:42
8208	Osama Aboulmagd	225	1 10.3.1	113	50	T	Y	113.50	10.3.1		what is "duration-based" RTS? It needs to be defined	as in comment	2017/1/9 9:42
8209	Osama Aboulmagd	225	1 10.3.2.4a	115	47	T	Y	115.47	10.3.2.4a		the paragraph of clause 10.3.2.4a is very vague. What does manaing RTS usage mean? What does length-based mean? The whole paragraph needs to be rewritten explaining those words like duration-based, etc.	as in comment	2017/1/9 9:42
8210	Osama Aboulmagd	225	1 10.49.1	144	30	T	Y	144.30	10.49.1		Why is the need for an AID assign rule? AID is assigned by the AP and is implementation issue. There is no need for a rule that probably no one will use it. Does the new rule improves any performance?	delete the sub-clause	2017/1/9 9:42
8211	Osama Aboulmagd	225	1 27.2.2	150	34	T	Y	150.34	27.2.2	8592	My ubderstading is the single NAV currently supported by 802.11 devices is updated baed on the Duration value in the MAC header of all received frame (Inter or Intra BSS). The so called "Basic NAV" is only updated based on Inter-BSS frames received.	it is better to find another name other than Baisc NAV. Mayve Iter-BSS NAV.	2017/1/9 9:42
8212	Osama Aboulmagd	225	1 27.2.3	152	14	T	Y	152.14	27.2.3		MU-EDCA needs to be defined	as in comment	2017/1/9 9:42

8213	Osama Aboulmagd	225	1 27.2.3	152	13	T	Y	152.13 27.2.3		The parameter HEMUEDCATimer[AC] seems to appear for the first time in the draft on page 152. No proper definition was given and its role in channel acces wasn't explained.	Introduce definition and describe its use including how to set its value	2017/1/9 9:42
8214	Osama Aboulmagd	225	1 27.2.3	152	8	T	Y	152.08 27.2.3		Clause 27.2.3 doesn specify clearly when an EDCA for UL MU Capable STAs is obtained. It focuses on the different parameter settings.	explain which counters are involved in obtaining the TXOP. Does HEMUEDCATimer[AC] only used to contrl the values of Cwmin, Cwmax, etc as implied in the last paragarph of this clause. Need to be clear	2017/1/9 9:42
8215	Osama Aboulmagd	225	1 27.4.1	157	28	T	Y	157.28 27.4.1		It is not clear to me under what conditions a non-AP STA sends a Multi-STA BlockAck frame. My undertanding is Multi-STA BlockAck is to acknowlege trigger-based PPDU transmitted by multiple non-AP STAs. I aslo understand that a non-AP STA will never send a trigger frame.	specify those conditions where a non-AP STA will send a Multi-STA BA	2017/1/9 9:42
8216	Osama Aboulmagd	225	1 27.5.1.3	163	27	T	Y	163.27 27.5.1.3	8593	what does "channel availability" mean?	clarify	2017/1/9 9:42
8217	Osama Aboulmagd	225	1 27.5.1.3	163	20	T	Y	163.20 27.5.1.3		what does "efficient way" mean? How the word "efficient" is defined?	delete the fisrt sentence or qualify the word "efficient"	2017/1/9 9:42
8218	Osama Aboulmagd	225	1 27.5.2.5	171	12	T	Y	171.12 27.5.2.5		Once again, What is "efficient way"?	clarify	2017/1/9 9:42
8219	Osama Aboulmagd	225	1 27.5.2.5	171	30	T	Y	171.30 27.5.2.5		Clause 27.5.2.5 desctibes two methods to achieve the same function. Since the use of Queue Size in QoS Control frame is mandatory while the use of the BSR A-Control is optional, the suggestion is to remove the optional one.	as in comment	2017/1/9 9:42
8220	Osama Aboulmagd	225	1 27.5.2.6	172	28	T	Y	172.28 27.5.2.6		If a STA doesn't support UL OFDMA RA, then I am assuming it associates with the AP by acquiring the medium and sends an association request maybe using a SU PPDU. Is that correct?	If correct, then I just adding some language to that effect after the first paragraph of the clause	2017/1/9 9:42
8221	Osama Aboulmagd	225	1 27.5.2.6	173	17	T	Y	173.17 27.5.2.6		In Figure 27-1, what does M-BA mean?	I think it mean Multi-STA BlockAck. If correct please make the changes.	2017/1/9 9:42
8222	Osama Aboulmagd	225	1 27.6.2	177	44	T	Y	177.44 27.6.2		Figure 27-3 and 27-4 need to be updated.	as in comment	2017/1/9 9:42
8223	Osama Aboulmagd	225	1 27.7	181	44	T	Y	181.44 27.7		Is TWT really required? If I remember correctly the issue that was discussed related to scheduled trigger frames for which the AP can easily sets its schedule and announce to STAs. Why is the need to include a heavy protocol to achieve such a simple function?	delete TWT operation and its related items from the draft	2017/1/9 9:42
8224	Osama Aboulmagd	225	1 27.7.2	180	23	T	Y	180.23 27.7.2		Let's consider a scenario where all STAs have individual TWT agreements with the AP. Would the AP group STAs to start a TWT SP and MU transmissions? I think some explanation is needed to be added for the AP behaviour.	as in comment	2017/1/9 9:42
8225	Osama Aboulmagd	225	1 27.7.3.1	183	7	T	Y	183.07 27.7.3.1		Figure 27-5 is supposed to describe the broadcast TWT operation. However I cannot see the word broadcast any where in the Figure. What exactly "broadcast: mean relative to the Figure. Is this a case of choosing a bad name for a bad protocol?	Clarify why the name "broadcast" was assigned to this procedure	2017/1/9 9:42
8226	Osama Aboulmagd	225	1 27.7.3.1	183	7	T	Y	183.07 27.7.3.1		From Figure 27-5, it is clear that there is significant overhead associated with Broadcast TWT. Only one MU PPDU was sent after the transmission of many overhead frames. The Figure speaks for itself. Adding TWT with its heavy protocol machinery is a source of significant overhead for a sunction that can be achieved in a simple way	Quantify the overhead involved in this figure. Better yet, just delete TWT and all its related items from the draft. Actually the whole first paragraph is speculative and maybe it is better to delete it.	2017/1/9 9:42
8227	Osama Aboulmagd	225	1 27.7.3.1	183	31	T	Y	183.31 27.7.3.1	8594	I thnik it would be much easire by explicitly specify the MMPDU that contains the TWT element, whether it is the TWT Req or the TWT Resp.	as in comment	2017/1/9 9:42
8228	Osama Aboulmagd	225	1 27.7.3.2	184	20	T	Y	184.20 27.7.3.2	8595	"Trigger-enabled TWT SP" need to be defined	as in comment	2017/1/9 9:42
8229	Osama Aboulmagd	225	1 27.7.3.3	185	35	T	Y	185.35 27.7.3.3		The term "broadcast TWT element" is used in many places but I wasn't able to find its format	clarify	2017/1/9 9:42

8230	Osama Aboulmagd	225	1 27.9.1	190	6	T	Y	190.06 27.9.1	what "system level performance" is? Is it delay, throughput or all performance metrics	it is better to delete these words and replace with something like "allows the concurrent use of the media by more than one STA".	2017/1/9 9:42
8231	Osama Aboulmagd	225	1 27.9.1	190	11	T	Y	190.11 27.9.1	what does "SR PPDU" mean?	clarify	2017/1/9 9:42
8232	Osama Aboulmagd	225	1 27.9.1	190	14	T	Y	190.14 27.9.1	Is OBSS_PD defined any where? If not then it needs to be addred to the definitions and abbreviations clauses	as in comment	2017/1/9 9:42
8233	Osama Aboulmagd	225	1 27.9.1	190	24	T	Y	190.24 27.9.1	The rules starting on line 24 are not clear. Does it mean that both of the NAV timers are not going to be updated if the PPDU is an inter-BSS PPDU? It seems there is a contradiction with the rules for updating the two NAV timers	Clarify	2017/1/9 9:42
8234	Osama Aboulmagd	225	1 27.9.1	190	37	T	Y	190.37 27.9.1	the term SR_Delay seems to be introduced for the first time in this subclause without proper definition	define the term	2017/1/9 9:42
8235	Osama Aboulmagd	225	1 27.9.1	190	50	E	Y	190.50 27.9.1	Line 50, "SR Backoff procedure for SR delayed case"; is there a formatting issue here. Should this be a subclause?	adjust the format if necessary	2017/1/9 9:42
8236	Osama Aboulmagd	225	1 27.9.2.2	191	4	T	Y	191.04 27.9.2.2	system level performance again	as in previous comment	2017/1/9 9:42
8237	Osama Aboulmagd	225	1 27.9.2.2	191	7	T	Y	191.07 27.9.2.2	parameters incuded in the inequality and the Figure need to be defined	as in comment	2017/1/9 9:42
8238	Osama Aboulmagd	225	1 27.9.2.2	192	20	E	Y	192.20 27.9.2.2	TB need to be replaced by Trigger-Based	as in comment	2017/1/9 9:42
8239	Osama Aboulmagd	225	1 27.9.2.2	192	16	T	Y	192.16 27.9.2.2	It is not clear what is the condition for the STA to consider an inter-BSS PPDU as not having been received	introduce the condition	2017/1/9 9:42
8240	Osama Aboulmagd	225	1 27.11.4	196	54	T	Y	196.54 27.11.4	the rule starting at line 54 doesn't seem be precise. Ignoring the HE PPDU is only for Inter-BSS PPDU, not for all the BSS color values	clarify	2017/1/9 9:42
8241	Osama Aboulmagd	225	1 27.14.1	199	14	T	Y	199.14 27.14.1	Intra PPDU power save needs to be defined	as in comment	2017/1/9 9:42
8242	Osama Aboulmagd	225	1 27.14.1	199	19	T	Y	199.19 27.14.1	shouldn't there be a condition where the STA goes to the doze state if the BSS-color is not the same as the AP color to which the STA is associated? Does the STA stays awake all the time for receiving an inetr-BSS PPDU	as in comment	2017/1/9 9:42
8243	Osama Aboulmagd	225	1 27.16.3	207	9	T	Y	207.09 27.16.3	It is not clear does this scheme quiet all the STAs in the BSS except two STAs doing sta-to-sta, or it keeps a set of STA not quiet. If a set of STA are not quiet, how this will help STA-to-STA communication.	clarify	2017/1/9 9:42
8244	Osama Aboulmagd	225	1 27.16.3	207	1	T	Y	207.01 27.16.3	What is the impact of Quieting all (or most of the STAs) on the BSS throughput. Has there been any study to quantify the impact?	discuss the impact on BSS throughput	2017/1/9 9:42
8245	Osama Aboulmagd	225	1 27.16.3	207	1	T	Y	207.01 27.16.3	There are many references in this clause that this feature is intended for STA-to-STA operation. However this operation is not defined together with the STA-to-STA signaling and communication	Define the missing operations	2017/1/9 9:42
8246	Pascal VIGER	225	1 9.2.4.5.7	21	25	T	Y	21.25 9.2.4.5.7	9.2.4.5.7 TXOP Duration Requested subfield The "TXOP Duration Requested" is used by a STA to indicate its need for its next EDCA TXOP. Such duration information is not relevant for UL MU operation (meaningless). An HE STA shall not use "TXOP Duration" format but only using the "queue size" format.	Add following sentence at the end of chapter 9.2.4.5.7: "An HE STA does not use the "TXOP Duration Requested" subfield format. For HE buffer status feedback operation for UL MU, it should either or both use the "queue size" format in QoS Control field (see 9.2.4.5.6) or the BSR format in A-Control subfield of the HE variant HT Control field (see 9.2.4.6.4.5). "	2017/1/9 9:42
8247	Pascal VIGER	225	1 9.2.4.6.4.1	23	37	E	Y	23.37 9.2.4.6.4.1	Table 9-18a–Control ID subfield values. The table misses the description of content for RDP (control ID value 6), with forward indication to the appropriate section.	as per comment, add sentence: "See 9.2.4.6.4.8 (Reverse direction protocol (RDP))"	2017/1/9 9:42
8248	Pascal VIGER	225	1 9.2.4.6.4.3	24	62	T	Y	24.62 9.2.4.6.4.3	The UL MU Disable subfield indicates whether UL MU operation is suspended or resumed by the non-AP STA. There is no information indicating the reason of such a suspending, and no procedure to enter or exit this suspending phase.	A procedure shall be defined. Otherwise, STAs may decide by themselves the usage of not of UL MU scheme, which may downgrade the efficiency of UL MU mode.	2017/1/9 9:42

8249	Pascal VIGER	225	1 9.2.4.6.4.5	25		T	Y	25.00 9.2.4.6.4.5	9.2.4.6.4.5 Buffer Status Report (BSR) The report contains buffer status information used for UL MU operation. But the AP should only receive amount of data directed to it.	As already stated in 9.2.4.5 QoS Control Field for the legacy format of buffer status, add following sentence after 1st paragraph of 9.2.4.6.4.5 BSR: "For reporting its buffer status information, a non-AP HE STA considers the amount of buffered traffic intended for the HE AP."		2017/1/9 9:42
8250	Pascal VIGER	225	1 9.2.4.6.4.7	28	10	T	Y	28.10 9.2.4.6.4.7	HE STA may report the channel availability information in the BQR A-Control subfield of frames it transmits if the AP. Is it possible to inform of the un-availability of the primary 20MHz channel ? In other words, is first row named '20 MHz' effective ?	need clarification		2017/1/9 9:42
8251	Pascal VIGER	225	1 9.2.5.2	31	1	T	Y	31.01 9.2.5.2	How to specify the Duration/ID for BQR Trigger Frame ? Only Basic, MU-RTS and MU-BAR TF are considered in this section.	Clarify the estimated duration for BQR, and especially when it is followed by multiple frames.		2017/1/9 9:42
8252	Pascal VIGER	225	1 9.3.1.23.4	50	51	T	Y	50.51 9.3.1.23.4	Selection of MU-RTS stations: The 802.11ac reservation scheme is conserved (20Mhz, 40Mhz, 80Mhz and so on) even if it is limited. It is better if the AP selects those stations answering a CTS in given channels. As example, two stations reserve a given band, each one in a respective 20 MHz channel: STA A is selected for primary 20MHz, but STA B is selected for the second 20MHz channel. This lets more chance to cover the full band, and avoids collision riskt for simultaneous CTS (synchronization requirement as defined in 17.3.9.10, Pre-correction accuracy requirements).	Modify the description of RU Allocation subfield in the User Info field (line 51 page 50), to support allocation of a given 20MHz RU to specific stations.		2017/1/9 9:42
8253	Pascal VIGER	225	1 9.3.1.23.1	48	23	T	Y	48.23 9.3.1.23.1	The MU-RTS can be used as a protection for UL transmission triggered by a Basic trigger frame. Using such successive TF frames is not efficient. It is more efficient if the basic trigger can also trigger CTS frames, before the UL transmissions occur. Thus overhead is reduced.	The "Trigger Dependent Common Info field" may be used to indicate the STA in charge of emitting HE-Triggered CTS frames. A specific structure composed of AID12 and RU Allocation subfields may be used. This replaces the requirement of using a dedicated MU-RTS trigger frame. The CTS frames will be emitted a SIFS after the Basic Trigger frame having such Trigger Dependent Common Info field. The UL triggered PPDUs are sent by STA a SIFS after CTS frames.		2017/1/9 9:42
8254	Pascal VIGER	225	1 9.3.1.23.7	51		T	Y	51.00 9.3.1.23.7	9.3.1.23.7 Bandwidth Query Report Poll variant As the Common Info field of the BQRP variant Trigger frame is defined in Figure 9-52d, there is missing the usage of such common info fields : are they all used or required ?	As done for MU-RTS, clarify which fields are reserved.		2017/1/9 9:42
8255	Pascal VIGER	225	1 27.5.1.3	163	17	T	Y	163.17 27.5.1.3	Buffer Query Report following MU-RTS procedure may be inefficient. As MU-RTS scheme relies on 802.11ac (contiguous band) and BQR supports punctured band among a whole similar BW, there is chance that HE STAs indicate in their BQR some 20 MHz channels that are not protected by MU-RTS/CTS. The usage of not protected channels may be problematic for legacy devices.	The MU-RTS variant may be enhanced to support emission of CTS frames along a punctured bandwidth. A HE STA already has the possibility to sense various 20MHz channels, determine those free, and emit on a specific (sub-)channel (according BQR capability). During its MU-RTS/CTS scheme, the HE AP may inform HE STAs which are BQR-capable (through a single bit in MU-RTS TF) that it is ready to receive CTS on non-contiguous channels		2017/1/9 9:42

8256	Pascal VIGER	225	1 10.3.2.8a.3	117	44	T	Y	117.44 10.3.2.8a.3	The MU-RTS acts as a protection mechanism for 20Mh, 40Mhz or 80Mhz primary band (see 9.3.1.23.4 MU-RTS variant). In section 10.3.2.8a.3 CTS response to MU-RTS, it is indicated that "If any 20 MHz channel indicated in the RU Allocation subfield of the User Info field is busy, the CTS frame response shall not be transmitted." Does this suppose that HE STA can transmit CTS frames in punctured/non-contiguous 20Mhz channels ?	- If yes, there is no more requirement to limit RU allocation to indicate only whether the CTS frame is transmitted on the primary 20 MHz channel, primary 40 MHz channel, primary 80 MHz channel, 160 MHz channel, or 80+80 MHz channel. Possibility should be offered to AP for allocating a given 20MHz RU (anywhere is its position among the BW) for a given STA for sending the CTS. - If no, please make the 2 texts aligned	2017/1/9 9:42
8257	Pascal VIGER	225	1 10.3.2.8a.3	117	22	T	Y	117.22 10.3.2.8a.3	"CTS response to MU-RTS" uses a different sensing period (ED-based CCA during the SIFS after receiving an MU-RTS frame) that "CTS after a RTS" (- 10.3.2.7 : CCA on all secondary channels has been idle for a PIFS prior to the start of the RTS frame). Is it normal ? what is the reason for ? Note: According to 10.22.2.5, HT/VHT/HE STAs use same CCA rules for determining channel width on secondary channels (e.g. PIFS interval for 5GHz)	as per comment	2017/1/9 9:42
8258	Pascal VIGER	225	1 9.4.2.218.3	86	30	T	Y	86.30 9.4.2.218.3	Class A STAs are high capability devices and class B STAs are low capability devices. There is missing a link to a detailed definition of such classes.	as per comment	2017/1/9 9:42
8259	Pascal VIGER	225	1 9.4.2.219	91	39	T	Y	91.39 9.4.2.219	In HE Operation element section, there are 2 different descriptions of BSS Color field. Clarification is needed.	as per comment	2017/1/9 9:42
8260	Pascal VIGER	225	1 9.4.2.219	91	50	E	Y	91.50 9.4.2.219	In description of PE Duration subfield, the term PE duration is used but has never been introduced earlier.	replace "PE duration" by "Packet Extension duration". Maybe also useful to introduce PE acronym in chapter 3.4 (Abbreviations and acronyms).	2017/1/9 9:42
8261	Pascal VIGER	225	1 9.4.2.219	92	15	T	Y	92.15 9.4.2.219	An AP corresponding to neither a nontransmitted BSSID nor a transmitted BSSID sets both MaxBSSID Indicator and Tx BSSID Indicator to 0. Does this AP correspond to a AP with no support of multi-BSS feature, or is there any other case ? It would be nice to clarify this point in the text.	as per comment	2017/1/9 9:42
8262	Pascal VIGER	225	1 9.4.2.221	94	4	T	Y	94.04 9.4.2.221	The MU EDCA Parameter Set element is used for proper operation of the QoS facility during the CP. The sentence is unclear, and particularly the CP term is not defined. If CP refers to contention period, is it useful to be used as this kind of period is the only allowed type (as according to 27.1, the use of HCCA is banned at HE STAs and thus there is no more CFP period).	Please clarify the sentence.	2017/1/9 9:42
8263	Pascal VIGER	225	1 9.4.2.221	94	52	T	Y	94.52 9.4.2.221	For value 0 of the AIFSN field, the sentence is unclear : "the AIFS is equal to the value of the MU EDCA Timer, i.e. EDCA is disabled for the duration specified by the MUEDCATimer for the corresponding AC". This lets think that the EDCA medium access will be enabled once the AIFS will expire. BUT this will not be possible, as AIFS timer is large (8*1024-1_{S}) and re-scheduled at each start of EDCA contention phase (see 10.3.2.3.6 AIFS).	Please clarify the sentence, in order to clearly know under which conditions the EDCA medium access will be re-enabled.	2017/1/9 9:42
8264	Pascal VIGER	225	1 27.2.3	152	19	T	Y	152.19 27.2.3	HEMUEDCATimer[AC] shall uniformly count down to 0. Is this countdown continuously performed along time, or is the countdown suspended in between each medium access (that means only counting down during contention procedure periods) ?	Please clarify when countdown is executed.	2017/1/9 9:42

8265	Pascal VIGER	225	1 9.4.2.221	94	62	T	Y	94.62 9.4.2.221	MU EDCA Timer field indicates a duration expressed in time unit (TU) (a TU equals to 1024 ++s). No exemplary value is provided for MU EDCA Timer field. By the way, is value 0 allowed (and so what is the consequence)?	According to 10.22.2.4 (Obtaining an EDCA TXOP), the value of AIFSN[AC] shall be greater than or equal to 2 for non-AP STAs. That results in having a AIFS timer value never null. Thus, the MU EDCA Parameter Set must provide a correct value, preventing the null case.	2017/1/9 9:42
8266	Pascal VIGER	225	1 10.22.2.2	130	1	T	Y	130.01 10.22.2.2	In 10.22.2.2, EDCA backoff procedure is resumed for contradictory reasons described in the two first paragraphs: When an HE STA successfully receives and does not receive the corresponding acknowledgement frame. A clarification (even text simplification) is needed.	as per comment	2017/1/9 9:42
8267	Pascal VIGER	225	1 11.49.1	144	34	T	Y	144.34 11.49.1	The formula for assigning AID is unclear. Is the formula limited to bits 5 to 8, what is the relation with definition of AID in chapter 9.4.1.8 AID field of Revmc ?	as per comment	2017/1/9 9:42
8268	Pascal VIGER	225	1 27.2.2	151	50	T	Y	151.50 27.2.2	Is it useful to mention "10.4.3.3 (NAV operation during the CFP)" for an HE STA ? As according to 27.1, the use of HCCA is banned at HE STAs, is there still exist a CFP period?	as per comment	2017/1/9 9:42
8269	Pascal VIGER	225	1 10.3.2.4	115	12	T	Y	115.12 10.3.2.4	Is it useful to mention "10.4.3.3 (NAV operation during the CFP)" for an HE STA ? As according to 27.1, the use of HCCA is banned at HE STAs, is there still exist a CFP period?	as per comment	2017/1/9 9:42
8270	Pascal VIGER	225	1 27.5.1.2	163	13	T	Y	163.13 27.5.1.2	Following sentence is unclear : "An MPDU sent in a broadcast RU of an HE MU PPDU shall not include information intended for a STA that is identified as the recipient of another RU in the same HE MU PPDU." This lets think a broadcast RU is not destined to any station. Isn't it a unicast RU instead ?	as per comment	2017/1/9 9:42
8271	Pascal VIGER	225	1 27.5.2.1	163	58	T	Y	163.58 27.5.2.1	There is a mix of STA, HE STA, non-AP STA terms used in this section in a confusing manner. As example, page 164 line 14, "A STA shall not transmit a Trigger frame..." whereas only a AP HE STA is able to do this.	as per comment	2017/1/9 9:42
8272	Pascal VIGER	225	1 27.5.2.1	164	24	T	Y	164.24 27.5.2.1	class A or class B devices are said to be defined in 28.3.14 (Transmit requirements for an HE trigger-based PPDU), whereas this seems not the case.	as per comment	2017/1/9 9:42
8273	Pascal VIGER	225	1 27.5.2.2.1	164	63	T	Y	164.63 27.5.2.2.1	The purpose of following sentence is unclear: "More than one Trigger frame may be aggregated in an A-MPDU. If more than one Trigger frame is aggregated in an A-MPDU, all of them shall have the same content." What is the aim of such duplication, to replace padding ?	as per comment	2017/1/9 9:42
8274	Pascal VIGER	225	1 27.5.2.2.2	166	51	T	Y	166.51 27.5.2.2.2	The paragraph 10 of section 27.5.2.2.2 is unclear. 1. "If an AP includes one or more Trigger Frames or HE variant HT Control fields with an UL MU Response Scheduling A-Control subfield, then they shall collectively elicit HE trigger-based PPDU responses..." - What does "AP includes" mean ? - what "they" refers to ? 2. "...such that at least one RU is allocated for each 20 MHz channel occupied by the eliciting PPDU. " In case of the one RU is of random access type, then there is chance to have no body emiting in that RU.	1. as per comment, re-word the sentence. 2. modify the sentence accordingly: ". . Such that at least one scheduled RU is allocated..." In a optimized manner to avoid any empty 20MHz channel, add a complement sentence at the end of the paragraph : "In order to limit the effect of unusued random RUs over a given 20MHz channel, an AP may substantially uniformly distribute scheduled RUs and random RUs over the set of 20 MHz channels used by the eliciting PPDU."	2017/1/9 9:42

8275 Pascal VIGER	225	1 27.5.2.2.3	167	38	T	Y	167.38 27.5.2.2.3	It is stated that "An AP may send the Trigger frame using any access category and follows the rules defined in 10.22.2". This is not applicable at all because AP does not know which AC to use. For Data or Ack frames, the AC is determined by examining the TID field of MSDU packet (TID is linked to UPs of MSDU from higher layer as refer to 5.1.1.3). For a Management frame, the AC is AC_VO. What is the procedure for a Trigger Frame, as it is a control frame (which by essence has no TID) ?	Procedure can envisage a mapping between the priority of the TF and the Access Categories AC0 - AC3 to insert the trigger frame. As example, by following sentence: " the trigger frame may be conveyed in the AC that corresponds to the type of uplink traffic that the HE STAs are requested to send in response to the trigger frame. If different ACs are requested to STAs, the HE AP may select an Access Category for the trigger frame corresponding to the AC with the highest priority among the requested Access Categories." Additionally, upon emergency for sending a Trigger Frame (BSR reports inform of an important amount of pending data), then " The AP may select one AC queue with the highest priority as the one that has the lowest backoff value, i.e. the next AC queue from which data will be sent on the medium. "		2017/1/9 9:42
8276 Pascal VIGER	225	1 27.5.2.3	167	58	T	Y	167.58 27.5.2.3	The 3rd paragraph describes the conditions for a HE STA to transmit a HE trigger-based PPDU. If the STA is not associated with the AP, procedure is TBD.	The TBD should be replaced by the random access procedure (as described in page 164 line 46). The case of AID=0 should also be considered with same behavior.		2017/1/9 9:42
8277 Pascal VIGER	225	1 27.5.2.3	170	1	T	Y	170.01 27.5.2.3	In case of Basic Trigger frame, STA behavior for selecting content for HE trigger-based PPDU is unclear, for the case that "the STA does not have a frame of the required type". What is such required type ? Does the required type refer to an AC type? In case of scheduled RU, it seems detrimental not to transmit any data PPDU (anyway the 'type' is) !	- Clarify the 'type' meaning. - Instead not transmitting or transmitting Qos Null frames, consider transmitting any other pending MPDU(s) (as per rules of 27.10.4) for the only case where a scheduled RU is allocated, in order to enhance medium usage.		2017/1/9 9:42
8278 Pascal VIGER	225	1 27.5.2.6.2	173	36	T	Y	173.36 27.5.2.6.2	The case of having an assigned RU with AID of the STA is not considered, in the case a STA has already started a random access procedure in the past (previous TF) and its OBO is pending (non null). Even it is specified that this scheduled STA will transmit other its scheduled RU, it is not specified that OBO procedure is not effective for this TF.	Add following sentence after 3rd paragraph: "An HE STA shall not decrement its OBO counter if it has found a RU assigned to it with its STA's AID."		2017/1/9 9:42
8279 Pascal VIGER	225	1 27.5.2.2.1	164	46	T	Y	164.46 27.5.2.2.1	A value of 0 in AID12 indicates that nonassociated STAs can transmit using the random access procedure. Section 27.5.2.6 (UL OFDMA-based random access) describes that STA shall use the RAPS element sent by AP. How nonassociated STA can manage several APs ?	Specify if a limit of number of APs shall be set for nonassociated STA (even the limit is only one AP).		2017/1/9 9:42
8280 Pascal VIGER	225	1 27.5.2.2.1	164	46	T	Y	164.46 27.5.2.2.1	A value of 0 in AID12 indicates that nonassociated STAs can transmit using the random access procedure. When support of multiple BSSID is activated, the case of several BSSs shall be managed with regards to the RAPS profile usage.	as per comment, a procedure is required for RAPS management in case of multiple-BSSID.		2017/1/9 9:42
8281 Pascal VIGER	225	1 27.5.2.6.3	174	20	T	Y	174.20 27.5.2.6.3	For retransmission procedure for random access, what is the effect if pending data was sent through EDCA during the while. Does OBO is erased or is let as-is to continue OBO procedure for any other remaining data ? What are the effects onto OCW ?	please clarify any effect in the case.when HE PPDU, which was initially trigger-based, was sent in EDCA.		2017/1/9 9:42
8282 Pascal VIGER	225	1 27.5.2.6.1	172	45	T	Y	172.45 27.5.2.6.1	HE STA shall use the most recently RAPS element, but this element should be received from the intended AP !	Modify the sentence of 4th patagraph:"An HE STA shall use the OCWmin and OCWmax values indicated in the RAPS element within Beacon or Probe Response frames most recently received by the AP emitting the Trigger Frame, regardless of the access category...".		2017/1/9 9:42

8283 Pascal VIGER	225	1 27.5.2.7	174	23	T	Y	174.23 27.5.2.7	NDP feedback report procedure is not detailled.What is a short feedback ? Are there several types of feedback ?	as per comment	2017/1/9 9:42
8284 Pascal VIGER	225	1 27.5.2.7	174	23	T	Y	174.23 27.5.2.7	NDP feedback report procedure is optional for non-AP STA. Does this mean it is mandatory for AP STA?	as per comment. Please confirm the mandatory or optional status.	2017/1/9 9:42
8285 Pascal VIGER	225	1 27.7.2	181	12	T	Y	181.12 27.7.2	The term "A TWT requesting STA should not initiate transmission of frames " is not so clear. I suppose "initiate transmission" means "accessing the medium by the STA itself in order to transmit". In case "initiate transmission" would just mean "transmit", it is no sense for the end of the sentence: "A TWT requesting STA ...should not " <transmit> "frames to the TWT responding STA within trigger-enabled TWT SPs for that TWT agreement."	Please modify the sentence, by replacing "should not initiate transmission of frames" by "should not initiate a medium access to transmit frames".	2017/1/9 9:42
8286 Pascal VIGER	225	1 27.7.3.3	185	40	T	Y	185.40 27.7.3.3	Second paragraph of 27.7.3.3: "A TWT scheduled STA should not initiate transmission of frames to the TWT scheduling STA outside of broadcast TWT SPs and within trigger-enabled TWT SPs." This sentence should be completed to which action the TWT scheduled STA should do.	I propose to clearly indicate after the sentence: "However, the TWT scheduled STA should wait for trigger frames sent by the TWT scheduling STA".	2017/1/9 9:42
8287 Pascal VIGER	225	1 27.7.3.3	184	17	T	Y	184.17 27.7.3.3	The TWT scheduling STA shall schedule for transmission a Trigger frame addressed to one or more TWT scheduled STAs during a trigger-enabled TWT SP. Due to density and other (legacy) STAs contending on the medium, there is good chance that the TWT SP start time is delayed. TWT STAs may miss the TWT SP for any of 2 reasons: - the TWT-TF is collided (worse case) - the TWT-TF is too much postponed : thus some TWT STAs will fallback from MU-EDCA to EDCA mode, or will transition to doze state	The Trigger Frames having a targeted wake time schedule (trigger-enabled SPs) shall be prioritized for being transmitted by HE AP. This will ensure the timing contract with TWT scheduled stations is respected for trigger-enabled TWT agreement, which is beneficial for medium usage efficiency.	2017/1/9 9:42
8288 Pascal VIGER	225	1 27.14.2	200	23	T	Y	200.23 27.14.2	Power save with UL OFDMA may make the STA waking up at the same time. They "may enter the doze state until the start of that TWT SP". If the TF is collided or delayed due to contention, STA s may miss the TWT SP (can not use TWT SP).	The Trigger Frames having a targeted wake time schedule (trigger-enabled SPs) shall be prioritized for being transmitted by HE AP. This will ensure the timing contract with TWT scheduled stations is respected for trigger-enabled TWT agreement, which is beneficial for medium usage efficiency.	2017/1/9 9:42
8289 Pascal VIGER	225	1 27.16.3.1	207	4	T	Y	207.04 27.16.3.1	There is a mis-configuration for EDCA contention between Quiet time period mode and MU EDCA Parameter mode: when a STA has both traffic to deliver STA2STA (during QTP period) and MU UL to AP (outside QTP period), what EDCA configuration to use ?	The MU EDCA mode is not able to support STA2STA communication. Instead of applying a penalty of EDCA parameters, it would be better efficient to let backoff counters count down as usual with no penalty, and to condition the transmission of data (when one EDCA backoff is down to zero) according QTP on/off mode. - In case of QTP period is off, then the MU EDCA mode may prevent any EDCA access. Thus the backoff down to zero is simply re-drawn. - In case of QTP period is on when a backoff counter reaches zero, if the data stored in the associated traffic queue include data to be addressed to another STA different from the access point (i.e. it is STA2STA data), then this data is transmitted. next the backoff counter is redrawn.	2017/1/9 9:42

8290	Pascal VIGER	225	1 9.4.2.221	94	62	T	Y	94.62 9.4.2.221	MU EDCA Parameters Set is not compatible with STA2STA (or also called P2P) traffics, like DLS or TDLS protocols. The penalty scheme as envisaged by MU EDCA Parameter Set penalizes the uplink traffic to the AP, but also blocks any legacy EDCA access for P2P communications.	The MU EDCA Parameter Set has to be modified (and as a result will be simplified) to support P2P traffics. The MU EDCA Timer is the only parameter kept, and indicates the duration of time during which the restricted UL MU mode is used. Principle consists in to let EDCA backoff counters count down as usual (that is to say with no penalty as currently envisaged by former MU EDCA Parameters set), and to condition the transmission of data (when one EDCA backoff is down to zero) according to the MU EDCA Timer activity and the data to be sent. - if MU EDCA Timer is not active (or timeout), then the transmission is allowed on the given queue - if MU EDCA Timer is not active, then only transmission of P2P data inside the expired queue is allowed. Next the backoff counter is redrawn as usual.		2017/1/9 9:42
8291	Pascal VIGER	225	1 9.4.2.221	94	62	T	Y	94.62 9.4.2.221	The specification of MU EDCA parameter Set prevent any EDCA backoff counter (e.g. by MU EDCA Timer, i.e. EDCA is disabled for the duration specified by the MUEDCATimer). Thus, this mechanism makes the EDCA backoff counters no longer mirror which AC queue should have the highest priority of transmission in the meaning of conventional EDCA (e.g. with oldest data stored in it). For instance, when the STA receives a trigger frame with a scheduled RU dedicated to it, the STA having its backoff counters frozen, cannot anymore use them to handle its QoS and send the data with the highest priority (not only regarding its Access Category, but also regarding the respective ages of the data in the AC[] queues). Therefore, MU EDCA Parameter Set has broken the classical QoS handling.	The MU EDCA Parameter Set can be modified to keep the EDCA penalty and allow keeping the backoff count down. Among the set of parameters used in 9.4.2.221, the MU EDCA Timer is the only parameter kept, and indicates the duration of time during which the restricted UL MU mode is used. Principle consists in to let EDCA backoff counters count down as usual (that is to say with no penalty as currently envisaged by former MU EDCA Parameters set), and to condition the transmission of data (when one EDCA backoff is down to zero) according to the MU EDCA Timer activity and the data to be sent. - if MU EDCA Timer is not active (or timeout), then the EDCA transmission is allowed on the given queue - if MU EDCA Timer is not active, then transmission through EDCA is dis-allowed. Next the backoff counter is		2017/1/9 9:42
8292	Pascal VIGER	225	1 27.5.2.2.2	165	46	T	Y	165.46 27.5.2.2.2	In case of multiple BSS, the TA field of TF shall be set to the MAC address of the transmitted BSSID. In order to distinguish (because it seems the case is not supported yet) between TF addressed to STAs of the single 'transmitted BSSID', and TF addressed to STAs of the overall multiple BSS set, the Individual/Group bit shall be used (forced to 1).	as per comment		2017/1/9 9:42
8293	Patrice Nezou	225	1 10.28.4	137	10	T	Y	137.10 10.28.4	A HE RD responder may transmit A-MPDU with MPDUs from multiple TIDs that are from the same AC or higher AC. What is the consequence for the backoff values of the transmitted Acs ? What about QoS ?	I propose to reset current backoff values of transmitting ACs.		2017/1/9 9:42
8294	Patrice Nezou	225	1 27.5.1.2	163	13	T	Y	163.13 27.5.1.2	"An MPDU sent in a broadcast RU of an HE MU PPDU shall not include information intended for a STA that is identified as the recipient of another RU in the same HE MU PPDU." Does it mean that broadcasted RU can not be mixed with any other types of RU ?	as per comment		2017/1/9 9:42
8295	Patrice Nezou	225	1 27.2.3	152	10	T	Y	152.10 27.2.3	When a STA is in MU EDCA mode, how the QoS data are selected from the ACs ?	Proposal: "The HE trigger-based PPDU is built based on the current backoff values of ACs. The backoff values must be updated after the transmission".		2017/1/9 9:42
8296	Patrice Nezou	225	1 27.2.3	152	29	T	Y	152.29 27.2.3	When a STA switches from MU EDCA to EDCA, how the backoff are restored ?	Proposal: "The backoff values must be resetted and CW is set to CWmin when switching from MU EDCA to EDCA."		2017/1/9 9:42

8297	Patrice Nezou	225	1 27.2.3	152	10	T	Y	152.10 27.2.3	A STA, exchanging QoS data frame with another in DLS mode and setting in MU EDCA mode, cannot transmit any QoS data frame related to the DLS transmission because the scheduled RU allocated by the AP are dedicated to transmit QoS data frame to the AP.	Disable MU transmission mode when direct link transmissions are initiated by sending a frame containing an OMI A-Control field, and reset EDCA parameters.	2017/1/9 9:42
8298	Patrice Nezou	225	1 27.5.2.2.2	166	49	T	Y	166.49 27.5.2.2.2	A 20MHz channel must not remain empty. The draft specifies:" at least one RU is allocated for each 20MHz channel ..." To be sure that RU is really used by a STA. It would be better that at least one RU is a scheduled RU.	Revise the text with the following words : " ... at least non random access RU is allocated ... "	2017/1/9 9:42
8299	Patrice Nezou	225	1 27.5.2.3	167	59	T	Y	167.59 27.5.2.3	If the STA is not associated with the AP, TBD	Remove TBD	2017/1/9 9:42
8300	Patrice Nezou	225	1 27.5.2.6.1	172	49	T	Y	172.49 27.5.2.6.1	An AP only "may" include RAPS element evenif UL OFDMA-based random access is unable. How can the STA set OCWmin and OCWmax itself if no RAPS is sent by the AP ?	A non-AP STA must define default values for OCWmin and OCWmax	2017/1/9 9:42
8301	Patrice Nezou	225	1 27.5.2.6.2	173	48	T	Y	173.48 27.5.2.6.2	"If the selected RU is considered busy as a result of either physical or virtual carrier sensing, then the HE STA shall not transmit its HE trigger-based PPDU in the randomly selected RU and it randomly selects any one of the RUs that are assigned to AID value 0 in the subsequent Trigger frame." Why keeping OBO equal to 0 ? For the next subsequent Trigger frame, perhaps no more data will be ready to send.	Proposal: "... the HE STA shall not transmit its HE trigger-based PPDU in the randomly selected RU and the HE STA shall reinitialize its OBO counter to a new random value in the range of 0 and OCWmin"	2017/1/9 9:42
8302	Patrice Nezou	225	1 9.7.3	108	10	T	Y	108.10 9.7.3	"The TIDs present in a data enabled A-MPDU context are also constrained by the channel access rules (for a TXOP holder; see 10.22.2 (HCF contention based channel access (EDCA)) and 10.22.3 (HCF controlled channel access (HCCA))) and the RD response rules (for an RD responder, see 10.28.4 (Rules for RD responder)). This is not shown in these tables." The rules to choose TIDs in a data enabled A-MPDU is not described for TXOP responder. It is described only for a TXOP holder and a RD responder. For a MU UL TX, the STA are TXOP responder and we are not in a RD transmission.	Proposal: "The TIDs present in a data enabled A-MPDU context are also constrained by the channel access rules (for a TXOP holder and a TXOP responder; see 10.22.2 (HCF contention based channel access (EDCA)) and 10.22.3 (HCF controlled channel access (HCCA))) and the RD response rules (for an RD responder, see 10.28.4 (Rules for RD responder)). This is not shown in these tables."	2017/1/9 9:42
8303	Patrice Nezou	225	1 27.5.2.2.3	167	38	T	Y	167.38 27.5.2.2.3	"An AP may send the Trigger frame using any access category and follows the rules defined in 10.22.2 (HCF contention based channel access (EDCA)) for obtaining and sharing the TXOP." How is the position of the Trigger frame in the selected queue ? If too many frame are waiting to be transmitted, the transmission information (for instance RU information) can be obsolete.	Proposal:" An AP may send the Trigger frame using any access category and follows the rules defined in 10.22.2 (HCF contention based channel access (EDCA)) for obtaining and sharing the TXOP. The Trigger frame is located in the head of the FIFO related to the selected access category"	2017/1/9 9:42
8304	Patrice Nezou	225	1 27.5.2.7	174	24	T	Y	174.24 27.5.2.7	"The NDP feedback report is a mechanism for an HE AP to collect short feedbacks from a very high number of HE STAs, in an efficient manner. The feedbacks (e.g. resource requests) are sent without data payloads in response to a Trigger frame. The feedbacks are not for channel sounding. This mechanism is optional for non-AP STA." No type of Trigger frame is defined for NDP feedback report generation.	Precise the NDP feedback procedure	2017/1/9 9:42

8305	Patrice Nezou	225	1 27.5.2.6.3	174	15	T	Y	174.15 27.5.2.6.3	"If the HE trigger-based PPDU is not successfully transmitted in the randomly selected RU, the STA shall update its OCW to 2xOCW + 1 for every retransmission, until the OCW reaches the value of OCWmax." What does it happen if the data to be retransmitted is finally sent through EDCA mode ? What is the behavior related to OCW and OBO values ?	Proposal: A retransmission procedure has to be initiated in the STA and the data to be retransmitted must be flagged. If the flagged data packet is transmitted before the end of the retransmisison procedure, the current OBO and OCW are resetted and reinitialized.	2017/1/9 9:42
8306	Paul Nikolich	225	1 3	7		G	Y	7.00 3	Resource Unit is missing from Definitions and Acronyms	add RU to acronyms and define Resource Unit	2017/1/9 9:42
8307	Paul Nikolich	225	1 3	7		G	Y	7.00 3	The term 'DC subcarrier' is missing from Defintions and Acronyms	add DC to acronyms and define DC subcarrier	2017/1/9 9:42
8308	Paul Nikolich	225	1 3	7		G	Y	7.00 3	The term target wake up time, TWT, is missing from Definitions and Acronyms	add TWT to acronyms and define target wake up time	2017/1/9 9:42
8309	Peter Ecclesine	225	1 6.2.37.4	13	59	E	N	13.59 6.2.37.4	Clause numbering 6.3.27.4 appears twice, also 6.3.27.4.2	Properly format clause numbering	2017/1/9 9:42
8310	Peter Ecclesine	225	1 6.3.4.2.2	11	59	E	N	11.59 6.3.4.2.2	Missing comma after ... here and P12 L62	Change to ...,	2017/1/9 9:42
8311	Peter Ecclesine	225	1 8.3.5.2.2	15	19	E	N	15.19 8.3.5.2.2	Missing comma after "DATA" here and P15 L48	add comma after DATA	2017/1/9 9:42
8312	Peter Ecclesine	225	1 9.2.4.7.1	30	13	E	N	30.13 9.2.4.7.1	HE PPDU duration reference in Table 9-19 should be Table 28-46 HE PHY characteristics, not Table 21-29 VHT PHY characteristics.	Change reference per comment to Table 28-46.	2017/1/9 9:42
8313	Peter Ecclesine	225	1 B.4.27.1	413	16	T	Y	413.16 B.4.27.1	HE MAC PICS missing Quieting Action frame, and it's use is necessary in radar bands so that DFS in-service monitoring requirments can be met.	Add mandatory reception of Quiet Time Period Action frame when some channels are in radar bands. Transmission can be optional like MU-RTS transmission is.	2017/1/9 9:42
8314	Peter Ecclesine	225	1 9.4.1.11	55	54	E	N	55.54 9.4.1.11	Quiet Time Period subclause reference should be 9.6.29, not 9.6.23a	change per comment	2017/1/9 9:42
8315	Peter Ecclesine	225	1 9.6.8.34	99	44	T	N	99.44 9.6.8.34	If AP supports QAB, the Quiet Time Period action frame may be required.	Insert changes to QAB frame format if required	2017/1/9 9:42
8316	Peter Ecclesine	225	1 9.6.8.36	99	56	T	Y	99.56 9.6.8.36	Keep Vendor Specific element as order 6 in FILS Discovery frame format as it is in 11ax baseline, do not delete it.	Do not change order 6 text	2017/1/9 9:42
8317	Peter Ecclesine	225	1 27.1	149	10	T	Y	149.10 27.1	It is useful for the reader to in 27.1 state which clause 27 procedures are mandatory and optional like 28.1.1 Introduction to the HE PHY. 300+ 'SHALL's (out of 430) can be removed within clause 27.	Write MAC introduction with Shalls in 27.1 and remove > 300 'SHALL's from remaining Clause 27 text.	2017/1/9 9:42
8318	Peter Ecclesine	225	1 27.3.2	152	55	E	Y	152.55 27.3.2	There are too many 'SHALL's in clause 27.3 dynamic fragmentation text.	State what is mandatory and optional in 27.3.2, then remove redundant shalls from 27.3.x	2017/1/9 9:42
8319	Peter Ecclesine	225	1 27.4.1	157	22	E	Y	157.22 27.4.1	There are too many 'SHALL's in clause 27.4 Block acknowledgement text.	State what is mandatory and optional in 27.4.1, then remove redundant shalls from 27.4.x	2017/1/9 9:42
8320	Peter Ecclesine	225	1 27.5.1.1	162	59	E	Y	162.59 27.5.1.1	There are too many 'SHALL's in clause 27.5 MU operation text.	State what is mandatory and optional in 27.5.1.1, 27.5.2.1, ... 27.5.2.6.1 and 27.5.3, then remove redundant shalls from 27.5.x	2017/1/9 9:42
8321	Peter Ecclesine	225	1 27.6.1	175	12	E	Y	175.12 27.6.1	There are too many 'SHALL's in clause 27.6 HE sounding protocol text	State what is mandatory and optional in 27.6.1, then remove redundant shalls from 27.6.x	2017/1/9 9:42
8322	Peter Ecclesine	225	1 27.7.1	179	64	E	Y	179.64 27.7.1	There are too many 'SHALL's in clause 27.7 TWT operation text	State what is mandatory and optional in 27.7.1, then remove redundant shalls from 27.7.x	2017/1/9 9:42
8323	Peter Ecclesine	225	1 27.8.1	187	46	E	Y	187.46 27.8.1	There are too many 'SHALL's in clause 27.8 Operating mode indication text	State what is mandatory and optional in 27.8.1, then remove redundant shalls from27.8.x	2017/1/9 9:42
8324	Peter Ecclesine	225	1 27.9.1	190	12	E	Y	190.12 27.9.1	There are too many 'SHALL's in clause 27.9 spatial reuse operation text	State what is mandatory and optional in 27.9.1. then remove redundant shalls from 27.9.x	2017/1/9 9:42
8325	Peter Ecclesine	225	1 27.11	195	44	E	Y	195.44 27.11	There are too many 'SHALL's in clause 27.11 Setting TXVECTOR parameters text	Insert an general section stating what is mandatory and optional in 27.11.1, then remove redundant shalls from 27.11.x	2017/1/9 9:42
8326	Peter Ecclesine	225	1 27.14	199	10	E	Y	199.10 27.14	There are too many 'SHALL's in clause 27.14.x text	Insert a general section stating what is mandatory and optional in 27.14.x, then remove redundant shalls from 27.14.x	2017/1/9 9:42
8327	Peter Ecclesine	225	1 27.15.1	201	10	E	Y	201.10 27.15.1	There are too many 'SHALL's in clause 27.15 PPDU format text	State what is mandatory and optional in 27.15.1, then remove redundant shalls from 27.15.x	2017/1/9 9:42
8328	Peter Ecclesine	225	1 27.16.1	206	19	E	Y	206.19 27.16.1	There are too many 'SHALL's in cause 27.16 HE BSS operation text	State what is mandatory and optional in 27.16.1. then remove redundant shalls from 27.16.x	2017/1/9 9:42

8329	Peter Ecclesine	225	1 28.3.17.3	345	55	T	Y	345.55 28.3.17.3	As the frequency bands are shared, receiver performance where the interfering signal is not our own modulation should be specified. Receiver selectivity with AWGN should be specified.	The interfering signal should not be the same signal as is used in 28.3.17.2 receiver sensitivity. Specify with AWGN interfering signal of bandwidth W MHz.	2017/1/9 9:42
8330	Peter Ecclesine	225	1 28.3.17.4	347	6	T	Y	347.06 28.3.17.4	As the frequency bands are shared, receiver performance where the interfering signal is not our own modulation should be specified. Receiver selectivity with AWGN should be specified.	The interfering signal should not be the same signal as is used in 28.3.17.2 receiver sensitivity. Specify with AWGN interfering signal of bandwidth W MHz.	2017/1/9 9:42
8331	Peter Ecclesine	225	1 28.1.3	212	61	T	Y	212.61 28.1.3	Regulatory requirements text (e.g.,17.3.8.3) should be added in HE PHY functions.	Repeat 17.3.8.3 text here and modify as necessary.	2017/1/9 9:42
8332	Peter Ecclesine	225	1 28.1.1	209	10	T	Y	209.10 28.1.1	Somewhere it should be mentioned that adaptivity at other than these specified CCA thresholds might be required by regulation, and that adaptivity is not specified here. Sharing the 5 GHz band in Europe under EN 301 893 is an example. The 2.4 is getting new rules too.	Insert "Regulatory requirements that do not affect interoperability are not addressed in this standard. Implementers are referred to the regulatory sources in Annex D for further information. Operation in countries within defined regulatory domains may be subject to additional or alternative national regulations."	2017/1/9 9:42
8333	Peter Ecclesine	225	1 27.1	149	10	T	Y	149.10 27.1	The MAC clause should have a regulatory requirements paragraph just after the introduction, as channel access might have regulatory constraints, e.g., EN 301 893 in Europe.	Insert "Regulatory requirements that do not affect interoperability are not addressed in this standard. Implementers are referred to the regulatory sources in Annex D for further information. Operation in countries within defined regulatory domains may be subject to additional or alternative national regulations."	2017/1/9 9:42
8334	Peter Khoury	225	1 9.2.4.6.4.7	28		T	Y	28.00 9.2.4.6.4.7	There should be some objective measure of whether a channel is available or not in the Bandwidth Query Report.	State either that the channel power should be less than -72dBm or make a reference to a preexisting level specified in the baseline.	2017/1/9 9:42
8335	Peter Khoury	225	1 9.3.1.23	47	44	T	Y	47.44 9.3.1.23	An FCS could be placed as part of the padding to enable a client device to abort construction of the UL triggered frame early and thus save power.	Add a clause stating that if the number of octets of padding is greater than 4 that the first 4 octets of padding shall consist of an FCS for the previous octets.	2017/1/9 9:42
8336	Peter Khoury	225	1 9.3.1.23	47	34	T	Y	47.34 9.3.1.23	The expected step size of 1dB is not present in Table 2-25g. The implied step size in the first row of the table is 8/9 of a dB.	Change -20dBm to -10dBm	2017/1/9 9:42
8337	Peter Khoury	225	1 27.5.2.2.1	164		E	Y	164.00 27.5.2.2.1	The sentence "An AP may transmit a PPDU that elicits an HE trigger-based PPDU from one or more STAs by including in the PPDU:" should specify whether the following paragraphs are "either or" or "and both"	An AP may transmit a PPDU that elicits an HE trigger-based PPDU from one or more STAs by including in the PPDU either: -One or more Trigger ... or -An UL MU Response ...	2017/1/9 9:42
8338	Peter Khoury	225	1 27.5.2.2.1	164	63	T	Y	164.63 27.5.2.2.1	The sentence "More than one Trigger frame may be aggregated in an A-MPDU. If more than one Trigger frame is aggregated in an A-MPDU, all of them shall have the same content." Is the situation in which more than one trigger frame is aggregated is a DL MU PPDU with multiple Trigger Frames transmitted to different users in different RUs? If this is the case then this sentence is overly restrictive as information about other users is being unicasted to a single user.	Clarify the language on situations in which trigger frames may be aggregated. If the situation described in the comment is valid allow trigger frames to different users in an A-MPDU to differ from each other.	2017/1/9 9:42
8339	Peter Khoury	225	1 9.3.1.23	46	62	T	Y	46.62 9.3.1.23	The trigger frame specifies the MCS for all users on the subsequent UL MU OFDMA frame. This seems overly restrictive especially when the non-AP STA has just received the trigger frame from which is has immediate knowledge of the channel. Its even more restrictive for the random access RUs in which case a client may be forced to use an MCS much lower than necessary and waste bandwidth or may be precluded from using an RU that was specified for an MCS that was too high for the current link budget.	Include an option for an Uplink OFDMA format similar to the downlink MU PPDU format that includes MCS but not RU. This new frame type would be specified in section 28.3.4 and would be a frame similar to the HE MU PPDU with another OFDMA signalling symbol in which uplink RU MCS could be specified by the transmitting stations.	2017/1/9 9:42

8340	Peter Loc	225	1 9.2.5.7	32	26	T	Y	32.26 9.2.5.7	The paragraph implies that the STAs receiving the MU-RTS measure the time in microseconds between the end of the MU-RTS and the end of the PPDU carrying the CTS frame. The measured times may differ from STA to STA due to the accuracy of the measurements. For legacy devices, the accuracy is not a factor, but for HE devices due to the stringent requirement on packet alignment at the AP, minor differences in the timing may adversely affect the alignment of the packets arriving at the AP.	Modify the paragraph starting from line 26 to the following: "In a CTS frame that is transmitted in response to an MU-RTS frame, the Duration/ID field is set to the value obtained from the Duration/ID field of the MU-RTS frame that elicited the CTS frame adjusted by subtraction of aSIFSTime and the number of microseconds required to transmit the CTS frame at a data rate determined by the rules in 9.7."	2017/1/9 9:42
8341	Peter Loc	225	1 4.3.14a	9	51	T	Y	9.51 4.3.14a	There are other Trigger Frame variants that HE-STAs are required to support, such as MU-RTS, MU-BAR and BSRQ	Change the feature statement on line 51 of this subclause to "Mandatory support for basic, MU-RTS, MU-BAR and BSRQ trigger frames."	2017/1/9 9:42
8342	Peter Loc	225	1 9.3.1.23	44	23	E	N	44.23 9.3.1.23	Referencing the wrong table for the No. of LTFs vs. Spatial Streams	Change Table 22-13 to Table 21-13	2017/1/9 9:42
8343	Peter Loc	225	1 9.3.1.23	47	5	E	N	47.05 9.3.1.23	Editorial change: "DCM is not be used"	DCM is not to be used	2017/1/9 9:42
8344	Peter Loc	225	1 9.3.1.23	42	26	T	N	42.26 9.3.1.23	The Trigger Dependent User Info field is not explicitly defined	Change "The Trigger frame can include an optional Trigger Dependent Common Info field and optional Trigger Dependent User Info field" to "The Trigger frame can optionally include a Trigger Dependent Common Info field and a Trigger Dependent User Info field. The Trigger Dependent Common Info field is a component of the Common Info Field. The Trigger dependent user info field is a component of the User info field."	2017/1/9 9:42
8345	Peter Loc	225	1 27.5.2.5	171	14	T	Y	171.14 27.5.2.5	To ensure that BSR feedback frames are aligned at the AP, STAs should use explicit BSR feedbacks in response to a BSRP variant Trigger Frame, eliminating any padding related issues from the transmitting STAs	Change the first paragraph of this sub clause to the following: The non-AP STA can either implicitly deliver BSRs in the QoS Control field or BSR A-Control field of any frame transmitted to the AP (unsolicited BSR) or shall explicitly deliver BSRs in any frame sent to the AP in response to a BSRP variant Trigger frame (solicited BSR).	2017/1/9 9:42
8346	Peter Loc	225	1 9.4.2.218.3	81	9	T	N	81.09 9.4.2.218.3	Dual band support field is not used in this draft and should be replaced by a more useful capability indication. Support for 5GHz and/or 2.4 GHz can be inferred from the Channel Width Set field	Make this "Dual Band Support" field a reserved field for future assignment.	2017/1/9 9:42
8347	Peter Loc	225	1 9.4.2.218.3	82	45	T	Y	82.45 9.4.2.218.3	Support of preamble puncturing in all secondary 20/40MHz channels should be mandatory to reduce complexity on the AP scheduling and to improve network efficiency	Remove or change the Preamble Puncturing Rx field to "reserved"	2017/1/9 9:42
8348	Peter Loc	225	1 9.4.2.218.3	87	59	T	Y	87.59 9.4.2.218.3	Due to the lack of a length indication, the decoder does not know if Tx Rx HE MCS Support field does not contain the Tx and Rx bitmaps. It would be more deterministic if both Tx BW Bitmap subfield or the Rx BW Bitmap fields are always present in the Tx Rx HE MCS support field.	Replace the paragraph starting on line 56 with the following: "The Tx BW Bitmap and the Rx BW Bitmap are always present, even if one or both of these subfields has the value of all zeros.	2017/1/9 9:42
8349	Peter Loc	225	1 10.3.2.4a	115	38	T	N	115.38 10.3.2.4a	HE Duration-based RTS threshold is not defined	The HE duration threshold may be defined by adding dot11HEDurationRTSThreshold. A question still remains: how does an HE STA enable the use of HE duration threshold? To simplify the 11ax standard, suggest to remove this HE Duration threshold.	2017/1/9 9:42
8350	Peter Loc	225	1 10.3.5	113	45	T	Y	113.45 10.3.5	The procedure to disable HE duration-based RTS is not described.	Unless the procedure is clearly defined, the draft should follow the existing RTS/CTS procedure. Remove the paragraph starting from lines 45 to line 48	2017/1/9 9:42
8351	Peter Loc	225	1 10.3.1	113	50	T	Y	113.50 10.3.1	The procedure to enable HE duration-based RTS is not described.	Unless the procedure is clearly defined, the draft should follow the existing RTS/CTS procedure. Remove the paragraph starting from lines 50 to line 54	2017/1/9 9:42
8352	Peter Loc	225	1 10.3.2.4	114	63	E	N	114.63 10.3.2.4	Typo	Change to "all of the following"	2017/1/9 9:42

8353	Peter Loc	225	1 10.3.2.4	114	48	T	Y	114.48 10.3.2.4	Redundant instruction for non-HE STAs because this has been addressed in the current IEEE802.11 standard.	Remove "If the STA is not an HE STA and When the received frame's RA is equal to the STA's own MAC address, the STA shall not update its NAV"	2017/1/9 9:42
8354	Peter Loc	225	1	150	29	T	Y	150.29	The statement "For an HE STA maintaining two NAVs, ..." implies that there are HE STAs may only support one NAV. Since supporting 2 NAVs is a requirement for HE-STAs, this statement should be rephrase.	Change "For an HE STA maintaining two NAVs, ..." to "For HE STAs,...."	2017/1/9 9:42
8355	Peter Loc	225	1 9.4.2.219	92	43	T	Y	92.43 9.4.2.219	It's not stated clearly that the HE-STAs joining the HE-BSS are required to support the HE-MCS indicated in the Basic HE-MCS and NSS Set for both Rx and Tx. For UL OFDMA and UL MU MIMO, it should be a requirement that HE STAs support the HE-MCS as indicated in the basic HE-MCS and NSS Set for receiving and transmitting.	Modify the statement on lines 43-44: The Basic HE MCS And NSS Set field indicates the HE-MCSs for each number of spatial streams in HE PPDUs that are supported by all HE STAs in the BSS (including IBSS and MBSS) in both Tx and Rx	2017/1/9 9:42
8356	Peter Loc	225	1 27.16.2	206	35	T	Y	206.35 27.16.2	The transition period after the AP transmits an announcement frame for BSS color change until the new BSS color takes effect could be very long, especially for STAs that are in sleep mode and STAs that are in the process of joining the existing BSS. Need to devise a scheme to minimize the potential problems that may arise during the long transitional time to handle newly associated STAs that are just associated with the AP using the existing BSS color.	What suggested here is just a temporary solution. A more detailed procedure should be developed to alleviate the problems mentioned. Modify the paragraph on line 43-45 as follows: "During the time leading up to the BSS Color change TBTT, an HE AP shall continue to advertise the existing BSS Color via the BSS Color subfield in HE Operation element with an indication that this BSS color is to be changed at the BSS color TBTT"	2017/1/9 9:42
8357	Peter Loc	225	1 28.1.1	209	51	T	N	209.51 28.1.1	HE PHY does not support only data field OFDM symbol of 12.8 us. It also supports data symbol of 4 us.	Change "The HE PHY supports a single Data field OFDM symbol duration of 12.8 ++s (excluding guard interval)." to "In addition to supporting the legacy OFDM data symbols of 3.2 us, HE-PHY also supports OFDM data symbol of 12.8 us (excluding guard interval).	2017/1/9 9:42
8358	Peter Loc	225	1 27.2.1	149	43	T	Y	149.43 27.2.1	The STA that receives a control frame without the TA for the first time does not know if the RA matches the saved TXOP holder address for the BSS to which it is associated. In fact, most STAs do not have the knowledge of whether the RA in the received frame is in the same BSS or not.	Modify the paragraph on lines 43-44 to the following: "The frame is a control frame that does not have a TA field and the RA matches the BSSID for the BSS to which it is associated".	2017/1/9 9:42
8359	Peter Loc	225	1 28.1.1	210	1	T	N	210.01 28.1.1	The statement "A non-AP STA is inclusive of a 20 MHz-only non-AP STA." is redundant. As already stated in 28.1.1, an HE STA is required to comply to clause 19 stated on lines 14-17 or clause 19 stated on lines 18-19.	Remove this line.	2017/1/9 9:42
8360	Peter Loc	225	1 28.3.3.6	238	7	G	Y	238.07 28.3.3.6	The statement "Only a non-AP HE STA can be a 20 MHz-only STA." is redundant. This draft standard is for HE devices, there is no need to add this trivial statement.	Remove "Only a non-AP HE STA can be a 20 MHz-only STA."	2017/1/9 9:42
8361	Peter Loc	225	1 28.1.1	211	59	G	N	211.59 28.1.1	"Maximum" and "at least" are contradictory.	Same paragraph but the word maximum is removed. (Responding with the requested beamforming feedback in an HE sounding procedure with the number of space-time streams in the HE NDP that the non-AP STA can respond to being at least 4)	2017/1/9 9:42
8362	Po-Kai Huang	225	1 3.2	5	9	E	N	5.09 3.2	Additional f)	Delete Additional f)	2017/1/9 9:42
8363	Po-Kai Huang	225	1 3.2	5	13	E	N	5.13 3.2	Additional g)	Delete Additional g)	2017/1/9 9:42
8364	Po-Kai Huang	225	1 4.3.13a	9	43	T	N	9.43 4.3.13a	The condition "Optional support for 1024-QAM on 242-, 484- and 996-tone Rus" seems to be covered by the condition "Optional support for HE-MCSs 10 and 11". The reason is that HE-MCSs 10 and 11 is basically 1024-QAM modulation based on the table in 28.5.	Replace the two sentences with "Optional support for 1024-QAM"	2017/1/9 9:42
8365	Po-Kai Huang	225	1 4.3.13a	9	60	E	N	9.60 4.3.13a	A term MU OFDMA is used in this section. Technically, OFDMA already signals a multi-user version of OFDM. Adding additional "MU" seems not to add further information	Delete "MU" in MU OFDMA.	2017/1/9 9:42

8366	Po-Kai Huang	225	1 6.3.27	13	56	T	N	13.56 6.3.27	It seems that HE Capabilities is also required in MLME-DLS.confirm because HT and VHT Capabilities are also included in MLME-DLS.confirm	Add HE Capabilities in MLME-DLS.confirm	2017/1/9 9:42
8367	Po-Kai Huang	225	1 9.2.4.1.8	19	40	T	N	19.40 9.2.4.1.8	There are two issues for the sentence "An HE AP indicates that it can set the More Data subfield to 1 by setting the More Data Ack subfield to 1 in the QoS Info field of frames it transmits." First, in 9.4.1.17, there are description saying that More Data Ack subfield is reserved for AP. Hence, the description in 9.4.1.17 contradicts with the description in 9.2.4.1.8. Second, the sentence seems to contradict with the meaning of More Data Ack subfield becuase in 9.4.1.17, it mentions that setting the More Data Ack subfield to 1 indicates that a STA can process Ack frames with the More Data bit in the Frame Control field equal to 1 and remain in the awake state.	Delete the sentence "An HE AP indicates that it can set the More Data subfield to 1 by setting the More Data Ack subfield to 1 in the QoS Info field of frames it transmits."	2017/1/9 9:42
8368	Po-Kai Huang	225	1 9.2.4.1.8	19	47	T	N	19.47 9.2.4.1.8	For the sentence "An HE TDLS peer STA indicates that it can set the More Data subfield to 1 by setting the More Data Ack subfield to 1 in the QoS Capability element it transmits," it seems that the sentence contradicts with the meaning of More Data Ack subfield becuase in 9.4.1.17, it mentions that setting the More Data Ack subfield to 1 indicates that a STA can process Ack frames with the More Data bit in the Frame Control field equal to 1 and remain in the awake state.	Delete the sentence "An HE TDLS peer STA indicates that it can set the More Data subfield to 1 by setting the More Data Ack subfield to 1 in the QoS Capability element it transmits."	2017/1/9 9:42
8369	Po-Kai Huang	225	1 9.2.4.6.4.4	25	16	T	N	25.16 9.2.4.6.4.4	There are 9 reserved bits for HE link adaptation. It is unclear why we need so many reserved bits. The issue of many reserved bits is that it will prevent aggregation of multiple control information and increase unnecessary overhead.	Reduce the number of reserved bits for HE link adaptation.	2017/1/9 9:42
8370	Po-Kai Huang	225	1 Contents	9	59	E	N	9.59 Contents	There are list for 9.2.4.6.4.7Bandwidth Query Report (BQR) and 9.2.4.6.4.8Reverse direction protocol (RDP), but there are no list for other types of A-control information	List all the types of A-control information.	2017/1/9 9:42
8371	Po-Kai Huang	225	1 9.2.4.6.4.6	27	19	E	N	27.19 9.2.4.6.4.6	The reference to Power pre-correction is wrong	Correct the reference to section of power pre-correction.	2017/1/9 9:42
8372	Po-Kai Huang	225	1 9.2.4.6.4.7	27	47	E	N	27.47 9.2.4.6.4.7	It seems that there are duplicate "HE" in description "HE DL HE MU transmission"	Simply use "HE DL MU transmission."	2017/1/9 9:42
8373	Po-Kai Huang	225	1 9.2.4.6.4.7	27	63	E	N	27.63 9.2.4.6.4.7	It seems that the descriptio "Bandwidth Query Report used for bandwidth query report operation to assist DL HE MU transmission (see 25.5.1.3. (Bandwidth query report operation)." is already covered by the description "Bandwidth Query Report used for Bandwidth Query report operation to assist HE DL HE MU transmission (see 27.5.1.3 (HE bandwidth query report operation for DL MU))"	Delete "Bandwidth Query Report used for bandwidth query report operation to assist DL HE MU transmission (see 25.5.1.3. (Bandwidth query report operation)."	2017/1/9 9:42
8374	Po-Kai Huang	225	1 9.2.4.6.4.7	28	6	T	N	28.06 9.2.4.6.4.7	It is not clear what does the first row of Table 9-18d represent. The bandwidth shall be the operating bandwidth of the STA.	Add "based on the operating bandwidth of the STA" at the end of "The Available Channel Bitmap subfield encoding is defined in Table 9-18d (Available Channel Bitmap subfield encoding)."	2017/1/9 9:42
8375	Po-Kai Huang	225	1 9.2.4.6.4.8	28	60	T	N	28.60 9.2.4.6.4.8	RDP Trigger frame is not defined anywhere in the spec. The term Trigger frame may also be misleading because the response from RDP responder is not carried in HE TB PPDU.	Simply use "for the RDP" and delete "Trigger frame."	2017/1/9 9:42
8376	Po-Kai Huang	225	1 9.3.1.23	41	47	E	N	41.47 9.3.1.23	There is a redundant parenthesis in RA field	Remoe the parenthesis in RA field.	2017/1/9 9:42
8377	Po-Kai Huang	225	1 9.3.1.23	42	7	E	N	42.07 9.3.1.23	There should be a space between "GI" and "And" in Figure 9-52d	Add space between "GI" and "And" in Figure 9-52d	2017/1/9 9:42
8378	Po-Kai Huang	225	1 9.3.1.23	44	49	E	N	44.49 9.3.1.23	In table 9-25e, it should be "Values 0 to 60".	Change "Values 0 to 61" to "Values 0 to 60".	2017/1/9 9:42

8379 Po-Kai Huang	225	1 9.3.1.23.1	48	41	T	N	48.41 9.3.1.23.1	There is no Table 8-159 in REVmc_D8.0	Correct the reference to minimum MPDU start spacing.	2017/1/9 9:42
8380 Po-Kai Huang	225	1 9.3.1.23.3	50	1	T	N	50.01 9.3.1.23.3	Currently, MU-BAR is the only variant of Trigger frames with variable length of User Info field due to variable length of BAR information. We see two issues for the current design with variable length of User Info field. First, STA needs to parse every BAR control to figure out the length even if STA does not support certain types of BAR request (ex multi-TID BAR variant). Second, In the future, if additional BAR variant is added, then legacy HE STA may not be able to parse the MU-BAR with the new BAR variant. This introduces backward compatibility issue.	Two options to address the issue. Option 1: Add a length field in Trigger dependent User Info field of MU-BAR to indicate the length of BAR control and BAR Info. Option 2: Add length field in Trigger dependent Common Info field of MU-BAR to indicate the length of the User Info field. Each User info field is padded to the indicated length if required.	2017/1/9 9:42
8381 Po-Kai Huang	225	1 9.4.2.218.3	81	8	T	N	81.08 9.4.2.218.3	Currently STBC capability if enabled would need to be supported over all BWs. STBC processing for 160MHz channels results in extra Si cost and value of using STBC in 160MHz is low and negligible. There should be a capability bit for Tx/Rx STBC with 160 MHz, so this cost is not needed for every STA supporting STBC.	Change "STBC Tx and Rx" to "STBC Tx and Rx for PPDU with bandwidth smaller than or equal to 80MHz." Add a new field with two bits at the end for "STBC Tx and Rx for PPDU with bandwidth equal to 160 MHz"	2017/1/9 9:42
8382 Po-Kai Huang	225	1 27.4.4.2	160	54	E	N	160.54 27.4.4.2	There is no section 10.3.2.11.2 in Draft 1.0	Fix the reference to MU Acknowledgement procedure	2017/1/9 9:42
8383 Po-Kai Huang	225	1 27.4.4.4	161	38	E	N	161.38 27.4.4.4	There is no section 10.3.2.11.4 in Draft 1.0	Fix the reference to MU Acknowledgement procedure	2017/1/9 9:42
8384 Po-Kai Huang	225	1 27.4.4.3	161	13	E	N	161.13 27.4.4.3	There is no section 10.3.2.11.3 in Draft 1.0	Fix the reference to MU Acknowledgement procedure	2017/1/9 9:42
8385 Po-Kai Huang	225	1 27.4.4.5	162	6	E	N	162.06 27.4.4.5	There is no section 10.3.2.11.4 in Draft 1.0	Fix the reference to MU Acknowledgement procedure	2017/1/9 9:42
8386 Po-Kai Huang	225	1 10.3.2.10.2	119	21	T	N	119.21 10.3.2.10.2	The title of 10.3.2.10.2 is misleading. It is obvioius that the section talks about HE MU PPDU, but the title uses the term "DL MU PPDU" which includes VHT MU PPDU.	Change the title of 10.3.2.10.2 to Acknowledgement procedure for HE MU PPDU in MU format	2017/1/9 9:42
8387 Po-Kai Huang	225	1 9.2.4.5.4	20	44	E	N	20.44 9.2.4.5.4	There is no section 10.3.2.11.2 in Draft 1.0. It seems that all the reference to MU acknowledgement procedure is broken.	Fix the reference to MU Acknowledgement procedure	2017/1/9 9:42
8388 Po-Kai Huang	225	1 9.4.2.218.2	76	42	T	N	76.42 9.4.2.218.2	Currently, the 32 bit BA Bitmap support capability bit is written as a capability bit for reception of 32 bit BA bitmap in Table 9-262z. However, it is generally agreed that 32 bit BA Bitmap is an option feature. Hence, 32 bit BA Bitmap should be an optional feature for transmission as well.	Two options. Option 1: Change description of Bit 21 to 32 bit BA Bitmap Support Rx. Add one capability bit in reserved field for 32 bit BA Bitmap Tx. Option 2: Change description of Bit 21 to 32 bit BA Bitmap Support Tx & Rx. Change the description in Table 9-262z correspondingly.	2017/1/9 9:42
8389 Po-Kai Huang	225	1 27.5.2.6	172	35	T	N	172.35 27.5.2.6	An HE AP may transmit a Basic Trigger frame or a BSRP Trigger frame that contains one or more RUs for random access. However, a STA only maintains one counter for OFDMA random access. Assume the same system behavior for two different types of solicitation is awkward. Specifically, a STA that intends to transmit data to AP may get its chance at the slot of BSR random access allocation and needs to backoff again.	Make clear separation between operation of regular random access allocations and BSR random access allocations by separating into two backoff counters for OFDMA random access based on trigger type.	2017/1/9 9:42
8390 Po-Kai Huang	225	1 3.2	29	4	E	N	29.04 3.2	Add definition for S-MPDU	Add definition for S-MPDU	2017/1/9 9:42

8391	Po-Kai Huang	225	1 27.4.4.3	161	8	T	N	161.08 27.4.4.3	In 27.4.4.3 DL MU PPDU soliciting an HE trigger-based PPDU response, it is not clear if the DL MU PPDU includes VHT MU PPDU.	Two suggested options to resolve the comment: If the answer is no, change the title to "HE DL MU PPDU soliciting an HE trigger-based PPDU response". Specify that trigger frame or UL MU response scheduling is not allowed in VHT MU PPDU. If the answer is yes, a sentence in the paragraph describes that "An Action frame in the DL MU PPDU is always responded with an HE trigger-based PPDU." This behavior contradicts with the description in Table 9-9--Ack Policy subfield in QoS Control field of QoS Data frames, where the content only allows DL HE MU PPDU to set MU Ack Policy. Change the following sentence "For a frame that is carried in a DL HE MU PPDU" in table 9-9 to "For a frame that is carried in a DL MU PPDU." Specify that trigger frame or UL MU response scheduling is allowed in VHT MU PPDU.		2017/1/9 9:42
8392	Po-Kai Huang	225	1 27.4.4	160	52	T	N	160.52 27.4.4	It will be worthwhile to clarify the definition of DL MU PPDU in this section. Specifically, does DL MU PPDU include VHT MU PPDU? It will also be worthwhile to clarify the definition of DL SU PPDU. Does DL SU PPDU mean any PPDU format from AP to one destination? Similarly it will be worthwhile to clarify the definition of SU PPDU. Is it PPDU with any format to a singl user?	Add the definition of DL MU PPDU, DL SU PPDU, and SU PPDU in Section 3.		2017/1/9 9:42
8393	Po-Kai Huang	225	1 27.10.4	193	58	T	N	193.58 27.10.4	Currently, it is required that Multi-STA Block Ack is used for response to multi-TID A-MPDU. However, if the receiver only receives one MPDU with EOF in the delimiter set to 1 due to error of receiving other MPDUs, and the A-MPDU is carried in VHT PPDU, then the receiver may treat the MPDU as VHT single MPDU and responds with Ack frame rather than Multi-STA Block Ack. Similarly, if the receiver only receives one MPDU carrying QoS Data with EOF in the delimiter set to 0 due to error of receiving other MPDUs, then the receiver may treat the MPDU as single TID and respond with Block Ack rather than Multi-STA Block Ack.	There are several options to resolve the ambiguity. Option 1: Have an indication to differentiate multi-TID A-MPDU from single TID A-MPDU or S-MPDU. The reserved bit in MPDU delimiter can be used for this purpose. Option 2: HE STA always responds Multi-STA Block Ack to A-MPDU sent from HE STA that supports Multi-STA Block Ack. Option 3: Relax the restriction that response to multi-TID A-MPDU shal be Multi-STA Block Ack and allow Ack and Block Ack. Add the condition that in multi-TID A-MPDU, there is only one MPDU that solicits Ack frame.		2017/1/9 9:42
8394	Po-Kai Huang	225	1 27.11.5	197	44	T	N	197.44 27.11.5	Based on the new response rule in 27.15.2, it is now possible that a TXOP responder transmits HE extended range PPDU. As a result, the setting rule of TXOP Duration field for the HE extended range PPDU response needs to be defined.	Add the setting rule when the TXOP responder transmits HE extended range PPDU. The rule can just aligns with the setting rule when TXOP responders transmits HE TB PPDU.		2017/1/9 9:42
8395	Po-Kai Huang	225	1 9.3.1.23.6	51	40	T	N	51.40 9.3.1.23.6	GCR MU-BAR has variable length for Trigger dependent common info field due to variable length of BAR information field. As a result, in the future if additional BAR variant is added, a STA that supports GCR MU-BAR may not be able to decode User Info field. Ideally, a STA that does not support the new BAR vairant will not be included in the User Info field. However, this introduces additional checking logic except User Info field to check if a STA is solicited by different variant of Trigger frame.	Suggest to add a length field in Trigger dependent Common Info field of MU-BAR to indicate the length of BAR control and BAR Info.		2017/1/9 9:42
8396	Po-Kai Huang	225	1 9.3.1.23.4	50	43	T	N	50.43 9.3.1.23.4	Similar to section 9.3.1.23.2, 9.3.1.23.3, 9.3.1.23.5, and 9.3.1.23.7, change the note related to Trigger Dependent Common Info field and Trigger Dependent User Info field to description.	As in comment		2017/1/9 9:42
8397	Po-Kai Huang	225	1 9.3.1.23.4	50	64	E	N	50.64 9.3.1.23.4	Similar to the description in 9.3.1.23, organize the description of RU allocation field at the end of the section with itemized list.	As in comment		2017/1/9 9:42

8398	Po-Kai Huang	225	1 9.4.1.62	57	46	T	N	57.46 9.4.1.62	The description of Sounding Dialog Token Number in Table 9-76a is for RU End Index.	Fix the description for Sounding Dialog Token Number.	2017/1/9 9:42
8399	Po-Kai Huang	225	1 9.4.2.218.2	70	42	T	N	70.42 9.4.2.218.2	Description for Maximum A-MPDU Length Exponent is empty. Understand that there are corresponding descriptions after the table, but it is weird that the table is empty.	Fill in the description.	2017/1/9 9:42
8400	Po-Kai Huang	225	1 9.4.2.219	91	39	T	N	91.39 9.4.2.219	There are two paragraphs for the description of BSS Color field.	Merge these two paragraphs into one paragraph for the descriptions of AP.	2017/1/9 9:42
8401	Po-Kai Huang	225	1 27.10.4	193	47	T	N	193.47 27.10.4	11ax introduces new EOF setting rule. However, the EOF setting rule in 10.13.7 and table 9-422 in 9.7.1 is not changed correspondingly.	Make sure that the description for EOF setting in 10.13.7 and Talbe 9-422 are consistent with the new EOF setting rule added in 27.10.4.	2017/1/9 9:42
8402	Po-Kai Huang	225	1 27.2.2	150	59	T	N	150.59 27.2.2	The fourth bullet for the setting of Intra-BSS NAV with the duration information is a conditional bullet that is only reuqired if the STA is a TXOP holder. The concept is there, but the description may need be revised for clear presentation.	Several option for better presentation. Option 1: Have two set of descriptions: one for the STA that is a TXOP holder. One for the STA that is not a TXOP holder. Option 2: Add note or description to clarify that the fourth bullet is a conditional bullet that is only required for checking when the STA is a TXOP holder.	2017/1/9 9:42
8403	Po-Kai Huang	225	1 27.2.2	150	58	T	N	150.58 27.2.2	The thrid bullet for the setting of Intra-BSS NAV with the duration information may need to be revised. Specficially, it is possible that a STA that is solicited by the Trigger frame does not respond to the Trigger frame. If the Trigger frame solicits a long transmission, then the STA may contend and transmit later and hurt the reception of UL MU transmissoin.	Revise the rule such that a HE STA always set NAV when receives a Trigger frame regardless of being solicited for response or not.	2017/1/9 9:42
8404	Po-Kai Huang	225	1 9.7.1	107	1	T	N	107.01 9.7.1	The MPDU Length field is used by HE PPDU as well. However, there is no corresponding description in equaltion 9-5.	Add the description for HE PPDU in equation 9-5.	2017/1/9 9:42
8405	Po-Kai Huang	225	1 9.7.3	107	30	E	N	107.30 9.7.3	It should be HE_EXT_SU rather than HE_EXT.	Fix the error.	2017/1/9 9:42
8406	Po-Kai Huang	225	1 9.7.3	107	35	T	N	107.35 9.7.3	Can Multi-TID be used in A-MPDU carried in non-HE PPDU such as VHT PPDU, HT PPDU, and non-HT PPDU? From the sentence, it may be implied that the restriction exists.	Directly specify if multi-TID A-MPDU can be carried in non-HE PPDU. From commenter's point of view, the answer is yes as long as the recipient supports multi-TID A-MPDU.	2017/1/9 9:42
8407	Po-Kai Huang	225	1 9.7.3	108	7	T	N	108.07 9.7.3	The underlined sentence does not exclude the cast that HE MU PPDU solicits one immediate response not carried in an HE trigger-based PPDU and solicits one immediate response carried in an HE trigger-based PPDU.	Add descriptions to exclude the case.	2017/1/9 9:42
8408	Po-Kai Huang	225	1 9.7.3	110	38	T	N	110.38 9.7.3	In Table 9-425, there is a description for Ack Policy equal to Ack requrest. However, in table 9-9, there is no description for Ack policy equal to "Ack request". Is Ack request a new policy or should it be revised as normal Ack? Same comment for the description in Note 1.	Clarify what is Ack policy equal to Ack request.	2017/1/9 9:42
8409	Po-Kai Huang	225	1 9.7.3	111	45	T	N	111.45 9.7.3	It should be "One Ack or Block Ack frame is ..." for the description of no HE BSS.	Revise the sentence as suggested by the comment.	2017/1/9 9:42
8410	Po-Kai Huang	225	1 10.3.2.8a.3	117	29	T	N	117.29 10.3.2.8a.3	The fourth bullet of the condition for responding to MU-RTS is covered by the second bullet.	Combine fourth bullet and second bullet.	2017/1/9 9:42
8411	Po-Kai Huang	225	1 10.3.2.8a.3	117	21	T	N	117.21 10.3.2.8a.3	The description of ED-based CCA and virtual CS in the second bullet of the condition for responding to MU-RTS seems to be redundant because the UL MU CS section has already included ED-based CCA and virtual CS.	Remove the description of ED-based CCA and virtual CS or turn the description of ED-based CCA and virtual CS to a note.	2017/1/9 9:42
8412	Po-Kai Huang	225	1 10.3.2.10.2	119	24	T	N	119.24 10.3.2.10.2	The description "defined by the UL trigger information" seems to be redundant. Further, there is really no specific definition for UL trigger information.	delete the description "defined by the UL trigger information". Similarly, Figure 10-12a should be reivsed.	2017/1/9 9:42
8413	Po-Kai Huang	225	1 10.3.2.10.3	120	2	T	N	120.02 10.3.2.10.3	For the format allowed for Multi-STA BA, can we just say Multi-STA BA transmission are allowed in any PPDU format except HE TB PPDU? It seems that this is the intention.	Revised as in comment.	2017/1/9 9:42
8414	Po-Kai Huang	225	1 10.3.2.10.3	120	5	T	N	120.05 10.3.2.10.3	The OFDMA part in OFDMA HE MU PPDU is redundant.	Remove OFDMA from OFDMA HE MU PPDU.	2017/1/9 9:42

8415 Po-Kai Huang	225	1 9.3.1.23	42	16	T	N	42.16 9.3.1.23	It is possible that AP may not have enough time to decode multiple responses, which can be up to 32-36 responses, to Trigger frame simultaneously and continue the following transmission in SIFS. AP can choose to separate the Trigger process to Multiple Trigger frame, but this will then increase the overhead.	Add a field called required MAC padding duration in Trigger Dependent Common Info every variant of Trigger frame except MU-RTS. A STA that receives the field must have MAC padding larger than or equal to the indicated required MAC padding duration. As a result, AP can have enough time. Add description that AP should make sure that STA has enough time to include the required response such as BSR.		2017/1/9 9:42
8416 Robert Stacey	225	1 9.4.2.218.3	83	40	T	Y	83.40 9.4.2.218.3	No "Doppler procedure" has been defined so it is not possible to determine how this bit should be set.	Return bit to the pool of reserved bits		2017/1/9 9:42
8417 Robert Stacey	225	1 28.2.2	223	51	T	Y	223.51 28.2.2	What is "the doppler effect" and how should it be considered? The spec does not define such an effect and there is no text defining a) how this a prameter should be set and b) what the PHY does with this parameter	Remove the DOPPLER parameter from Table 28-1		2017/1/9 9:42
8418 Robert Stacey	225	1 28.3.10.7.2	275	33	T	Y	275.33 28.3.10.7.2	What is "Doppler mode"? Such a mode is not defined and thus it is not possible to determine how this bit is set	Return bit to the pool of reserved bits		2017/1/9 9:42
8419 Robert Stacey	225	1 28.3.10.7.2	277	35	T	Y	277.35 28.3.10.7.2	What is "Doppler mode"? Such a mode is not defined and thus it is not possible to determine how this bit is set	Return bit to the pool of reserved bits		2017/1/9 9:42
8420 Robert Stacey	225	1 9.3.1.23	45	11	T	Y	45.11 9.3.1.23	What is a "high doppler mode of transmission" and why does this need to be indicated in the Trigger frame? There is no corresponding field in the HE trigger-based PPDU so nothing to set there.	Remove Doppler field from the Common Info field		2017/1/9 9:42
8421 Robert Stacey	225	1 27.16.3	207	1	T	Y	207.01 27.16.3	The QPT procedure is incomplete. It appears to be a frame exchange between a station and the AP that performs no function. From the name it appears to require that some undefined set of STAs not transmit for a certain amount of time. How a STA determines it is part of this set is not defined. What the AP does as a result of a setup exchange is not defined either.	Remove feature by deleting 9.4.2.223-225 and 27.16.3		2017/1/9 9:42
8422 Robert Stacey	225	1	80	10	T	Y	80.10	The QPT Support capability is not clear. QPT operation is not defined.	Remove the QPT Support field		2017/1/9 9:42
8423 Robert Stacey	225	1 10.43.1	138	6	T	N	138.06 10.43.1	"= don't care": if it's a don't care why mention the the field?	Change to "Request TWT, Suggest TWT or Demand TWT"		2017/1/9 9:42
8424 Robert Stacey	225	1 10.43.1	137	55	E	N	137.55 10.43.1	Markup on Table 10-19a is unnecessary since editing instruciton is "insert"	Remove markup		2017/1/9 9:42
8425 Robert Stacey	225	1 10.43.1	137	59	T	N	137.59 10.43.1	The first row after the heading row in Table 10-19a appears to be part of the heading. However, the relationship between the first heading row and this row is not clear.	Clarify menaing of first body row in table		2017/1/9 9:42
8426 Robert Stacey	225	1 9.2.4.6.4.5	25	34	T	Y	25.34 9.2.4.6.4.5	The two methods for reporting queue size (Queue Size field in QoS Data and BSR A-Control) are not compatible with each other. The Queue Size in QoS Data is reported per TID while Queue Size in BSR A-Control is reported per AC. An AP collecting Queue Size per TID would not know how to partition the BSR information (since it is the sum of the queue size for two TIDs). An AP that collects queue size per AC may make inaccurate allocations to STAs that do not support multi-TID aggregation or if the AP itself cannot receive multi-TID A-MPDUs.	Change the BSR so that it either reports queue size per TID or simplify it so that it just indicates which Acs have traffic.		2017/1/9 9:42

8427 Robert Stacey	225	1 9.2.4.6.4.5	25	34	T	Y	25.34 9.2.4.6.4.5	The BSR is poorly designed. Its only purpose is to report queue state for traffic not in the current aggregate (since queue size in QoS Control can do it for traffic in the aggregate). Even so, it is not strictly necessary since that status could be collected through multi-TID aggregation or through a separate access. It is not compatible with queue size reported in QoS Control since it reports per AC and has a queue size range that different from queue size in QoS Control.	Redesign BSR so that it reports queue size in a manner compatible with queue size in QoS Control. Say 3 fields of 8-bits representing the queue sizes of TIDs in each of the ACs not represeted by the TID of the QoS Data frame carrying the BSR. Queue size reported in a manner compatible with queue size in QoS Control (units of 256 octets). The TIDs reported in sets: say {1, 0, 4, 6} and {2, 3, 5, 7}, so that if the QoS Data frame is for a TID in set 1 the queue size for other TIDs are in set 1.		2017/1/9 9:42
8428 Robert Stacey	225	1 28.3.16	344	33	T	N	344.33 28.3.16	Either the HE NDP PPDU is a distinct PPDU format or it isn't. If it is a distinct format it should be listed with the other formats in 28.3.4. If it is a special case of the HE SU PPDU then just describe it as such (in 28.3.4). During the comment period we had it then we removed it then we added it again but in a different place. Let's decide.	Remove clause 28.3.16. Add a sentence to 28.3.4 (PPDU formates): "The HE NDP PPDU is an HE SU PPDU with a zero length Data field and a 4 us Packet Extension field"		2017/1/9 9:42
8429 Robert Stacey	225	1 9.4.2.218.2	80	4	T	N	80.04 9.4.2.218.2	The BSRP A-MPDU Aggregation capability is unclear. What does it mean for a STA to accept a BSRP Trigger frame? If the software doesn't crash does that constitute acceptance? What exactly is the condition for setting the field? The STA must be able to "accept" the BSRP Trigger frame when it is aggregated with at least one control frame AND at least one Data frame and at least one Management frame? What if it "accepts" the BSRP Trigger frame but only in a S-MPDU. Or Only if aggregated with data (not control and nt management)?	Clarify the conditions for indicating support		2017/1/9 9:42
8430 Robert Stacey	225	1 9.4.2.218.2	80	17	E	N	80.17 9.4.2.218.2	(A-)MPDU: the bracketed (A-) is unnecessary. The A-Control field is present in an A-MPDU by virtue of being present in an MPDU. It doesn't appear in an A-MPDU withing being in an MPDU.	Remove "(A-)"		2017/1/9 9:42
8431 Robert Stacey	225	1 9.4.2.218.2	80	16	T	N	80.16 9.4.2.218.2	Why do we need to signal a capability for generating a BQR? If a STA is capable of generating a BQR it could just generate one. We don't have capability settings for all the things STAs are capable of generating. Why is this one special?	Remove reference to non-AP STA usage. Change to "Indicates that the AP is will use information in the BQR A-Control subfied when scheduling STAs for UL operation"		2017/1/9 9:42
8432 Robert Stacey	225	1 27.4	157	16	T	Y	157.16 27.4	The Block Acknowledgement subclause is poorly written. The overview section should provide an overview and define the relationship to HT-immediate block ack.	Introduce the block ack extensions in the overview (or intro) subclause. Give the new procedure a name (e.g., HE-immendiate block ack). Ennumerate the extnesions (e.g., An HE extension to the block ack feature, called HE-immeidate block ack, is defined in 27.4.2, 27.4.3 and 27.4.4. HE-immeidate block ack builds on the features defined for HT-immediate block ack, with the following extensiosn: 1) Support for a Multi-STA BlockAck frame, 2) Support for a Multi-STA BlockAckReq (MU-BAR), 3) Additional options for the block ack scoreboard size, ...". Move the requirements into the subsequent subclauses.		2017/1/9 9:42

8433	Robert Stacey	225	1 10.5	122	31	T	N	122.31 10.5	The term "static fragmention" is not descriptive of the characteristic being descibed. It is not the whole procedure that is different, it is just the requirement for each fragment having the same number of octets that changes.	Name the charactreristic not the procedure: uniformly fragmented MSDU or MMPDU and non-uniformly fragmented MSDU or MMPDU. Since we are now defining a term, remove all the "shalls". The shalls apply to the implementation so we make an additional shall statement against the STA once the term has been defined. Change to read: "With a uniformly fragmented MSDU or MMPDU, the length of each fragment consists of an equal number of octets for all fragments except the last, which may be smaller. The length of each fragment is an even number of octets, except the last fragment, which may be either an even or an odd numver of octets. The length of each fragment is never larger than dot11FragmentationThreshold unless security encapsulation is invoked for the MPDU. If security encapsulation is invoked for the MPDU, then the MPDU shall be expanded	2017/1/9 9:42
8434	Robert Stacey	225	1 27.3.1	152	41	T	N	152.41 27.3.1	"An HE STA supports the static fragmentation procedure...". The procedure that is supported by an HE STA is the fragmentation procedure, not the static fragmentation procedure. What is called "static fragmetnation" is just a small part of that procedure (i.e., the genreation of uniformly sized fragments).	Change to read "An HE STA supports the fragmentation procedure defined in 10.2.7, ,,,"	2017/1/9 9:42
8435	Robert Stacey	225	1 27.3.2	152	55	T	N	152.55 27.3.2	In 10.5 there is a statement referencing conditions defined in 27.3.2 that need to be met. The single paragraph in 27.3.2 is a mixture of conditions, a statement permitting fragmentation of A-MSDUs and a procedure for fragmenting where the length of each fragment is not uniform. Separate the conditions from the other statements.	Define a non-uniformly fragmentated MSDU, A-MSDU or MMPDU: "With a non-uniformly fragmented MSDU, A-MSDU or MMPDU, the length of each fragment is not necessarily the same. The length of the first fragment is greater than or equal to the minimum fragment size indicated in the Minimum Fragment Size subfield of the HE Capabilities Information field in the HE Capabilities element sent by the recipient STA. If the length of the MSDU, A-MSDU or MMPDU is less than the minimum fragment size, then the MSDU, A-MSDU or MMPDU is not fragmented." And then define the conditions under which it can be used: "An HE STA may non-uniformly fragment an MSDU, A-MSDU or MMPDU provided the following conditions are met: 1) The recipient STA has indicated support for level 1, level 2 or level 3 fragmentation in the HE Fragmentation Support	2017/1/9 9:42
8436	Robert Stacey	225	1 27.3	152	36	T	N	152.36 27.3	The new fragmentation procedure is poorly written and needs some structure.	Structure 27.3 as follows. An introductory subclause that defines how the existing procedure applies and what is new (non-uniformly fragmented MSDUs and MMPDUs, fragmetation of an A-MSDU, fragmentation under a block ack agreement). Then define the conditions under which the new procedures apply. Then define the new procedures.	2017/1/9 9:42

8437 Robert Stacey	225	1 27.3.3.1	153	16	T	N	153.16 27.3.3.1	Statement does not make sense. "transmitting an MPDU or A-MPDU": sending an A-MPDU that does not contain a MPDU is silly. A fragment is an MPDU by definition (see REVmc/D8.0 P1306L44) so an MPDU cannot contain a fragment. "Shall solicit an immediate response" is incomplete. What is the immediate response? My jokes solicit an immediate reponse, usually a groan. "For each of the fragments in the MPDU" is non-sensisical since a fragment is an MPDU and it is the MSDU, A-MSDU or MMPDU that is in multiple pieces. How does the STA do the soliciting? If I've fragmented an Action No Ack and what to send it? Is it no longer possible to send it or do I just need to use a different procedure?	Fix		2017/1/9 9:42
8438 Robert Stacey	225	1 27.3.3.1	153	22	T	N	153.22 27.3.3.1	"A STA shall not transmit a fragment containing all or part of an A-MSDU". By definition, a fragment contains a "portion of an MSDU, A-MSDU or MMPDU" (see P152L55). The constraint on A-MSDU size in Table 9-19 applies to the A-MSDU not the fragment. So the statement is unncessary (the fragment can never be bigger than the A-MSDU).	Delete paragraph "A STA shall not transmit a fragment..."		2017/1/9 9:42
8439 Robert Stacey	225	1 27.3.3.1	153	26	T	N	153.26 27.3.3.1	The NOTE is unrelated to any of the nearby text and simple makes a reference to another statement elsewhere	Delete NOTE		2017/1/9 9:42
8440 Robert Stacey	225	1 27.3.3.1	153	29	T	N	153.29 27.3.3.1	"receive explicit indications in response frames" is way too vague. Under level 1, fragments solicit an Ack frame and "explicit indications of none received" is not posible. Under level 2, fragments are sent in order and it is not possible to send more than one fragment of an MSDU, A-MSDU or MMPDU at a time. So the statement can be reformulated to apply to the first fragment since it can never happen that a later fragment is sent without an earlier fragment being ACK'ed. Also, under level 2 you can go further. not only can you retransmit the full MSDU, A-MSDU or MMPDU, you can refragment differently. Under level 3 it is possible for fragments to be delivered out of order. Given the big differences beween the fragmentation levels as it related to refragmentation it makes sense to have separate statements for each.	Remove the statement (and NOTE) from the General subclause and add a level-specific statement to the level 2 subclause and level 3 subclause. No statement is needed in the level 1 subclause since the condition doesn't apply. The satement for the level 2 subclause only needs to reference the first fragment: "If a BlockAck frame is received in response to an A-MPDU that carries the first fragment of a MSDU, A-MSDU or MMPDU and the BlockAck frame indicates that the fragment was not received, then the MSDU, A-MSDU or MMPDU may be refragmented for retransmission." No additional statement about retransmitting the same fragment is needed since the only options are refragment or not refragment and not refragment is retransmit the same. For level 3, a more complex set of rules are needed.	2017/1/9 9:42
8441 Robert Stacey	225	1 27.3.3.1	153	41	T	Y	153.41 27.3.3.1	The statement prevents a legacy device from sending a fragment since the term dynamic fragment is so broadly defined ("A dynamic fragment is an MPDU, the payload of which carries a portion of an MSDU, A-MSDU or MMPDU"), that it covers what we consider a "legacy" fragment, too. I beleive the original author has conflated the terms dynamic fragment (the MPDU) and dynamic fragmentation (the procedures). But then the statement is circular: you shall not send a fragment using the dynamic fragmentation procedures unless you are using the dynamic fragmentation procedures.	Delete the statement. Alternatively, more accurately define "dynamic fragment". I believe that it would be better to call the thing that gets sent a "non-uniformly fragment MSDU, A-MSDU or MMPDU" (see previous comment regarding statement on P152L55). Then you can make a statement like: A STA shall not send a non-uniformly fragmented MSDU, A-MSDU or MMPDU unless it is following the procudures defined in 27.3.3.2, 27.3.3.3 or 27.3.3.4."		2017/1/9 9:42

8442 Robert Stacey	225	1 27.3.3.2	153	47	T	N	153.47 27.3.3.2	"not sent under a block ack agreement" is not compatible with baseline fragmentation. Should be "sent as a non-A-MPDU frame". Even if a block ack agreement is in place, the originator can fragment and send as long as the fragment is sent in a non-A-MPDU frame.	The only difference between the level 1 fragmentation and the baseline fragmentation procedure is the requirement on equal lengh fragments. Thus this section should reference the baseline procedure with that one exception. Delete content of subclause and replace with "An originator STA may transmit a non-uniformly fragmented MSDU, A-MSDU or MMPDU following the procedure defined in 10.2.7, 10.5 and 10.6 if the Fragmentation Support subfield in the HE MAC Capabilities Information field of the HE Capabilities element is 1." A non-uniformly fragmented MSDU, A-MSDU or MMPDU" should be defined (see previous comment regarding P152L55).		2017/1/9 9:42
8443 Robert Stacey	225	1 27.3.3.2	153	60	T	N	153.60 27.3.3.2	The value of level 1 signaling in the block ack agreement is questionable. Level 1 is supported without a block ack agreement (provided the recipient has indicated level 1 support in its HE Capabilities element). Why should putting a block ack agreement in place disable it?	Remove level 1 negotiation from the block ack agreement.		2017/1/9 9:42
8444 Robert Stacey	225	1 27.3.3.2	154	1	T	N	154.01 27.3.3.2	This is a silly statement to make. Are there other ways to generate an S-MPDU?	Delete sentence		2017/1/9 9:42
8445 Robert Stacey	225	1 27.3.3.3	154	7	T	N	154.07 27.3.3.3	Level 2 fragmentation only makes sense if there is a block ack agreement in place.	Delete 1st paragraph of subclause.		2017/1/9 9:42
8446 Robert Stacey	225	1 27.3.3.3	154	26	T	N	154.26 27.3.3.3	This is a silly statement to make. Are there other ways to generate an S-MPDU?	Delete sentence. At best it should be a NOTE.		2017/1/9 9:42
8447 Robert Stacey	225	1 27.3.3.3	154	21	T	N	154.21 27.3.3.3	This long paragraph basically says you can send a fragment under level 2 fragmentation either as a non-A-MPDU frame or in an A-MPDU. Sending fragments as a non-A-MPDU frame is what level 1 fragmenation support provides. So level 2 fragementation is level 1 plus support for sending fragments in an A-MPDU. Describe it as such.	Change to read "With level 2 dynamic fragmentation, an HE STA may send a non-uniformally fragmented MSDU, A-MSDU or MMPDU to a STA that has the Fragmentation Support subfield of the HE MAC Capabilities field in the HE Capabilities element set to 2 or 3. The STA follows the procedure defined in 10.2.7, 10.5 and 10.6 for sending the fragment in a non-A-MPDU frame. In addition, the STA may send the fragment in a A-MPDU."		2017/1/9 9:42
8448 Robert Stacey	225	1 27.3.3.3	154	35	T	N	154.35 27.3.3.3	The rules for including fragments in an A-MPDU under level 2 fragemention are not defined. For example, there should be a rule preventing two fragments of the same MSDU being included. There should also be a rule that the next fragment can only be included once the previous fragment has been acknowledged.	Add the statement: "An originator STA shall not include more than one fragment of an MSDU, A-MSDU or MMPDU in an A-MPDU." Add the statement: "A fragment that is not the first fragment of an MSDU, A-MSDU or MMPDU shall only be sent if the previous fragment of the MSDU, A-MSDU or MMPDU has been acknowledged. NOTE--Fragments are sent in order of lowest fragment number to highest fragment number as defined in 10.5."		2017/1/9 9:42
8449 Robert Stacey	225	1 27.3.4.1	155	12	T	N	155.12 27.3.4.1	The fragmentation support nuances are not reflected in the MIB variable. The MIB variable is binary while the Fragment Support field has 4 values.	Delete the MIB variable or make it reflect the STA fragmentation capabilities.		2017/1/9 9:42
8450 Robert Stacey	225	1 27.3.4.1	155	12	T	N	155.12 27.3.4.1	Requiring consistent settings on the MIB variable and Fragmentation Support field is all good and well, but it is not sufficient. The STA has certain capabilities based on choices made by the implementer. A peer STA learns of these from the HE Capability element. A management station learns of these capabilities using the simple network management protocol ("reading the MIB"). So the setting of the HE Capabilities element and the setting of the "OptionImplemented" MIB objects must trace back to the implemented support.	Change the 1st paragraph to read: "An HE STA shall set the Fragmentation Support field in the HE MAC Capabilities Information field of the HE Capabilities element as follows: - Set to 1 if... - Set to 2 if ..., Set to 3 if ..., - Otherwise set to 0" Then add a subsequent paragraph: "An HE STA that sets Fragmentation Support field to 0 shall set the dot11HEDynamicFragmentationImplemented to false. Otherwise, the HE STA shall set the dot11HEDynamicFragmentaitonImplemented to true."		2017/1/9 9:42

8451	Robert Stacey	225	1 27.3.4.1	155	29	T	N	155.29 27.3.4.1	"of a number of outstanding MSDUs" is inconsistent with "The term outstanding refers to an MPDU that contains...". An MSDU is not an MPDU.	Fix	2017/1/9 9:42
8452	Robert Stacey	225	1 27.3.4.1	155	47	T	N	155.47 27.3.4.1	"all or part": by definition, a fragment contains part of an A-MSDU (see P152L55). Also, the requirement is not clear on whether the "of arbitrary length" applies to the fragment or the A-MSDU.	Change to read: "A STA that has dot11AMSDUFragmentationOptionImplemented true shall be capable of receiving a fragmented A-MSDU where the length of the A-MSDU is less than or equal to the maximum A-MSDU size as specified in Table 9-19 (Maximum data unit sizes (in octets) and durations (in microseconds))."	2017/1/9 9:42
8453	Robert Stacey	225	1 27.3.4.1	155	27	T	N	155.27 27.3.4.1	It is not clear how the Nmax requirement is applied. Are there two Nmax, one for MSDUs and one for MMPDUs? What about A-MSDUs? It seems that we really need a reserved buffer for MMPDUs otherwise outstanding MSDUs/A-MSDUs could block transmission of a critical MMPDU, or, at least, make delivery complicated by Nmax considerations (the STA could always send as a fragment burst). Also, there are really two requirements here: the implementation requirement and the cabability signaling requirement.	Break this into two separate requirements, an implementation requirement and a signaling requirement. Ensure that there is a always buffer space for a fragmented MMPDU. Change to read: "A recipient STA shall support the concurrent reassembly of Nmax outstanding fragmented MSDUs and A-MSDUs (if supported) from the same transmitting STA where Nmax is either in the set 1, 2, ..., 2^6 or is unlimited. A fragmented MSDU or A-MSDU is outstanding if delivery of the MSDU or A-MSDU has not yet been completed (i.e., the acknowledgment of the final fragment has not been received and the MSDU or A-MSDU has not been discarded due to retries, lifetime, or for some other reason). The recipient STA shall indicate Nmax in the Maximimum Number of Fragmented MSDUs subfield in the HE MAC Capabilities Information field in the HE Capabilities	2017/1/9 9:42
8454	Robert Stacey	225	1 27.3.4.2	155	56	T	N	155.56 27.3.4.2	The statement "MPDU or S-MPDU that carries one or more dynamic fragments" is non-sensical since a fragment is an MPDU per definition. We already have specific rules as to when an Ack frame is the appropriate response so this whole sentence is unnecessary.	Delete sentence.	2017/1/9 9:42
8455	Robert Stacey	225	1 27.3.4.2	155	58	T	N	155.58 27.3.4.2	There is no need to reference Ack frame and BlockAck frame response rules for fragments any more than there is a need to reference these rules for MPDUs that are not fragments. There are special rules for generating the block ack bitmap, but that belongs in the Block Acknowledgement subclause.	Delete sentence.	2017/1/9 9:42
8456	Robert Stacey	225	1 27.3.4.2	155	56	T	N	155.56 27.3.4.2	The statement "MPDU or A-MPDU that carries one or more dynamic fragments" is non-sensical since a fragment is an MPDU by definition. All the requirements in this subclause have to do with acknowledgement. The Ack frame rules for fragments in the first bullet are the same as the Ack frame rules for non-fragments and covered by the general rules for MPDU acknowledgement (nothing special happens if the MPDU is a fragment). There are special rules for handling the block ack bitmap related to fragmentation, but that belongs in the Block Acknowledgement subclause.	Delete the first paragraph.	2017/1/9 9:42
8457	Robert Stacey	225	1 27.3	152	36	E	N	152.36 27.3	To maintain consistency between the baseline procedures and the new Clause 27 procedures, reorganize subclause 27.3 (Fragmentation). The baseline refers to fragmentation for the "originator" procedure and defragmentation for the "recipient" procedure.	Change heading of 27.3 (Fragmentation) to "Fragmentation and defragmentation". Change the heading of subclause 27.3.3 (Procedure at the originator) to "Fragmentantation". Change the heading of subclause 27.3.4 (Procedure at the recipient) to "Defragmentation". Remove the heading 27.3.2 (Support and requirements for dynamic fragmentation) and combine content with 27.3.1 (General).	2017/1/9 9:42

8458	Robert Stacey	225	1 27.3.4.3	156	31	T	Y	156.31 27.3.4.3	Flushing the reassembly buffer of incomplete MSDUs, A-MSDUs and MMPDUs that will never be completed is more involved than simply comparing sequence numbers against BlockAckReq frame's starting sequence number. There are other ways in which the originator can indicate to the recipient that an MSDU will never complete. See the rules in 10.24.7.6.2 (Operation for each received Data frame) for flushing the reorder buffer on receipt of a QoS Data frame. Similar rules are needed for the reassmebly buffer.	Develop a comprehensize set of rules for flushing the reassembly buffer of incomplete MSDUs/A-MSDUs that will never be completed. For example, the originator can indicate that an MSDU with SN=x will never be completed (because the MSDU has been discarded) by sending a QoS Data frame with SN=x+WinSizeB.	2017/1/9 9:42
8459	Robert Stacey	225	1 27.4.1	157	21	T	N	157.21 27.4.1	"An HE STA can use ...": the conditions for Compressed BlockAck frame and Multi-STA BlockAck frame use are more elaborate than this. The statement carries no value.	Delete sentence.	2017/1/9 9:42
8460	Robert Stacey	225	1 27.4.1	157	22	T	N	157.22 27.4.1	"An HE STA shall support generation...if HT-immediate BA is supported...": An HE STA is an HT STA. HT-immediate block ack support is mandatory for an HT STA hence it is mandatory for an HE STA thus the "if HT-immediate..." condition is unecessary. Making the "generation" of a particular frame type mandatory is meanlingless. Frame types are "generated" to meet protocol requirements, for example, a Compressed BlockAck frame is sent in response to Compressed BlockAckReq frame so there is no need for a standalone statement on the generation of such frames. If a STA supports a protocol (such as HT-immediate block ack) it supports the generation of the frames required to implement that procotol. SImilarly, statements regarding the generation of Multi-STA BlockAck frame is unnecessary.	Delete 2nd and 3rd sentence of the first paragraph.	2017/1/9 9:42
8461	Robert Stacey	225	1 27.4.1	157	37	T	N	157.37 27.4.1	"An HE STA may send a Multi-STA BlockAck frame in response to an HE trigger-based PPDU." This statement is incomplete. It may do that but only if certain conditions are met and, in fact, it shall do that if those conditions are met. It cannot, for example, do that if the HE trigger-based PPDU carries frames a management frame of type Action No Ack.	Delete the first sentence: the conditions under which a Multi-STA BlockAck frame are transmitted need to be more explicitly stated.	2017/1/9 9:42
8462	Robert Stacey	225	1 27.4.1	157	37	T	N	157.37 27.4.1	"A Multi-STA BlockAck frame contains one or more...": the states are obvious from a glance at the frame format.	Delete the second sentence.	2017/1/9 9:42
8463	Robert Stacey	225	1 27.4.1	157	39	E	N	157.39 27.4.1	"... with different AID subfield values" is cumbersome.	Change the sentence to read: "An HE AP that sends a Multi-STA BlockAck frame where the STA Info fields address more than one STA shall set the RA field to the broadcast address."	2017/1/9 9:42
8464	Robert Stacey	225	1 27.4.1	157	41	E	N	157.41 27.4.1	"...or with the same values of the AID subfield in Per STA Info subfields...": poor grammar	Change the sentence to read: "An HE AP that transmits a Multi-STA BlockAck frame where the STA Info fields address a single STA shall set the RA field to either the address of that STA or the broadcast address."	2017/1/9 9:42
8465	Robert Stacey	225	1 27.4.1	157	43	T	N	157.43 27.4.1	The last sentence in this paragraph is already covered by a previous statement at P157L28.	Delete sentence.	2017/1/9 9:42
8466	Robert Stacey	225	1 27.4.1	157	48	T	N	157.48 27.4.1	What does it mean to support "Multi-STA BlockAck"? The term is not defined. "shall examine": this is not testable so the shall is not appropriate. There is no such thing as a "Multi-STA". There is no such thing as a BA agreement.	Delete the first sentence and change the second to read: "A STA that receives a Multi-STA BlockAck frame performs the following operations for each BA Information field in the Multi-STA BlockAck frame that is addressed to it:"	2017/1/9 9:42
8467	Robert Stacey	225	1 27.4.1	157	56	T	N	157.56 27.4.1	The introductory sentence says that "a STA performs the following", but this (second) bullet does not descibe an action.	The meaning of the fields in a frame are defined in the frame formats section. This is a behavioral clause and should define an action. Fix.	2017/1/9 9:42

8468	Robert Stacey	225	1 9.3.1.9.7	37	20	E	N	37.20 9.3.1.9.7	We have an MU-BAR and MU-RTS but we have a Multi-STA BlockAck. Let's be consistent: is it multi-user or multi-STA?	Change the name of the Multi-STA BlockAck frame to MU BlockAck frame.	2017/1/9 9:42
8469	Robert Stacey	225	1 27.4.1	157	61	T	N	157.61 27.4.1	The rules for responding to a BlockAckReq frame are defined in 10.24.7 (more accurately 10.24.7.5) but the rules for responding to an MU-BAR frame are not defined there. It seem that the sentence needs to be two sentences: how to respond to a BlockAckReq frame and another on how to respond to an MU-BAR frame. Also this sentence references itself: if the repsonse is defined in this subclause there should be no need to reference it. References statements should not contain shall statements; references are informative and help the reader find the normative text. A statement like "shall respond with a BlockAck frame as defined in" does not account for the full suite of options in 10.24.7 (10.24.7.5 only requires a reponse if Address 1 matches). The reference should be to 10.24.7.5 not 10.24.7 since it is only 10.24.7.5 that deals with responding to a BlockAckReq	Change to read "An HE STA responds to a BlockAckReq frame as defined in 10.24.7.5 (Generation and transmission of BlockAck frames by an HT STA or DMG STA)."	2017/1/9 9:42
8470	Robert Stacey	225	1 9.3.1.9.1	34	11	T	N	34.11 9.3.1.9.1	Since the Multi-TID, Compressed Bitmap and GCR Mode subfields no longer exist, changes are needed throughout to replace references to these subfields with references to the BA Type subfield.	Update 10.24.6 and any other occurances.	2017/1/9 9:42
8471	Robert Stacey	225	1 27.4.3	159	26	T	N	159.26 27.4.3	A change to the block ack setup procedure is needed to account for the potentially larger window size. A statement in REVmc/D8.0 P1384L45 limits the transmit window size to 64: "If the value in the Buffer Size field of the ADDBA Response frame is smaller than the value in the ADDBA Request frame, the originator shall change the size of its transmission window (WinSizeO) so that it is not greater than the value in the Buffer Size field of the ADDBA Response frame and is not greater than the value 64."	Change the statement in REVmc to read: "If the value in the Buffer Size field of the ADDBA Response frame is smaller than the value in the ADDBA Request frame, the originator shall change the size of its transmission window (WinSizeO) so that it is not greater than the value in the Buffer Size field of the ADDBA Response frame and is not greater than the value 64 if the sender of the ADDBA Response frame is a non-HE STA and not greater than 256 if the sender of the ADDBA Response frame is an HE STA."	2017/1/9 9:42
8472	Robert Stacey	225	1 9.3.1.9.7	37	31	E	N	37.31 9.3.1.9.7	The Per STA Info field is not really per STA since there could be multiple addressed to the same STA.	Change the field name to STA Info throughout.	2017/1/9 9:42
8473	Robert Stacey	225	1 9.3.1.9.7	37	37	E	N	37.37 9.3.1.9.7	"Per" in the Per AID TID Info field name is not meaningful.	Change the field name to AID/TID Info throughout. BTW, we have various conjuction styles in field names (e.g., underscore as in TID_INFO field, slash as in Duration/ID field and +HTC/Order field, lower case 'and' as in VHT-MCS and NSS Set field, uppercase 'And')	2017/1/9 9:42
8474	Robert Stacey	225	1 9.3.1.9.7	38	13	T	Y	38.13 9.3.1.9.7	"The Ack Type field is not set to 1 when responding to a BlockAckReq frame..." responding to a BlockAckReq frame with a Multi-STA BlockAck frame is not possible.	Change to read: "The Ack Type field is not set to 1 when responding to an MU-BAR frame."	2017/1/9 9:42
8475	Robert Stacey	225	1 9.3.1.9.7	38	4	T	N	38.04 9.3.1.9.7	The TID value for a management frame acknowledgement is descriptive and shouldn't be a NOTE.	Change from a NOTE to a statement that reads: "	2017/1/9 9:42
8476	Robert Stacey	225	1 9.3.1.9.7	38	22	E	N	38.22 9.3.1.9.7	The Block Ack Starting Sequence Control and Block Ack Bitmap subfields are either both present or both absent. No need for separate rows in Table 9-24b. Also they are not optional fields as described in the column heading.	Simplify the table. Change the heading to the 3rd column to "Block Ack Starting Sequence Control and Block Ack Bitmap subfields". For each row simply indicate "Present", "Not Present" or "N/A".	2017/1/9 9:42
8477	Robert Stacey	225	1 9.3.1.9.7	38	31	T	N	38.31 9.3.1.9.7	"context" column: A-MPDUs don't solicit anything; the MPDUs in the A-MPDU do the soliciting. Also, there is no way for a BlockAckReq frame to solicit a Multi-STA response so this statement should be deleted.	Change to read: Sent in response to an A-MPDU that carries a QoS Null frame or one or more QoS Data frames of the same TID where the Ack Policy subfield is MU Ack."	2017/1/9 9:42

8478 Robert Stacey	225	1 9.3.1.8.2	33	61	T	N	33.61 9.3.1.8.2	Meaning needs to be assigned to the nonzero values of the Fragment Number subfield or the strikeout removed	Remove the strikeout	2017/1/9 9:42
8479 Robert Stacey	225	1 9.3.1.9.7	36	20	T	N	36.20 9.3.1.9.7	Only 4 values of the 16 available values of the Fragment Number subfield have any meaning, the other 12 values are reserved. The table can be simplified. Also, the meaning of Fragmentation Level 3 ON/OFF is not clear since it doesn't relate to any other text in this subclause.	The table is better presented in 3 columns (Fragment Number subfield, Block Ack Bitmap subfield length, Block Ack Bitmap subfield interpretation). The rows would be {0, 8 octets, <interpretation>}, {4, 32 octets, <interpretation>}, {1, 8 octets, <interpretation>}, {5, 32 octets, <interpretation>}, {Otherwise, -, Reserved} and <interpretation> is substituted by the text in paragraphs below. For example, the <interpretation> for Fragment Number = 0 is "Indicates the receive status of 64 MSDUs and A-MSDUs. Each bit that is 1 indicates successful reception of a single MSDU or A-MSDU or fragment of an MSDU or A-MSDU with the first bit corresponding to...".	2017/1/9 9:42
8480 Robert Stacey	225	1 9.3.1.9.7	36	61	T	N	36.61 9.3.1.9.7	With level 2 fragmentation, each bit does not necessarily acknowledge the successful reception of a single MSDU or A-MSDU. It could acknowledge a fragment thereof.	Change to read: "...acknowledges the successful reception of a single MSDU or A-MSDU or fragment thereof in the order of sequence number..."	2017/1/9 9:42
8481 Robert Stacey	225	1 27.4.2	158	37	T	N	158.37 27.4.2	"TID value of that MPDU": Not all MPDUs have a TID field. "that requires acknowledgement": needs to be more specific. "receiving a single MPDU": this appers to refer to S-MPDU (i.e., MPDU in an A-MPDU subframe wth EOF = 1). "A single MPDU" is grammetically equivalent to "an MPDU".	Fix	2017/1/9 9:42
8482 Robert Stacey	225	1 27.4.2	158	21	E	N	158.21 27.4.2	The subclause heading is unnecessary long.	Change heading to "STA Info field format selection in a Multi-STA BlockAck frame"	2017/1/9 9:42
8483 Robert Stacey	225	1 27.4.4.1	160	34	T	N	160.34 27.4.4.1	The EOF field is not what solicits an immediate response. It is also inaccurate (The EOF field is set in the padding delimiters at the end of an A-MPDU). EOF=1 with Lengh > 0 is the equivalent of not setting the Aggregation field in an HT PPDU.	Delete "and the EOF field setting"	2017/1/9 9:42
8484 Robert Stacey	225	1 27.4.4.1	160	31	T	N	160.31 27.4.4.1	The fact that a STA can send a PPDU and get a variety of responses dependent on the frame carried in the PPDU is a truism and does not need stating. The statement specifically related to QoS Data frames and QoS Null frames is incomplete. No response is also a possibilty.	Delete sentence.	2017/1/9 9:42
8485 Robert Stacey	225	1 9.3.1.23	41	34	E	N	41.34 9.3.1.23	The terminology for the various Trigger frame variants is inconsistent throught the draft.	Terminology similar to the BlockAck frame should be adopted. It is worth keeping "Trigger" in the name since they all serve that purpose: allocate resporses and trigger a synchronized response. We should use the name "Trigger frame" for the generic case (where the variant does not matter) and then the names "Basic Trigger frame", "Beamforming Report Trigger frame", "MU-BAR Trigger frame", "MU-RTS Trigger frame", "Buffer Status Report Trigger frame", "GCR MU-BAR Trigger frame", "Bandwidth Query Report Trigger frame". Note we can drop "Poll" from the name since "Trigger" is symantically equivalent.	2017/1/9 9:42
8486 Robert Stacey	225	1 10.28.3	136	44	T	N	136.44 10.28.3	Non-HE STAs don't send Multi-STA BlockAck frames so the edits here don't make sense.	Remove the Multi-STA Block Ack insertion.	2017/1/9 9:42

8487	Robert Stacey	225	1 27.4.4.2	160	53	T	N	160.53 27.4.4.2	This convention of prefixing MPDU with a (A-) adds ambiguity. Presumably the intent is to apply the requirement to both MPDUs and A-MPDUs. However, MPDUs and A-MPDUs are very different beasts. An A-MPDU is a framing structure that encapsulates MPDUs. The "at most one of the MPDUs" is a very different statement from "at most one of the A-MPDUs". Also, an A-MPDU does not have an Ack Policy subfield. Nor do most MPDUs for that matter.	Change the statement so that it refers to frames that have an Ack Policy subfield.	2017/1/9 9:42
8488	Robert Stacey	225	1 27.4.4.2	160	52	T	N	160.52 27.4.4.2	SU PPDU is not a defined	Create a definition in 3.2	2017/1/9 9:42
8489	Robert Stacey	225	1 27.4.4	160	27	T	N	160.27 27.4.4	We don't need shall rules to prevent implementors from doing stupid things at the initiator side (like a rule to not solicit an immediate response from more than one STA). What we need are rules at the responder side that prevent bad things happening.	Add a statement that clarifies when an HE trigger-based PPDU is used as a response to HE MU PPDU and when an SU PPDU is is used "An HE STA transmits an HE trigger-based PPDU in response to an HE MU PPDU (provided the conditions in xxx [CCA, NAV, etc.] are met) when the A-MPDU in the HE MU PPDU that is received by the STA includes a Trigger frame or a QoS Data frame or QoS Null frame with a UL MU Scheduling Response A-Control field. An HE STA transmits an SU PPDU in response to an HE MU PPDU if the A-MPDU in the HE MU PPDU that is received by the STA iincludes an MPDU that solicits an immediate response and the A-MPDU does not include any of the following: 1) a Trigger frame 2) a QoS Data frame or QoS Null frame with a DL MU Scheduling Response A-Control field 3) A QoS Data frame or QoS Null frame where the Ack Policy subfield in the	2017/1/9 9:42
8490	Robert Stacey	225	1 27.4.4.2	160	52	T	N	160.52 27.4.4.2	DL MU PPDU is not defined. It could be HE MU PPDU or VHT PPDU with Group ID between 1 and 62 or both.	Change all occurances of DL MU PPDU to HE MU PPDU.	2017/1/9 9:42
8491	Robert Stacey	225	1 27.4.4.2	160	57	T	N	160.57 27.4.4.2	If DL MU PPDU includes VHT PPDU then we break backward compatibility with this requirement ("... shall not include an Action frame...").	Change all occurances of DL MU PPDU to HE MU PPDU.	2017/1/9 9:42
8492	Robert Stacey	225	1 27.4.4.2	160	58	T	N	160.58 27.4.4.2	A DL MU PPDU (= HE MU PPDU?) does not solicit an immediate response; the frames it carries do the soliciting. The list is not all inclusive, other responses might be possible. Item 1: an S-MPDU does not necessarily have an Ack Policy field; only an S-MPDU that is a QoS Data or QoS Null frame has such a field. Item 2: An A-MPDU does not have an Ack Policy. Item 3: An A-MPDU does not have an Ack Policy. How does the recipient know the A-MPDU is a multi-TID A-MPDU?	"A STA that receives an HE MU PPDU with an A-MPDU that contains QoS Data or QoS Null frames addressed to it, responds as follows: 1) If there is only one QoS Data or QoS Null frame, it is an S-MPDU and the ack policy is Normal Ack, then the STA responds with an Ack frame carried in an SU PPDU. 2) If the QoS Data or QoS Null frames have ack policy Implicit BAR and all the QoS Data and QoS Null frames are associated with the same block ack agreement, then the STA responds with a Compressed BlockAck frame carried in an SU PPDU 3) If the QoS Data and QoS Null frames have ack policy Implicit BAR and are associated with two or more block ack agreements, then the STA responds with a Multi-STA BlockAck frame carried in an SU PPDU."	2017/1/9 9:42
8493	Robert Stacey	225	1 27.4.4.4	161	33	T	N	161.33 27.4.4.4	Poorly titled subclause. An HE trigger-based PPDU does not solicit anything. It is the AP that decides what follows the HE trigger-based PPDUs (there can be more than one). It even says so in the subclause: "If the AP intends..."	The text in 27.4.4.4 and 27.4.4.5 should be in the MU operation subclauses	2017/1/9 9:42
8494	Robert Stacey	225	1 8.3.5.2.2	15	34	T	N	15.34 8.3.5.2.2	There is no need for a new STA_INDEX parameter. USER_INDEX and STA_INDEX are semantically equivalent. Let's choose one and stick with it.	Remove STA_INDEX. Update the text for USER_INDEX to include HE MU PPDU. Use same name for PHY-DATA.indication.	2017/1/9 9:42

8495	Robert Stacey	225	1	162	56	T	N	162.56	DL OFDMA With MIMO PPDU is not defined. There is no such thing as a DL OFDMA With MIMO Support field. The capability that most closely resembles this is the DL MU-MIMO On Partial Bandwidth field.	Describe in terms of TXVECTOR parameters.	2017/1/9 9:42
8496	Robert Stacey	225	1 27.5.1.2	163	3	T	N	163.03 27.5.1.2	"The Type and Subtype subfields ... may be different... ": Meaningless statement.	Remove statement	2017/1/9 9:42
8497	Robert Stacey	225	1 27.5.1.2	163	8	T	N	163.08 27.5.1.2	"Two STA-ID fields in HE-SIG_B..." We hide the PHY details behind the PHY service interface so this statement should be made in terms of the TXVECTOR parameter STA_ID_LIST. Since STA_ID_LIST has a subclause of its own (27.11.1) might as well do it there.	Define in terms of TXVECTOR parameters: "An AID shall appear only once in the TXVECTOR parameter array STA_ID_LIST." A statement regarding the 2046 entry can be made in the PHY clause itself. The TXVECTOR just needs to identify the used resources. HE-SIG-B is then built (in the PHY) using this infomation and "2046" entries added as needed.	2017/1/9 9:42
8498	Robert Stacey	225	1 3.2	3	4	T	N	3.04 3.2	The term RU is not defined and is inconsistently used. In some places it refers to a frequency segment (e.g., a 26-tone RU) and in other places it refers to something that carries the PSDU intneded for a STA (e.g., P195L50: "...that RU is set to the AID of the STA receiving the PSDU..."). In the single stream case this may not matter, but in the SU-MIMO (multi-stream) case and especially in the MU-MIMO case it does matter.	Add a definition for resource unit (RU) to 3.2. "resource unit (RU): A set of 26, 52, 106, 242, 484, 996 or 2x996 subcarriers."	2017/1/9 9:42
8499	Robert Stacey	225	1 28.3.3.2	230	6	E	N	230.06 28.3.3.2	Headings for Tables 28-3, 28-4, 28-5 and Figures 28-2, 28-3 and 28-4: HE PPDU in this context is less accurate than channel width	Change "HE PPDU" to "channel width"	2017/1/9 9:42
8500	Robert Stacey	225	1 27.6.4	179	14	T	N	179.14 27.6.4	"An HE NDP shall use the HE SU PPDU format...": An HE NDP is by definition an HE SU PPDU so the shall statement is not necessary.	Remove statement	2017/1/9 9:42
8501	Robert Stacey	225	1 27.6.4	179	14	T	N	179.14 27.6.4	"An HE STA shall transmit an HE NDP using the following TXVECTOR parameters" The shall statement is not necessary. An NDP is by definition a HE SU PPDU with a certain format so the statement needs to be descriptive.	Change to read: "The TXVECTOR parameters for an HE NDP are as follows: - FORMAT is HE_SU; - HE_LTF_TYPE is either 2x HE LTF or 4x HE-LTF; - NUM_STS indicates two or more space-time streams; etc."	2017/1/9 9:42
8502	Robert Stacey	225	1 27.6.3	179	4	T	Y	179.04 27.6.3	Even if the feedback is greater than 11454B, it may be sent in a single PPDU since the segmented report can be sent in MPDUs aggregated into a single A-MPDU. In fact, this should be the preferred way to send feedback. If there is a constraint it is on the duration of the PPDU.	We should limit options here: Require the complete report in a single MPDU or all segments of a segmented report in a single A-MPDU unless the resulting PPDU duration exceeds the duration indicated in the Duration field of the HE NDP Announcement frame (or some absolute limit). Consider applying these rules to the VHT sounding protocol as well (to minimize implementation variation).	2017/1/9 9:42
8503	Robert Stacey	225	1 27.6.3	179	4	T	Y	179.04 27.6.3	"... shall be transmitted in a single PPDU..." It may be impossible for the beamformee to meet this requirement if the report is sent in an HE trigger-based PPDU and the beamformer has not allocated sufficient resources.	Define beamformee behavior for all cases. If the beamformer allocates sufficient resources, the beamformee should return the complete beamfroming report in the HE trigger-based PPDU even if it has to segment to meet the 11454B MPDU length limit. If the beamformer has not allocated sufficient resources, the beamformee may send partial report or null (some beamformee implementations may not want to dynamically segment to meet allocaiton constraints).	2017/1/9 9:42

8504 Robert Stacey	225	1 27.6.3	179	1	T	Y	179.01 27.6.3	Despite the sublcause title, there are no rules for segmenting (or fragmenting) an HE Compressed Beamforming report.	Define rules for fragmenting an HE Compressed Beamforming report along the lines of those defined for a VHT Compressed Beamforming report (10.34.5.3 of 802.11-2016) with one change: to help the beamformer implementation, require that the Compressed Beamforming Feedback Matrix V fields not be split: pad to octet boundary and then start again in next segment.	2017/1/9 9:42
8505 Robert Stacey	225	1 11.2.2.6	142	31	T	N	142.31 11.2.2.6	A Multi-STA BlockAck frame is a BlockAck frame. The term BlockAck frame refers to all variants. The term Compressed BlockAck frame is used for the compressed variant (not BlockAck)	Remove references to Multi-STA BlockAck and use BlockAck alone	2017/1/9 9:42
8506 Robert Stacey	225	1 11.2.2.6	142	32	T	N	142.32 11.2.2.6	The RA could be a broadcast address in which case the STA is identified by the AID in the STA Info field of the Multi-STA BlcokAck frame.	Change to "...for the PS STA addressed by the BlockAck frame..."	2017/1/9 9:42
8507 Robert Stacey	225	1 11.2.2.6	142	35	T	Y	142.35 11.2.2.6	"An HE AP indicates..." The format of the QoS Info field in the QoS Capability element sent by an AP is different from the QoS Info field in the QoS Capability element sent by a non-AP STA. The Mode Data Ack subfield does not exist for an AP.	Remove statement	2017/1/9 9:42
8508 Robert Stacey	225	1 11.2.2.6	142	32	T	Y	142.32 11.2.2.6	"the HE PS STA" has no antecedent (there is a "PS STA" antencedent, but it is not the same thing as an HE PS STA for backward compatibility reasons). The More Data signaling in BlockAck frames is only supported when an HE AP is buffering BUs for an HE non-AP STA and this needs to be made clear.	Create a new paragraph that begins: "If an HE AP has buffered BUs to transmit to an HE non-AP STA, the AP may set the Mode Data field in a BlockAck frame..."	2017/1/9 9:42
8509 Robert Stacey	225	1 11.2.2.6	141	64	T	Y	141.64 11.2.2.6	An HE STA could respond to a Trigger frame with a PS-Poll frame. There is no description of how the AP should deal with a PS Poll sent this way. The current text at the cited location states that the "AP shall respond after a SIFS either with a Data or Management frame, or with an Ack frame." What about a Multi-STA BlockAck frame?	Add details for PS-Poll operation in HE trigger-based PPDUs.	2017/1/9 9:42
8510 Robert Stacey	225	1 9.4.2.200	74	11	E	N	74.11 9.4.2.200	Invalid cross-reference	Change 10.44.3.4 to 27.7.3.4	2017/1/9 9:42
8511 Robert Stacey	225	1 9.4.2.218.2	77	29	T	Y	77.29 9.4.2.218.2	TWT operation as defined in 27.7 is the appropriate flavor of TWT for an HE STA. TWT operation in 10.43 is for the baseline with the HE extensions.	Change to "as described in 27.7" (2 times)	2017/1/9 9:42
8512 Robert Stacey	225	1 9.4.2.218.2	77	34	T	Y	77.34 9.4.2.218.2	TWT operation as defined in 27.7 is the appropriate flavor of TWT for an HE STA. TWT operation in 10.43 is for the baseline with the HE extensions.	Change to "as described in 27.7" (2 times)	2017/1/9 9:42
8513 Robert Stacey	225	1 27.7.3	187	8	E	N	187.08 27.7.3	Wrong cross-reference	Change to "10.43.8"	2017/1/9 9:42
8514 Robert Stacey	225	1 9.4.2.218.2	80	38	T	N	80.38 9.4.2.218.2	aPSDUMaxLength is 6,500,631 octets. But 2^22-1 is only 4,194,303 octets. Allow the A-MPDU to reach the PSDU limit.	Allow values 1, 2 and 3	2017/1/9 9:42
8515 Robert Stacey	225	1 9.3.3.1	52	26	T	N	52.26 9.3.3.1	The Beacon frame body table (Table 9-27) does not include the MU EDCA Parameter Set element	Add it	2017/1/9 9:42
8516 Robert Stacey	225	1 9.3.3.5	53	15	T	N	53.15 9.3.3.5	The Association Response frame body table (Table 9-30) does not include the MU EDCA Parameter Set element	Add it	2017/1/9 9:42
8517 Robert Stacey	225	1 9.3.3.8	54	9	T	N	54.09 9.3.3.8	The Reassociation Response frame Body table (Table 9-32) does not include the MU EDCA Parameter Set element	Add it	2017/1/9 9:42
8518 Robert Stacey	225	1 9.3.3.11	55	6	T	N	55.06 9.3.3.11	The Probe Response frame Body table (Table 9-34) does not include the MU EDCA Parameter Set element	Add it	2017/1/9 9:42

8519	Robert Stacey	225	1 9.4.2.221	94	65	T	Y	94.65 9.4.2.221	Default MU EDCA Parameters set for non-AP STA operation are missing (compared to default EDCA parameter set in 802.11-2016 Table 9-137 & Table 9-138)	Add defaults: AC_BK: AIFSN = 7/ ECWmin = 15 / ECWmax = 15 / MU EDCA Timer = 13*8TUs AC_BE: AIFSN = 13/ ECWmin = 15 / ECWmax = 15 / MU EDCA Timer = 13*8TUs AC_VI: AIFSN = 2/ ECWmin = 15 / ECWmax = 15 / MU EDCA Timer = 13*8TUs AC_VO: AIFSN = 2/ ECWmin = 15 / ECWmax = 15 / MU EDCA Timer = 13*8TUs	2017/1/9 9:42
8520	Robert Stacey	225	1 27.5.2.6.2	173	1	T	N	173.01 27.5.2.6.2	The UL OFDMA-based random access procedure for unassociated STAs is not defined	Define	2017/1/9 9:42
8521	Robert Stacey	225	1 9.4.2.1	67	15	T	Y	67.15 9.4.2.1	A WG motion is required to allocate an element ID for the HE Capabilities element. It can't be justified and I doubt it would be approved.	Change to Element ID Extension and update format accordingly	2017/1/9 9:42
8522	Robert Stacey	225	1 9.4.2.1	67	19	T	Y	67.19 9.4.2.1	A WG motion is required to allocate an element ID for the HE Operation element. It can't be justified and I doubt it would be approved.	Change to Element ID Extension and update format accordingly	2017/1/9 9:42
8523	Robert Stacey	225	1 27.5.2.2.3	167	30	E	N	167.30 27.5.2.2.3	Invalid cross-reference	Change to 10.22.2.2	2017/1/9 9:42
8524	Robert Stacey	225	1 27.5.2.2.3	167	26	E	N	167.26 27.5.2.2.3	Invalid cross-reference	Change to 10.22.2.7	2017/1/9 9:42
8525	Robert Stacey	225	1 27.15.2	201	44	T	N	201.44 27.15.2	An HE trigger-based PPDU is ONLY sent in response to a Trigger frame. So it is not possible to send a Control frame response in the same PPDU format. Also, why can't the PPDU format be non-HT?	Fix	2017/1/9 9:42
8526	Robert Stacey	225	1 27.15.2	201	50	T	N	201.50 27.15.2	Why is it important that the Trigger frame be in an HE PPDU? If the Trigger frame is in a non-HT PPDU or VHT PPDU the response is the same. Why does it matter that it's a Control response? If it's a QoS Data response it's carried in the same PPDU format.	Fix	2017/1/9 9:42
8527	Robert Stacey	225	1 27.5.2.6	174	20	T	Y	174.20 27.5.2.6	Random access behavior for unassociated STAs is not defined	Define behavior for unassociated STAs	2017/1/9 9:42
8528	Robert Stacey	225	1 9.2.4.6.4.4	25	8	E	N	25.08 9.2.4.6.4.4	The reference to the Link adaptation using the HE variant HT Control field is erouneous	The reference shall be modified from 9.31.4 to 27.13	2017/1/9 9:42
8529	Robert Stacey	225	1 27.13	199	1	T	N	199.01 27.13	It is not clear what the receiving side (AP/STA) is expected to do with the HE-MCS / NSS values in this A-control	Need a description for receiver sode behavior in response to this A-control field (similarly to section 27.8, which details what is expected from the receiving side to do with the OMI A-control field values)	2017/1/9 9:42
8530	Robert Stacey	225	1 10.13.2	154	42	E	Y	154.42 10.13.2	wrong link to HE Capabilities Element	need to change it to 9.4.2.218 (HE Capabilities element)	2017/1/9 9:42
8531	Robert Stacey	225	1 28.2.2	222	14	T	N	222.14 28.2.2	APEP_LENGTH is defined in the range 1 to 1048575 while the maximum allowed A-MPDU in HE is 6500531 octets, need to fix it	Change to 6,500,531	2017/1/9 9:42
8532	Robert Stacey	225	1 9.3.1.23	47	34	T	N	47.34 9.3.1.23	Range mismatch	Values 0 to 90 map to -110 to -20 dBm	2017/1/9 9:42
8533	Robert Stacey	225	1 27.6.2	176	25	T	N	176.25 27.6.2	Missing TA field setting rules of NDPA in MultiBSSID is supported, as defined in Trigger frame (see section 27.5.2.2.2)	Need to add the TA field setting rules for the NDPA in case of dot11MultiBSSIDActivated is false / true, similar to the rules of trigger frame (section 27.5.2.2.2)	2017/1/9 9:42
8534	Robert Stacey	225	1 27.4.1	157	36	T	N	157.36 27.4.1	Missing TA field setting rules of Multi-STA BlockACK frame in MultiBSSID is supported, as defined in Trigger frame (see section 27.5.2.2.2)	Need to add the TA field setting rules for the Multi-STA BlockACK frame in case of dot11MultiBSSIDActivated is false / true, similar to the rules of trigger frame (section 27.5.2.2.2)	2017/1/9 9:42
8535	Robert Stacey	225	1 273.3.4	154	39	T	Y	154.39 273.3.4	Level 3 fragmentation offers no benefit over level 2 fragmentation in terms of packing efficiency and, in fact, reduces performance since it reduces the available block ack window size.	Remove the level 3 fragmentation feature or replace it with a scheme that has better performance. A scheme with better performance is the following: Assign sequence numbers to MPDUs (not MSDUs). Add a start of MSDU (SOM) flag and end of MSDU flag (EOM) to the MPDU header (the Fragment Number field bits could be reused). The block ack window size would thus not be reduced to accommodate the fragment numbering. Multiple fragments of an MSDU could be included in the same A-MPDU.	2017/1/9 9:42
8536	Rojan Chitrakar	225	1 4.3.14a	9	21	T	N	9.21 4.3.14a	non-AP STA mentioned here should be 20 MHz only non-AP STA instead?	Change "non-AP STA" to "20 MHz only non-AP STA"	2017/1/9 9:42

8537	Rojan Chitrakar	225	1 4.3.14a	9	26	T	N	9.26 4.3.14a	non-AP STA mentioned here should be 20 MHz only non-AP STA instead?	Change "non-AP STA" to "20 MHz only non-AP STA"	2017/1/9 9:42
8538	Rojan Chitrakar	225	1 8.3.5.12.2	16	20	T	N	16.20 8.3.5.12.2	The PHY-CCA.indication(BUSY, {primary}) primitive is issued by the PHY as long as a valid PPDU is detected at a sufficient signal strength over the primary 20 MHz channel. However, just based on this indication, it is not possible for the MAC to understand which of the 20 MHz channels other than the primary 20 MHz are actually busy. To facilitate better spectrum re-use during DL/UL OFDMA transmissions, it would be beneficial for the MAC to be aware of the busy/idle state of the rest of the 20 MHz channels even when the primary 20 MHz channel is busy.	In order to enable the MAC to understand which of the 20 MHz channels other than the primary 20 MHz are actually busy, add three more channel-list elements for HE STAs: primary20: In an HE STA, indicates that the primary 20 MHz channel is busy but the rest of the 20 MHz channels within the operating channel width are idle. primary40: In an HE STA, indicates that the primary 40 MHz channel is busy but the rest of the 20 MHz channels within the operating channel width are idle. primary80: In an HE STA, indicates that the primary 80 MHz channel is busy but the rest of the 20 MHz channels within the operating channel width are idle.	2017/1/9 9:42
8539	Rojan Chitrakar	225	1 9.3.1.23	45	36	T	N	45.36 9.3.1.23	STAs with limited/inaccurate transmission power adjustment capabilities may not be able to accurately match the "Target RSSI" level specified in the Trigger Frame. This may cause large differences in the received power among STAs, leading to severe Multi-User Interference (MUI). As an example, an STA located very close to the AP may cause high RSSI at the AP even at minimum transmission power. This issue would be even more serious in the case of random access since the AP cannot know which STAs will actually transmit.	In order to enable the AP to reduce the chances of Multi-User Interference (MUI), aside from AID = 0, add two more special AIDs to identify RUs for random access with some restrictions as below: AID = 2008: Only STAs whose estimated received signal power at the AP does not exceed the "Target RSSI" specified in the Trigger frame, when the STA transmits at the transmit power level calculated as per Eqn. 28-118, may transmit on the RU. AID = 2009: Only STAs that cause the estimated received signal power at the AP to exceed the "Target RSSI" specified in the Trigger frame, even when the STA transmits at minimum transmit power level calculated as per Eqn. 28-118, may transmit on the RU. The definition of AID = 0 remains the same: AID = 0 : Random access with no restriction.	2017/1/9 9:42
8540	Rojan Chitrakar	225	1 9.3.1.23	42	32	T	N	42.32 9.3.1.23	Even though the Basic Trigger variant Trigger frame allows STAs to aggregate management frames with Data frames in an HE trigger based PPDU, in certain situations, it is more efficient if the AP is able to restrict the frame type that is included in the HE trigger based PPDU. For e.g. during the BSS setup, the AP can expect many simultaneous exchanges of block ack setup frames. In such times, it would be more efficient for the AP to restrict the uplink frames to management frames (ADDBA request/ADDBA response etc.).	Add a new Trigger variant for management frame types (Management frame Trigger variant) to solicit specific management frames from STAs. An two octet "preferred response type" field in the Type dependent common info field can be used to specify the specific management frame. The same encoding for frame subtypes defined in Section 9. Frame formats, may be reused. For Action frames, the remaining bits may be used to specify the Action category (as defined in 9.4.111) as well as the Action field defined for each Action frame.	2017/1/9 9:42
8541	Rojan Chitrakar	225	1 9.4.2.139	68	30	T	N	68.30 9.4.2.139	Instead of defining new Action frames (L3 Frag BA Request/Response) for block ack setup for L3 fragmentation, it is more efficient to reuse the HE Fragmentation Operation subfield to indicate L3 fragmentation as well.	Use the value of 3 for the HE Fragmentation Operation subfield in the ADDBA request/response frames to negotiate Block Ack setup under fragmentation level 3.	2017/1/9 9:42
8542	Rojan Chitrakar	225	1 9.6.5.1	98	46	T	N	98.46 9.6.5.1	Instead of defining new Action frames (L3 Frag BA Request/Response) for block ack setup for L3 fragmentation, it is more efficient to reuse the HE Fragmentation Operation subfield to indicate L3 fragmentation as well.	Remove Block Ack Action field values 3, 4 and 5 and instead use the value of 3 for the HE Fragmentation Operation subfield in the ADDBA request/response frames to negotiate Block Ack setup under fragmentation level 3.	2017/1/9 9:42
8543	Rojan Chitrakar	225	1 11.2.2.17	143	49	T	N	143.49 11.2.2.17	Inclusion of BSS Color Change Announcement element should also be classified as a critical update.	Add "Inclusion of BSS Color Change Announcement element" to the list.	2017/1/9 9:42

8544	Rojan Chitrakar	225	1 27.3.3.4	154	39	T	N	154.39 27.3.3.4	Instead of defining new Action frames (L3 Frag BA Request/Response) for block ack setup for L3 fragmentation, it is more efficient to reuse the HE Fragmentation Operation subfield to indicate L3 fragmentation as well.	use the value of 3 for the HE Fragmentation Operation subfield in the ADDBA request frames to initiate Block Ack setup under fragmentation level 3.	2017/1/9 9:42
8545	Rojan Chitrakar	225	1 27.3.3.4	154	41	T	N	154.41 27.3.3.4	Instead of defining new Action frames (L3 Frag BA Request/Response) for block ack setup for L3 fragmentation, it is more efficient to reuse the HE Fragmentation Operation subfield to indicate L3 fragmentation as well.	use the value of 3 for the HE Fragmentation Operation subfield in the ADDBA response frames to accept Block Ack setup under fragmentation level 3.	2017/1/9 9:42
8546	Rojan Chitrakar	225	1 27.3.3.4	154	46	T	N	154.46 27.3.3.4	More detail is required for the block acknowledgment record used during L3 fragmentation. It is mentioned that the block acknowledgment record maintains "up to" 4 bits per MSDU. Does it mean that it is also possible to have fewer than 4 (e.g. only 2) bits per MSDU if the MSDU only contain 2 fragments? If this is the case, a separate table would be required to track the number of fragments present in each received MSDU. If this is the intended effect, please provide more detail on how the recipient maintains and updates the block acknowledgment record (and other tables if applicable) under L3 fragmentation.	Please clarify the meaning of "up to" 4 bits per MSDU. If the block acknowledgement record may maintain variable number of bits per MSDU, please provide more detail on how the recipient maintains and updates the block acknowledgment record (and other tables if applicable) under L3 fragmentation.	2017/1/9 9:42
8547	Rojan Chitrakar	225	1 27.3.4.1	155	39	T	N	155.39 27.3.4.1	Some sort of timeout timer would still be required for defragmentation of dynamic fragments, else the incompletely received MSDUs, A-MSDU or MMPDU may cause the recipient's buffer to be full.	Clarify why the receive timer rules do not apply to dynamic fragments. Else, provide alternate mechanism to flush the recipient's buffer.	2017/1/9 9:42
8548	Rojan Chitrakar	225	1 27.4.1	157	49	E	N	157.49 27.4.1	Incomplete name in the sentence "... each received Multi-STA sent by an STA ..."	change "Multi-STA" to "Multi-STA Block Ack frame"	2017/1/9 9:42
8549	Rojan Chitrakar	225	1 27.4.3	160	8	G	N	160.08 27.4.3	Either incomplete or unclear sentence: "The values in the recipient's record ..."	Re-write the sentence in an easier to understand manner.	2017/1/9 9:42
8550	Rojan Chitrakar	225	1 27.4.4.1	160	46	T	N	160.46 27.4.4.1	"soliciting" should be "solicited"	replace "soliciting" with "solicited"	2017/1/9 9:42
8551	Rojan Chitrakar	225	1 27.4.4.5	162	23	T	N	162.23 27.4.4.5	The sentence "... announce the support the reception of MU multi-STA BlockAck frame.", refers to non-existence capability "MU multi-STA BlockAck frame". The closest thing appears to be "Group Addressed Multi-STA Block-Ack In DL MU Support" but that bit refers to support for the reception of a group-addressed Multi-STA BlockAck frame sent in a "non-broadcast" RU instead of a broadcast RU as stated in this clause.	Replace "reception of MU multi-STA BlockAck frame" with the correct HE capability subfield.	2017/1/9 9:42
8552	Rojan Chitrakar	225	1 27.5.2.2.2	166	38	T	N	166.38 27.5.2.2.2	"User Info field" should be "A-control subfield"?	Replace "User Info field" with "A-control subfield"	2017/1/9 9:42
8553	Rojan Chitrakar	225	1 27.52.2.2	167	15	T	N	167.15 27.52.2.2	"AC Preference Level subfield" should be "Preferred AC subfield" and grammar is wrong	Replace the sentence with "The AP may assign any value defined in Table 9-25i (Preferred AC subfield encoding) in the Preferred AC subfield in the Trigger Dependent User Info field for an HE STA identified by the AID12 subfield of the User Info field of a Basic Trigger frame."	2017/1/9 9:42
8554	Rojan Chitrakar	225	1 27.5.2.3	167	64	T	N	167.64 27.5.2.3	"- Otherwise, a STA shall not send an HE trigger-based PPDU." The conditions listed missed the case of AID12 = 0 i.e. transmission of HE trigger-based PPDU during OFDMA based UL Random Access.	Add the condition for the case of AID12 = 0 i.e. transmission of HE trigger-based PPDU during OFDMA based UL Random Access.	2017/1/9 9:42

8555	Rojan Chitrakar	225	1 27.5.2.4	170	36	T	N	170.36 27.5.2.4	Based on the description of the subsequent paragraph, the ED based CCA considers the status of a wide band channel on a 20 MHz granularity, i.e. as long as the 20 MHz channels containing the allocated RUs are considered idle, even if the other 20 MHz channels are busy (including the primary 20 MHz), a STA is still allowed to transmit the HE trigger- based PPDU. However, the virtual CS i.e. NAV is considered over the whole wide band. Even a narrow band OBSS transmission on the primary 20 MHz channel will set the STA's Inter-BSS NAV thereby rendering all the remaining 20 MHz channels of the wide band unusable for UL MU even when the ED based CCA returns idle on those 20 MHz channels. As such, it will be beneficial to record, in addition to the duration of the Inter-BSS NAV, the busy/idle state of the 20 MHz channels other than the primary 20 MHz. If the 20 MHz channels containing the	When recording the inter-BSS NAV set by an inter-BSS PPDU, in addition to recording the NAV duration of the Inter-BSS PPDU, the busy/idle state of the 20 MHz channels other than the primary 20 MHz are also recorded. A STA may also keep this record in conjunction with the HE bandwidth query report operation. This allows the virtual CS to be considered on a 20 MHz granularity as well i.e. the virtual CS is considered busy on a 20 MHz channel only if the NAV counter is nonzero and the 20 MHz channel was recorded as busy when the NAV was recorded. If the 20 MHz channels containing the allocated RUs in a Trigger frame are considered idle by both the ED based CCA as well as the virtual CS, a STA is allowed to transmit the HE trigger- based PPDU on the allocated RU.		2017/1/9 9:42
8556	Rojan Chitrakar	225	1 27.5.2.6	172	23	E	N	172.23 27.5.2.6	The term "UL OFDMA-based random access" is very long. Define an acronym for "UL OFDMA-based random access" for easy referencing.	Following the 802.11 tradition of four letter acronyms for channel access schemes (e.g. EDCA, HCCA, MCCA etc.), would like to suggest UORA (Uplink OFDMA-based Random Access). Add a definition for UORA in Clause 3.2 and Clause 3.4 and replace all appropriate repetitive instances of "Uplink OFDMA-based Random Access" with UORA.		2017/1/9 9:42
8557	Rojan Chitrakar	225	1 27.5.2.6.1	172	33	T	N	172.33 27.5.2.6.1	STAs with limited/inaccurate transmission power adjustment capabilities may not be able to accurately match the "Target RSSI" level specified in the Trigger Frame. This may cause large differences in the received power among STAs, leading to severe Multi-User Interference (MUI). As an example, an STA located very close to the AP may cause high RSSI at the AP even at minimum transmission power. This issue would be even more serious in the case of random access since the AP cannot know which STAs will actually transmit.	In order to enable the AP to reduce the chances of Multi-User Interference (MUI), aside from AID = 0, add two more special AIDs to identify RUs for random access with some restrictions as below: AID = 2008: Only STAs whose estimated received signal power at the AP does not exceed the "Target RSSI" specified in the Trigger frame, when the STA transmits at the transmit power level calculated as per Eqn. 28-118, may transmit on the RU. AID = 2009: Only STAs that cause the estimated received signal power at the AP to exceed the "Target RSSI" specified in the Trigger frame, even when the STA transmits at minimum transmit power level calculated as per Eqn. 28-118, may transmit on the RU. The definition of AID = 0 remains the same: AID = 0 : Random access with no restriction.		2017/1/9 9:42
8558	Rojan Chitrakar	225	1 27.5.2.6.1	172	49	T	N	172.49 27.5.2.6.1	This note (If the STA does not receive the RAPS element, the STA does not transmit any HE trigger-based PPDU using random access RUs.) implies that an STA performing Active Scan may not use Random Access to transmit Probe Request frames to an AP from which it has not received Beacon/Probe Response frames. Since unassociated STAs were one of the target device categories given as example when the random access scheme was introduced, this limitation appears restrictive.	Define default values for OCWmin and OCWmax that may be used by unassociated STAs to transmit the probe request frames using random access RUs.		2017/1/9 9:42
8559	Rojan Chitrakar	225	1 27.5.2.7	174	21	T	N	174.21 27.5.2.7	NDP feedback report procedure lacks details	Please provide more details for the proposed NDP feedback report procedure		2017/1/9 9:42
8560	Rojan Chitrakar	225	1 27.5.3	175	33	T	N	175.33 27.5.3	In the sentence "An HE MU PPDU transmitted by the AP..." if the HE MU PPDU refers to the one that starts an MU Cascading sequence, please specify as such.	Qualify the HE MU PPDU to which the A-MPDU contents applies as the one that starts an MU cascading sequence.		2017/1/9 9:42
8561	Rojan Chitrakar	225	1 27.9.1	190	11	E	N	190.11 27.9.1	Definition of "SR PPDU" is missing	Add definition of "SR PPDU"		2017/1/9 9:42

8562	Rojan Chitrakar	225	1 27.9.1	190	42	T	N	190.42 27.9.1	The timing of PHYCCARESET.request primitive as well as the TXOP limitations if any is not clear in the case of spatial reuse during the reception of non-HE PPDU.	Clarify the he timing of PHYCCARESET.request primitive as well as the TXOP limitations if any in the case of spatial reuse during the reception of non-HE PPDU.	2017/1/9 9:42
8563	Rojan Chitrakar	225	1 27.10.2	192	43	T	N	192.43 27.10.2	More detail is required for the use of HE MU PPDU in the UL.	Provide details of UL HE MU PPDU.	2017/1/9 9:42
8564	Rojan Chitrakar	225	1 28.3.3.2	229	24	T	N	229.24 28.3.3.2	Does the sentence "The 242-tone RU is used in the 20 MHz HE SU PPDU format." imply that the 242-tone RU may not be used in the 20 MHz HE trigger based PPDU? If yes, this is contradictory with the sentence on P229L7 that says "The 26-tone RU, 52-tone RU, 106-tone RU and 242-tone RU are used in the 20 MHz, 40 MHz, 80 MHz, 160 MHz and 80+80 MHz HE MU PPDU formats or HE trigger-based PPDU formats using OFDMA transmission,..." In certain situations, it may be useful for the AP to trigger a single STA to send back a HE trigger-based PPDU on the full channel bandwidth e.g. using the 242-tone RU in a 20 MHz band .	Allow the AP to assign, in a Trigger frame, the largest RU on a channel to a single STA to transmit its uplink frame/s in an HE trigger based PPDU using OFDMA transmission. E.g. the 242-tone RU may be used in the 20 MHz HE trigger-based PPDU format using OFDMA transmission.	2017/1/9 9:42
8565	ron porat	225	1 28.3.11.5.4	321		T	Y	321.00 28.3.11.5.4	Lines 6-13 deal with the case where, in an MU PPDU, either no LDPC user has an extra symbol or all users are BCC encoded. However, the following isn't clear: an MU PPDU has a mixture of LDPC and BCC users and some LDPC users have an extra symbol. Should the BCC users set a,N_sym based on 28-86 or 28-85? The confusion arises because the 'if' statement on line 6 doesn't have an explicitly specified else clause and it's not clear whether the 'note' on line 14 applies only when the 'if' condition is met or is true universally.	Make it clear that BCC users shall set a,N_sym based on 28-86. Delete the text on lines 14-15 ("Note that users with .... Equation (28-86)") On line 8, after the words "shall be set to 0, and", add the underlined text: update the common pre-FEC padding factor and NSYM values for all users as follows	2017/1/9 9:42
8566	ron porat	225	1 28.4.2	372		T	Y	372.00 28.4.2	In an 11ac MU transmission with mixed BCC/LDPC users, the airtime for all the users was the same. However, the PSDU length as defined in 28-131 of 11ax D1.0 does not satisfy this property. In particular, for a mixture of BCC and LDPC users, when an LDPC extra symbol is added, BCC users' PSDU will not align with the rest	Ensure same airtime for all users, irrespective of coding. Update equation 28-131 as follows: a. Use two separate equations, one for the BCC and one for the LDPC case. b. Equation for LDPC case: same as equation 28-131, except that we omit the '-- N_tail' at the end c. Equation for BCC case: same as equation 28-131, except that we use Nsym instead of Nsym,init, and NDBPS,last,u instead of NDBPS,last,init,u	2017/1/9 9:42
8567	ron porat	225	1 28.3.10.7	275	34	T	Y	275.34 28.3.10.7	1 bit in HE-SIG-A assigned to handle Doppler, but no mechanism provided (Table 28-16 and 28-17)	Propose to adopt traveling pilots (similar to 11ah) to handle Doppler	2017/1/9 9:42
8568	ron porat	225	1 28.3.10.7	274	6	T	Y	274.06 28.3.10.7	Spatial Reuse Field value definition lacks detail	Propose to adopt document 1476r8 to complete the definition of the SRP based spatial reuse feature	2017/1/9 9:42
8569	ron porat	225	1 9.4.2.218.3	84	56	T	Y	84.56 9.4.2.218.3	In Table 9-262aa, capability bit for NSTS Total <= 80 MHz. Description is confusing.	Propose the following rewording: "The maximum value for Nsts.total that can be sent in a DL MU MIMO transmission on full or partial bandwidth that includes that STA"	2017/1/9 9:42
8570	ron porat	225	1 9.4.2.218.3	85	13	T	Y	85.13 9.4.2.218.3	In Table 9-262aa, capability bit for NSTS Total > 80 MHz. Description is confusing.	Propose the following rewording: "The maximum value for Nsts.total that can be sent in a DL MU MIMO transmission on full or partial bandwidth that includes that STA"	2017/1/9 9:42
8571	ron porat	225	1 27.5.2.7	174	24	T	Y	174.24 27.5.2.7	PHY design for NDP feedback report procedure is missing	Please provide PHY design details for this feature	2017/1/9 9:42
8572	ron porat	225	1 28.3.18.4.4	359		T	Y	359.00 28.3.18.4.4	Text describing EVM computation is inconsistent with motioned document 1427r2 - parts should either be modified or removed	Make the following changes: a. On line 2, change "step e)" to "step f)" b. Step h (lines 20-25) should be deleted from D1.0	2017/1/9 9:42

8573	Rui Cao	225	1 28.3.10.10	311	20	T	Y	311.20	28.3.10.10	"HELTFk is the k-th element of the common HE-LTF sequence generated by ... ", the usage of "k-th" is vague, which can mean k starts from 1 at the left most of the HELTF sequence. Need to clarity the wording.	Change it to "HELTFk is value of the common HE-LTF sequence on subcarrier k ..." or refer to Equations (28-58) and (28-59) for the definition of k.	2017/1/9 9:42
8574	RUI YANG	225	1 28.3.14.3	342	9	E	Y	342.09	28.3.14.3	In "with P the maximum power", the unit of P should be specified.	Change to "with P the maximum power in dBm".	2017/1/9 9:42
8575	RUI YANG	225	1 28.3.14.3	342	55	T	Y	342.55	28.3.14.3	"The symbol clock error shall be pre-compensated by the same ppm amount as CFO error." The source/reference of the ppm value should be specified.	Either delete this sentence or provide the source to obtain the ppm amount and how to compensate the symbol clock error.	2017/1/9 9:42
8576	RUI YANG	225	1 9.3.1.23 Trigger frame format	47	24	E	Y	47.24	9.3.1.23 Trigger frame format	In the sentence: "The Target RSSI subfield of the User Info field indicates the target received signal power of the HE trigger based PPDU response," it is not clear if the "received signal power" at AP or STA.	Change to "The Target RSSI subfield of the User Info field indicates the target received signal power averaged over the AP's antennas of the HE trigger based PPDU response."	2017/1/9 9:42
8577	RUI YANG	225	1 28.3.14.2	341		E	Y	341.00	28.3.14.2	The first paragraph of this subclause is not necessary. The two signaled variables (i.e., Target_RSSI and Tx_pwr^AP) should be described (including the information about the source of the signals and their physical meaning) when they are introduced in Eq (28-118) and (28-119), respectively.	Removed the first paragraph, and describe Target_RSSI and Tx_pwr^AP under Eq (28-118) and Eq (28-119), respectively, with the information about the source and physical meaning.	2017/1/9 9:42
8578	RUI YANG	225	1 28.3.14.2	341	7	T	Y	341.07	28.3.14.2	It is not clear if "the target receive signal power" is from each STA or the total received power.	Make it clear if "the target receive signal power" is from each STA or the total received power.	2017/1/9 9:42
8579	RUI YANG	225	1 28.3.14.2	341		E	N	341.00	28.3.14.2	The descriptions of Tx_pwr^AP and DL_RSSI should be done for one after another, rather in a interleaved way.	Describe Tx_pwr^AP first, then DL_RSSI.	2017/1/9 9:42
8580	RUI YANG	225	1 28.3.14.2	341	14	E	Y	341.14	28.3.14.2	The font of the letters in "Target" in Eq. (28-119) should be the same.	Make the font the same in "Target"	2017/1/9 9:42
8581	RUI YANG	225	1 28.3.14.2	341	41	T	Y	341.41	28.3.14.2	How to obtain BF gain, and how to apply the BF gain into the power pre-correction equation should be specified. It is not clear if the BF gain includes both Tx (@STA) and Rx (@AP) BF gain.	Provide the way(s) to obtain the BR gains and make it clear if it refers to Tx or/and Rx BF gain.	2017/1/9 9:42
8582	RUI YANG	225	1 28.3.14.2	341	44	T	Y	341.44	28.3.14.2	The formulation that considers max and min tx power should be explicitly given in Eq (28-118).	Update Equation (28-118) including min and max Tx powers.	2017/1/9 9:42
8583	RUI YANG	225	1 28.3.14.2	341	59	T	Y	341.59	28.3.14.2	Where to obtain "maximum UL transmit power of HE trigger-based PPDU for the assigned MCS" should be given.	Provide the source to obtain "maximum UL transmit power of HE trigger-based PPDU for the assigned MCS"	2017/1/9 9:42
8584	RUI YANG	225	1 28.3.14.3	342	8	E	Y	342.08	28.3.14.3	"max(P-32, -10 dBm)" is a confusion expression	Change to "max(P-32, -10) (dBm) "	2017/1/9 9:42
8585	Sameer Vermani	225	1 28.3.16	344	55	E	N	344.55	28.3.16	The symbol for mu to signify micro-seconds is not correct in the line about PE field	Correct to apprpriate greek alphabet	2017/1/9 9:42
8586	Sameer Vermani	225	1 27.6	177	14	E	N	177.14	27.6	This line "If the HE beamformee is not capable of partial bandwidth feedback or if there is only one STA info element in the NDP Announcement frame then the HE beamformer shall set the RU Start Index and the RU End Index to values indicating a full bandwidth feedback such as in the case of Ng = 4, for 80 MHz full bandwidth feedback the RU Start Index and RU End Index is set to 0 and 36, respectively as shown in Table YY-1." needs to break and also please correct reference to the table. YY-1 does not seem to be the valid table reference.	Replace with "If the HE beamformee is not capable of partial bandwidth feedback or if there is only one STA info element in the NDP Announcement frame then the HE beamformer shall set the RU Start Index and the RU End Index to values indicating a full bandwidth feedback. As an example, in the case of Ng = 4, for 80 MHz full bandwidth feedback the RU Start Index and RU End Index are set to 0 and 36, respectively as shown in Table YY-1."	2017/1/9 9:42
8587	Sameer Vermani	225	1 27.6	178	39	E	N	178.39	27.6	"The beamformer initiating HE sounding protocol with one beamformee, shall not request MU-type feedback, CQI feedback, and SU-type partial bandwidth feedback, i.e., RU start index and RU end index do not cover full bandwidth, in NDP announcement." needs improvement	Suggested text "The beamformer initiating HE sounding protocol with one beamformee, shall not request MU-type feedback, CQI feedback or an SU-type partial bandwidth feedback (a SU -type feedback where RU start index and RU end index do not cover full bandwidth, in NDP announcement)."	2017/1/9 9:42

8588	Sameer Vermani	225	1 27.6	178	32	T	N	178.32 27.6	"The HE Compressed Beamforming feedback is comprised of the HE Compressed Beamforming Report information and the MU Exclusive Beamforming Report information." seems out of place	Delete the cocerned line. This belongs to another section.	2017/1/9 9:42
8589	Sameer Vermani	225	1 9.6.28.2	64	6	E	N	64.06 9.6.28.2	The etxt "The HE MU Exclusive Beamforming Report information consists of Delta SNR subfields for each of the space-time stream (1 to Nc) of a subset of subcarriers typically spaced Ng apart, where Ng is signaled in the Grouping subfield of the HE MIMO Control field. Starting from the lowest frequency subcarrier and continuing to the highest frequency subcarrier. Specifically, the locations of the feedback subcarriers for delta SNR subfield shall be identical to the subcarrier locations of the compressed V matrices feedback." needs to improve	Suggested text "The HE MU Exclusive Beamforming Report information consists of Delta SNR subfields for each of the space-time stream (1 to Nc) of a subset of subcarriers typically spaced Ng apart, where Ng is signaled in the Grouping subfield of the HE MIMO Control field, starting from the lowest frequency subcarrier and continuing to the highest frequency subcarrier. Specifically, the locations of the feedback subcarriers for delta SNR subfield shall be identical to the subcarrier locations of the compressed beamforming feedback matrix V."	2017/1/9 9:42
8590	Sheng Sun	225	1 9.2.4.5.4	20	43	T	Y	20.43 9.2.4.5.4	The new HE rule added to Table 9-9, how would a receipient return a multi-STA BA in response to a DL HE MU PPDU? Additionally it is not clear what type of the trigger frame is used to return the response. There is MU ACK trigger frame type.	clarify	2017/1/9 9:42
8591	Sheng Sun	225	1 9.4.2.200	70	50	T	Y	70.50 9.4.2.200	The terms Scheduling STA and Scheduled STA need to be defined	as in comment	2017/1/9 9:42
8592	Sheng Sun	225	1 27.2.2	150	34	T	Y	150.34 27.2.2	My ubderstading is the single NAV currently supported by 802.11 devices is updated baed on the Duration value in the MAC header of all received frame (Inter or Intra BSS). The so called "Basic NAV" is only updated based on Inter-BSS frames received.	it is better to find another name other than Baisc NAV. Mayve Iter-BSS NAV.	2017/1/9 9:42
8593	Sheng Sun	225	1 27.5.1.3	163	27	T	Y	163.27 27.5.1.3	what does "channel availability" mean?	clarify	2017/1/9 9:42
8594	Sheng Sun	225	1 27.7.3.1	183	31	T	Y	183.31 27.7.3.1	I thnik it would be much easire by explicitly specify the MMPDU that contains the TWT element, whether it is the TWT Req or the TWT Resp.	as in comment	2017/1/9 9:42
8595	Sheng Sun	225	1 27.7.3.2	184	20	T	Y	184.20 27.7.3.2	"Trigger-enabled TWT SP" need to be defined	as in comment	2017/1/9 9:42
8596	Sigurd Schelstraete	225	1 28.3.3.1	228	56	E	N	228.56 28.3.3.1	Make numbered list of subcarrier types, instead of running text	See comment	2017/1/9 9:42
8597	Sigurd Schelstraete	225	1 28.3.3.1	228	60	T	N	228.60 28.3.3.1	Replace "not used for data/pilot transmission" with " not used for either data or pilot transmission"	See comment	2017/1/9 9:42
8598	Sigurd Schelstraete	225	1 28.3.3.2	229	1	T	N	229.01 28.3.3.2	Section 28.3.3.2 is called "Resource unit, guard and DC subcarriers". Split it into a section on "Resource units" (including all text from page 229, line 3 to page 235, line 25) and one on "guard and DC subcarriers" (including text from page 235, line 27 to page 235, line 48).	See comment	2017/1/9 9:42
8599	Sigurd Schelstraete	225	1 28.3.3.2	229	9	T	Y	229.09 28.3.3.2	It would be preferable to control the behavior of the HE AP through e.g. a MIB variable. This variable would control whether the AP needs to take special measures in the presence on non-HE OBSS or not.	Introduce configuration control for the behavior of an HE AP in the presence of non-HE OBSS.	2017/1/9 9:42
8600	Sigurd Schelstraete	225	1 28.3.3.2	229	9	T	N	229.09 28.3.3.2	"if an HE AP operates in a DFS channel where there is a non-HE OBSS" needs to be more specific as to when the condition applies.	Provide more detail as to which metrics will trigger the specific condition to not request 26-tone RUs.	2017/1/9 9:42
8601	Sigurd Schelstraete	225	1 28.3.3.2	229	11	T	Y	229.11 28.3.3.2	"and the HE non-AP STA shall not respond with 26-tone RU". This may put STAs that oberve an OBSS at a disadvantage, since it has no way to indicate explicitly why it is not responding. It may be underserved as a result.	It would be better to have a mechanism that enables STAs to indicate the presence of a non-HE OBSS to the HE AP.	2017/1/9 9:42

8602	Sigurd Schelstraete	225	1 28.3.3.2	230	6	T	Y	230.06 28.3.3.2	The subcarrier indices in Table 28-3 are correct for a PPDU with CH_BANDWIDTH equal to 20 MHz in an 20 MHz BSS. If the BW of the BSS is wider than 20 MHz, I assume that a PPDU with CH_BANDWIDTH equal to 20 MHz would be sent in the primary channel of the BSS, causing all indices to shift accordingly. The text should be clearer on the position of the RU's when the CH_BANDWIDTH is less than the BSS bandwidth.	Add clarification on the interpretation of the RU indices when the CH_BANDWIDTH is less than the BSS bandwidth. Similarly for Table 28-4 and 28-5.	2017/1/9 9:42
8603	Sigurd Schelstraete	225	1 28.3.3.2	230	6	T	N	230.06 28.3.3.2	Replace "Subcarrier indices" with "Data and Pilot subcarriers indices"	See comment Similarly for Table 28-4 and 28-5.	2017/1/9 9:42
8604	Sigurd Schelstraete	225	1 28.3.3.2	233	24	T	N	233.24 28.3.3.2	Figure 28-3 does not show the number of DC carriers for the first four rows, unlike figures 28-2 and 28-4	Add number of DC carriers to figure	2017/1/9 9:42
8605	Sigurd Schelstraete	225	1 28.3.3.2	235	27	T	N	235.27 28.3.3.2	"The 20 MHz HE MU PPDU and HE trigger-based PPDU with more than one RU has 7 DC subcarriers". This is not correct. A 20 MHz PPDU with a single RU smaller than 242 tones also has 7 DC tones.	Change to "A 20 MHz HE MU PPDU and HE trigger-based PPDU carrying one or more RUs smaller than 242 tones has 7 DC subcarriers"	2017/1/9 9:42
8606	Sigurd Schelstraete	225	1 28.3.3.2	235	30	T	N	235.30 28.3.3.2	"The 40 MHz HE PPDU with a 484-tone RU has 5 DC subcarriers located at [-| ||i2: 2].". The text does not mention the case of 40 MHz PPDU with smaller RU sizes.	Add numebr of DC carriers for a 40 MHz PPDU with RU size(s) smaller than 484.	2017/1/9 9:42
8607	Sigurd Schelstraete	225	1 28.3.3.2	235	31	T	N	235.31 28.3.3.2	"An 80 MHz HE MU PPDU and HE trigger-based PPDU with more than one RU has 7 DC subcarriers". This is not correct sincs an 80 MHz PPDU with a single RU smaller than 996 tones also has 7 DC carriers.	Change to "An 80 MHz HE MU PPDU and HE trigger-based PPDU with one or more RU's smaller than 996 tones has 7 DC subcarriers"	2017/1/9 9:42
8608	Sigurd Schelstraete	225	1 28.3.3.2	235	37	T	N	235.37 28.3.3.2	"The 20 MHz HE PPDU format has 11 guard subcarriers (6, 5)". Notation (6,5) is not explained anywhere.	Clarify. Similarly on lines 39 and 41 (notation (12,11))	2017/1/9 9:42
8609	Sigurd Schelstraete	225	1 28.3.3.2	235	37	T	N	235.37 28.3.3.2	Why are guard carriers treated differently from null subcarriers. Both types are carriers without energy on it. The distinction seems rather artifical.	Considering merging guard carriers with null subcarriers	2017/1/9 9:42
8610	Sigurd Schelstraete	225	1 28.3.3.2	235	48	T	N	235.48 28.3.3.2	Don't use term "legacy preambles".	Use e.g. non-HE preamble fields	2017/1/9 9:42
8611	Sigurd Schelstraete	225	1 28.3.3.3	236	16	T	N	236.16 28.3.3.3	Table 28-6, for 40 MHz RU sizes 26, 52 and 106 defines tones +/-3 as null subcarriers, while +2:2 are defined as DC subcarriers. What's wrong with defining -3:+3 as DC subcarriers?	Define -3:+3 as DC subcarriers	2017/1/9 9:42
8612	Sigurd Schelstraete	225	1 28.3.3.4	236	35	T	N	236.35 28.3.3.4	Unclear sentence "In the 1x HE-LTF, the pilot locations are the pilot subcarrier indices that are multiples of 4 of the pilot subcarriers for data field."	Change to "In the 1x HE-LTF, the pilot locations in HE-LTF only consists of the pilot subcarriers for data field that are multiples of four."	2017/1/9 9:42
8613	Sigurd Schelstraete	225	1 28.3.3.4	236	42	T	N	236.42 28.3.3.4	The pilot tones are specific to RU's. Table 28-7 should use a format similar to e.g. Table 28-3 to Table 28-5, showing the pilot tones belonging to each RU	Show the pilot tones specific to each RU	2017/1/9 9:42
8614	Sigurd Schelstraete	225	1 28.3.3.5	237	16	T	N	237.16 28.3.3.5	"when operating 20 MHz". Improve wording	Change to e.g. "when operating in 20 MHz-only mode"	2017/1/9 9:42
8615	Sigurd Schelstraete	225	1 28.3.3.5	237	21	T	N	237.21 28.3.3.5	"a 20 MHz operating non-AP STA". What is the correct term for this type of STA? 20 MHz-only STA?	Settle on a term to describe this kind of STA and use the terminology consistently.	2017/1/9 9:42
8616	Sigurd Schelstraete	225	1 27.15.2	201	37	T	N	201.37 27.15.2	"An HE non-AP STA may transmit an HE trigger-based PPDU to a peer STA if it has received from the peer STA an HE Capabilities element with the UL MU PPDU Support field equal to 1; otherwise the STA shall not transmit an HE trigger-based PPDU to the peer STA.". Do we even need this requirement? HE Trigger-based PPDUs should only be sent in response to a Trigger Frame sent by the peer STA. If the peer STA doesn't want to receive trigger-based PPDUs, it should not send a Trigger Frame.	Clarify	2017/1/9 9:42
8617	Sigurd Schelstraete	225	1 27.15.2	201	38	T	N	201.38 27.15.2	Name of field should be "UL MU" instead of "UL MU PPDU Support"	Correct name of field	2017/1/9 9:42

8618	Sigurd Schelstraete	225	1 27.16.1	204	60	T	N	204.60 27.16.1	What is an "HE mesh STA"? HE STA with dot11MeshActivated equal to True?	Clarify. The same term also appears in other places in this section.	2017/1/9 9:42
8619	Sigurd Schelstraete	225	1 27.16.1	205	4	T	Y	205.04 27.16.1	"A STA shall set all the subfields of the VHT Capabilities and HT Capabilities element it transmits to respective values that indicate the same capabilities provided in the HE Capabilities element it transmits.". This requirement is not sufficiently specific. A mapping between relevant HE fields and HT/VHT fields should be provided.	See comment	2017/1/9 9:42
8620	Sigurd Schelstraete	225	1 27.16.1	205	52	T	N	205.52 27.16.1	Change "preamble puncture" to "preamble puncturing"	See comment	2017/1/9 9:42
8621	Sigurd Schelstraete	225	1 27.16.3.2	207	57	E	N	207.57 27.16.3.2	Change "Quite" to "Quiet"	See comment	2017/1/9 9:42
8622	Sigurd Schelstraete	225	1 27.16.3.2	207	57	T	N	207.57 27.16.3.2	Unclear sentence "the requested HE STA can transmit frame belongs to the requested type of STA-to-STA operation"	Improve wording	2017/1/9 9:42
8623	Sigurd Schelstraete	225	1 28.1.1	209	14	T	N	209.14 28.1.1	The bullet list with additional mandatory requirements can be simplified. For instance, it looks like Clause 19 is mandatory in all cases.	Change to: "compliant with the mandatory requirements of the following PHY specifications: - Clause 19 - Clause 21 for AP STAs and for non-AP STAs capable of 40 and 80 MHz channel widths in 5 GHz"	2017/1/9 9:42
8624	Sigurd Schelstraete	225	1 28.1.1	209	24	T	N	209.24 28.1.1	Other than mandating Clause 21, how can it be said that the HE PHY is "based on the VHT PHY"? The differences are in fact significant.	I see no need to need to document the whole genealogy. This adds little information. Delete sentence (lines 24-32).	2017/1/9 9:42
8625	Sigurd Schelstraete	225	1 28.1.1	209	32	E	N	209.32 28.1.1	Start new pararaph before "THE HE PHY extends the maximum number of users ..."	See comment	2017/1/9 9:42
8626	Sigurd Schelstraete	225	1 28.1.1	209	36	T	N	209.36 28.1.1	run-on sentence	Start new sentence starting at "and in an MU-MIMO resource unit"	2017/1/9 9:42
8627	Sigurd Schelstraete	225	1 28.1.1	209	44	T	N	209.44 28.1.1	Change RU to "resource unit" as in the paragraph above.	See comment	2017/1/9 9:42
8628	Sigurd Schelstraete	225	1 28.1.1	209	44	E	N	209.44 28.1.1	Change "is" to "are"	See comment	2017/1/9 9:42
8629	Sigurd Schelstraete	225	1 28.1.1	209	64	T	N	209.64 28.1.1	Clarify sentence	Change "An HE STA refers to an AP STA and a non-AP STA" to "The term HE STA can refer to both an AP STA or a non-AP STA"	2017/1/9 9:42
8630	Sigurd Schelstraete	225	1 28.1.1	210	1	T	N	210.01 28.1.1	Delete sentence	"A non-AP STA is inclusive of a 20 MHz-only non-AP STA." is not needed. The capabilities listed below make that clear. If anything, the sentence is confusing.	2017/1/9 9:42
8631	Sigurd Schelstraete	225	1 28.1.1	210	9	T	N	210.09 28.1.1	What is "primary 20 MHz PPDU bandwidth"?	Does it mean a single 242-tone RU occupying the primary 20 MHz channel?	2017/1/9 9:42
8632	Sigurd Schelstraete	225	1 28.1.1	210	12	T	N	210.12 28.1.1	Change "defined" to "allowed". BCC definition is not explicitly linked to bandwidth.	See comment	2017/1/9 9:42
8633	Sigurd Schelstraete	225	1 28.1.1	210	14	T	N	210.14 28.1.1	Second bullet should describe the type of PPDU for which BCC is not allowed	Probably something like "an MU PPDU occupying an RU ..."	2017/1/9 9:42
8634	Sigurd Schelstraete	225	1 28.1.1	210	15	T	N	210.15 28.1.1	Third bullet should describe the type of PPDU for which BCC is not allowed	Probably something like "an MU PPDU occupying an RU ..."	2017/1/9 9:42
8635	Sigurd Schelstraete	225	1 28.1.1	210	18	T	N	210.18 28.1.1	"An HE PPDU using HE MCS 10 or 11". Also, an RU within an MU PPDU using MCS 10 or 11?	Clarify	2017/1/9 9:42
8636	Sigurd Schelstraete	225	1 28.1.1	210	25	T	Y	210.25 28.1.1	If a STA is 20 MHz-only and were to use more than four streams, then: - BCC is not allowed (per line 16) - LDPC is not mandatory (per lines 23 and 27).	How to resolve this? - 20 MHz-only can not send more than 4 streams (or declare capability to do so)? - remove "except when the STA is an 20 MHz only non-AP STA" on lines 25 and 28?	2017/1/9 9:42
8637	Sigurd Schelstraete	225	1 28.1.1	210	31	T	N	210.31 28.1.1	"LDPC when declaring support for MCS10 and MCS11". Confirm that this also applies to 20 MHz-only STAs.	See comment	2017/1/9 9:42
8638	Sigurd Schelstraete	225	1 28.1.1	210	37	T	N	210.37 28.1.1	The GI/HE-LTF mandatory requirements are to support certain combinations of values. Reword for clarity.	For instance "Support for 0.8 usec GI in combination with 2x LTF" (similarly for other cases)	2017/1/9 9:42
8639	Sigurd Schelstraete	225	1 28.1.1	210	52	T	Y	210.52 28.1.1	Mandatory support for number of spatial streams is not listed	What is the mandatory number of spatial streams?	2017/1/9 9:42
8640	Sigurd Schelstraete	225	1 28.1.1	210	57	T	N	210.57 28.1.1	The GI/HE-LTF mandatory requirements are to support certain combinations of values. Reword for clarity.	For instance "Support for 0.8 usec GI in combination with 1x LTF" (similarly for other cases)	2017/1/9 9:42

8641	Sigurd Schelstraete	225	1 4.3.14a	9	18	T	Y	9.18 4.3.14a	Requirement not clear: "An HE non-AP STA supporting 20 MHz, 40 MHz, 80 MHz, 160 MHz and 80+80 MHz is also a VHT non-AP STA". Does this mean that the HE non-AP STA has to support all listed BW's before it is required to be a VHT non-AP STA?	Clarify. A HE STA should be a VHT STA, regardless of whether it supports 160/80+80.	2017/1/9 9:42
8642	Sigurd Schelstraete	225	1 9.2.4.1.8	19	35	T	N	19.35 9.2.4.1.8	Define non-HE STA	See comment	2017/1/9 9:42
8643	Sigurd Schelstraete	225	1 9.2.4.6.4.1	22	61	T	N	22.61 9.2.4.6.4.1	"The Control subfield with Control ID subfield equal to 0, if present, is the first subfield of the sequence." Are there restriction if the Control subfield with Control ID subfield equal to 0 is not present or is no specific ordering required in that case. If not, mention this explicitly.	See comment	2017/1/9 9:42
8644	Sigurd Schelstraete	225	1 9.2.4.6.4.1	22	61	T	N	22.61 9.2.4.6.4.1	"The Control subfield with Control ID subfield equal to 0, if present, is the first subfield of the sequence." If the Control subfield with Control ID subfield equal to 0 is present, there is no room for a second subfield. What's the point of this requirement?	Clarify	2017/1/9 9:42
8645	Sigurd Schelstraete	225	1 9.2.4.6.4.2	24	13	T	N	24.13 9.2.4.6.4.2	Change "for the soliciting frame" to "for the Trigger Frame preceding the UL MU response"	See comment	2017/1/9 9:42
8646	Sigurd Schelstraete	225	1 9.2.4.6.4.2	24	21	T	N	24.21 9.2.4.6.4.2	What is F_val?	Clarify	2017/1/9 9:42
8647	Sigurd Schelstraete	225	1 9.52.4.6.4.6	27	37	T	N	27.37 9.52.4.6.4.6	"B5 of the UL Power Headroom subfield is set to 1 to indicate ...". Make this a separate field if this bit serves a specific purpose.	See comment	2017/1/9 9:42
8648	Sigurd Schelstraete	225	1 9.3.1.20	40	32	T	N	40.32 9.3.1.20	The Nc subfield in Figure 9-25a is not defined.	Add description after line 30 on page 41	2017/1/9 9:42
8649	Sigurd Schelstraete	225	1 9.3.1.20	41	6	T	N	41.06 9.3.1.20	"Feedback Type And Ng" and "Codebook Size" are two separate fields in Figure 9-51b. However, they are treated as a single 3-bit field in Table 9-25a. Split the first column into two columns to show the value of each of the fields.	See comment	2017/1/9 9:42
8650	Sigurd Schelstraete	225	1 9.3.1.23	41	37	T	N	41.37 9.3.1.23	Split sentence for clarity	Change "The Trigger frame solicits and allocates resources for UL MU transmissions a SIFS after the PPDU that carries the Trigger frame." to "The Trigger frame solicits and allocates resources for UL MU transmissions. The UL MU transmissions start a SIFS after the PPDU that carries the Trigger frame."	2017/1/9 9:42
8651	Sigurd Schelstraete	225	1 9.3.1.23	42	8	E	N	42.08 9.3.1.23	Insert space between "GI" and "And"	See comment	2017/1/9 9:42
8652	Sigurd Schelstraete	225	1 9.3.1.23	42	26	T	N	42.26 9.3.1.23	The sentence "The Trigger frame can include an optional Trigger Dependent Common Info field and optional Trigger Dependent User Info field." looks out of place. This paragraph is about Trigger Type subfield.	Move sentence to more appropriate location	2017/1/9 9:42
8653	Sigurd Schelstraete	225	1 9.3.1.23	42	57	T	N	42.57 9.3.1.23	"HE trigger-based PPDU" could be plural.	Change "the value of the L-SIG Length field of the HE trigger-based PPDU that is the response to the Trigger frame" to "the value of the L-SIG Length field of all the HE trigger-based PPDUs that are sent in response to the Trigger frame"	2017/1/9 9:42
8654	Sigurd Schelstraete	225	1 9.3.1.23	43	7	T	N	43.07 9.3.1.23	"HE trigger-based PPDU" could be plural.	Change "the bandwidth in the HE-SIG-A of the HE trigger-based PPDU" to "the bandwidth in the HE-SIG-A field of all the HE trigger-based PPDUs that are sent in response to the Trigger frame"	2017/1/9 9:42
8655	Sigurd Schelstraete	225	1 9.3.1.23	44	26	T	N	44.26 9.3.1.23	Change "the same as" to "the same as the encoding of"	See comment	2017/1/9 9:42
8656	Sigurd Schelstraete	225	1 9.3.1.23	44	56	T	N	44.56 9.3.1.23	Split the "packet extension subfield" into two fields, similar to what was done for HE-SIG-A: one field for "pre-FEC padding factor" and one field for "PE Disambiguity".	See comment	2017/1/9 9:42

8657	Sigurd Schelstraete	225	1 9.3.1.23	45	11	T	Y	45.11 9.3.1.23	"The Doppler subfield indicates a high doppler mode of transmission" What does this mean? How would the AP know about the Doppler mode of the environment? Is the AP moving?	Clarify	2017/1/9 9:42
8658	Sigurd Schelstraete	225	1 9.3.1.23	45	38	E	N	45.38 9.3.1.23	Typo: "not equals to 0"	Change to "not equal to 0""	2017/1/9 9:42
8659	Sigurd Schelstraete	225	1 9.3.1.23	46	33	E	N	46.33 9.3.1.23	Change "B19-B13 are 0000000 indicates" to "A value of 0000000 for B19-B13 indicates ...". Note that this appears in many places in the text on lines 31-57.	See comment	2017/1/9 9:42
8660	Sigurd Schelstraete	225	1 9.3.1.23	47	15	T	Y	47.15 9.3.1.23	Is it allowed to choose "Starting Spatial Stream" such that there are gaps in the total number of streams. E.g: Starting Spatial Stream=0, N_SS=1 and Starting Spatial Stream=2, N_SS=1.	Specify that there should be no gaps in the numbering of all the streams in an UL MU-MIMO transmission.	2017/1/9 9:42
8661	Sigurd Schelstraete	225	1 9.3.1.23	47	15	T	N	47.15 9.3.1.23	Should "Starting Spatial Stream" value always be 0 for RU's that use "pure" OFDMA?	Clarify	2017/1/9 9:42
8662	Sigurd Schelstraete	225	1 9.3.1.23	47	47	E	N	47.47 9.3.1.23	Change "the rest bits" to "the remaining bits"	See comment	2017/1/9 9:42
8663	Sigurd Schelstraete	225	1 9.3.1.23	47	62	E	N	47.62 9.3.1.23	Change "max TF MAC Padding Duration ..." to "if max TF MAC Padding Duration ..."	Occurs three times on lines 62-65. Same on page 48, lines 11-14.	2017/1/9 9:42
8664	Sigurd Schelstraete	225	1 9.4.1.62	57	57	T	N	57.57 9.4.1.62	Wrong definition of "sounding dialog token number"	Provide correct definition	2017/1/9 9:42
8665	Sigurd Schelstraete	225	1 9.4.1.63	58	27	T	Y	58.27 9.4.1.63	Where is N_RX,BFEE defined?	Define	2017/1/9 9:42
8666	Sigurd Schelstraete	225	1 9.4.1.63	58	28	T	N	58.28 9.4.1.63	Possibly wrong reference: "where Nr and Nc satisfy Equation (8-1)."	Correct reference	2017/1/9 9:42
8667	Sigurd Schelstraete	225	1 9.4.1.63	58	35	T	N	58.35 9.4.1.63	"The HE Compressed Beamforming Report information has the same structure and order". Same as what?	Clarify	2017/1/9 9:42
8668	Sigurd Schelstraete	225	1 9.4.1.63	59	56	E	N	59.56 9.4.1.63	Repeat header row for Table 9-76c	See comment	2017/1/9 9:42
8669	Sigurd Schelstraete	225	1 9.4.1.63	60	14	T	N	60.14 9.4.1.63	List the values for (S,E) instead of saying "(S, E) for 80 MHz + 256"	See comment. Apply this throughout the tables 9-76c, 9-76d,	2017/1/9 9:42
8670	Sigurd Schelstraete	225	1 9.4.1.64	64	20	T	N	64.20 9.4.1.64	"The HE MU Exclusive Beamforming Report information has the same structure and order Table 9-76f". Sentence not clear. Same as what?	Clarify	2017/1/9 9:42
8671	Sigurd Schelstraete	225	1 9.4.2.218.1	76	19	T	N	76.19 9.4.2.218.1	Replace "defined in the subclauses below." with references to the relevant subclauses	See comment	2017/1/9 9:42
8672	Sigurd Schelstraete	225	1 9.4.2.218.1	79	42	T	N	79.42 9.4.2.218.1	"Definition" and "Encoding" are empty for "Maximum A-MPDU Length Exponent"	See comment	2017/1/9 9:42
8673	Sigurd Schelstraete	225	1 9.4.2.218.3	81	32	T	N	81.32 9.4.2.218.3	Why is "NSTS Total For <= 80 MHz" 2 bits and "NSTS Total For > 80 MHz" 3 bits? Their definition and encoding are identical in Table 9-262aa.	Change "2" to "3", since 3 bits are already allocated (B37-B39)	2017/1/9 9:42
8674	Sigurd Schelstraete	225	1 9.4.2.218.3	83	41	T	Y	83.41 9.4.2.218.3	What is "Doppler procedure"?	Clarify	2017/1/9 9:42
8675	Sigurd Schelstraete	225	1 9.4.2.218.3	84	40	T	Y	84.40 9.4.2.218.3	There are 6 conditions for setting the MU Beamformer bit. Some of them are potentially contradictory. E.g: Set to 1 if SU Beamformer subfield is 1, Set to 0 if sent by non-AP STA. Also, two of the conditions are: Set to 0 if the SU Beamformer subfield is 0, Set to 1 if SU Beamformer subfield is set to 1. This would make the MU Beamformer bit identical to the SU Beamformer bit. Clearly some extra hierarchy or conditions are needed to specify the value of the MU Beamformer bit.	Correct Encoding of MU Beamformer bit.	2017/1/9 9:42

8676	Sigurd Schelstraete	225	1 9.4.2.218.3	84	49	T	Y	84.49 9.4.2.218.3	Beamformee STS Capability is indicated in the HE Capabilities element. We believe HE should support MU-MIMO and BF optimized for up to 8 antennas. This means not being restricted by limited feedback capability of certain non-AP STAs. Ideally, all non-AP STAs should support Beamformee STS Capability equal to 8. Given that the feedback requirements are relatively straightforward for 1 and 2-antennas receivers, we could consider making it mandatory for those STAs. These are also the devices that are prime candidates for MU-MIMO and BF.	Define a class of non-AP STAs for which Beamformee STS Capability (and NSTS Total Capability) equal to 8 is mandatory (for instance, as function of N_STS supported by STA)		2017/1/9 9:42
8677	Sigurd Schelstraete	225	1 9.4.2.218.3	86	6	T	Y	86.06 9.4.2.218.3	The name "HE ER SU Payload" is not very descriptive. Replace with a name that better covers the definition.	See comment		2017/1/9 9:42
8678	Sigurd Schelstraete	225	1 9.4.2.218.4	86	44	T	N	86.44 9.4.2.218.4	There is no reason to call the field "Highest NSS Supported M1". It's better and cleaner to call it "Highest NSS Supported" and clarify how this is encoded, as is done throughout the draft (see e.g. "NSTS Total For <= 80 MHz", "Number Of Sounding Dimensions For <= 80 MHz", ... All of those fields are encoded as the number of streams minus 1, but that is not reflected in the field name)	See comment		2017/1/9 9:42
8679	Sigurd Schelstraete	225	1 9.4.2.218.4	87	56	T	N	87.56 9.4.2.218.4	"If all of the bits of the Tx BW Bitmap subfield and all of the bits of the Rx BW Bitmap subfield are zero, then none of the subfields of the Tx Rx HE MCS Support field beyond Highest MCS Supported need to be present."This means that "Tx BW bitmap", "Rx BW bitmap", ... could be absent. That should be reflected in Figure 9-589cm.	Add "(if present)" for the fields that are not always included.		2017/1/9 9:42
8680	Sigurd Schelstraete	225	1 9.4.2.218.4	88	30	T	N	88.30 9.4.2.218.4	What is the encoding of NSS: #streams or #streams - 1.	Clarify		2017/1/9 9:42
8681	Sigurd Schelstraete	225	1 9.4.2.218.5	88	59	T	N	88.59 9.4.2.218.5	Change name of "NSS M1" to "NSS" and make it clear that they content of the field is number of streams - 1	See comment		2017/1/9 9:42
8682	Sigurd Schelstraete	225	1 9.4.2.218.5	89	39	E	N	89.39 9.4.2.218.5	Typo: change ".." to "."	See comment		2017/1/9 9:42
8683	Sigurd Schelstraete	225	1 9.4.2.219	91	39	T	N	91.39 9.4.2.219	The "BSS Color" field has two definitions: lines 39-42 and lines 44-47. Which is correct?	Clarify		2017/1/9 9:42
8684	Sigurd Schelstraete	225	1 9.4.2.220	93	26	E	N	93.26 9.4.2.220	Typo: change "Lenght" to "Length"	See comment		2017/1/9 9:42
8685	Sigurd Schelstraete	225	1 9.4.2.220	93	51	T	N	93.51 9.4.2.220	Change "minimum value of OCW" to "minimum value of the exponent of OCW"	See comment		2017/1/9 9:42
8686	Sigurd Schelstraete	225	1 9.4.2.220	93	60	T	N	93.60 9.4.2.220	Change "maximum value of OCW" to "maximum value of the exponent of OCW"	See comment		2017/1/9 9:42
8687	Sigurd Schelstraete	225	1 9.4.2.223	95	55	E	N	95.55 9.4.2.223	Change "STA-2-STA" to "STA-to-STA" (as e.g. on line 50)	See comment		2017/1/9 9:42
8688	Sigurd Schelstraete	225	1 9.4.2.218.5	98	5	T	N	98.05 9.4.2.218.5	Clarify sentence. Change "The PPE Thresholds Info field is (NSS M1 + 1) x Number of bits set to 1 in the RU Index Bitmask subfield x 6 bits in length." to "The PPE Thresholds Info field contains 6 x (NSS M1 + 1) bits for every bit in the RU Index Bitmask subfield that is different from zero."	See comment		2017/1/9 9:42
8689	Sigurd Schelstraete	225	1 9.7.1	107	1	T	N	107.01 9.7.1	Where is HE PPDU in (9-5)?	Change "VHT PPDU" to "VHT and HE PPDU"		2017/1/9 9:42
8690	Sigurd Schelstraete	225	1 17.2.2.1	145	24	T	Y	145.24 17.2.2.1	In Table 17-1, it says that a value of "false" for "TRIGGER_RESPONDING" means that "the MAC entity requests that the PHY entity does not have to do synchronization". In 17.2.2.6 it says that "false" means that "the MAC sublayer is requesting that the PHY entity does not do synchronization". In other words: in one case, the MAC does not require (but presumably permits) timing correction, in the other case, the MAC does not allow synchronization. It's not clear why the MAC would forbid synchronization, even if it doesn't explicitly request it.	Change definition of "TRIGGER_RESPONDING" such that it indicates that the MAC does not require synchronization, but does not forbid it either.		2017/1/9 9:42

8691	Sigurd Schelstraete	225	1 17.2.2.1	145	53	T	Y	145.53 17.2.2.1	"pre-compensate for carrier frequency offset (CFO) error and symbol clock error". Relative to what?	Indicate that correction is done relative to the reference provided by the trigger frame.	2017/1/9 9:42
8692	Sigurd Schelstraete	225	1 27.1	149	8	T	N	149.08 27.1	Shouldn't section called "Introduction" briefly summarize the purpose of the Clause? Now all it says is that "The use of HCCA and TSPEC are banned at HE STAs."	Provide brief summary of Clause 27 as part of 27.1.	2017/1/9 9:42
8693	Sigurd Schelstraete	225	1 27.2.1	150	13	T	Y	150.13 27.2.1	One of the conditions for inter-BSS frame is: "An HE AP receives either a VHT MU PPDU or an HE MU PPDU". Does this imply that STAs can never use the MU format - even if they only transmit to one user.	Use of MU format by STAs should be clarified. Page 212, line 9 states that non-AP STAs may support "Transmission of an HE MU PPDU over partial PPDU bandwidth and full PPDU bandwidth". In that case, reception of an HE MU by the HE AP could be intra-BSS.	2017/1/9 9:42
8694	Sigurd Schelstraete	225	1 27.3.3.1	153	19	E	N	153.19 27.3.3.1	Typo: change ".." to "."	See comment	2017/1/9 9:42
8695	Sigurd Schelstraete	225	1 27.4.4.3	161	15	T	N	161.15 27.4.4.3	Improve wording "An Action frame in the DL MU PPDU is always responded with an HE trigger-based PPDU."	Change to e.g. "The response to an action frame in the DL MU PPDU is always an HE trigger-based PPDU."	2017/1/9 9:42
8696	Sigurd Schelstraete	225	1 27.5.1.1	162	49	T	N	162.49 27.5.1.1	"The transmission of each RU in an HE MU PPDU shall be padded to end at the same time". This requirement is already covered by the various decriptions of PHY and MAC padding. Since there is no further information on how to implement the padding here, it is better to change this to an informative statement.	Change to "The transmission of each RU in an HE MU PPDU are padded to end at the same time"	2017/1/9 9:42
8697	Sigurd Schelstraete	225	1 27.5.1.1	162	58	T	N	162.58 27.5.1.1	There is no "DL OFDMA With MIMO Support field" in HE Capabilities. Should this be "DL MUMIMO On Partial Bandwidth" field?	Clarify	2017/1/9 9:42
8698	Sigurd Schelstraete	225	1 27.5.1.2	163	8	T	N	163.08 27.5.1.2	"Two STA-ID fields in HE-SIG-B shall not have the same value ..." This requirements belongs in the PHY section. Replace it here with a more MAC-centric requirement (e.g. "The same user can not be scheduled in two different RU's")	See comment	2017/1/9 9:42
8699	Sigurd Schelstraete	225	1 27.5.1.3	163	20	T	N	163.20 27.5.1.3	"allocating DL MU and UL MU resources". Section 27.5.1.3 is called "HE bandwidth query report operation for DL MU". Should the title be changed or should UL MU resources be deleted?	Clarify	2017/1/9 9:42
8700	Sigurd Schelstraete	225	1 27.5.2.2.2	166	21	T	Y	166.21 27.5.2.2.2	"Number of HE-LTF Symbols is set to 1" So only single-stream transmisson is allowed?	Clarify	2017/1/9 9:42
8701	Sigurd Schelstraete	225	1 27.5.2.3	168	5	T	N	168.05 27.5.2.3	In the bullet list on page 168, sometimes we explicitly refer to the "Common field of the Trigger frame" sometimes just "The trigger Frame"	Include "Common field" in all cases	2017/1/9 9:42
8702	Sigurd Schelstraete	225	1 27.5.2.3	168	6	T	N	168.06 27.5.2.3	In the bullet list on page 168, sometimes we use "soliciting Trigger frame", sometimes "eliciting Trigger frame" or just "Trigger frame".	Use consistent wording	2017/1/9 9:42
8703	Sigurd Schelstraete	225	1 27.5.2.3	168	46	T	N	168.46 27.5.2.3	"The MCS parameter shall be set to shall be set to the value of the MCS field in the Common Info field of the eliciting Trigger frame". The MCS is not in the Common field, but the User Info field.	Correct. Also correct typo (repetition of "shall be set to")	2017/1/9 9:42
8704	Sigurd Schelstraete	225	1 27.5.2.3	168	169	T	Y	169.69 27.5.2.3	NSYM is not a TXVECTOR parameter. What is the correct requirement?	Clarify	2017/1/9 9:42
8705	Sigurd Schelstraete	225	1 27.5.2.5	171	41	T	N	171.41 27.5.2.5	Wrong reference: Table 9-XX	Correct reference	2017/1/9 9:42
8706	Sigurd Schelstraete	225	1 27.5.2.6.1	173	46	E	N	173.46 27.5.2.6.1	Typo: change "0If" to "0 if"	See comment	2017/1/9 9:42
8707	Sigurd Schelstraete	225	1 27.5.2.7	174	22	T	Y	174.22 27.5.2.7	"NDP feedback report procedure" does not have enough detail to be implementable.	Complete definition or delete section.	2017/1/9 9:42
8708	Sigurd Schelstraete	225	1 27.6.2	176	23	E	N	176.23 27.6.2	Change "more than one APs" to "more than one AP"	See comment	2017/1/9 9:42

8709	Sigurd Schelstraete	225	1 27.6.2	176	60	T	Y	176.60 27.6.2	"the maximum number of space-time streams it can receive in an HE NDP" and "the total number of space-time streams (summed across all users) it can receive" are indicated by two different parameters in HE Capabilities, neither of which is called "Beamformee STS Capability". Reference should be made to "Beamformee STS" and "NSTS Total" fields respectively. Also note that these fields may have different values for BW<=80 and BW>80.	Replace reference to "Beamformee STS Capability field" with references to "Beamformee STS" and "NSTS Total" fields	2017/1/9 9:42
8710	Sigurd Schelstraete	225	1 27.6.2	177	1	T	N	177.01 27.6.2	"shall set the Ng field value in the STA Info field of the HE NDP Announcement frame to either 0 (for Ng = 4) or 1 (for Ng = 16).". There are no other possible values than 0 and 1, so this requirement is superfluous. There are a limited number of possible combinations of codebook and Ng however (see Table 9-25a).	Change statement to informative or delete the sentence.	2017/1/9 9:42
8711	Sigurd Schelstraete	225	1 27.6.2	177	19	T	N	177.19 27.6.2	Wrong reference: Table YY-1	Correct reference	2017/1/9 9:42
8712	Sigurd Schelstraete	225	1 27.6.2	177	35	T	Y	177.35 27.6.2	"An HE beamformer that transmits an HE NDP Announcement frame that has only one STA Info field shall set the Nc Index field to 0 and the Ng field to 0." Nc=0 and Ng=0 are still valid values, so setting them to zero does not explicitly indicate that the STA has to select the values, instead of the AP.	Add a requirement that the beamformee shall ignore the values of Nc and Ng when the HE NDP Announcement frame only has one STA Info field.	2017/1/9 9:42
8713	Sigurd Schelstraete	225	1 27.6.2	178	44	T	N	178.44 27.6.2	"Supporting MU-type feedback over full BW is mandatory for HE beamformees participating in HE sounding protocol with more than one beamformee.". STA's don't have a choice in who participates in the sounding. Does this refer to STAs declaring a specific capability? If so, clarify.	See comment. Similar comment for line 54.	2017/1/9 9:42
8714	Sigurd Schelstraete	225	1 27.6.2	178	50	E	N	178.50 27.6.2	Typo: change "parital" to "partial"	See comment (also on line 56)	2017/1/9 9:42
8715	Sigurd Schelstraete	225	1 27.6.2	178	65	T	Y	178.65 27.6.2	Add the following requirement for HE NDP feedback from the beamformee: "If the HE NDP is received with the field TxBF in HE-SIG-A set to 1, the beamformee shall not apply channel smoothing during its estimation of the channel that is used to determine the HE sounding feedback."	See comment	2017/1/9 9:42
8716	Sigurd Schelstraete	225	1 27.6.3	179	5	T	Y	179.05 27.6.3	"The HE beamformer shall support maximum MPDU length for HE Compressed beamforming feedback of size which is the minimum of:" How can the HE beamformer know which MPDU length it has to support based on this requirement? What is the minimum of 11 454 and an unknown number?	Clarify	2017/1/9 9:42
8717	Sigurd Schelstraete	225	1 27.6.4	179	31	T	Y	179.31 27.6.4	"Beamformee STS Capability field" is not defined. Use "Beamformee STS" field instead. Also note that this fields may have different values for BW<=80 and BW>80.	See comment	2017/1/9 9:42
8718	Sigurd Schelstraete	225	1 27.6.4	179	37	T	N	179.37 27.6.4	Change "destination of an HE NDP" to "RA of an HE NDP"	See comment	2017/1/9 9:42
8719	Sigurd Schelstraete	225	1 27.6.4	179	37	T	N	179.37 27.6.4	Change "source of an HE NDP" to "TA of an HE NDP"	See comment	2017/1/9 9:42
8720	Sigurd Schelstraete	225	1 27.8.3	189	39	T	N	189.39 27.8.3	"it will not respond to all variants of the Trigger frame". Should this be "it will not respond to any variants of the Trigger frame" or are there certain types of Trigger Frame it will still respond to?	Clarify	2017/1/9 9:42
8721	Sigurd Schelstraete	225	1 27.9.2.2	191	7	T	N	191.07 27.9.2.2	Where are OBSSPDmin and OBSSPDmax defined?	Clarify	2017/1/9 9:42
8722	Sigurd Schelstraete	225	1 27.9.2.2	191	36	E	N	191.36 27.9.2.2	Resolution/quality of Figure 27-6 should be improved	See comment	2017/1/9 9:42
8723	Sigurd Schelstraete	225	1 27.9.2.2	192	1	T	N	192.01 27.9.2.2	NOTE is not clear	Clarify NOTE	2017/1/9 9:42
8724	Sigurd Schelstraete	225	1 27.11.1	195	48	T	N	195.48 27.11.1	Is it correct that the STA_ID_LIST contains one element per RU? If so, add this to the description.	See comment	2017/1/9 9:42

8725	Sigurd Schelstraete	225	1 27.11.1	195	57	T	Y	195.57 27.11.1	"The AP may include only one element with this value in a DL MU PPDU.". Does this mean there can only be one RU that is intended for more than one STA? This would mean that only one RU can do MU-MIMO, regardless of the number of RU's in the HE MU frame.	If this is indeed the case, this is an unacceptable limitation. Let the AP control the number of RU's with MU-MIMO.	2017/1/9 9:42
8726	Sigurd Schelstraete	225	1 27.11.3	196	31	E	N	196.31 27.11.3	Change "or the PPDU" to "or if the PPDU"	See comment	2017/1/9 9:42
8727	Sigurd Schelstraete	225	1 27.11.3	196	31	T	N	196.31 27.11.3	Replace "number of spatial streams" with reference to TXVECTOR parameter NUM_STS	See comment	2017/1/9 9:42
8728	Sigurd Schelstraete	225	1 27.11.4	196	51	E	N	196.51 27.11.4	Change "with which it is associated or intends to transmit" to "with which it is associated or to which it intends to transmit"	See comment	2017/1/9 9:42
8729	Sigurd Schelstraete	225	1 27.15.2	201	28	T	N	201.28 27.15.2	Change "An HE AP transmits" to "An HE AP may transmit", as in the paragraph above	See comment	2017/1/9 9:42
8730	Sigurd Schelstraete	225	1 27.15.2	201	28	T	N	201.28 27.15.2	Change "An HE non-AP transmits" to "An HE non-AP may transmit", as in the paragraph above	See comment	2017/1/9 9:42
8731	Sigurd Schelstraete	225	1 28.1.1	210	60	T	N	210.60 28.1.1	Support for LDPC coding does not cover the case of 20 MHz-only STA with capability to send more than four streams. Note that for this case, LDPC is neither mandatory or optional.	Clarify requirement	2017/1/9 9:42
8732	Sigurd Schelstraete	225	1 28.1.1	211	6	T	N	211.06 28.1.1	Improve wording: "the right 106-tone RU"	As opposed to "the wrong 106-tone RU"? Even left/right is not clear when talking about frequency.	2017/1/9 9:42
8733	Sigurd Schelstraete	225	1 28.1.1	211	10	T	N	211.10 28.1.1	Beam change missing from list?	Add here if appropriate	2017/1/9 9:42
8734	Sigurd Schelstraete	225	1 28.1.1	211	16	T	N	211.16 28.1.1	Shouldn't sounding also be mandatory for APs that have to support MU-MIMO?	Clarify	2017/1/9 9:42
8735	Sigurd Schelstraete	225	1 28.1.1	211	33	T	N	211.33 28.1.1	Clarify "Reception of the payload of an HE MU PPDU over a 106-tone RU within a 20 MHz PPDU bandwidth and full bandwidth PPDU"	See comment	2017/1/9 9:42
8736	Sigurd Schelstraete	225	1 28.1.1	212	6	T	Y	212.06 28.1.1	Should CFO/power compensation etc ... be mandatory for non-AP STA that supports UL MU?	Add appropriate requirement	2017/1/9 9:42
8737	Sigurd Schelstraete	225	1 28.1.1	212	9	T	N	212.09 28.1.1	What is meant with "partial PPDU bandwidth"? An RU with an MU PPDU?	Clarify	2017/1/9 9:42
8738	Sigurd Schelstraete	225	1 28.1.1	212	9	T	N	212.09 28.1.1	Do we need a term for a non-AP STA sending an HE MU PPDU? This sounds like neither uplink nor downlink. Can it only send to the AP or to other STAs as well?	Clarify	2017/1/9 9:42
8739	Sigurd Schelstraete	225	1 28.1.3.3	213	24	T	N	213.24 28.1.3.3	"HE-PHY-compliant developer" is not clear.	Use wording as in 21.1.3.3 "The models are optimized for simplicity and clarity of presentation, but do not necessarily reflect any particular implementation."	2017/1/9 9:42
8740	Sigurd Schelstraete	225	1 28.1.4	213	49	T	N	213.49 28.1.4	"Support for the HE SU PPDU format is mandatory." No need to state this here. This bullet lists only possible formats. Mandatory vs.optional is already covered in 28.1.1.	Delete "Support for the HE SU PPDU format is mandatory."	2017/1/9 9:42
8741	Sigurd Schelstraete	225	1 28.1.4	213	52	T	N	213.52 28.1.4	"Support for the HE extended range SU PPDU format is mandatory." No need to state this here. This bullet lists only possible formats. Mandatory vs.optional is already covered in 28.1.1.	Delete "Support for the HE extended range SU PPDU format is mandatory."	2017/1/9 9:42
8742	Sigurd Schelstraete	225	1 28.1.4	213	55	T	N	213.55 28.1.4	"Support for the HE MU PPDU format is mandatory." No need to state this here. This bullet lists only possible formats. Mandatory vs.optional is already covered in 28.1.1.	Delete "Support for the HE MU PPDU format is mandatory."	2017/1/9 9:42
8743	Sigurd Schelstraete	225	1 28.1.4	213	60	T	N	213.60 28.1.4	"Support for the HE trigger-based PPDU format is mandatory." No need to state this here. This bullet lists only possible formats. Mandatory vs.optional is already covered in 28.1.1.	Delete "Support for the HE trigger-based PPDU format is mandatory."	2017/1/9 9:42
8744	Sigurd Schelstraete	225	1 28.2.2	214	25	T	N	214.25 28.2.2	Table 28-1 stretches over several pages. Repeat header row for better readability.	See comment	2017/1/9 9:42
8745	Sigurd Schelstraete	225	1 28.2.2	215	14	E	N	215.14 28.2.2	Improve wording "The value comes from ..."	"The value is derived from ..."	2017/1/9 9:42
8746	Sigurd Schelstraete	225	1 28.2.2	217	5	T	N	217.05 28.2.2	Wrong reference: 26.3.12.3.2	Correct reference	2017/1/9 9:42

8747	Sigurd Schelstraete	225	1 28.2.2	217	22	T	N	217.22 28.2.2	"VHT NDP PPDU or HE NDP PPDU". Is it the intention to allow HE PPDUs to use sounding information from VHT PPDUs? If so, shouldn't VHT PPDUs also be allowed to use HE sounding information?	Clarify	2017/1/9 9:42
8748	Sigurd Schelstraete	225	1 28.2.2	217	33	T	N	217.33 28.2.2	Should SNR be defined per RU for HE MU PPDUSs?	Clarify	2017/1/9 9:42
8749	Sigurd Schelstraete	225	1 28.2.2	217	38	T	N	217.38 28.2.2	Clarify "each spatial stream of the receiver." to distinguish it more clearly from the SU case	E.g. "For the subset of spatial streams in the PPDU that is intended for the receiver"	2017/1/9 9:42
8750	Sigurd Schelstraete	225	1 28.2.2	217	42	T	N	217.42 28.2.2	Clarify "for each spatial stream per user.". Does this imply there is only one stream per user? Does "each spatial stream per user" mean "all streams across users"?	Clarify	2017/1/9 9:42
8751	Sigurd Schelstraete	225	1 28.2.2	218	11	T	N	218.11 28.2.2	FEC_CODING support shows MU for TXVECTOR and MU for RXVECTOR (4th and 5th column). However, this will depend on the PPDU format. It would be more correct to say: - For HE SU: Y/Y - For HE MU: MU/Y - For HE_EXT_SU: Y/Y - For HE_TRIG: Y/MU	Specify per format	2017/1/9 9:42
8752	Sigurd Schelstraete	225	1 28.2.2	218	20	T	N	218.20 28.2.2	"Indicates the presence of the extra OFDM symbol" should be symbol segment since no complete symbol is added.	Correct	2017/1/9 9:42
8753	Sigurd Schelstraete	225	1 28.2.2	218	37	T	N	218.37 28.2.2	"all RUs are not STBC encoded" is ambiguous	Replace with "no RUs are STBC encoded". Similarly on line 44.	2017/1/9 9:42
8754	Sigurd Schelstraete	225	1 28.2.2	219	19	T	N	219.19 28.2.2	"it is a monotonically increasing function of the received power" is a statement of fact. It probably should be a requirement instead.	Change to make it a requirement (shall or should)	2017/1/9 9:42
8755	Sigurd Schelstraete	225	1 28.2.2	219	25	T	N	219.25 28.2.2	RSSI_LEGACY should be renamed to avoid the term "legacy" since this term is not used in the baseline document to refer to preamble types.	Rename	2017/1/9 9:42
8756	Sigurd Schelstraete	225	1 28.2.2	219	28	T	N	219.28 28.2.2	The term "PHY legacy preamble" should not be used.	Replace with "non-HE preamble fields"	2017/1/9 9:42
8757	Sigurd Schelstraete	225	1 28.2.2	219	31	T	N	219.31 28.2.2	"it is a monotonically increasing function of the received power" is a statement of fact. It probably should be a requirement instead.	Change to make it a requirement (shall or should)	2017/1/9 9:42
8758	Sigurd Schelstraete	225	1 28.2.2	219	33	T	N	219.33 28.2.2	"modulation and coding scheme" can be plural	Replace with "modulation and coding scheme(s)"	2017/1/9 9:42
8759	Sigurd Schelstraete	225	1 28.2.2	219	33	T	N	219.33 28.2.2	MCS support shows MU for TXVECTOR and MU for RXVECTOR (4th and 5th column). However, this will depend on the PPDU format. It would be more correct to say: - For HE SU: Y/Y - For HE MU: MU/Y - For HE_EXT_SU: Y/Y - For HE_TRIG: Y/MU	Correct	2017/1/9 9:42
8760	Sigurd Schelstraete	225	1 28.2.2	219	40	T	N	219.40 28.2.2	DCM support shows MU for TXVECTOR and MU for RXVECTOR (4th and 5th column). However, this will depend on the PPDU format. It would be more correct to say: - For HE SU: Y/Y - For HE MU: MU/Y - For HE_EXT_SU: Y/Y - For HE_TRIG: Y/MU	Correct	2017/1/9 9:42
8761	Sigurd Schelstraete	225	1 28.2.2	219	50	T	N	219.50 28.2.2	"HE extend range SU" should be "HE extended range SU"	Correct	2017/1/9 9:42
8762	Sigurd Schelstraete	225	1 28.2.2	219	51	T	N	219.51 28.2.2	The term SU RU is not clearly defined	Rename or provide definition	2017/1/9 9:42
8763	Sigurd Schelstraete	225	1 28.2.2	219	53	T	N	219.53 28.2.2	Replace "DCM is not applied to STBC" with "DCM is not applied in combination with STBC"	See comment	2017/1/9 9:42
8764	Sigurd Schelstraete	225	1 28.2.2	220	11	T	N	220.11 28.2.2	SIG_B_COMPRESSION_MODE is not an independent parameter. SIG-B compression is only used for full-BW MU-MIMO. Whether the PPDU is full BW MU-MIMO will follow from other fields in TXVECTOR.	Remove "SIG_B_COMPRESSION_MODE" from the Table	2017/1/9 9:42
8765	Sigurd Schelstraete	225	1 28.2.2	221	15	T	N	221.15 28.2.2	Replace "Right 106-tone RU" with "higher in frequency"	See comment	2017/1/9 9:42
8766	Sigurd Schelstraete	225	1 28.2.2	221	18	T	N	221.18 28.2.2	The term "channel bonding" has been replaced with "preamble puncturing"	Replace wording	2017/1/9 9:42

8767	Sigurd Schelstraete	225	1 28.2.2	221	18	T	N	221.18 28.2.2	The values for CH_BANDWIDTH for HE_MU format should be included in this table. Values in SIG-A should reference the values in this table, not the other way around.	Provided enumerated list with possible values.	2017/1/9 9:42
8768	Sigurd Schelstraete	225	1 28.2.2	221	24	T	N	221.24 28.2.2	What is the estimated channel width of an HE_TRIG PPDU in RXVECTOR? Isn't it already known at the AP? What would be the bandwidth if not all triggered STAs respond to the trigger? There could be many more possibilities than the ones listed.	Clarify	2017/1/9 9:42
8769	Sigurd Schelstraete	225	1 28.2.2	221	33	T	N	221.33 28.2.2	"The TXVECTOR parameter CH_BANDWIDTH does not represent the channel width of the transmitted PPDU.". It might.	Replace with "The TXVECTOR parameter CH_BANDWIDTH does not necessarily represent the channel width of the transmitted PPDU."	2017/1/9 9:42
8770	Sigurd Schelstraete	225	1 28.2.2	222	42	T	N	222.42 28.2.2	NUM_STS support in RXVECTOR is indicated as MU (column 5) for HE_MU. Does this mean that each receiver has to indicate the NUM_STS for all users in the MU PPDU? Why?	Clarify	2017/1/9 9:42
8771	Sigurd Schelstraete	225	1 28.2.2	222	46	T	N	222.46 28.2.2	"non MU-MIMO RU". Previously "SU RU" was used. Need a clear term for this type of RU.	Use unique terminology to refer to RU with only one user	2017/1/9 9:42
8772	Sigurd Schelstraete	225	1 28.2.2	222	49	T	N	222.49 28.2.2	"NUM_STS summed over all users per RU is not greater than 8." is a statement of fact. It should be a requirement.	Replace with "NUM_STS summed over all users per RU shall not be greater than 8."	2017/1/9 9:42
8773	Sigurd Schelstraete	225	1 28.2.2	222	51	T	N	222.51 28.2.2	NUM_STS support in TXVECTOR is indicated as MU (column 4) for HE_TRIG. Each Trigger-based frame has only one user.	Change "MU" to "Y"	2017/1/9 9:42
8774	Sigurd Schelstraete	225	1 28.2.2	223	25	T	N	223.25 28.2.2	Remove paragraph starting at line 25. This is too much detail and refers to B0-B7 that are not used in this section. Alse delete NOTE.	See comment	2017/1/9 9:42
8775	Sigurd Schelstraete	225	1 28.2.2	223	51	T	N	223.51 28.2.2	"Indicates whether the doppler effect should be considered for the PPDU." There is no indication anywhere in the document what this means. This requirement is not actionable.	Clarify or remove parameter.	2017/1/9 9:42
8776	Sigurd Schelstraete	225	1 28.2.2	224	20	T	N	224.20 28.2.2	RU_ALLOCATION is not explicitly indicated in the PPDU for HE_TRIG, so it can not be part of RXVECTOR.	Replace "MU" in column 5 with "N"	2017/1/9 9:42
8777	Sigurd Schelstraete	225	1 28.2.2	224	29	T	N	224.29 28.2.2	"a single user allocation in an RU". Previously terms "SU RU and "non MU-MIMO RU" were used.	Use unique terminology to refer to RU with only one user	2017/1/9 9:42
8778	Sigurd Schelstraete	225	1 28.2.2	224	38	T	N	224.38 28.2.2	The value of HE_LTF_MODE can not be chose independently from the GI_TYPE	Restrict the number of possible combinations of GI and LTF type. Either have a single parameter to list the combinations or add NOTE.	2017/1/9 9:42
8779	Sigurd Schelstraete	225	1 28.2.2	224	56	T	N	224.56 28.2.2	NUM_HE_LTF also needs to be be supported for format "HE_MU". The value is needed in HE-SIG-A for MU format.	Change "FORMAT is HE_TRIG" to "FORMAT is HE_TRIG or HE_MU"	2017/1/9 9:42
8780	Sigurd Schelstraete	225	1 28.2.2	225	52	T	N	225.52 28.2.2	Why is PREAMBLE_TYPE only specified for HE? Shouldn't TX/RXVECTOR also be updated for other types?	Clarify	2017/1/9 9:42
8781	Sigurd Schelstraete	225	1 28.2.2	226	4	T	N	226.04 28.2.2	The parameter "PE_DURATION" should be renamed "MAX_PE_DURATION", since it doesn't give the actual value of the PE field.	See Comment. Also updated\ decription.	2017/1/9 9:42
8782	Sigurd Schelstraete	225	1 28.2.2	226	13	T	N	226.13 28.2.2	BEAM_CHANGE is described as boolean value (true/false). In most other binary cases, 0/1 is used. Which is correct?	Use either boolean or 0/1 consistently.	2017/1/9 9:42
8783	Sigurd Schelstraete	225	1 28.2.2	227	4	T	N	227.04 28.2.2	Why does the MAC need to know the Scrambler Initialization value? RXVECTOR already contains CH_BANDWIDTH_IN_NON_HT and DYN_BANDWIDTH_IN_NON_HT for NON_HT format. For other formats, this value carries no information.	Remove "SCRAMBLER_INITIAL_STATE" from the Table	2017/1/9 9:42
8784	Sigurd Schelstraete	225	1 28.3.2.1	227	48	T	N	227.48 28.3.2.1	"The MU transmissions include DL MU transmissions and UL MU transmissions." What do we call an HE MU transmitted by an non-AP STA? This is an allowed option (see page 212, line 9), but it appears to be neither UL or DL MU.	Clarify	2017/1/9 9:42

8785	Sigurd Schelstraete	225	1 28.3.2.1	227	50	T	N	227.50 28.3.2.1	"simultaneously transmit frames". There is only one frame. Use term PSDU instead of frame.	See comment	2017/1/9 9:42
8786	Sigurd Schelstraete	225	1 28.3.2.1	227	54	T	N	227.54 28.3.2.1	"simultaneous frames from more than one non-AP STAs.". It is allowed to trigger a sinlge STA, so it would be more correct to say "one or more non-AP STAs"	See comment	2017/1/9 9:42
8787	Sigurd Schelstraete	225	1 28.3.2.1	227	55	T	N	227.55 28.3.2.1	"Non-AP STAs transmit their frames using HE trigger-based PPDU format and employ either UL OFDMA, UL MU-MIMO, or a mixture of both." The STAs don't employ OFDMA or MU-MIMO. They simply transmit in their given RU with the requested number of HE-LTFs and are pretty much ignorant to whether MU-MIMO is applied or not.	Delete "and employ either UL OFDMA, UL MU-MIMO, or a mixture of both."	2017/1/9 9:42
8788	Sigurd Schelstraete	225	1 28.3.2.1	227	59	T	N	227.59 28.3.2.1	Replace "On an RU" with "within an RU"	See comment	2017/1/9 9:42
8789	Sigurd Schelstraete	225	1 28.3.2.1	227	64	T	N	227.64 28.3.2.1	Who is "they"?	Improve wording	2017/1/9 9:42
8790	Sigurd Schelstraete	225	1 28.3.2.1	228	1	T	N	228.01 28.3.2.1	"SU transmission" in a given RU can only be done using HE MU format. The use of the term SU in this case is confusing. We need a better term to distinguish RUs with one user vs. RUs shared by multiple users.	See comment	2017/1/9 9:42
8791	Sigurd Schelstraete	225	1 28.3.3.1	228	12	T	N	228.12 28.3.3.1	Replace "several" with "one or more". MU format can be used for one user.	See Comment. Also updated\ decription.	2017/1/9 9:42
8792	Sigurd Schelstraete	225	1 28.3.3.1	228	12	T	N	228.12 28.3.3.1	Remove "in general"	See comment	2017/1/9 9:42
8793	Sigurd Schelstraete	225	1 28.3.3.1	228	13	T	N	228.13 28.3.3.1	"In HE, the time region covers the entire data portion of an HE PPDU". No mention has been made of "time regions" so far. The need for this is not clear.	Replace "In HE, the time region covers the entire data portion of an HE PPDU, and the frequency region includes a number of contiguous subcarriers with the exception of the RUs which straddle DC where nulls are placed in the middle of the band." with "In HE, subsets consists of contiguous subcarriers called resource units (RU) with the exception of the RUs which straddle DC where nulls are placed in the middle of the band."	2017/1/9 9:42
8794	Sigurd Schelstraete	225	1 28.3.3.1	228	17	T	N	228.17 28.3.3.1	Reference to Table 28-15 should probably be Figure 28-1	Correct reference	2017/1/9 9:42
8795	Sigurd Schelstraete	225	1 28.3.3.1	228	18	T	N	228.18 28.3.3.1	Sentence starting at "Similar to OFDM, ..." is essentially repetition.	Remove sentence	2017/1/9 9:42
8796	Sigurd Schelstraete	225	1 28.3.3.1	228	20	T	N	228.20 28.3.3.1	The term "subchannelization" is only used twice on this page and nowhere else in the document.	Delete this sentence and the use of "subchannelization"	2017/1/9 9:42
8797	Sigurd Schelstraete	225	1 28.3.3.1	228	50	T	N	228.50 28.3.3.1	Sentence starting at "Subchannelization defines subchannels, ..." is essentially repetition.	Remove sentence	2017/1/9 9:42
8798	Sigurd Schelstraete	225	1 28.3.3.5	237	26	T	N	237.26 28.3.3.5	Improve wording "some RUs in 20 MHz operating STAs are restricted to be used in 40, 80, 80+80 or 160 MHz OFDMA operation."	Change to e.g. "the use of some RUs in the presence of 20 MHz operating STAs is not allowed in 40, 80, 80+80 or 160 MHz OFDMA transmissions."	2017/1/9 9:42
8799	Sigurd Schelstraete	225	1 28.3.3.5	237	34	T	N	237.34 28.3.3.5	Delete "(2 26-tone RUs are restricted)". This adds no useful information.	See comment	2017/1/9 9:42
8800	Sigurd Schelstraete	225	1 28.3.3.5	237	36	T	N	237.36 28.3.3.5	Delete "(7 26-tone RUs are restricted)". This adds no useful information.	See comment	2017/1/9 9:42
8801	Sigurd Schelstraete	225	1 28.3.3.5	237	38	T	N	237.38 28.3.3.5	Delete "(14 26-tone RUs are restricted)". This adds no useful information.	See comment	2017/1/9 9:42
8802	Sigurd Schelstraete	225	1 28.3.3.5	237	42	T	N	237.42 28.3.3.5	Delete "(2 of 52-tone RUs are restricted)". This adds no useful information.	See comment	2017/1/9 9:42
8803	Sigurd Schelstraete	225	1 28.3.3.5	237	44	T	N	237.44 28.3.3.5	Delete "(4 of 52-tone RUs are restricted)". This adds no useful information.	See comment	2017/1/9 9:42
8804	Sigurd Schelstraete	225	1 28.3.3.5	237	49	T	N	237.49 28.3.3.5	Delete "(2 of 106-tone RUs are restricted)". This adds no useful information.	See comment	2017/1/9 9:42
8805	Sigurd Schelstraete	225	1 28.3.3.5	237	50	T	N	237.50 28.3.3.5	Delete "(4 of 106-tone RUs are restricted)". This adds no useful information.	See comment	2017/1/9 9:42
8806	Sigurd Schelstraete	225	1 28.3.3.5	237	57	T	N	237.57 28.3.3.5	"all 242-tone RUs of 20 MHz operating STAs". How can there be more than one 242-tone RU in 20 MHz? What does this requirement mean?	Clarify	2017/1/9 9:42
8807	Sigurd Schelstraete	225	1 28.3.3.5	237	57	T	N	237.57 28.3.3.5	"It is optional ...". Support for an option should be indicated in e.g. Capabilities. How is support for this option communicated?	Clarify	2017/1/9 9:42

8808	Sigurd Schelstraete	225	1 28.3.3.6	238	1	T	N	238.01 28.3.3.6	"20 MHz-only" instead of "20 MHz only"?	Use one term consistenly throughout the draft	2017/1/9 9:42
8809	Sigurd Schelstraete	225	1 28.3.3.6	238	1	T	N	238.01 28.3.3.6	It seems more logical to have current section 28.3.3.6 before 28.3.3.5	Swap sections	2017/1/9 9:42
8810	Sigurd Schelstraete	225	1 28.3.3.6	238	5	T	N	238.05 28.3.3.6	"A 20 MHz only HE STA operates in the primary 20 MHz channel as a mandatory mode." is not correct language for a standard.	Change to "A 20 MHz only HE STA shall only operate in the primary 20 MHz channel."	2017/1/9 9:42
8811	Sigurd Schelstraete	225	1 28.3.3.6	238	5	T	Y	238.05 28.3.3.6	"A 20 MHz only HE STA operates in the primary 20 MHz channel as a mandatory mode." Having 20 MHz-only systems operate in only the primary channel is suboptimal. There should be an option for 20-MHz only devices to operate in any 20 MHz channels.	See comment	2017/1/9 9:42
8812	Sigurd Schelstraete	225	1 28.3.3.6	238	9	T	N	238.09 28.3.3.6	"An HE AP in 5 GHz shall be 80 MHz capable". This is already covered in 28.1.1. No need to repeat.	Delete	2017/1/9 9:42
8813	Sigurd Schelstraete	225	1 28.3.3.6	238	13	T	N	238.13 28.3.3.6	Add references to Table 28-3 to 28-5 for clarity	See comment	2017/1/9 9:42
8814	Sigurd Schelstraete	225	1 28.3.3.7	238	19	T	N	238.19 28.3.3.7	The purpose of this section is not clear or informative.	Delete 28.3.3.7	2017/1/9 9:42
8815	Sigurd Schelstraete	225	1 28.3.3.8.1	238	27	T	N	238.27 28.3.3.8.1	Change title to "Supported RU sizes for DL MU-MIMO"	See comment	2017/1/9 9:42
8816	Sigurd Schelstraete	225	1 28.3.3.8.1	238	30	T	N	238.30 28.3.3.8.1	There should be a similar requirement for transmit side (MU-MIMO only on RU sizes >= 106 tones)	Add requirement	2017/1/9 9:42
8817	Sigurd Schelstraete	225	1 28.3.3.8.1	238	30	T	N	238.30 28.3.3.8.1	Add reference to HE Capabilities field "DL MUMIMO On Partial Bandwidth"	See comment	2017/1/9 9:42
8818	Sigurd Schelstraete	225	1 28.3.3.8.2	238	38	E	N	238.38 28.3.3.8.2	Change "to minimum of" to "to the minimum of"	See comment	2017/1/9 9:42
8819	Sigurd Schelstraete	225	1 28.3.3.8.3	238	55	T	N	238.55 28.3.3.8.3	Most of the text in 28.3.3.8.3 seems to belong in either HE-SIG-A or HE-SIG-B sections. Move the relevant text to the appropriate sections and describe resource allocation in more general terms for this section.	See comment	2017/1/9 9:42
8820	Sigurd Schelstraete	225	1 28.3.3.8.3	238	60	T	N	238.60 28.3.3.8.3	Use HE-SIG-B instead of SIGB	Replace throughout the text.	2017/1/9 9:42
8821	Sigurd Schelstraete	225	1 28.3.3.8.3	239	17	T	Y	239.17 28.3.3.8.3	Paragraph starting at line 17 describes receiver operation. Transmitter behavior should be described instead.	Describe contents of HE-SIG-B from transmitter point of view.	2017/1/9 9:42
8822	Sigurd Schelstraete	225	1 28.3.3.8.3	239	38	T	N	239.38 28.3.3.8.3	"If a STA finds that it is a member of the beamformee group in RU r, its corresponding NSTS,r,u interpreted from the HE-SIG-B user specific blocks shall not be zero for the STA in the PPDU." There is no way the receiver can control the value of the HE-SIG-B user specific blocks, so this requirement as formulated for the receiver does not make sense.	Change to e.g. "If a STA is included as a a member of the beamformee group in RU r, its corresponding NSTS,r,u as contained in the HE-SIG-B user specific blocks shall not be zero."	2017/1/9 9:42
8823	Sigurd Schelstraete	225	1 28.3.3.9.1	239	46	T	N	239.46 28.3.3.9.1	Do we really need a subsection to 28.3.3.9? 28.3.3.9.1 is the only subsection here and it's only one sentence long.	Merge 28.3.3.9 and 28.3.3.9.1	2017/1/9 9:42
8824	Sigurd Schelstraete	225	1 28.3.3.9.1	239	49	T	N	239.49 28.3.3.9.1	Change "more than one" to "one or more"	See comment	2017/1/9 9:42
8825	Sigurd Schelstraete	225	1 28.3.3.9.1	239	50	T	N	239.50 28.3.3.9.1	STA should be plural	Change "The non-AP STA uses" to "The non-AP STA(s) use"	2017/1/9 9:42
8826	Sigurd Schelstraete	225	1 28.3.3.9.1	239	52	T	N	239.52 28.3.3.9.1	Mention both MU-MIMO and OFDMA in the introductory section 28.3.3.9.1	See comment	2017/1/9 9:42
8827	Sigurd Schelstraete	225	1 28.3.3.10.2	240	1	T	N	240.01 28.3.3.10.2	Change title to "Supported RU sizes for UL MU-MIMO"	See comment	2017/1/9 9:42
8828	Sigurd Schelstraete	225	1 28.3.3.10.2	240	3	T	N	240.03 28.3.3.10.2	Add reference to HE Capabilities field "UL MUMIMO "	See comment	2017/1/9 9:42
8829	Sigurd Schelstraete	225	1 28.3.3.10.2	240	6	T	N	240.06 28.3.3.10.2	There should be a similar requirement for receiver side (MU-MIMO only on RU sizes >= 106 tones)	Add requirement	2017/1/9 9:42
8830	Sigurd Schelstraete	225	1 28.3.3.10.2	240	23	E	N	240.23 28.3.3.10.2	Change "to minimum of" to "to the minimum of"	See comment	2017/1/9 9:42
8831	Sigurd Schelstraete	225	1 28.3.3.10.2	240	29	T	N	240.29 28.3.3.10.2	Clarify "A total of up to 8". Each STA individually only has knowledge of its own streams. Isn't this more a requirement on HE-LTF?	Clarify	2017/1/9 9:42
8832	Sigurd Schelstraete	225	1 28.3.3.10.2	240	39	T	N	240.39 28.3.3.10.2	Change "indicates the transmitting STAs" to "indicates to the transmitting STAs"	See comment	2017/1/9 9:42
8833	Sigurd Schelstraete	225	1 28.3.3.10.2	240	55	T	N	240.55 28.3.3.10.2	"will not transmit" should be a requirement	Change to "shall not transmit"	2017/1/9 9:42
8834	Sigurd Schelstraete	225	1 28.3.4	241	14	T	N	241.14 28.3.4	Change "that is not a response of a Trigger frame" to "when the PPDU is not a response to a Trigger Frame"	See comment	2017/1/9 9:42

8835	Sigurd Schelstraete	225	1 28.3.4	241	28	T	N	241.28 28.3.4	"HE-SIG-A field is repeated". Strictly speaking it is not simply a repetition, since the interleaving is different.	Clarify	2017/1/9 9:42
8836	Sigurd Schelstraete	225	1 28.3.4	242	4	T	N	242.04 28.3.4	SIGNAL is all-caps for L-SIG and RL-SIG, but not for HE-SIG-A and HE-SIG-B.	Use "SIGNAL" or "Signal" consistently	2017/1/9 9:42
8837	Sigurd Schelstraete	225	1 28.3.4	242	27	T	N	242.27 28.3.4	Text mentions the field HE-SIG-A-R. This is not mentioned anywhere else. Should this be used in the definition of the preamble or should be remove it?	Clarify	2017/1/9 9:42
8838	Sigurd Schelstraete	225	1 28.3.5	243	16	T	N	243.16 28.3.5	Figure 28-9 shows L-SIG, RL-SIG, HE-SIG-A. Don't' bring L-STF or L-LTF into the description.	Remove line 16 (starting at "These transmit blocks") to line 22. Similarly for lines 53 to 59.	2017/1/9 9:42
8839	Sigurd Schelstraete	225	1 28.3.5	244	31	T	N	244.31 28.3.5	Don't use term "legacy preamble".	Use e.g. non-HE preamble fields	2017/1/9 9:42
8840	Sigurd Schelstraete	225	1 28.3.5	244	31	T	N	244.31 28.3.5	"on the 20 MHz channels where the STA's HE modulated fields are located" is not clear.	Change to "on the 20 MHz channels that overlap with the RU's that are used by the HE-modulated fields"	2017/1/9 9:42
8841	Sigurd Schelstraete	225	1 28.3.5	245	29	T	N	245.29 28.3.5	Change "number of spatial stream" to "number of spatial streams"	See comment	2017/1/9 9:42
8842	Sigurd Schelstraete	225	1 28.3.6.2	249	53	T	N	249.53 28.3.6.2	For HE_MU, L-STF should only be sent in the 20 MHz channels that overlap with active RU's, so the CH_BANDWIDTH alone does not determine L-STF sequence over the full frequency.	Add special requirements for HE_MU. Similar for L-LTF, L-SIG and RL_SIG.	2017/1/9 9:42
8843	Sigurd Schelstraete	225	1 28.3.6.4	250	42	T	N	250.42 28.3.6.4	Change "in subcarriers k" to "at subcarriers locations"	See comment	2017/1/9 9:42
8844	Sigurd Schelstraete	225	1 28.3.6.4	250	47	T	N	250.47 28.3.6.4	Wrong reference: 228.3.9	Correct	2017/1/9 9:42
8845	Sigurd Schelstraete	225	1 28.3.6.5	250	59	T	N	250.59 28.3.6.5	No need to repeat copnstruction of RL-SIG. It is sufficient to mention that it is identical to L-SIG.	Delete text in section and replace with "Construction of RL-SIG is identical to construction of L-SIG"	2017/1/9 9:42
8846	Sigurd Schelstraete	225	1 28.3.6.8	253	8	T	N	253.08 28.3.6.8	There is no per-20 MHz phase rotation for HE-STF (see page 267, line 4, "In HE modulated fields, gamma_k,BW = 1 in all the subcarriers")	Remove bullet b)	2017/1/9 9:42
8847	Sigurd Schelstraete	225	1 28.3.6.9	253	32	T	N	253.32 28.3.6.9	There is no per-20 MHz phase rotation for HE-LTF (see page 267, line 4, "In HE modulated fields, gamma_k,BW = 1 in all the subcarriers")	Remove bullet b)	2017/1/9 9:42
8848	Sigurd Schelstraete	225	1 28.3.6.10.1	253	59	T	N	253.59 28.3.6.10.1	Bullet (a) needs to be rewritten to describe a step in the construction of the data field.	Change to e.g. "Construct the SERVICE field as described in 28.3.11.3 and append the PSDU to the SERVICE field"	2017/1/9 9:42
8849	Sigurd Schelstraete	225	1 28.3.6.10.1	254	9	T	N	254.09 28.3.6.10.1	The description of Segment parser is incomplete and inconsistent with e.g. 28.3.6.10.2	Use definition from 28.3.6.10.2 ("Segment parser (if needed): In a 160 MHz or 80+80 MHz transmission with a 2×996-tone RU, divide the output of each stream parser into two frequency subblocks as described in 28.3.11.6 (Stream parser). This block is bypassed for 20 MHz, 40 MHz, and 80 MHz transmissions.")	2017/1/9 9:42
8850	Sigurd Schelstraete	225	1 28.3.6.10.1	254	15	T	N	254.15 28.3.6.10.1	The description of Segment deparser is incomplete and inconsistent with e.g. 28.3.6.10.2	Use definition from 28.3.6.10.2 ("Segment deparser (if needed): In 160 MHz transmission, merge the two frequency subblocks into one frequency segment as described in 28.3.11.12 (Segment deparser). This block is bypassed for 20 MHz, 40 MHz, 80 MHz, and 80+80 MHz transmissions.")	2017/1/9 9:42
8851	Sigurd Schelstraete	225	1 28.3.6.10.1	254	24	T	N	254.24 28.3.6.10.1	There is no per-20 MHz phase rotation for data (see page 267, line 4, "In HE modulated fields, gamma_k,BW = 1 in all the subcarriers")	Remove bullet o)	2017/1/9 9:42
8852	Sigurd Schelstraete	225	1 28.3.6.10.1	254	29	T	N	254.29 28.3.6.10.1	Change "prepend a GI " to "Prepend a GI determined by the TXVECTOR parameter GI_TYPE" as in 28.3.6.11.4	See comment	2017/1/9 9:42
8853	Sigurd Schelstraete	225	1 28.3.6.10.2	254	42	T	N	254.42 28.3.6.10.2	Bullet (a) needs to be rewritten to describe a step in the construction of the data field.	Change to e.g. "Construct the SERVICE field as described in 28.3.11.3 and append the PSDU to the SERVICE field"	2017/1/9 9:42
8854	Sigurd Schelstraete	225	1 28.3.6.10.2	254	49	T	N	254.49 28.3.6.10.2	"LDPC encode with APEP_LENGTH in the TXVECTOR" is not clear	Replace bullet with: "d) LDPC encoder: LDPC encode as described in 28.3.11.5.2 (LDPC coding)."	2017/1/9 9:42
8855	Sigurd Schelstraete	225	1 28.3.6.10.2	255	12	T	N	255.12 28.3.6.10.2	There is no per-20 MHz phase rotation for data (see page 267, line 4, "In HE modulated fields, gamma_k,BW = 1 in all the subcarriers")	Remove bullet o)	2017/1/9 9:42

8856	Sigurd Schelstraete	225	1 28.3.6.10.2	255	18	T	N	255.18 28.3.6.10.2	Change "prepend a GI " to "Prepend a GI determined by the TXVECTOR parameter GI_TYPE" as in 28.3.6.11.4	See comment	2017/1/9 9:42
8857	Sigurd Schelstraete	225	1 28.3.6.11.4	255	52	T	N	255.52 28.3.6.11.4	It may be better to re-number the bullet list to run from n) to r). This makes it consistent with 28.3.6.10.1 and 28.3.6.10.2	re-number the bullet list to run from n) to r) instead of from a) to e)..	2017/1/9 9:42
8858	Sigurd Schelstraete	225	1 28.3.6.11.4	255	54	T	N	255.54 28.3.6.11.4	There is no per-20 MHz phase rotation for data (see page 267, line 4, "In HE modulated fields, gamma_k,BW = 1 in all the subcarriers")	Remove bullet b)	2017/1/9 9:42
8859	Sigurd Schelstraete	225	1 28.3.7	256	6	T	N	256.06 28.3.7	Change "For an HE MU PPDU it is carried in the HE-SIG-B field." to "For an HE MU PPDU it is carried per user in the HE-SIG-B field."	See comment	2017/1/9 9:42
8860	Sigurd Schelstraete	225	1 28.3.7	256	21	E	N	256.21 28.3.7	Start new paragraph at "HE-MCSs with indices 10 and 11 ..."	See comment	2017/1/9 9:42
8861	Sigurd Schelstraete	225	1 28.3.7	256	23	E	N	256.23 28.3.7	Start new paragraph at "The HE extended range SU PPDU ..."	See comment	2017/1/9 9:42
8862	Sigurd Schelstraete	225	1 28.3.7	256	30	T	N	256.30 28.3.7	Paragraph on DCM should be improved for clarity.	Change to e.g. "DCM is an optional modulation scheme used for the HE-SIG-B field and the Data field in an HE PPDU. The use of DCM for the HE-SIG-B field in an HE MU PPDU is indicated in HE-SIG-A. The use of DCM for the Data field in an HE SU PPDU, HE trigger-based PPDU or HE extended range SU PPDU is indicated in HE-SIG-A. The use of DCM for the Data field in an HE MU PPDU is indicated in HE-SIG-B. DCM is only applied for the HE-MCSs with indices 0, 1, 3 and 4."	2017/1/9 9:42
8863	Sigurd Schelstraete	225	1 28.3.8	256	61	T	N	256.61 28.3.8	Rename the parameter T_GI,LegacyPreamble	Use e.g. T_GI,Pre-HE. Also replace all occurrences of T_GI,Legacy in the current draft with the new term.	2017/1/9 9:42
8864	Sigurd Schelstraete	225	1 28.3.8	257	4	T	N	257.04 28.3.8	T_GI,HE-LTF and T_GI,Data reference parameters that are defined later	Move rows T_GI,HE-LTF and T_GI,Data to after row T_GI4,Data	2017/1/9 9:42
8865	Sigurd Schelstraete	225	1 28.3.8	257	26	T	N	257.26 28.3.8	Move reference ("see Table 28-14 ...") from column2 to column 3	See comment	2017/1/9 9:42
8866	Sigurd Schelstraete	225	1 28.3.8	257	40	T	N	257.40 28.3.8	Where is T_GI_SIG-A-R used?	Can this be removed?	2017/1/9 9:42
8867	Sigurd Schelstraete	225	1 28.3.8	258	4	T	N	258.04 28.3.8	Move N_service and N_tail to Table 28-12. They are not timing-related constants	See comment	2017/1/9 9:42
8868	Sigurd Schelstraete	225	1 28.3.8	258	7	T	N	258.07 28.3.8	There is no need to define T_SYML. All fields prior to HE-STF have a dedicated parameter for symbol duration (e.g. T_L-STF, T_L-LTF, ...)	Remove row "T_SYML"	2017/1/9 9:42
8869	Sigurd Schelstraete	225	1 28.3.8	258	16	T	N	258.16 28.3.8	Add definition of "non-OFDMA HE PPDU" to definition section	See comment	2017/1/9 9:42
8870	Sigurd Schelstraete	225	1 28.3.8	258	43	T	N	258.43 28.3.8	What's the use of the parameters N_DC, N_Guard,Left and N_Guard,Right in Table 28-10.	Propose to delete	2017/1/9 9:42
8871	Sigurd Schelstraete	225	1 28.3.8	259	34	T	N	259.34 28.3.8	Where is N_user,total defined?	Define before use	2017/1/9 9:42
8872	Sigurd Schelstraete	225	1 28.3.8	259	40	T	N	259.40 28.3.8	First column says N_CBPSS,u. Second column says N_CBPSS,r,u. Which is it?	Clarify	2017/1/9 9:42
8873	Sigurd Schelstraete	225	1 28.3.8	259	59	E	N	259.59 28.3.8	Start new line at "For HE modulated fields ..."	See comment	2017/1/9 9:42
8874	Sigurd Schelstraete	225	1 28.3.8	259	61	T	N	259.61 28.3.8	There is no TXVECTOR parameter NUM_RUS in Table 28-1	Clarify value of N_RU	2017/1/9 9:42
8875	Sigurd Schelstraete	225	1 28.3.8	260	6	T	N	260.06 28.3.8	There is no TXVECTOR parameter NUM_USERS_TOTAL in Table 28-1	Clarify value of NUM_USERS_TOTAL	2017/1/9 9:42
8876	Sigurd Schelstraete	225	1 28.3.8	260	10	E	N	260.10 28.3.8	Replace "at r-th RU" with " in the r-th RU"	See comment	2017/1/9 9:42
8877	Sigurd Schelstraete	225	1 28.3.8	260	15	T	N	260.15 28.3.8	Where is the value N_STS as defined for MU PPDU used?	If not used, delete	2017/1/9 9:42
8878	Sigurd Schelstraete	225	1 28.3.8	260	18	T	N	260.18 28.3.8	Clarify "total number" as "total number over all users in the RU"	See comment	2017/1/9 9:42
8879	Sigurd Schelstraete	225	1 28.3.8	260	38	T	N	260.38 28.3.8	Where is the value N_SS as defined for MU PPDU used?	If not used, delete	2017/1/9 9:42
8880	Sigurd Schelstraete	225	1 28.3.9	261	30	T	N	261.30 28.3.9	Wrong reference: 22.3.7 is TVHT	Probably 21.3.7	2017/1/9 9:42
8881	Sigurd Schelstraete	225	1 28.3.9	261	37	T	N	261.37 28.3.9	"The signal is transmitted on subcarriers -122 to -4 and 4 to 122". Not all subcarriers are necessarily used. Change to "The signal is transmitted on all or a subset of subcarriers -122 to -4 and 4 to 122"	See comment. Similar for lines 41, 44, 48	2017/1/9 9:42

8882	Sigurd Schelstraete	225	1 28.3.9	262	6	E	N	262.06 28.3.9	Change "signal of" to "signal on"	See comment	2017/1/9 9:42
8883	Sigurd Schelstraete	225	1 28.3.9	262	28	T	N	262.28 28.3.9	Instead of a single figure 28-18, have one figure for HE MU and one figure for formats that do not contain HE-SIG-B	See comment Also duplicate (28-2) for the two cases.	2017/1/9 9:42
8884	Sigurd Schelstraete	225	1 28.3.9	262	28	T	N	262.28 28.3.9	Looks like (28-3) defines a subfield, rather than a field	Change subscript to "SubField". Similarly for equation (28-4).	2017/1/9 9:42
8885	Sigurd Schelstraete	225	1 28.3.9	263	41	T	N	263.41 28.3.9	The dimensions of Q in (28-4) don't look correct. A STA transmitting N_STS,r,u streams on N_TX antennas needs a spatial mapping matrix of dimensions N_TX x N_STS,r,u. Instead, the subscript (M_r,u + m) implies that the matrix is larger.	Correct. No need for M_r,u in spatial mapping matrix (it is needed in T_CS,HE). Maybe the matrix Q needs a label depending on r,u.	2017/1/9 9:42
8886	Sigurd Schelstraete	225	1 28.3.9	264	40	E	N	264.40 28.3.9	Start new line at "For the L_SIG ..."	See comment	2017/1/9 9:42
8887	Sigurd Schelstraete	225	1 28.3.9	264	45	T	N	264.45 28.3.9	It is not clear what "and 1 otherwise" refers to.	Change to "It is 1 for all other fields"	2017/1/9 9:42
8888	Sigurd Schelstraete	225	1 28.3.9	265	17	T	N	265.17 28.3.9	"is the cardinality of the set of subcarriers modulated with data within K_r for the HE-STF and Data fields". Is this correct? In e.g. (28-109), the sum over K_r includes pilot tones.	Correct	2017/1/9 9:42
8889	Sigurd Schelstraete	225	1 28.3.9	265	38	T	N	265.38 28.3.9	Why do we need a column "Guard interval duration in Table 28-14?	Remove column	2017/1/9 9:42
8890	Sigurd Schelstraete	225	1 28.3.9	267	4	E	N	267.04 28.3.9	Change "in all subcarriers" to "for all subcarriers"	See comment	2017/1/9 9:42
8891	Sigurd Schelstraete	225	1 28.3.10.1	267	40	T	N	267.40 28.3.10.1	As shown in Figure 28-18, the pre-HE modulated fields are L_STF, L-LTF, L_SIG, RL_SIG, HE-SIG-A and HE-SIG-B. The HE portion starts at RL-SIG. This is not consistent with line 40.	Correct. Not all pre-HE modulated fields are part of HE-portion.	2017/1/9 9:42
8892	Sigurd Schelstraete	225	1 28.3.10.1	267	41	T	N	267.41 28.3.10.1	"The pre-HE modulated fields for the various HE PPDU formats are the following". Not consistent with Figure 28-18.	Make consistent	2017/1/9 9:42
8893	Sigurd Schelstraete	225	1 28.3.10.1	267	47	T	N	267.47 28.3.10.1	repeated HE-SIG-A is not a field that is defined in e.g. Table 28-8.	Remove "repeated HE-SIG-A"	2017/1/9 9:42
8894	Sigurd Schelstraete	225	1 28.3.10.2.1	267	61	T	N	267.61 28.3.10.2.1	"In UL MU transmission the cyclic shift value is based on the transmit chain index of each STA." Is it? This is not consistent with e.g. (28-15). There, per-stream CSD is used and it does not depend on the user starting stream index. I'm not even sure thaty "transmit chain index" is defined anywhere.	Clarify and make consistent	2017/1/9 9:42
8895	Sigurd Schelstraete	225	1 28.3.10.2.2	268	19	T	N	268.19 28.3.10.2.2	28.3.10.2.2 needs a description of the CS per stream for the case of UL MU-MIMO.	Add requirements for UL MU-MIMO	2017/1/9 9:42
8896	Sigurd Schelstraete	225	1 28.3.10.3	268	29	E	N	268.29 28.3.10.3	comma is missing between i_seg and i_TX in superscript of r_L-STF. This happens in many other places as well.	Add comma (here and in other signal definitions throughout the draft)	2017/1/9 9:42
8897	Sigurd Schelstraete	225	1 28.3.10.3	268	52	T	N	268.52 28.3.10.3	Wrong reference: 22.3.8.3.4	Probably 21.3.7.3	2017/1/9 9:42
8898	Sigurd Schelstraete	225	1 28.3.10.3	268	62	T	N	268.62 28.3.10.3	Break definition of Omega_20MHz in separate sentences for clarity.	e.g.: "is a set of 20 MHz channels that contains the channels where pre-HE modulated fields are located. For an HE trigger-based PPDU or HE MU PPDU with preamble puncturing, it contains one or more values within the range 0 to N20MHz +/- 1. For other HE formats the index runs from 0 to N20MHz +/- 1."	2017/1/9 9:42
8899	Sigurd Schelstraete	225	1 28.3.10.5	270	39	T	N	270.39 28.3.10.5	Include value of Length field for Trigger-based PPDUs (taken directly from Trigger frame, instead of being calculated)	See comment	2017/1/9 9:42
8900	Sigurd Schelstraete	225	1 28.3.10.5	271	3	T	N	271.03 28.3.10.5	Improve language for clarity	Change two sentences starting at "Extra 4 BPSK ..."to "d_k, k=0,..., 47 are mapped to the data tones in the range -26:26. In addition, tones [-28,-27,27,28] are also modulated with BPSK. The constellations on those tones are [-1 -1 -1 1] respectively."	2017/1/9 9:42
8901	Sigurd Schelstraete	225	1 28.3.10.5	271	49	T	N	271.49 28.3.10.5	P0 should be lower case	Change P_0 to p_0	2017/1/9 9:42
8902	Sigurd Schelstraete	225	1 28.3.10.6	272	23	T	N	272.23 28.3.10.6	"The RL-SIG field is used to identify an HE PPDU." This needs more explanation.	Clarify	2017/1/9 9:42
8903	Sigurd Schelstraete	225	1 28.3.10.7.2	273	23	T	N	273.23 28.3.10.7.2	Change "Set to 1 indicates" to "Set to 1 to indicate"	See comment	2017/1/9 9:42
8904	Sigurd Schelstraete	225	1 28.3.10.7.2	273	23	T	N	273.23 28.3.10.7.2	"pre-HE-STF portion" is not terminology used before.	Change to "pre-HE modulated fields"	2017/1/9 9:42
8905	Sigurd Schelstraete	225	1 28.3.10.7.2	273	25	T	N	273.25 28.3.10.7.2	Change "Set to 0 indicates" to "Set to 0 to indicate"	See comment	2017/1/9 9:42

8906	Sigurd Schelstraete	225	1 28.3.10.7.2	273	33	T	N	273.33 28.3.10.7.2	"This fields indicates"should be a requirement	Change to "This field shall be set to DL for ..."	2017/1/9 9:42
8907	Sigurd Schelstraete	225	1 28.3.10.7.2	274	6	T	N	274.06 28.3.10.7.2	What is the value of "SR Disallowed"?	Clarify	2017/1/9 9:42
8908	Sigurd Schelstraete	225	1 28.3.10.7.2	274	10	T	Y	274.10 28.3.10.7.2	"NOTE--This part needs further development." indicates that this feature is not sufficiently mature.	Consider decoupling SR from the remainder of the document.	2017/1/9 9:42
8909	Sigurd Schelstraete	225	1 28.3.10.7.2	274	13	T	N	274.13 28.3.10.7.2	What is the value of "SR_Delay"?	Clarify	2017/1/9 9:42
8910	Sigurd Schelstraete	225	1 28.3.10.7.2	274	34	T	N	274.34 28.3.10.7.2	"Neither DCM nor STBC shall be applied when both the DCM and STBC are set to 1.". Add this clarification to the DCM and sTBC fields as well.	See comment	2017/1/9 9:42
8911	Sigurd Schelstraete	225	1 28.3.10.7.2	275	8	T	N	275.08 28.3.10.7.2	Replace "extra OFDM Symbol" with "extra OFDM Symbol Segment" (3 occurences in third column)	See comment	2017/1/9 9:42
8912	Sigurd Schelstraete	225	1 28.3.10.7.2	275	34	T	Y	275.34 28.3.10.7.2	" Doppler mode" is not explained anywhere. This requirement is not actionable.	Either clarify or remove bit. Similar comment for Table 28-17.	2017/1/9 9:42
8913	Sigurd Schelstraete	225	1 28.3.10.7.2	276	16	T	N	276.16 28.3.10.7.2	"This fields indicates"should be a requirement	Change to "This field shall be set to DL for ..."	2017/1/9 9:42
8914	Sigurd Schelstraete	225	1 28.3.10.7.2	276	46	T	N	276.46 28.3.10.7.2	What is the value of "SR_Restricted"?	Clarify	2017/1/9 9:42
8915	Sigurd Schelstraete	225	1	277	4	T	N	277.04	Replace "full" with "contiguous" (4 occurences in third column)	See comment	2017/1/9 9:42
8916	Sigurd Schelstraete	225	1 28.3.10.7.2	277	59	T	N	277.59 28.3.10.7.2	Replace "extra OFDM Symbol" with "extra OFDM Symbol Segment" (1 occurences in first column and 1 in third column)	See comment	2017/1/9 9:42
8917	Sigurd Schelstraete	225	1 28.3.10.7.2	277	59	T	N	277.59 28.3.10.7.2	"extra OFDM Symbol" does not explain how value should be set.	Add:"Set to 1 if an extra OFDM symbol segment for LDPC is present Set to 0 if an extra OFDM symbol segment for LDPC is present"	2017/1/9 9:42
8918	Sigurd Schelstraete	225	1 28.3.10.7.2	278	8	T	N	278.08 28.3.10.7.2	Add definition of MU-MIMO RU's to definition section (see third column)	See comment	2017/1/9 9:42
8919	Sigurd Schelstraete	225	1 28.3.10.7.2	279	4	T	Y	279.04 28.3.10.7.2	A 20 MHz PPDU only occupies one of the four 20 MHz subbands. Why do all four 20 MHz subbands have the same value? Shouldn't only the primary 20 do SR. The other subbands should be open for use anyway.	Clarify the requirements and NOTE 1 of Table 28-18	2017/1/9 9:42
8920	Sigurd Schelstraete	225	1 28.3.10.7.2	281	53	T	N	281.53 28.3.10.7.2	The unit of SRP in Table 28-19 can not be dBm, given that it is a sum of two values expressed in dBm (which is similar to power squared in the linear domain)	Remove "dBm" from the rows of the Table	2017/1/9 9:42
8921	Sigurd Schelstraete	225	1 28.3.10.7.2	282	29	T	Y	282.29 28.3.10.7.2	There is virtually no explanation or context on the SRP parameter or "Acceptable Receiver Interference level_AP". Notation and statements on lines 29 to 40 are far too dense to be informative.	Either clarify or relegate feature to future amendment.	2017/1/9 9:42
8922	Sigurd Schelstraete	225	1 28.3.10.7.3	282	45	E	N	282.45 28.3.10.7.3	Change :Common field" to "Common Field"	See comment	2017/1/9 9:42
8923	Sigurd Schelstraete	225	1 28.3.10.7.3	282	50	T	N	282.50 28.3.10.7.3	"x = N +· 8 when the Center 26-tone RU subfield is present, and x = N +· 8 - 1 otherwise" should be "x = N +· 8 + 1 when the Center 26-tone RU subfield is present, and x = N +· 8 otherwise". See Table 28-20.	See comment	2017/1/9 9:42
8924	Sigurd Schelstraete	225	1 28.3.10.7.3	282	51	T	N	282.51 28.3.10.7.3	"L = 20 for the HE-SIG-B user specific fields" should be "L = 21 or 42 for the HE-SIG-B user specific fields", since the CRC is calculated over two consecutive user specific fields, except for the last one.	See comment	2017/1/9 9:42
8925	Sigurd Schelstraete	225	1 28.3.10.7.3	283	4	E	N	283.04 28.3.10.7.3	Formatting problem with formula for I(D)		2017/1/9 9:42
8926	Sigurd Schelstraete	225	1 28.3.10.7.3	283	12	T	N	283.12 28.3.10.7.3	"the output is stopped at c4" is potentially confusing. Line 8 already makes it clear which bits are needed.	Remove "the output is stopped at c4"	2017/1/9 9:42
8927	Sigurd Schelstraete	225	1 28.3.10.7.4	283	34	T	N	283.34 28.3.10.7.4	Replace T_SYML with T_HE-SIG-A in (28-16), as defined in Table 28-9 (3 occurences)	See comment	2017/1/9 9:42
8928	Sigurd Schelstraete	225	1 28.3.10.7.4	284	14	T	N	284.14 28.3.10.7.4	Replace T_SYML with T_HE-SIG-A in (28-17), as defined in Table 28-9 (3 occurences)	See comment	2017/1/9 9:42
8929	Sigurd Schelstraete	225	1 28.3.10.7.4	284	35	T	N	284.35 28.3.10.7.4	Replace "the same data bits" with "identical encoded bits"	See comment	2017/1/9 9:42
8930	Sigurd Schelstraete	225	1 28.3.10.7.4	284	36	T	N	284.36 28.3.10.7.4	"The data bits of HE-SIG-A1 and HE-SIG-A3 shall be BCC encoded at rate, R = 1/2 (...) HE-SIG-A2 shall be BCC encoded at rate, R = 1/2, mapped ...". This makes it sound as if HE_SIG-A1 and HE-SIG-A2 are encoded separately, while the encoding is done over the full 52 bits.	Rewrite to make it clear that encoding is common and that only the first 52 encoded bits are then interleaved.	2017/1/9 9:42

8931	Sigurd Schelstraete	225	1 28.3.10.7.4	284	43	T	N	284.43	28.3.10.7.4	Replace "The QBPSK constellation on HE-SIG-A2 is used to differentiate between an HE extended range SU PPDU and an HE MU PPDU when m = 1 in Equation (28-11), which indicates HE MU PPDU or HE extended range SU PPDU." with "The QBPSK constellation on HE-SIG-A2 is used to differentiate between an HE extended range SU PPDU and an HE MU PPDU, which both use m=1 in (28-11)."	See comment	2017/1/9 9:42
8932	Sigurd Schelstraete	225	1 28.3.10.7.4	285	6	T	N	285.06	28.3.10.7.4	Labels in Figure 28-19 are incomplete (e.g. HE-SIG- in upper figure)	Fix	2017/1/9 9:42
8933	Sigurd Schelstraete	225	1 28.3.10.7.4	285	29	T	N	285.29	28.3.10.7.4	Replace T_SYML with T_HE-SIG-A in (28-18), as defined in Table 28-9 (3 occurences)	See comment	2017/1/9 9:42
8934	Sigurd Schelstraete	225	1 28.3.10.7.4	285	47	T	N	285.47	28.3.10.7.4	Replace T_SYML with T_HE-SIG-A in (28-18), as defined in Table 28-9 (3 occurences)	See comment	2017/1/9 9:42
8935	Sigurd Schelstraete	225	1 28.3.10.8.1	285	60	T	N	285.60	28.3.10.8.1	"The HE-SIG-B field is separately encoded on each 20 MHz band.". This is not correct.	Replace with a better description, i.e.: two content channels repeated over up to eight 20 MHz subbands. This would be a good place to introduce the concept of content channels BTW.	2017/1/9 9:42
8936	Sigurd Schelstraete	225	1 28.3.10.8.1	286	6	T	N	286.06	28.3.10.8.1	Figure is hard to read	Replace with better illustration of HE-SIG-B field	2017/1/9 9:42
8937	Sigurd Schelstraete	225	1 28.3.10.8.2	286	54	E	N	286.54	28.3.10.8.2	Change "fall between" to "fall in the range"	See comment	2017/1/9 9:42
8938	Sigurd Schelstraete	225	1 28.3.10.8.2	286	55	E	N	286.55	28.3.10.8.2	Change "fall between" to "fall in the range"	See comment	2017/1/9 9:42
8939	Sigurd Schelstraete	225	1 28.3.10.8.2	287	17	T	N	287.17	28.3.10.8.2	The explanation on lines 17 to 22 would be clearer by explicitly indicating the indices of the 242-tone RU. E.g.: content channel 1 on RU with indices -500:-259, content channel 2 on indices -258:-17, with CC1 repeated on 17:58, ...	Clarify text by explicitly using the subcarrier indices	2017/1/9 9:42
8940	Sigurd Schelstraete	225	1 28.3.10.8.2	287	35	E	N	287.35	28.3.10.8.2	Start new line before "The same value for the bit signaling ..."	See comment	2017/1/9 9:42
8941	Sigurd Schelstraete	225	1 28.3.10.8.2	287	40	T	Y	287.40	28.3.10.8.2	"When RUs greater than 242 subcarriers are signaled in the RU allocation signaling in a portion of the bandwidth, the signaling is carried in both content channels placed in the order of the absolute subcarrier index.". I do not understand the requirement expressed here. Please clarify.	Clarify	2017/1/9 9:42
8942	Sigurd Schelstraete	225	1 28.3.10.8.2	288	1	T	N	288.01	28.3.10.8.2	Clarify description of 160 MHz mapping of content channels by explicitly refering to indices of RU's (lines 1 to 5)	See comment	2017/1/9 9:42
8943	Sigurd Schelstraete	225	1 28.3.10.8.3	288	58	E	N	288.58	28.3.10.8.3	Change "tail bits added" to "tail bits appended"	See comment	2017/1/9 9:42
8944	Sigurd Schelstraete	225	1 28.3.10.8.3	288	63	T	N	288.63	28.3.10.8.3	Change "the bits corresponding to two STAs (i.e. two User fields) are encoded together" to "two User Fields are combined into a User Block Field".	See comment	2017/1/9 9:42
8945	Sigurd Schelstraete	225	1 28.3.10.8.3	288	64	T	N	288.64	28.3.10.8.3	Delete "the STAs scheduled in the HE MU PPDU are split into groups of two". This is repetition and there is no need to mention HE MU, since this is the only format that has HE-SIG-B.	See comment	2017/1/9 9:42
8946	Sigurd Schelstraete	225	1 28.3.10.8.3	289	1	T	N	289.01	28.3.10.8.3	Replace "group of two user fields" with "User Block field"	See comment	2017/1/9 9:42
8947	Sigurd Schelstraete	225	1 28.3.10.8.3	289	13	T	N	289.13	28.3.10.8.3	"When the code rate of the HE-SIG-B MCS is not equal to 1/2". Make it clear that bits from both common field and user specific field need to be concatenated before the puncturing.	See comment	2017/1/9 9:42
8948	Sigurd Schelstraete	225	1 28.3.10.8.3	289	36	T	N	289.36	28.3.10.8.3	Replace T_SYML with T_HE-SIG-B in (28-20), as defined in Table 28-9 (2 occurences)	See comment	2017/1/9 9:42
8949	Sigurd Schelstraete	225	1 28.3.10.8.3	289	57	T	N	289.57	28.3.10.8.3	Wrong reference: parameters are defined in 21.3.7.3	Correct reference	2017/1/9 9:42
8950	Sigurd Schelstraete	225	1 28.3.10.8.3	290	13	E	N	290.13	28.3.10.8.3	typo: change "his" to "is"	Correct	2017/1/9 9:42
8951	Sigurd Schelstraete	225	1 28.3.10.8.4	290	32	T	N	290.32	28.3.10.8.4	Change "user fields in each RU" to "users in each RU"	See comment	2017/1/9 9:42

8952	Sigurd Schelstraete	225	1 28.3.10.8.4	290	43	T	N	290.43 28.3.10.8.4	Improve wording. Change "Set to 1 to indicate that the center 26-tone RU is allocated in the Common Block fields of both HE-SIG-B content channels with the same value. Set to 0, otherwise." to "Set to 1 to indicate that a user is allocated to the center 26-tone RU. Set to 0 otherwise. Use the same value in both content channels."	See comment	2017/1/9 9:42
8953	Sigurd Schelstraete	225	1 28.3.10.8.4	290	48	T	N	290.48 28.3.10.8.4	Improve wording. Change "Set to 1 to indicate that the center 26-tone RU is allocated for one individual 80 MHz in the Common Block fields of both HE-SIG-B content channels. Set to 0, otherwise." to "Set to 1 to indicate that a user is allocated to the center 26-tone RU. Set to 0 otherwise. Each content channel carries the value for one 80 MHz segment."	See comment	2017/1/9 9:42
8954	Sigurd Schelstraete	225	1 28.3.10.8.4	291	8	T	N	291.08 28.3.10.8.4	Change "user fields per RU" to "users per RU"	See comment	2017/1/9 9:42
8955	Sigurd Schelstraete	225	1 28.3.10.8.4	292	30	T	N	292.30 28.3.10.8.4	Why is the description of code 01110001 "242-tone RU empty", but code 01110010 is "484-tone RU with zero HE-SIG-B User Specific field". Use consistent description for "empty" arrangements.	See comment	2017/1/9 9:42
8956	Sigurd Schelstraete	225	1 28.3.10.8.4	292	32	E	N	292.32 28.3.10.8.4	Change "field" to "fields"	See comment	2017/1/9 9:42
8957	Sigurd Schelstraete	225	1 28.3.10.8.4	292	36	E	N	292.36 28.3.10.8.4	Change "field" to "fields"	See comment	2017/1/9 9:42
8958	Sigurd Schelstraete	225	1 28.3.10.8.4	293	37	T	N	293.37 28.3.10.8.4	Change "assignment to the user" to "assignment to each user"	See comment	2017/1/9 9:42
8959	Sigurd Schelstraete	225	1 28.3.10.8.4	293	42	T	N	293.42 28.3.10.8.4	Change "assignment to the user" to "assignment to each user"	See comment	2017/1/9 9:42
8960	Sigurd Schelstraete	225	1 28.3.10.8.4	293	49	T	N	293.49 28.3.10.8.4	Change "Use Specific" to "User Specific"	See comment	2017/1/9 9:42
8961	Sigurd Schelstraete	225	1 28.3.10.8.4	294	25	T	N	294.25 28.3.10.8.4	Change "The contents of the User field differ based on ..." to "The contents of the User fields differ depending on ..."	See comment	2017/1/9 9:42
8962	Sigurd Schelstraete	225	1 28.3.10.8.4	295	1	T	N	295.01 28.3.10.8.4	Change "HE-SIG-B user field" to "user field" for consistency	See comment. Same comment for line 2 and 6	2017/1/9 9:42
8963	Sigurd Schelstraete	225	1 28.3.10.8.4	295	1	T	N	295.01 28.3.10.8.4	Use consistent wording. An RU with only one user has been referred to as "single STA in an RU" (page 294.25), ""field for an SU allocation" (page 295.1), "field for a non-MU-MIMO allocation" (page 295.6)	Decide on naming for an RU with one user.	2017/1/9 9:42
8964	Sigurd Schelstraete	225	1 28.3.10.8.4	295	12	T	N	295.12 28.3.10.8.4	STAID or STA-ID?	Use one term consistenly in third column.	2017/1/9 9:42
8965	Sigurd Schelstraete	225	1 28.3.10.8.4	295	29	T	N	295.29 28.3.10.8.4	Change "the RU carries no data" to "no user is assigned to the RU"	See comment	2017/1/9 9:42
8966	Sigurd Schelstraete	225	1 28.3.10.8.4	296	6	T	N	296.06 28.3.10.8.4	Change "the payload of the HE MU PPDU is modulated with dual carrier modulation" to "the payload of the corresponding user of the HE MU PPDU is modulated with dual carrier modulation"	See comment	2017/1/9 9:42
8967	Sigurd Schelstraete	225	1 28.3.10.8.4	296	37	E	N	296.37 28.3.10.8.4	Change "indication for" to "indication of"	See comment	2017/1/9 9:42
8968	Sigurd Schelstraete	225	1 28.3.10.8.4	296	48	T	N	296.48 28.3.10.8.4	Change "the payload of the HE MU PPDU is modulated with dual carrier modulation" to "the payload of the corresponding user of the HE MU PPDU is modulated with dual carrier modulation"	See comment	2017/1/9 9:42
8969	Sigurd Schelstraete	225	1 28.3.10.9	298	38	T	N	298.38 28.3.10.9	Change "HE PPDUs except HE trigger-based PPDUs" to "HE PPDUs that are not HE trigger-based PPDUs". This occurs in numerous places in this section	See comment	2017/1/9 9:42
8970	Sigurd Schelstraete	225	1 28.3.10.9	298	44	T	Y	298.44 28.3.10.9	Don't use such an abstract definition of the tones for HE-STF. List the tones instead.	The tones are -112:16:112, -240:16:240, -496:16:496 for 20, 40, 80 MHz respectively for PPDUs tahta rte not trigger-based and -120:8:120, -248:8:248, -504:8:504 for Trigger-based PPDUs.	2017/1/9 9:42
8971	Sigurd Schelstraete	225	1 28.3.10.9	300	24	T	N	300.24 28.3.10.9	Change "tone indices for which no RUs are defined" to "tone indices that fall within RU's that have no user(s) assigned to them"	See comment	2017/1/9 9:42
8972	Sigurd Schelstraete	225	1 28.3.10.9	300	29	E	N	300.29 28.3.10.9	Change "of transmit chain" to "and transmit chain"	See comment	2017/1/9 9:42
8973	Sigurd Schelstraete	225	1 28.3.10.9	301	2	E	N	301.02 28.3.10.9	Change "of transmit chain" to "and transmit chain"	See comment	2017/1/9 9:42

8974	Sigurd Schelstraete	225	1 28.3.10.9	301	10	T	Y	301.10 28.3.10.9	The dimensions of Q in (28-35) don't look correct. A STA transmitting N_STS,r,u streams on N_TX antennas needs a spatial mapping matrix of dimensions N_TX x N_STS,r,u. Instead, the subscript (M_r,u + m) implies that the matrix is larger.	Correct. No need for M_r,u in spatial mapping matrix (it is needed in T_CS,HE). Maybe the matrix Q needs a label depending on r,u. Same issue exists for HE-LTF and Data for Trigger-based PPDUs.	2017/1/9 9:42
8975	Sigurd Schelstraete	225	1 28.3.10.10	301	40	T	N	301.40 28.3.10.10	Delete "with more than one RU"	See comment	2017/1/9 9:42
8976	Sigurd Schelstraete	225	1 28.3.10.10	301	48	T	N	301.48 28.3.10.10	Change "transmission of 1x HE-LTF" to "1x HE-LTF mode" for consistentcy with previous sentence	See comment	2017/1/9 9:42
8977	Sigurd Schelstraete	225	1 28.3.10.10	302	7	E	N	302.07 28.3.10.10	Change "is defined" to "and is defined"	See comment	2017/1/9 9:42
8978	Sigurd Schelstraete	225	1 28.3.10.10	302	8	T	N	302.08 28.3.10.10	"HE-LTF symbol duration". Previosuly, the term HE-LTF mode was used. Use one term consistently.	See comment	2017/1/9 9:42
8979	Sigurd Schelstraete	225	1 28.3.10.10	302	22	T	N	302.22 28.3.10.10	Delete "transmitted and located"	See comment. Similar change on page 302.39, page 303.1, page 303.21, page 304.1, page 304.30, page 305.1, page 306.1, page 307.1,	2017/1/9 9:42
8980	Sigurd Schelstraete	225	1 28.3.10.10	308	15	E	N	308.15 28.3.10.10	Introduce line break after line 15 and add the word: "where:" to introduce defintions of LTF_80MHz_left_1x and LTF_80MHz_right_1x	See comment	2017/1/9 9:42
8981	Sigurd Schelstraete	225	1 28.3.10.10	309	10	E	N	309.10 28.3.10.10	Introduce line break after line 10 and add the word: "where:" to introduce defintions of LTF_80MHz_part1_2x, ...	See comment	2017/1/9 9:42
8982	Sigurd Schelstraete	225	1 28.3.10.10	310	60	T	N	310.60 28.3.10.10	Change "For an 80+80 MHz transmission" to "For an 80+80 MHz transmission using 1x HE-LTF"	See comment	2017/1/9 9:42
8983	Sigurd Schelstraete	225	1 28.3.10.10	311	1	T	N	311.01 28.3.10.10	Change "For an 80+80 MHz transmission" to "For an 80+80 MHz transmission using 2x HE-LTF"	See comment	2017/1/9 9:42
8984	Sigurd Schelstraete	225	1 28.3.10.10	311	6	T	N	311.06 28.3.10.10	Change "For an 80+80 MHz transmission" to "For an 80+80 MHz transmission using 4x HE-LTF"	See comment	2017/1/9 9:42
8985	Sigurd Schelstraete	225	1 28.3.10.10	311	11	T	Y	311.11 28.3.10.10	The masking described in (28-53) would benefit from a little more explanation. Currently the text is not very clear.	Clarify	2017/1/9 9:42
8986	Sigurd Schelstraete	225	1 28.3.10.10	313	5	T	N	313.05 28.3.10.10	"neither masking by orthogonal code nor single stream pilot are not used.". What does this mean? Neither is used? Avoid double negation for clarity.	Clarify	2017/1/9 9:42
8987	Sigurd Schelstraete	225	1 28.3.10.10	313	10	E	N	313.10 28.3.10.10	Change "of transmit chain" to "and transmit chain"	See comment	2017/1/9 9:42
8988	Sigurd Schelstraete	225	1 28.3.10.10	313	28	E	N	313.28 28.3.10.10	Change "of transmit chain" to "and transmit chain"	See comment	2017/1/9 9:42
8989	Sigurd Schelstraete	225	1 28.3.10.10	314	1	T	N	314.01 28.3.10.10	"When a 1x, 2x or 4x HE-LTF is transmitted". This means always, since these are the only HE-LTF modes that are defined.	Delete "When a 1x, 2x or 4x HE-LTF is transmitted"	2017/1/9 9:42
8990	Sigurd Schelstraete	225	1 28.3.10.10	314	1	T	N	314.01 28.3.10.10	Is this paragraph in the right place? Why is this specifc to HE-LTF. The spatial mapping matrix is applied starting at HE-STF.	Move paragraph to more appropriate section.	2017/1/9 9:42
8991	Sigurd Schelstraete	225	1 28.3.10.11.1	314	12	T	N	314.12 28.3.10.11.1	"The number of OFDM symbols in the Data field is determined by the Length field in L-SIG". Actually it's the other way around. The value in L-SIG is determined (among others things) by the number of OFDM symbols. The first sentence seems to describe receiver operation.	Delete sentence	2017/1/9 9:42
8992	Sigurd Schelstraete	225	1 28.3.10.11.2	314	31	E	N	314.31 28.3.10.11.2	Change "on all" to "for all"	See comment	2017/1/9 9:42
8993	Sigurd Schelstraete	225	1 28.3.10.11.2	314	31	E	N	314.31 28.3.10.11.2	Change "with" to "consisting of"	See comment	2017/1/9 9:42
8994	Sigurd Schelstraete	225	1 28.3.10.11.2	315	31	T	N	315.31 28.3.10.11.2	Delete the word "excess" from "excess bits in the last OFDM symbol". These are simply the bits in the last OFDM symbol.	See comment	2017/1/9 9:42
8995	Sigurd Schelstraete	225	1 28.3.10.11.2	316	52	T	N	316.52 28.3.10.11.2	"the MAC delivers a PSDU that fills the available octets ...". Add reference to A-MPDU padding (27.10.2 & 27.10.3).	See comment	2017/1/9 9:42
8996	Sigurd Schelstraete	225	1 28.3.10.11.4	317	21	T	N	317.21 28.3.10.11.4	Change "PHY padding" to "pre-FEC PHY padding"	See comment	2017/1/9 9:42
8997	Sigurd Schelstraete	225	1 28.3.10.11.5	317	41	T	N	317.41 28.3.10.11.5	"Mandatory/optional support for LDPC is already covered in detail in section 28.1". No need to repeat it here.	Delete paragraph starting at line 41.	2017/1/9 9:42

8998	Sigurd Schelstraete	225	1 28.3.10.11.5.2	318	42	T	N	318.42	28.3.10.11.5.2	move (28-70) to beginning of section 28.3.1.1.5.2 (i.e. define N_sym,init first)	Start section 28.3.10.11.5.2 with "The initial number of OFDM symbols in the Data field with LDPC encoding in an HE SU PPDU is calculated using Equation (28-xx)." Then define N_sym,init	2017/1/9 9:42
8999	Sigurd Schelstraete	225	1 28.3.10.11.5.2	318	61	T	N	318.61	28.3.10.11.5.2	Change "and increment Navbits by the following Equation (28-72) instead of Equations (19-39)," to "Navbits shall be incremented according to Equation (28-72) instead of Equation (19-39)."	See comment	2017/1/9 9:42
9000	Sigurd Schelstraete	225	1 28.3.10.11.5.2	318	62	T	N	318.62	28.3.10.11.5.2	Start new sentence instead of ", followed by recomputing Npunc as in Equation (19-40):"	Replace with "After this, the number of punctured bits N_punc shall be calculated as in Equation (19-40)."	2017/1/9 9:42
9001	Sigurd Schelstraete	225	1 28.3.10.11.5.2	319	23	T	N	319.23	28.3.10.11.5.2	Change "update" to "calculate". No value for N_CBPS,LAST has been calculated so far.	See comment	2017/1/9 9:42
9002	Sigurd Schelstraete	225	1 28.3.10.11.5.2	319	30	T	N	319.30	28.3.10.11.5.2	Delete "For completeness,"	See comment	2017/1/9 9:42
9003	Sigurd Schelstraete	225	1 28.3.10.11.5.4	320	42	E	N	320.42	28.3.10.11.5.4	Change "where" to "for which"	See comment	2017/1/9 9:42
9004	Sigurd Schelstraete	225	1 28.3.10.11.5.4	320	63	T	N	320.63	28.3.10.11.5.4	Change "pre-FEC padding factor" to "pre-FEC padding factor a"	See comment	2017/1/9 9:42
9005	Sigurd Schelstraete	225	1 28.3.10.11.5.4	321	6	T	N	321.06	28.3.10.11.5.4	Change "If among all the users" to "If for none of the users"	See comment	2017/1/9 9:42
9006	Sigurd Schelstraete	225	1 28.3.10.11.6	323	1	T	N	323.01	28.3.10.11.6	Change "Note that for all RU sizes the coded bits of each OFDM symbol" to "Note that for all RU sizes the coded bits per OFDM symbol and per RU size"	See comment	2017/1/9 9:42
9007	Sigurd Schelstraete	225	1 28.3.10.11.6	323	1	T	N	323.01	28.3.10.11.6	"evenly allocated" is not clear. Does this mean "is always a multiple of N_SS"?	Clarify	2017/1/9 9:42
9008	Sigurd Schelstraete	225	1 28.3.10.11.7	323	24	T	N	323.24	28.3.10.11.7	"output bits of each stream parser" should be "output bits of the segment parser"	Correct	2017/1/9 9:42
9009	Sigurd Schelstraete	225	1 28.3.10.11.7	323	33	T	N	323.33	28.3.10.11.7	Change "frequency subblock" to "frequency segment"	See comment (also on lines 34, 39, 51 and 52)	2017/1/9 9:42
9010	Sigurd Schelstraete	225	1 28.3.10.11.8	324	4	T	Y	324.04	28.3.10.11.8	"1 padding bit is added before the bits are interleaved.". Should this bit also be removed after interleaving?	Clarify	2017/1/9 9:42
9011	Sigurd Schelstraete	225	1 28.3.10.11.8	324	32	T	N	324.32	28.3.10.11.8	"The interleaver parameters NCOL and NROW, for the HE-SIG-A and HE-SIG-B fields". Why is this paragraph in the data section?	Move HE-SIG-A and HE-SIG-B related requirements to the appropriate sections	2017/1/9 9:42
9012	Sigurd Schelstraete	225	1 28.3.10.11.9	325	31	T	N	325.31	28.3.10.11.9	I literally can't read the bit encoding shown in Figures 28-30 to 28-33. Either improve quatlity of the figures or find another way to define the encoding.	See comment	2017/1/9 9:42
9013	Sigurd Schelstraete	225	1 28.3.11.10	327	51	T	N	327.51	28.3.11.10	First sentence not needed. Delete "This subclause ... using STBC coding"	See comment	2017/1/9 9:42
9014	Sigurd Schelstraete	225	1 28.3.11.11	329	47	T	N	329.47	28.3.11.11	Error in reference	Fix reference	2017/1/9 9:42
9015	Sigurd Schelstraete	225	1 28.3.11.13	330	54	T	N	330.54	28.3.11.13	Pilot indices are already listed in Table 28-7. It is better not to duplicate this information.	Remove Table 28-29 and replace with reference to Table 28-7. Similar comment for Tables 28-31, 28-33, 28-34, 28-36, 28-37	2017/1/9 9:42
9016	Sigurd Schelstraete	225	1 28.3.11.13	331	19	T	N	331.19	28.3.11.13	Notation P^KR26i_n is not clear, since the superscript elsewhere denotes a single tone index. Replace with P^k_n and specify that k belongs to K_R26i. Similar for indices that do not belong to K_R26i. (Also occurs in many other places in this section)	See comment	2017/1/9 9:42
9017	Sigurd Schelstraete	225	1 28.3.11.13	331	49	T	N	331.49	28.3.11.13	Typo: PPD BW. Replace with "PPDU BW"	See comment. Also in Tables 28-33, 28-34, 28-36, 28-37	2017/1/9 9:42
9018	Sigurd Schelstraete	225	1 28.3.11.13	332	22	E	N	332.22	28.3.11.13	Replace "in subcarriers" with "at subcarriers"	See comment	2017/1/9 9:42
9019	Sigurd Schelstraete	225	1 28.3.11.13	334	30	T	N	334.30	28.3.11.13	"For a 996-tone RU transmission, the pilot mapping for its 16 pilots is the same as the mapping for 484-tone RU transmission.". How can this be? This does not sound correct.	Clarify or correct.	2017/1/9 9:42
9020	Sigurd Schelstraete	225	1 28.3.11.14	336	55	T	N	336.55	28.3.11.14	"Q is a spatial mapping/steering matrix with NTX rows and NSTS,r,total columns". The number of columns does not need to be NSTS,r,total for a trigger-based PPDU.	add "for HE PPDUs that are not Trigger-based"	2017/1/9 9:42

9021	Sigurd Schelstraete	225	1 28.3.12	337	18	T	Y	337.18 28.3.12	It is stated that the content of the Packet Extension is arbitrary. Is it really? Wouldn't it have to be spectrally contained to the same RU(s) at least?	Clarify	2017/1/9 9:42
9022	Sigurd Schelstraete	225	1 28.3.12	338	41	T	N	338.41 28.3.12	Add reference to Trigger frame after "Common Info field of the Trigger frame" (section 9.3.1.23)	See comment	2017/1/9 9:42
9023	Sigurd Schelstraete	225	1 28.3.12	339	1	T	N	339.01 28.3.12	Agree with Editor's note: move lines 3 to 37 to HE-SIG-A section	See comment	2017/1/9 9:42
9024	Sigurd Schelstraete	225	1 28.3.12	339	58	T	N	339.58 28.3.12	text starting on line 58 of page 339 and ending on line 19 of page 340 belongs in HE receive procedure (28.3.20)	Move text to 28.3.20	2017/1/9 9:42
9025	Sigurd Schelstraete	225	1 28.3.13	340	30	T	N	340.30 28.3.13	BEAM_CHANGE is not defiined when PPDU format NON_HT (see Table 28-1), so it's not clear how to interpret this requirement.	Remove sentence starting at "The L-STF ..."	2017/1/9 9:42
9026	Sigurd Schelstraete	225	1 28.3.14.2	341	14	E	N	341.14 28.3.14.2	Font changes in the word "Target_RSSI"	Fix	2017/1/9 9:42
9027	Sigurd Schelstraete	225	1 28.3.14.2	341	34	T	N	341.34 28.3.14.2	Don't use term "legacy preamble"	Replace with e.g. pre-HE modulated fields	2017/1/9 9:42
9028	Sigurd Schelstraete	225	1 28.3.14.3	342	49	T	N	342.49 28.3.14.3	Start new subsection starting at line 49 (28.3.14.4 CFO pre-compensation)	See comment	2017/1/9 9:42
9029	Sigurd Schelstraete	225	1 28.3.15.2	344	13	T	N	344.13 28.3.15.2	"SNR" should be "Delta SNR"	Correct	2017/1/9 9:42
9030	Sigurd Schelstraete	225	1 28.3.15.3	344	22	T	N	344.22 28.3.15.3	Wrong reference: CQI-only feedback is described in 9.4.1.65.	Correct reference	2017/1/9 9:42
9031	Sigurd Schelstraete	225	1 28.3.16	344	56	T	N	344.56 28.3.16	Add the allowed HE-LTF modes for an HE-NDP in the bullet list.	See comment	2017/1/9 9:42
9032	Sigurd Schelstraete	225	1 28.3.17.3	345	64	T	N	345.64 28.3.17.3	Unknown reference: Table xx-a	Replace with correct reference	2017/1/9 9:42
9033	Sigurd Schelstraete	225	1 28.3.17.3	346	2	T	N	346.02 28.3.17.3	"of the frequency segment lower in the frequency of the desired signal." is not clear. Replace with "of the frequency segment of the desired signal that is lowest in frequency"	See comment	2017/1/9 9:42
9034	Sigurd Schelstraete	225	1 28.3.17.6.4	349	16	E	N	349.16 28.3.17.6.4	lots of white space on line 16	Correct	2017/1/9 9:42
9035	Sigurd Schelstraete	225	1 28.3.17.6.4	349	21	T	N	349.21 28.3.17.6.4	Where is OBSS_PD used in this formula defined? Provide reference.	See comment	2017/1/9 9:42
9036	Sigurd Schelstraete	225	1 28.3.17.6.4	349	36	T	N	349.36 28.3.17.6.4	Does detection in the seconday 40 use the same OBSS_PD as detection in a 20 MHz subchannel of the secondary 40 (see lines 36 and 40)? Shouldn't the levels be different.	Clarify	2017/1/9 9:42
9037	Sigurd Schelstraete	225	1 28.3.18.1	350	6	T	Y	350.06 28.3.18.1	"The bandwidth of the spectral mask applied to an HE PPDU shall be determined by the bandwidth indicated in the Bandwidth subfield of the HE-SIG-A field.". This is different from e.g. VHT, where a 20 MHz PPDU could be sent with an 80 MHz mask (see e.g. defintion of 80 MHz mask PPDU). Why the change?	If no compelling reason for changing relative to VHT, delete first sentence of 28.3.18.1	2017/1/9 9:42
9038	Sigurd Schelstraete	225	1 28.3.18.1	353	55	T	N	353.55 28.3.18.1	Update definition of 80 MHz mask PPDU (definition section) to cover the case of preamble puncturing.	See comment	2017/1/9 9:42
9039	Sigurd Schelstraete	225	1 28.3.18.1	355	25	T	N	355.25 28.3.18.1	Change "all transmission modes" to "all transmission modes except 80+80 MHz where the RF LO falls outside both frequency segments"	See comment	2017/1/9 9:42
9040	Sigurd Schelstraete	225	1 28.3.19	360	14	E	N	360.14 28.3.19	In first paragraph of 28.3.19, mention Figure 28-43 before Figure 28-44.	See comment	2017/1/9 9:42
9041	Sigurd Schelstraete	225	1 28.3.19	360	48	T	N	360.48 28.3.19	Figure 128-43 and subsequent figures do not show post-FEC padding.	Add post-FEC padding to figures.	2017/1/9 9:42
9042	Sigurd Schelstraete	225	1 28.3.19	362	44	T	N	362.44 28.3.19	Wrong reference: 26.2.x	See comment	2017/1/9 9:42
9043	Sigurd Schelstraete	225	1 28.3.19	364	51	T	N	364.51 28.3.19	Figure 28-46 should include post-FEC padding.	Add post-FEC padding (most liekly in box "Padding & Tail")	2017/1/9 9:42
9044	Sigurd Schelstraete	225	1 28.3.20	364	61	T	N	364.61 28.3.20	Change Non-HT to NON_HT	See comment	2017/1/9 9:42
9045	Sigurd Schelstraete	225	1 28.3.20	365	5	T	N	365.05 28.3.20	The term "cell" is used here without explanation or reference.	Explain "cell" or replace with a better term	2017/1/9 9:42
9046	Sigurd Schelstraete	225	1 28.3.20	365	12	T	N	365.12 28.3.20	Shouldn't CS/CCA state In Figure 28-47 end after reception of PHY-CCA.Indication?	Improve Figure to show correct end of CS/CCA state.	2017/1/9 9:42
9047	Sigurd Schelstraete	225	1 28.3.20	365	30	T	N	365.30 28.3.20	Show post-FEC padding in Figure 28-47	See comment	2017/1/9 9:42
9048	Sigurd Schelstraete	225	1 28.3.20	368	49	E	N	368.49 28.3.20	Change "No filtered out" in Figure 28-51 to "not filtered out" (3 occurences)	See comment	2017/1/9 9:42

9049	Sigurd Schelstraete	225	1 28.3.20	369	11	T	N	369.11 28.3.20	"The PHY includes the most recently measured RSSI value". Which one, the one measure during L-STf or HE-STF? Figure 28-47 shows RSSI measurements at two places.	Clarify	2017/1/9 9:42
9050	Sigurd Schelstraete	225	1 28.3.20	369	30	E	N	369.30 28.3.20	Change "meet" to "meets"	see comment	2017/1/9 9:42
9051	Sigurd Schelstraete	225	1 28.3.20	370	56	T	N	370.56 28.3.20	"SignalExtension is 0 usec when TXVECTOR parameter NO_SIG_EXTN is true". This may be correct at transmitter side, but the receiver does not know the value of TXVECTOR. How will the receiver decide the value of SignalExtension?	Clarify	2017/1/9 9:42
9052	Sigurd Schelstraete	225	1 28.4.1	371	20	T	N	371.20 28.4.1	Wrong reference "Table 25-1"	Correct reference	2017/1/9 9:42
9053	Sigurd Schelstraete	225	1 28.4.2	372	17	E	N	372.17 28.4.2	Formula 28-131 is slightly cut off on the left and the right	Correct	2017/1/9 9:42
9054	Song-Haur An	225	1 9.2.4.6.4.2	23	64	E	Y	23.64 9.2.4.6.4.2	First time abbreviation should be included in the Abbreviation Section.	Need to add RU to the Abbreviations List (Sec 3.4)	2017/1/9 9:42
9055	Song-Haur An	225	1 28.3.4	242	27	E	Y	242.27 28.3.4	HE-SIG-A-R is not defined.	Need to define and explain how to use it	2017/1/9 9:42
9056	Song-Haur An	225	1			G	N		It's not clear in the Nov presnetations that the 4 times of performance improvement has been verified by simulations. There have been a lot of quesuions.	Need to define a represnetative use case and evaluate the performance improvement wth respect to 11n and ac.	2017/1/9 9:42
9057	Sriram Venkateswaran	225	1 28.3.6.2	249	57	E	Y	249.57 28.3.6.2	Section 21.3.7.5 should be section 22.3.7.5	Change section number	2017/1/9 9:42
9058	Sriram Venkateswaran	225	1 28.3.6.6	251	40	E	Y	251.40 28.3.6.6	Section 17.3.5.7 should be section 18.3.5.7	Change section number	2017/1/9 9:42
9059	Sriram Venkateswaran	225	1 28.3.6.8	253	23	E	Y	253.23 28.3.6.8	Section 21.3.10 should be section 28.3.10	Change section number	2017/1/9 9:42
9060	Sriram Venkateswaran	225	1 28.3.8	256	38	E	Y	256.38 28.3.8	Change Table number 19-6 to 20-6 and Table number 21-5 to 22-5	Change table numbers	2017/1/9 9:42
9061	Sriram Venkateswaran	225	1 28.3.9	264	2	E	Y	264.02 28.3.9	Change 'SR' to subscript in NSR	Change NSR to N_{SR}	2017/1/9 9:42
9062	Sriram Venkateswaran	225	1 28.3.9	265	17	E	Y	265.17 28.3.9	Change 'subcarriers modulated with data' to 'modulated subcarriers'	Make the change suggested	2017/1/9 9:42
9063	Sriram Venkateswaran	225	1 28.3.10.3	269	1	E	Y	269.01 28.3.10.3	Change Section 19-8 to 18-6	Change section number	2017/1/9 9:42
9064	Sriram Venkateswaran	225	1 28.3.10.3	269	11	T	Y	269.11 28.3.10.3	Change reference to Equation 28-8 to 28-9	Change equation number reference	2017/1/9 9:42
9065	Sriram Venkateswaran	225	1 28.3.10.10	311	17	T	Y	311.17 28.3.10.10	For greater clarity, HELTF should include r, u, and m as its subscripts	This change will affect the draft in multiple places, but is suggested to improve clarity. Add subscripts m,r,u to HE-LTF	2017/1/9 9:42
9066	Sriram Venkateswaran	225	1 28.3.10.10	313	1	E	Y	313.01 28.3.10.10	Change equation references as follows: equation 19-27 replaced by 20-27, equation 21-45 replaced by 22-45	Change equation number reference	2017/1/9 9:42
9067	Sriram Venkateswaran	225	1 28.3.10.10	313	16	T	Y	313.16 28.3.10.10	Beta_r can be used to simplify equation 28-58 and also make it consistent	Use beta_r in equation 28-58 to simplify it and make it consistent	2017/1/9 9:42
9068	Sriram Venkateswaran	225	1 28.3.11.5.4	320	40	E	Y	320.40 28.3.11.5.4	Missing N in N_{av,bits,u}	Change to N_{av,bits,u}	2017/1/9 9:42
9069	Sriram Venkateswaran	225	1 28.3.11.5.4	321	31	T	Y	321.31 28.3.11.5.4	a_init used wrongly instead of a	Change a_init to a	2017/1/9 9:42
9070	Sriram Venkateswaran	225	1 28.3.11.5.4	321		E	Y	321.00 28.3.11.5.4	The words "represented by ainit, in the last OFDM symbol(s)" can be dropped	Drop the suggested words	2017/1/9 9:42
9071	Sriram Venkateswaran	225	1 28.3.11.9	327	15	T	Y	327.15 28.3.11.9	Missing words between "a" and "and" in the following text: exploit frequency diversity for a and and is in the range of for a 2ÿ Ö³996-tone RU	Paragraph needs to be rephrased/missing words inserted	2017/1/9 9:42
9072	Sriram Venkateswaran	225	1 28.3.11.9	327	18	E	Y	327.18 28.3.11.9	Move the line "The NSD here refers to the NSD with DCM = 1, which is half the value of NSD with DCM = 0." to the beginning of the paragraph. Otherwise, while reading this paragraph, the reader might have a mistaken notion of NSD	Move the line "The NSD here refers to the NSD with DCM = 1, which is half the value of NSD with DCM = 0." to the beginning of the paragraph.	2017/1/9 9:42
9073	Sriram Venkateswaran	225	1 28.3.11.12	330		T	Y	330.00 28.3.11.12	There should be no "l" in the subscript of lines 17, 26 (left side of equations) and lines 12, 32	Remove "l" from the subscript in the lines mentioned	2017/1/9 9:42
9074	Sriram Venkateswaran	225	1 28.3.11.12	330	28	T	Y	330.28 28.3.11.12	"l" in the right side of the equation 28-100 (second case) should actually be 1 (numeral one)	Change "l" to 1 (one) on the right side of equation 28-100 (second case)	2017/1/9 9:42
9075	Sriram Venkateswaran	225	1 28.3.11.14	336	30	T	Y	336.30 28.3.11.14	<= NSD,r should actually be < NSD,r	Change <= to <	2017/1/9 9:42
9076	Sriram Venkateswaran	225	1 28.3.14.1	340	55	E	Y	340.55 28.3.14.1	Word "in" is missing	Change "participating STAs HE trigger-based" to "participating STAs in HE trigger-based"	2017/1/9 9:42
9077	Sriram Venkateswaran	225	1 28.3.14.3	342	9	E	Y	342.09 28.3.14.3	Word "being" is missing	Change "with P the maximum power" to "with P being the maximum power"	2017/1/9 9:42

9078	Sriram Venkateswaran	225	1 28.3.14	341		T	Y	341.00	28.3.14	Each STA that is scheduled in the Trigger frame calculates UL transmit power, , of the HE trigger-based PPDU for the assigned MCS using Equation (28-118).	For Equation (28-118), better to explicitly specify the bandwidth over which UL transmit power is averaged. AP power is averaged over 20MHz but for UL Tx its not specified.	2017/1/9 9:42
9079	Sriram Venkateswaran	225	1 28.3.18.4.4			T	Y		28.3.18.4.4	The potential LO leakage tones for 20 MHz operating devices are the center of primary 20 MHz of the HE PPDU tone plan and +/-3 tones. The potential LO leakage tones for 40MHz operating devices are the center of the primary 40 MHz of the PPDU tone plan and +/-3 tones. For 80 MHz capable devices that transmits 20 MHz or 40 MHz PPDU, the potential LO leakage tone exist outside the PPDU bandwidth and should not affect the transmitter modulation accuracy test.	Explicitly specify the LO leakage tones for 20 in 40 and 80 in 80	2017/1/9 9:42
9080	Sriram Venkateswaran	225	1 28.3.18.4.4	357		E	Y	357.00	28.3.18.4.4	Equation 28-122, i_s (I subscript s is not defined)	Define the variable i_s (I subscript s)	2017/1/9 9:42
9081	Sriram Venkateswaran	225	1 28.3.6.1			E	Y		28.3.6.1	tone rotation for the 20MHz subband is reffered to 21.3.7.5. which should be 22.3.7.5	Fix references	2017/1/9 9:42
9082	Sriram Venkateswaran	225	1 28.3.9	263	51	T	Y	263.51	28.3.9	The statement "The total power of the time domain HE modulated field signals summed over all transmit chains should not exceed the total power of the time domain pre-HE modulated field signals summed over all transmit chains." may not be true for extended range PPDUs with boosted LTFs etc.	If this line does not hold for all cases, please give proper qualifications (or delete it if the spec specifies these powers clearly in other places and the line is redundant)	2017/1/9 9:42
9083	Sriram Venkateswaran	225	1 9.4.2.218.3	83		T	Y	83.00	9.4.2.218.3	Table 9-262 aa has the following line "B15: Indicates support of reception of 1xLTF and 1.6uS guard interval duration for HE Trigger-based PPDUs" - change reception to transmission	Change reception to transmission	2017/1/9 9:42
9084	Sriram Venkateswaran	225	1 28.3.5	247	7	E	Y	247.07	28.3.5	It is preferred to add a new transmitter block diagram for the Data field of an HE downlink MU OFDMA transmission (possibly with a mixture of OFDMA RU and MU-MIMO RU, LDPC/BCC)	add a new transmitter block diagram for DL-MU OFDMA	2017/1/9 9:42
9085	Sriram Venkateswaran	225	1 9.4.2.218.5	90	16	E	Y	90.16	9.4.2.218.5	"Table 9-262ad: PPET8 and PPET16 encoding": When DCM is enabled, packet extension requirement for a given Nss/QAM/RU size is not very clear. E.g: When DCM is enabled on RU484, will it use PE requirement based on RU242 or RU996?	Clarity needed. Good to add examples.	2017/1/9 9:42
9086	Sriram Venkateswaran	225	1 27.6.4	179	19	T	Y	179.19	27.6.4	NUM_STS indicates two or more space-time streams Does this mean NSTS 1 with CQI mode is not possible?	Clarification required, change wording if NSTS 1 with CQI mode is possible	2017/1/9 9:42
9087	Sriram Venkateswaran	225	1 28.5			E	Y		28.5	RU 969 in MCS tables	Change to 996	2017/1/9 9:42
9088	Sriram Venkateswaran	225	1 27.14.11	199		E	Y	199.00	27.14.11	Is UL_FLAG referred in section 27.14.1 is same as UPLINK_FLAG in section 27.11? If yes, please change it in section 27.14 to be consistent	Change to UPLINK_FLAG	2017/1/9 9:42
9089	Sriram Venkateswaran	225	1 28.3.20	369		T	Y	369.00	28.3.20	"The PHY entity shall maintain PHY-CCA.indication(BUSY, channellist) primitive for the predicted duration of the transmitted PPDU, as defined by RXTIME in Equation (28-128), for all supported modes, unsupported modes, Reserved HE-SIG-A Indication, and invalid HE-SIG-A CRC". For SIGA CRC failure case, SIGA contents will not be usable and in such case, how receiver will compute RXTIME which requires CP and LTF size which are not multiple of 4uS?	Clarification required. For SIGA CRC failure case, shall we use length from LSIG? If so, the spec should state it explicitly	2017/1/9 9:42
9090	Sriram Venkateswaran	225	1 28.3.14	341		T	Y	341.00	28.3.14	Each STA that is scheduled in the Trigger frame calculates UL transmit power, , of the HE trigger-based PPDU for the assigned MCS using Equation (28-118).	For Equation (28-118), need to specify the bandwidth over which UL transmit power is averaged. AP power is averaged over 20MHz but for UL Tx its not specified.	2017/1/9 9:42
9091	Sriram Venkateswaran	225	1 28.3.20	368		E	Y	368.00	28.3.20	m factor computation check is swapped between the two branches (eg Len_mod_3=1 is MU/RE but is shows as Len_mod_3=2 is MU/RE.	Change the diagram to correctly reflect m factor computation check	2017/1/9 9:42

9092	Sriram Venkateswaran	225	1 28.3.10	301		E	Y	301.00 28.3.10	Circular reference in the following line: "In an HE SU PPDU, HE extended range SU PPDU and HE MU PPDU with a single RU (the RU having an MU-MIMO allocation or an SU allocation), the number of HE-LTF symbols, NHE-LTF, is a function of the total number of space-time streams NSTS as shown in Table 28-12 (Frequently used parameters)". Table 28.12 doesn't show the mapping and and refers back to section 28.3.10.	Fix circular reference by showing the mapping in one of the places		2017/1/9 9:42
9093	stephane baron	225	1 9.2.4.6.3	22	26	E	Y	22.26 9.2.4.6.3	consider renumbering the bits number from B2-B29 to B1-B28	as in comment		2017/1/9 9:42
9094	stephane baron	225	1 9.2.4.6.4.4	22	16	T	N	22.16 9.2.4.6.4.4	We do not need 9 reserved bit in the Link adaptation control information subfield	put only 5 reserved bits from B7 to B11 to align the lenght of the HE link adaptation control field on 16 bits (12+4 control ID).		2017/1/9 9:42
9095	stephane baron	225	1 9.3.1.23	43	2	E	Y	43.02 9.3.1.23	HE stations are now handling two NAVs	replace NAV by NAVs in line 2 and 5		2017/1/9 9:42
9096	stephane baron	225	1 27.5.2.3	170	2	T	Y	170.02 27.5.2.3	required type of a basic trigger frame is not defined. Use the "Preferred AC" instead of the "required type"	Modify the text as follow :" If the Trigger Type field of the soliciting Trigger frame is Basic Trigger and the AC Preference Level subfield of the trigger dependant info field is set to 1, then if the STA does not have a frame corresponding to the AC value indicated in the Preferred AC subfield, the STA shall either not transmit a response or transmit one or more QoS Null frames.		2017/1/9 9:42
9097	stephane baron	225	1 27.5.2.23	170	5	T	Y	170.05 27.5.2.23	When the AC preference Level is set to 0 in a Basic trigger, A-MPDU content of the trigger based PPDU is not defined (if the STA doesn't support A-MPDU with multiple TIDs).When the AC preference Level is set to 0, the STA is responsible of the AC selection, and shall respect the EDCA rules to ensure QoS to its applications.	Add the following sentence between lines 4 and 5 : "If the Trigger Type field of the soliciting Trigger frame is Basic Trigger and the AC Preference Level subfield of the trigger dependant info field is set to 0, the STA shall follow the EDCA rules to determine the content of each A-MPDU by selecting frames from the non empty AC queue with the lowest corresponding backoff counter value.		2017/1/9 9:42
9098	stephane baron	225	1 9.7.3	108	11	T	Y	108.11 9.7.3	The Case of the "TXOP responder" is missing in note 2	replace "TXOP holder" with "TXOP holder, TXOP responder"		2017/1/9 9:42
9099	stephane baron	225	1 27.5.2.2.1	164	46	E	Y	164.46 27.5.2.2.1	doublon : suppress one of the double "."	as in comment		2017/1/9 9:42
9100	stephane baron	225	1 27.5.2.23	167	59	T	Y	167.59 27.5.2.23	Non associated STA behavior in MU UL is not defined	Use same mechanism as described in Multi user uplink random access for non associated STA		2017/1/9 9:42
9101	stephane baron	225	1 27.5.2.7	174	24	T	Y	174.24 27.5.2.7	The NDP feedback mechanism is not defined	create a new type of trigger frame to indicate to the STA the time/frequency/space dimensions.		2017/1/9 9:42
9102	stephane baron	225	1 9.3.1.23	42	52	T	Y	42.52 9.3.1.23	Create a new type of trigger frame for the NDP	Allocate one of the reserved value of the Trigger Type field to the NDP feedback mechanism		2017/1/9 9:42
9103	stephane baron	225	1 27.5.2.6.2	173	40	E	Y	173.40 27.5.2.6.2	In the exemple of random access the text describing the figure 27-1 should the rules defined line 30. decrementing the nonzero OBO counters by 1 in every RU assigned to AID value 0 is less clear than decrementing by a value equal to the number of Rus assigned to AID 0	replace the sentence by "For instance, as shown in Figure 27-1 (Illustration of the UL OFDMA-based random access procedure), the number of RUs assigned to AID value 0 beeing equal to 2, STA 1 decrements it OBO counter from 3 to 1, and STA 2 decrements its OBO counter smaller than 2 to 0.		2017/1/9 9:42
9104	stephane baron	225	1 27.5.2.6.2	173	46	E	Y	173.46 27.5.2.6.2	dot and space missing	replace "AID value 0If the selected" by "AID value 0. If the selected"		2017/1/9 9:42
9105	stephane baron	225	1 27.5.2.6.2	173	48	T	Y	173.48 27.5.2.6.2	The random access procedure suffer from a low efficiency (<38%), so the draft shall not additional collision cases. The procedure described line 49 to 52 will create extra collisions, on the subsequent trigger frame reception, since the STA that failed to transmit in previous trigger frame due to a busy channel (already having their OBO to 0) will fight against new stations decrementing their OBO to 0. So the congestion window cannot fully play its role	replace the sentence by : "If the selected RU is considered busy as a result of either physical or virtual carrier sensing, then the HE STA shall not transmit its HE trigger-based PPDU in the randomly selected RU and roll backs its OBO value to its original value."		2017/1/9 9:42

9106	Stephen McCann	225	1 9.3.1.20	40	31	T	Y	40.31 9.3.1.20	Within Figure 9-51b, the initial sub-field is shown as "AID11". This is not defined within the document.	Either remove this sub-field from the figure, or replace it with "AID"	2017/1/9 9:42
9107	Stephen McCann	225	1 27.16.3.2	207	62	T	Y	207.62 27.16.3.2	The following sentence "NOTE--The GAS protocol can be used by an HE STA to inform an AP the type of STA-to-STA operations" does not read correctly and the grammar requires some correction.	Change the cited setence to "NOTE--The HE STA can use the GAS protocol to transport an element that informs an AP about the type(s) of STA-to-STA operations that the HE STA supports."	2017/1/9 9:42
9108	Stephen McCann	225	1 9.4.2.218.2	80	13	E	N	80.13 9.4.2.218.2	The referenced clause 11.47 does not exist.	Change the reference to clause "11.47" to "27.16.3". A similar change is also required at P95L50.	2017/1/9 9:42
9109	Stephen McCann	225	1 9.4.2.223	95	50	E	N	95.50 9.4.2.223	The following sentence "The Quiet Time Period Setup element defines a period for an STA-to-STA operation" does not read correctly.	Change the cited sentence to "The Quiet Time Period Setup element defines a period for an STA-to-STA operation to occur"	2017/1/9 9:42
9110	Stephen McCann	225	1 9.4.2.223	95	54	E	N	95.54 9.4.2.223	Typo "STA-2-STA"	Change the cited words to "STA-to-STA"	2017/1/9 9:42
9111	Stephen McCann	225	1 9.4.2.218.2	80	10	E	N	80.10 9.4.2.218.2	The term QTP is introduced by the draft at this point.	Create an acronym for QTP in clause 3.4	2017/1/9 9:42
9112	Stephen McCann	225	1 9.4.2.224	96	37	T	Y	96.37 9.4.2.224	The term "Vendor Specific Service Identifier" is used in Figure 9-589cz, "Vendor Specific Service ID" on P96L22 and also "Vendor Specific Service Type" on P207L48, which appear to be the same parameter.	Clarify and use a consistent term at the cited places. "Vendor Specific Service ID" may be the suitable one to use. In addition, an example of such a Service ID may be useful to avoid confusion with many specific service related terms introduced by the IEEE 802.11aq draft.	2017/1/9 9:42
9113	Sudhir Srinivasa	225	1 28.1.1	210	58	T	Y	210.58 28.1.1	The (4xHELTF+0.8us GI) mode seems to be missing	Include this mode under "may support"	2017/1/9 9:42
9114	Sudhir Srinivasa	225	1 9.4.2.218.3	84	6	T	Y	84.06 9.4.2.218.3	Not clear which field(s) (or OFDM symbols) the constellation support and Nss support apply to.	Clarify exactly which of the constellation or spatial stream support constraints apply to DCM DATA and SIGB DCM.	2017/1/9 9:42
9115	Suhwook Kim	225	1 9.4.2.218.2	77	40	E	N	77.40 9.4.2.218.2	There is no definition or abbreviation of "S-MPDU"	Add abbreviation of S-MPDU as "single MPDU"	2017/1/9 9:42
9116	Suhwook Kim	225	1 27.3.4.4	156	62	E	N	156.62 27.3.4.4	There is no definition of FN in equation	Define FN as "Fragment Number in Fragment Number subfield"	2017/1/9 9:42
9117	Suhwook Kim	225	1 27.3.4.4	156	62	E	N	156.62 27.3.4.4	In "where the operations on the sequence numbers are performed module 4096", "module" should be "modulo"	Change to "where the operations on the sequence numbers are performed modulo 4096"	2017/1/9 9:42
9118	Suhwook Kim	225	1 27.3.3.4	154	42	T	Y	154.42 27.3.3.4	In "The receiver STA that accepts the HT-Immediate block ack session shall respond with an L3 Frag BA Response if it has allocated resources for operating in a block ack session with level 3 fragmentation enabled", what does "allocated resources" mean? In general, allocated resource means frequency resource unit by trigger frame in this specification. However, "allocated resources" in that sentence doesn't look like frequency resource. It may be about hardware stuff.	Change to "The receiver STA that accepts the HT-Immediate block ack session shall respond with an L3 Frag BA Response if it can support operating in a block ack session with level 3 fragmentation enabled"	2017/1/9 9:42
9119	Suhwook Kim	225	1 28.3.10.8.5	295	18	T	Y	295.18 28.3.10.8.5	In this spec, STAID 0 is only for broadcast frame. If an AP want to send a data or management frame to an unassociated STA, STA-ID field in HE-SIG-B would be 0 because the receiver STA doesn't have an AID yet. In this case, all stations near the AP will decode this frame unnessocery becase its STA-ID field is 0. It is desirable to avoid.	Define broadcast STAID value for unassociated STA only	2017/1/9 9:42
9120	Suhwook Kim	225	1 27.5.1.2	163	9	T	Y	163.09 27.5.1.2	In this spec, STAID 0 is only for broadcast frame. If an AP want to send a data or management frame to an unassociated STA, STA-ID field in HE-SIG-B would be 0 because the receiver STA doesn't have an AID yet. In this case, all stations near the AP will decode this frame unnessocery becase its STA-ID field is 0. It is desirable to avoid.	Define broadcast STAID value for unassociated STA only	2017/1/9 9:42

9121	Suhwook Kim	225	1 27.5.2.2.1	164	46	T	Y	164.46 27.5.2.2.1	If AP sets AID12 field to 0, associated STAs and non-associated STAs can transmit on the same resource unsing random access. However, it will be undesirable because their transmissions have different priority, frame type, and purpose. AP has to manage UL OFDMA random access to achieve high effiency. So AP should be able to allocate resource to association STAs only or unassociation STAs only.	Define broadcast AID12 value for unassociated STA only		2017/1/9 9:42
9122	Suhwook Kim	225	1 27.5.2.6.1	172	34	T	Y	172.34 27.5.2.6.1	If AP sets AID12 field to 0, associated STAs and non-associated STAs can transmit on the same resource unsing random access. However, it will be undesirable because their transmissions have different priority, frame type, ack policy, frame length, and purpose. AP has to manage UL OFDMA random access to achieve high effiency. So AP should be able to allocate resource to association STAs only or unassociation STAs only.	Define broadcast AID12 value for unassociated STA only		2017/1/9 9:42
9123	Suhwook Kim	225	1 9.3.1.23	45	35	T	Y	45.35 9.3.1.23	If AP sets AID12 field to 0, associated STAs and non-associated STAs can transmit on the same resource unsing random access. However, it will be undesirable because their transmissions have different priority, frame type, ack policy, frame length, and purpose. AP has to manage UL OFDMA random access to achieve high effiency. So AP should be able to allocate resource to association STAs only or unassociation STAs only.	Define broadcast AID12 value for unassociated STA only		2017/1/9 9:42
9124	SUNGEUN LEE	225	1 9.2.4.6.4.6	27	19	E	Y	27.19 9.2.4.6.4.6	Wrong section reference	Fix the wrong section reference 26.3.13.2 (Power pre-correction) to the correct one		2017/1/9 9:42
9125	SUNGEUN LEE	225	1 9.2.4.6.4.7	27	65	E	Y	27.65 9.2.4.6.4.7	Wrong section reference and missed parenthesis (see 25.5.1.3 (Bandwidth query report operation)	Change the wrong reference section to the correct one, and put one more right parenthesis at the end of the sentence, e.g., (see 27.5.1.3 (HE bandwidth query report operation for DL MU))		2017/1/9 9:42
9126	SUNGEUN LEE	225	1 9.4.2.200	73	14	E	Y	73.14 9.4.2.200	Wrong section reference 25.14 (Link adaptation using the HE variant HT Control field) in the Table 9-262k1-TWT Flow Identifier field for a broadcast TWT element	Change the wrong reference to the correct one		2017/1/9 9:42
9127	SUNGEUN LEE	225	1 9.4.2.200	73	40	E	Y	73.40 9.4.2.200	Wrong section reference 25.14 (Link adaptation using the HE variant HT Control field) in the Table 9-262k1-TWT Flow Identifier field for a broadcast TWT element	Change the wrong reference to the correct one		2017/1/9 9:42
9128	SUNGEUN LEE	225	1 9.4.2.218.2	78	41	E	Y	78.41 9.4.2.218.2	Wrong section reference 25.4.2 in 'All ACK Support' row of Table 9-262z-Subfields of the HE MAC Capabilities Information field	Change the wrong reference to the correct one		2017/1/9 9:42
9129	SUNGEUN LEE	225	1 10.28.4	137	11	E	Y	137.11 10.28.4	Wrong section reference 25.10.4 (A-MPDU with multiple TID)	Change the wrong reference to the correct one		2017/1/9 9:42
9130	SUNGEUN LEE	225	1 27.5.2.2.3	167	26	E	Y	167.26 27.5.2.2.3	Wrong section reference 9.22.2.7 (Multiple frame transmission in an EDCA TXOP)	Change the wrong reference to the correct one, 10.22.2.7 (Multiple frame transmission in an EDCA TXOP) given P802.11ax D1.0		2017/1/9 9:42
9131	SUNGEUN LEE	225	1 27.5.2.2.3	167	30	E	Y	167.30 27.5.2.2.3	Wrong section reference 9.22.2.2 (EDCA backoff procedure)	Change the wrong reference to the correct one, 10.22.2.2 (EDCA backoff procedure) given P802.11ax D1.0		2017/1/9 9:42
9132	SUNGEUN LEE	225	1 27.6.4	179	14	E	Y	179.14 27.6.4	Wrong section reference	Fix the wrong section reference 26.1.4 (PPᶻ·ᵈᶠ formats) to the correct one		2017/1/9 9:42
9133	SUNGEUN LEE	225	1 2.15.4.1	203	10	E	Y	203.10 2.15.4.1	Wrong section reference	Fix the wrong section reference 26.5 (Parameters for HE-MCSs) to the correct one		2017/1/9 9:42
9134	SUNGEUN LEE	225	1 28.1.1	209	59	T	Y	209.59 28.1.1	MCS 1 supports QPSK with DCM	Include QPSK DCM for the supported modulation.		2017/1/9 9:42
9135	SUNGEUN LEE	225	1 28.1.1	210	39	E	Y	210.39 28.1.1	Precise description for 1x HE-LTF is 1x LTF not 1x	Change the word '1x' to 'an 1x LTF'.		2017/1/9 9:42
9136	SUNGEUN LEE	225	1 28.1.1	210	60	T	Y	210.60 28.1.1	0.8us + 4x LTF is optional mode to support mainly for beamforming feedback on SU and MU PPDUs	Add the statement to describe 0.8us + 4x LTF optional mode, i.e., "0.8 us GI duration on both HE-LTF and data symbols when the HE-LTF is a 4x-LTF (transmit and receiver) for HE SU PPDUs, HE MU PPDUs"		2017/1/9 9:42

9137	SUNGEUN LEE	225	1 28.2.2	217	5	E	Y	217.05 28.2.2	CHAN_MAT parameter in Table 28-1 includes wrong reference as 26.3.12.3.2 (Beamforming feedback)	Change the wrong reference to the correct one	2017/1/9 9:42
9138	SUNGEUN LEE	225	1 28.2.2	219	51	T	Y	219.51 28.2.2	SU RU in HE MU PPDU is not an accurate term to describe for DCM		2017/1/9 9:42
9139	SUNGEUN LEE	225	1 28.2.2	221	18	T	Y	221.18 28.2.2	The terminology 'preamble supporting channel bonding' is not precise	Replace 'preamble supporting channel bonding' to 'preamble puncturing'	2017/1/9 9:42
9140	SUNGEUN LEE	225	1 28.2.2	222	11	T	Y	222.11 28.2.2	HD NDP PPDU only uses HE SU PPDU format without the Data field, therefore, it is not precise to describe HE NDP PPDU in HE_SU,HE_MU,HE_EXT_SU or HE_TRIG format row.	Separate the row into two rows, one is 'FORMAT is HE_SU', the other is 'FORMAT is HE_MU,HE_EXT_SU or HE_TRIG', and includes HE_NDP_PPDU description only in 'FORMAT is HE_SU' row.	2017/1/9 9:42
9141	SUNGEUN LEE	225	1 28.2.2	222	22	T	Y	222.22 28.2.2	HD NDP PPDU only uses HE SU PPDU format with 0 octet in the PSDU_LENGTH. Therefore, it is not precise to describe HE NDP PPDU in HE_SU,HE_MU,HE_EXT_SU or HE_TRIG format row.	First, separate the row into two rows, one is 'FORMAT is HE_SU', the other is 'FORMAT is HE_MU,HE_EXT_SU or HE_TRIG'. In 'FORMAT is HE_SU' row. Include the description of HE NDP PPDU. In 'FORMAT is HE_MU,HE_EXT_SU or HE_TRIG', change the minimum octet size from 0 to 1 describing the number of octets in the HE PSDU.	2017/1/9 9:42
9142	SUNGEUN LEE	225	1 28.2.2	223	28	E	Y	223.28 28.2.2	Improve the description on note for B1-B6. Integer can be in decimal, in octal, or in binary format, so 'B1-B6 is integer' description is not sufficient.	Update the note to express decimal value, e.g., Note. B1-B6 indicates a decimal integer of a binary number from B1 to B6, where B1 is MSB.	2017/1/9 9:42
9143	SUNGEUN LEE	225	1 28.2.2	223	20	T	Y	223.20 28.2.2	all 1s in TXOP denotes the no duration information, but it does not mean it is an invalid value.	Describe all 1 case (127) with better wording	2017/1/9 9:42
9144	SUNGEUN LEE	225	1 28.2.2	226	15	T	Y	226.15 28.2.2	HE-LTF1 is not clearly defined in the specification, so detailed description for the first symbol of HE-LTF is required to be added	Change HE-LTF1 into the first symbol of HE-LTF	2017/1/9 9:42
9145	SUNGEUN LEE	225	1 28.2.2	226	17	T	Y	226.17 28.2.2	HE-LTF1 is not clearly defined in the specification, so detailed description for the first symbol of HE-LTF is required to be added	Change HE-LTF1 into the first symbol of HE-LTF	2017/1/9 9:42
9146	SUNGEUN LEE	225	1 28.3.3.2	229	32	E	Y	229.32 28.3.3.2	Remove additional period at the end of the statement	Remove additional period at the end of the statement	2017/1/9 9:42
9147	SUNGEUN LEE	225	1 28.3.3.2	230	1	E	Y	230.01 28.3.3.2	Add - in 484-tone for the consistency	Add - in 484-tone for the consistency	2017/1/9 9:42
9148	SUNGEUN LEE	225	1 28.3.3.2	232	34	T	Y	232.34 28.3.3.2	242-tone in a 20MHz HE PPDU can be used for MU, therefore SU text for 242-tone in Figure 28-2 is not appropriate	Remove SU text in Figure 28-2	2017/1/9 9:42
9149	SUNGEUN LEE	225	1 28.3.3.2	233	27	T	Y	233.27 28.3.3.2	484-tone in a 40MHz HE PPDU can be used for MU, therefore SU text for 484-tone in Figure 28-3 is not appropriate	Remove SU text in Figure 28-3	2017/1/9 9:42
9150	SUNGEUN LEE	225	1 28.3.3.2	234	30	T	Y	234.30 28.3.3.2	996-tone in a 80MHz HE PPDU can be used for MU, therefore SU text for 996-tone in Figure 28-4 is not appropriate	Remove SU text in Figure 28-4	2017/1/9 9:42
9151	SUNGEUN LEE	225	1 28.3.3.5	237	35	E	Y	237.35 28.3.3.5	It is better not to use arabic numerals to describe the number of RUs since 26/52/106-tone RUs also starts with arabic numerals so that text can bring some confusion	(2 26-tone RUs) -> (two 26-tone RUs) (7 26-tone RUs) -> (seven 26-tone RUs) (14 26-tone RUs) -> (fourteen 26-tone RUs) (2 of 52-tone RUs) -> (two 52-tone RUs) (4 of 52-tone RUs) -> (four 52-tone RUs) (2 of 106-tone RUs) -> (two 106-tone RUs) (4 of 106-tone RUs) -> (four 106-tone RUs)	2017/1/9 9:42
9152	SUNGEUN LEE	225	1 28.3.3.6	238	1	E	Y	238.01 28.3.3.6	20 MHz only and 20 MHz-only are mixed over the spec, and it is required to have the consistent expression for a non-AP STA which operates 20 MHz channel only.	Unify 20 MHz only and 20 MHz-only descriptions to represent a non-AP HE STA which operates 20 MHz channel width only.	2017/1/9 9:42
9153	SUNGEUN LEE	225	1 28.3.3.6	238	5	T	Y	238.05 28.3.3.6	It is not clear on the possibility of the operation in secondary channels from 'primary 20 MHz channel as a mandatory mode' description.	Clarify the operation capability on secondary 20MHz channels of 20 MHz-only STA, e.g., only primary 20MHz support or else, and if it is required to operate, define the procedure and signaling.	2017/1/9 9:42
9154	SUNGEUN LEE	225	1 28.3.3.6	238	1	T	Y	238.01 28.3.3.6	20 MHz-only STA is only for non-AP HE STA, so for the clarification, 20 MHz-only non-AP HE STA would be more appropriate	Change the title as 20 MHz-only non-AP HE STAs	2017/1/9 9:42
9155	SUNGEUN LEE	225	1 28.3.5	242	51	E	Y	242.51 28.3.5	Verb 'Relicate' is not appropriate as an item of block explanation	Change item k description into a noun form	2017/1/9 9:42

9156	SUNGEUN LEE	225	1 28.3.5	242	52	E	Y	242.52 28.3.5	Verb 'Multiply' is not appropriate as an item of block explanation	Change item I description into a noun form	2017/1/9 9:42
9157	SUNGEUN LEE	225	1 28.3.6.4	250	47	E	Y	250.47 28.3.6.4	Fix the wrong section reference number	Change 228.3.9 to 28.3.9	2017/1/9 9:42
9158	SUNGEUN LEE	225	1 28.3.6.6	251	32	T	Y	251.32 28.3.6.6	HE-SIG-A1/A2 is used to represent either data bits in field or symbol itself in a mixed way. HE-SIG-A1 and HE-SIG-A2 are described as two parts of HE-SIG-A field over the specification and in HE-SIG-A field tables, and two OFDM symbols are created based on data bits of HE-SIG-A1 and HE-SIG-A2. Therefore, clarification is required.	Unify the definition of HE-SIG-A1/A2/A3/A4 over the specification, e.g.,replace 'consists of two symbols' to 'consists of two parts', and change 'and is constructed' to ', and the HE-SIG-A symbols are constructed'	2017/1/9 9:42
9159	SUNGEUN LEE	225	1 28.3.6.6	251	47	T	Y	251.47 28.3.6.6	Require to keep consistency for the definition of HE-SIG-A1 and HE-SIG-A2 whether those are fields or symbols.	Unify the definition of HE-SIG-A1/A2 over the specification, e.g., change 'Duplicate HE-SIG-A1 and HE-SIG-A2' to 'Duplicate the symbols constructed from HE-SIG-A1 and HE-SIG-A2'	2017/1/9 9:42
9160	SUNGEUN LEE	225	1 28.3.6.6	251	62	T	Y	251.62 28.3.6.6	Make it consistent for the definition and usage of HE-SIG-A1/A2/A3/A4, which would represents either data bit field or symbol.	Unify the definition of HE-SIG-A1/A2/A3/A4 over the specification, e.g., replace 'consists of four symbols' to 'consists of four parts', and change 'field is constructed' to 'symbols are constructed'	2017/1/9 9:42
9161	SUNGEUN LEE	225	1 28.3.6.9	253	35	E	Y	253.35 28.3.6.9	pilot subcarrier is more appropriate term rather than pilot tone for the consisistency of the document	change the text 'pilot tones' to 'pilot subcarriers'	2017/1/9 9:42
9162	SUNGEUN LEE	225	1 28.3.6.8	253	5	T	Y	253.05 28.3.6.8	For trigger-based PPDU or MU PPDU, HE-STF is transmissed only for (an) assigned RU(s), therefore HE-STF generation over the whole bandwidth indicated by CH_BANDWIDTH can be misleading.	massage the sentence or add the description to clarify HE-STF is transmitted only for the assigned RU(s) for certain scenarios	2017/1/9 9:42
9163	SUNGEUN LEE	225	1 28.3.6.9	253	29	T	Y	253.29 28.3.6.9	For trigger-based PPDU or MU PPDU, HE-LTF is transmissed only for (an) assigned RU(s), therefore HE-LTF generation over the whole bandwidth indicated by CH_BANDWIDTH can be misleading	massage the sentence or add the description to clarify HE-LTF is transmitted only for the assigned RU(s) for certain scenarios	2017/1/9 9:42
9164	SUNGEUN LEE	225	1 28.3.9	261	30	E	Y	261.30 28.3.9	Wrong section reference see 22.3.7 (Mathematical description of signals) based on 802.11-2016	Change the wrong reference to the correct one, i.e., 21.3.7 (Mathematical description of signals) based on 802.11-2016	2017/1/9 9:42
9165	SUNGEUN LEE	225	1 28.3.9	263	63	E	Y	263.63 28.3.9	Wrong section reference 18.3.2.5 (Mathematical conventions in the signal descriptions)	Change to the wrong section number to the correct one, i.e., 17.3.2.5 (Mathematical conventions in the signal descriptions) based on 802.11-2016	2017/1/9 9:42
9166	SUNGEUN LEE	225	1 28.3.6.6	265	32	T	Y	265.32 28.3.6.6	HE-SIG-A1 is an information parts of HE-SIG-A field, and the symbol is composed of the information in HE-SIG-A1, therefore 'symbol' is not accurate to describe HE-SIG-A1. Morevoer, the terminology 'part' is already used in Encoding and modulation subclause.	For consistency with other clause and clarification, change the text 'two symbols' to 'two parts'	2017/1/9 9:42
9167	SUNGEUN LEE	225	1 28.3.6.6	265	62	T	Y	265.62 28.3.6.6	HE-SIG-A1 is an information parts of HE-SIG-A field, and the symbol is composed of the information in HE-SIG-A1, therefore 'symbol' is not accurate to describe HE-SIG-A1. Morevoer, the terminology 'part' is already used in Encoding and modulation subclause.	For consistency with other clause and clarification, change the text 'four symbols' to 'four parts'	2017/1/9 9:42
9168	SUNGEUN LEE	225	1 28.3.9	265	47	E	Y	265.47 28.3.9	TGI2,L-LTF parameter does not exist. Fix the wrong parameter name TGI2,L-LTF in the row L-LTF	Change TGI2,L-LTF to TGI,L-LTF	2017/1/9 9:42
9169	SUNGEUN LEE	225	1 28.3.9	266	3	T	Y	266.03 28.3.9	TGI,HE-LTF1 parameter is never defined in the specification. In addition, GI duration is depending on LTF+CP combination, which is not one-to-one mapping from HE-LTF mode. Moreover, the parameter TGI,HE-LTF is already described in Table 28-9-Timing-related constants (P802.11ax D1.0). Therefore, TGI,HE-LTF1 would be replaced as TGI,HE-LTF	Replace TGI,HE-LTF1 to TGI,HE-LTF	2017/1/9 9:42

9170	SUNGEUN LEE	225	1 28.3.9	266	6	T	Y	266.06 28.3.9	TGI,HE-LTF2 parameter is never defined in the specification. In addition, GI duration is depending on LTF+CP combination, which is not one-to-one mapping from HE-LTF mode. Moreover, the parameter TGI,HE-LTF is already described in Table 28-9-Timing-related constants (P802.11ax D1.0). Therefore, TGI,HE-LTF2 would be replaced as TGI,HE-LTF	Replace TGI,HE-LTF2 to TGI,HE-LTF	2017/1/9 9:42
9171	SUNGEUN LEE	225	1 28.3.9	266	8	T	Y	266.08 28.3.9	TGI,HE-LTF4 parameter is never defined in the specification. In addition, GI duration is depending on LTF+CP combination, which is not one-to-one mapping from HE-LTF mode. Moreover, the parameter TGI,HE-LTF is already described in Table 28-9-Timing-related constants (P802.11ax D1.0). Therefore, TGI,HE-LTF4 would be replaced as TGI,HE-LTF	Replace TGI,HE-LTF4 to TGI,HE-LTF	2017/1/9 9:42
9172	SUNGEUN LEE	225	1 28.3.10.3	268	52	E	Y	268.52 28.3.10.3	Wrong section and subsection numbers 22.3.8.3.4 (L-SIG definition)	Change the wrong section and subsection numbers to the correct one, i.e., 21.3.8.2.4 (L-SIG definition) based on 802.11-2016	2017/1/9 9:42
9173	SUNGEUN LEE	225	1 28.3.10.4	268	14	T	Y	268.14 28.3.10.4	The GI parameter in Eq (28-10) based on P802.11ax D1.0 is wrong. It should be TGI,L-LTF	Change TGI,LegacyPreamble to TGI,L-LTF in L-LTF equation for BEAM_CHANGE is 0, i.e., Eq. (28-10) based on P802.11ax D1.0	2017/1/9 9:42
9174	SUNGEUN LEE	225	1 28.3.10.4	269	62	E	Y	269.62 28.3.10.4	Equation (18-8) is an incorrect reference number from REVmc.	Change to (17-8)	2017/1/9 9:42
9175	SUNGEUN LEE	225	1 28.3.10.3	269	27	E	Y	269.27 28.3.10.3	Wrong section reference 22.3.10.11.1 (Transmission in VHT format)	Change the wrong section number to the correct one, i.e., 21.3.10.11.1 (Transmission in VHT format) based on 802.11-2016	2017/1/9 9:42
9176	SUNGEUN LEE	225	1 28.3.10.5	272	5	T	Y	272.05 28.3.10.5	The summation range for iBW should be from 0 to N_20MHz-1	Change summation upper bound of iBW from N20MHz to N20MHz-1 for L-SIG equation, ie.g., Eq (28-13)	2017/1/9 9:42
9177	SUNGEUN LEE	225	1 28.3.10.7.2	273	23	T	Y	273.23 28.3.10.7.2	HE-LTF1 is not clearly defined in the specification, so detailed description for the first symbol of HE-LTF is required to be added	Change HE-LTF1 into the first symbol of HE-LTF	2017/1/9 9:42
9178	SUNGEUN LEE	225	1 28.3.10.7.2	273	25	T	Y	273.25 28.3.10.7.2	HE-LTF1 is not clearly defined in the specification, so detailed description for the first symbol of HE-LTF is required to be added	Change HE-LTF1 into the first symbol of HE-LTF	2017/1/9 9:42
9179	SUNGEUN LEE	225	1 28.3.10.7.2	273	46	T	Y	273.46 28.3.10.7.2	It would be required to clarify what P20 is (primary 20MHz) and to be consistent further with Eq (28-18) and (28-19) in P802.11ax D1.0 for P20	Clarify P20 description in MCS field of HE SU and HE extended range PPDU Table	2017/1/9 9:42
9180	SUNGEUN LEE	225	1 28.3.10.7.2	274	7	T	Y	274.07 28.3.10.7.2	Specify the SRP-based spatial reuse methodology refered in Spatial Reuse field	Specify SRP-based spatial reuse for clarifying the meaning of SR Disallowed in Spatial Reuse field	2017/1/9 9:42
9181	SUNGEUN LEE	225	1 28.3.10.7.2	274	10	T	Y	274.10 28.3.10.7.2	Complete Spatial Reuse field definition and usage for HE SU and HE extended range SU PPDUs	Complete Spatial Reuse field definition and usage for HE SU and HE extended range SU PPDUs and remove 'NOTE-This part needs further development'	2017/1/9 9:42
9182	SUNGEUN LEE	225	1 28.3.10.7.2	274	13	E	Y	274.13 28.3.10.7.2	Reference 27.11a (TXVECTOR parameters SPATIAL_REUSE for an HE PPDU) is incorrect in Spatial Reuse field	Change 27.11a (TXVECTOR parameters SPATIAL_REUSE for an HE PPDU) to the correct reference 27.11.6	2017/1/9 9:42
9183	SUNGEUN LEE	225	1 28.3.10.7.2	276	44	T	Y	276.44 28.3.10.7.2	Complete Spatial Reuse field definition and usage for HE MU PPDU.	Complete Spatial Reuse field definition and usage for HE MU PPDU and remove 'NOTE-This part needs further development'	2017/1/9 9:42
9184	SUNGEUN LEE	225	1 28.3.10.7.2	276	33	E	Y	276.33 28.3.10.7.2	Fix the typo HE-SIB-B	Change HE-SIB-B to HE-SIG-B	2017/1/9 9:42
9185	SUNGEUN LEE	225	1 28.3.10.7.2	276	47	E	Y	276.47 28.3.10.7.2	Reference 27.11a (TXVECTOR parameters SPATIAL_REUSE for an HE PPDU) is incorrect in Spatial Reuse field	Change 27.11a (TXVECTOR parameters SPATIAL_REUSE for an HE PPDU) to the correct reference 27.11.6	2017/1/9 9:42
9186	SUNGEUN LEE	225	1 28.3.10.7.3	283	2	E	Y	283.02 28.3.10.7.3	upper bound L is slightly truncated in I(D) equation	Reconfigure equation to display all parameters properly	2017/1/9 9:42
9187	SUNGEUN LEE	225	1 28.3.10.10	311	23	E	Y	311.23 28.3.10.10	Equation (22-46) is an incorrect reference number from REVmc.	Change to (21-46)	2017/1/9 9:42
9188	SUNGEUN LEE	225	1 28.3.10.10	313	3	E	Y	313.03 28.3.10.10	Equation (22-46) is an incorrect reference number from REVmc.	Change to (21-46)	2017/1/9 9:42
9189	SUNGEUN LEE	225	1 28.3.10.10	313	23	T	Y	313.23 28.3.10.10	TGI in HE-LTF equation, i.e., Eq (28-58) should be clarified more from the parameter table.	Replace TGI to TGI,HE-LTF and also update the description in parameter table accordingly	2017/1/9 9:42

9190	SUNGEUN LEE	225	1 28.3.10.10	313	38	T	Y	313.38 28.3.10.10	TGI in HE-LTF equation, i.e., Eq (28-59) should be clarified more from the parameter table.	Replace TGI to TGI,HE-LTF and also update the description in parameter table accordingly	2017/1/9 9:42
9191	SUNGEUN LEE	225	1 28.3.11.5.2	318	34	E	Y	318.34 28.3.11.5.2	Equation (20-35) is an incorrect reference number from REVmc.	Change to (19-35)	2017/1/9 9:42
9192	SUNGEUN LEE	225	1 28.3.11.5.2	318	47	E	Y	318.47 28.3.11.5.2	Equation (20-36) is an incorrect reference number from REVmc.	Change to (19-36)	2017/1/9 9:42
9193	SUNGEUN LEE	225	1 28.3.11.5.5	322	24	E	Y	322.24 28.3.11.5.5	Wrong section reference 20.3.11.7.5 (LDPC PPDU encoding process),	Change to the wrong section number to the correct one, i.e., 19.3.11.7.5 (LDPC PPDU encoding process) based on 802.11-2016	2017/1/9 9:42
9194	SUNGEUN LEE	225	1 28.3.11.5.5	322	26	E	Y	322.26 28.3.11.5.5	Wrong section reference 20.3.11.7.5 (LDPC Wrong section references PPDU encoding process)	Change to the wrong section number to the correct one, i.e., 19.3.11.7.5 (LDPC PPDU encoding process) based on 802.11-2016	2017/1/9 9:42
9195	SUNGEUN LEE	225	1 28.3.11.5.5	322	33	E	Y	322.33 28.3.11.5.5	20.3.11.7.5 (LDPC PPDU encoding process),	Change to the wrong section number to the correct one, i.e., 19.3.11.7.5 (LDPC PPDU encoding process) based on 802.11-2016	2017/1/9 9:42
9196	SUNGEUN LEE	225	1 28.3.11.10	327	58	E	Y	327.58 28.3.11.10	Wrong section reference 22.3.10.9.4 (Space-time block coding),	Change the wrong section number to the correct one, i.e., 21.3.10.9.4 (Space-time block coding) based on 802.11-2016	2017/1/9 9:42
9197	SUNGEUN LEE	225	1 28.3.11.9	327	40	E	Y	327.40 28.3.11.9	Section number is wrong as 18.3.5.8	Change the wrong section number and description to 17.3.5.8 (Subcarrier modulation mapping) based on 802.11-2016	2017/1/9 9:42
9198	SUNGEUN LEE	225	1 28.3.11.11	329	4	E	Y	329.04 28.3.11.11	Wrong section reference (see 25.3.10.7)	Change the wrong reference to the correct one	2017/1/9 9:42
9199	SUNGEUN LEE	225	1 28.3.11.14	335	55	T	Y	335.55 28.3.11.14	RU range r is from 0 to N_RU in Eq (28-109)	Change the range of r from 0 to NRU-1 in Eq (28-109) based on P802.11ax D1.0	2017/1/9 9:42
9200	SUNGEUN LEE	225	1 28.3.11.14	336	58	E	Y	336.58 28.3.11.14	Wrong section reference 22.3.10.11.1 (Transmission in VHT format)	Change the wrong section number to the correct one, i.e., 21.3.10.11.1 (Transmission in VHT format) based on 802.11-2016	2017/1/9 9:42
9201	SUNGEUN LEE	225	1 28.3.19	362	44	E	Y	362.44 28.3.19	Wrong section reference	Fix the wrong section reference 26.2.x (Support for NON-HT,HT, and VTH formats) to the correct one	2017/1/9 9:42
9202	SUNGEUN LEE	225	1 28.3.19	362	57	E	Y	362.57 28.3.19	Wrong section reference 22.3.18.5 (CCA sensitivity)	Change the wrong section number to the correct one, i.e., 21.3.18.5 (CCA sensitivity) based on 802.11-2016	2017/1/9 9:42
9203	SUNGEUN LEE	225	1 28.3.20	368	62	E	Y	368.62 28.3.20	Wrong section reference 22.3.18.5 (CCA sensitivity)	Change the wrong section number to the correct one, i.e., 21.3.18.5 (CCA sensitivity) based on 802.11-2016	2017/1/9 9:42
9204	SUNGEUN LEE	225	1 28.3.20	368	13	E	Y	368.13 28.3.20	Refered section numbers in the figure 28-51 are wrong since it was based on 802.11ac-2013.	Update many section numbers in the Figure 28-51-PHY receive state machine to refer the correc section based on 802.11-2016	2017/1/9 9:42
9205	SUNGEUN LEE	225	1 28.4.1	371	20	E	Y	371.20 28.4.1	Table 25-1 is an incorrect reference.	Change to correct reference Table (xx-yy)	2017/1/9 9:42
9206	Thomas Handte	225	1 28.3.3.1	228	48	E	N	228.48 28.3.3.1	Differentiation between OFDM and OFDMA in Fig. 28-1 not clear. Why is user A addressed in OFDM and OFDMA mode?	Have to separate Figures: One for OFDM and one for OFDMA	2017/1/9 9:42
9207	Thomas Handte	225	1 28.3.3.10.3	240	8	T	Y	240.08 28.3.3.10.3	Not clear what "masking LTF sequence of each spatial stream by a distinct orthogonal code" is	Specify or reference what is a distinct orthogonal code and how it is defined	2017/1/9 9:42
9208	Thomas Handte	225	1 28.3.10.7.2	274	10	T	Y	274.10 28.3.10.7.2	Signaling for spatial reuse needs further development	Specify signaling for spatial reuse. Equivalent specification as in Table 28-19 may be appropriate	2017/1/9 9:42
9209	Thomas Handte	225	1 28.3.10.7.2	276	40	T	Y	276.40 28.3.10.7.2	Signaling for spatial reuse needs further development	Specify signaling for spatial reuse. Equivalent specification as in Table 28-19 may be appropriate	2017/1/9 9:42
9210	Thomas Handte	225	1 28.3.10.7.2	279	23	T	N	279.23 28.3.10.7.2	Spatial reuse fields labelled with 2, 3, and 4. In some BW setups, all or some of the fields have an identical and redundant value.	Consider declaring fields as reserved. This would affect spatial reuse fields 2, 3, and 4 and Note 1	2017/1/9 9:42
9211	Thomas Handte	225	1 28.3.10.8.4	292	1	E	N	292.01 28.3.10.8.4	(continued) in table header missing	Add "(continued)"	2017/1/9 9:42
9212	Thomas Handte	225	1 28.3.10.8.4	293	1	E	N	293.01 28.3.10.8.4	(continued) in table header missing	Add "(continued)"	2017/1/9 9:42
9213	Thomas Handte	225	1 28.3.11.9	325	2	E	N	325.02 28.3.11.9	Add information about which bits decide the quadrant	Add "Bit label b0 and b5 specify the quadrant of 1024-QAM constellation."	2017/1/9 9:42
9214	Tomoko Adachi	225	1 27.4			T	Y	27.4	Even if the STA receives only a Trigger frame and an Action Ack frame, it should respond with a Multi-STA BlockAck as there might be data frames aggregated. The response behavior will be simple if whenever an Action Ack frame is received with a Trigger frame, the STA has to respond with a Multi-STA BlockAck.	Specify that whenever an Action Ack frame is aggregated with a Trigger frame, the STA shall respond with a Multi-STA BlockAck.	2017/1/9 9:42

9215	Tomoko Adachi	225	1 10.28.4	137	11	E	Y	137.11 10.28.4	Wrong reference number.	Change "25.10.4" to "27.10.4".	2017/1/9 9:42
9216	Tomoko Adachi	225	1 27.10.4	194	30	T	Y	194.30 27.10.4	The rules are described in 27.10.4 when the STA gains access to the medium and aggregate QoS Data frames from one or more TIDs in the A-MPDU. But the Action frame is not mentioned. It is as though implicitly restricting such case but not clear.	Change the part "When TXOP limit is not zero then the STA may aggregate QoS Data frames from one or more TIDs in the A-MPDU under the following conditions:" to "When TXOP limit is not zero then the STA may aggregate QoS Data frames from one or more TIDs but not Action frames in the A-MPDU under the following conditions:"	2017/1/9 9:42
9217	Tomoko Adachi	225	1 3.1			T	Y	3.1	Definition of OFDMA should be added in 3.1.	Insert clause 3.1 to the draft and add definition of OFDMA there.	2017/1/9 9:42
9218	Tomoko Adachi	225	1 3.1			T	Y	3.1	In the baseline, there is the following note after the definition of MU-MIMO: "NOTE--IEEE Std 802.11 supports only downlink (DL) MU-MIMO. See downlink multi-user multiple input, multiple output (DL-MU-MIMO) (in 3.2)." This is now not true.	Insert the definition of MU-MIMO and its note to clause 3.1 of the draft and strike out the note to show its deleted.	2017/1/9 9:42
9219	Tomoko Adachi	225	1 3.1			T	Y	3.1	In the baseline, PPDU is defined as follows: "The unit of data exchanged between *two peer* PHY entities to provide the PHY data service." This won't include MU PPDU.	Insert the definition of PPDU to clause 3.1 of the draft and strike out the "two peer" part to show its deleted.	2017/1/9 9:42
9220	Tomoko Adachi	225	1 3.2			T	Y	3.2	The current definition of MU PPDU in the baseline is limited to DL and MU-MIMO. UL and OFDMA should be also included.	Insert the definition of MU PPDU to clause 3.2 of the draft and change the definition of MU PPDU to also cover UL and OFDMA.	2017/1/9 9:42
9221	Tomoko Adachi	225	1 3.2			T	Y	3.2	The current definition of user in the baseline covers MU-MIMO but not OFDMA.	Insert the definition of user to clause 3.2 of the draft and change the definition of user to also cover OFDMA.	2017/1/9 9:42
9222	Tomoko Adachi	225	1 3.2			T	Y	3.2	The definition of UL-MU-MIMO should be included.	Add a definition of UL-MU-MIMO in clause 3.2.	2017/1/9 9:42
9223	Tomoko Adachi	225	1 3.2			T	Y	3.2	The definition of HE BSS should be included.	Add a definition of HE BSS in clause 3.2.	2017/1/9 9:42
9224	Tomoko Adachi	225	1 3.2			T	Y	3.2	The definition of HE beamformee should be included.	Add a definition of HE beamformee in clause 3.2.	2017/1/9 9:42
9225	Tomoko Adachi	225	1 3.2			T	Y	3.2	The definition of HE beamformer should be included.	Add a definition of HE beamformer in clause 3.2.	2017/1/9 9:42
9226	Tomoko Adachi	225	1 3.2			T	Y	3.2	The definition of HE-MCS should be included.	Add a definition of HE-MCS in clause 3.2.	2017/1/9 9:42
9227	Tomoko Adachi	225	1 3.2			T	Y	3.2	The definition of HE MU PPDU should be included.	Add a definition of HE MU PPDU in clause 3.2.	2017/1/9 9:42
9228	Tomoko Adachi	225	1 3.2			T	Y	3.2	The definition of HE PPDU should be included.	Add a definition of HE PPDU in clause 3.2.	2017/1/9 9:42
9229	Tomoko Adachi	225	1 3.2			T	Y	3.2	The definition of HE SU PPDU should be included.	Add a definition of HE SU PPDU in clause 3.2.	2017/1/9 9:42
9230	Tomoko Adachi	225	1 3.2			T	Y	3.2	The definition of DL-OFDMA should be included.	Add a definition of DL-OFDMA in clause 3.2.	2017/1/9 9:42
9231	Tomoko Adachi	225	1 3.2			T	Y	3.2	The definition of UL-OFDMA should be included.	Add a definition of UL-OFDMA in clause 3.2.	2017/1/9 9:42
9232	Tomoko Adachi	225	1 3.2			T	Y	3.2	The definition of SR should be included.	Add a definition of SR in clause 3.2.	2017/1/9 9:42
9233	Tomoko Adachi	225	1 3.2			T	Y	3.2	The definition of SRP-based SR should be included.	Add a definition of SRP-based SR in clause 3.2.	2017/1/9 9:42
9234	Tomoko Adachi	225	1 3.4			E	Y	3.4	The acronym definition of UL-MU-MIMO should be added.	Add an acronym definition of UL-MU-MIMO in clause 3.4.	2017/1/9 9:42
9235	Tomoko Adachi	225	1 3.4			E	Y	3.4	The acronym definition of DL-OFDMA should be added.	Add an acronym definition of DL-OFDMA in clause 3.4.	2017/1/9 9:42
9236	Tomoko Adachi	225	1 3.4			E	Y	3.4	The acronym definition of UL-OFDMA should be added.	Add an acronym definition of UL-OFDMA in clause 3.4.	2017/1/9 9:42
9237	Tomoko Adachi	225	1 3.4			E	Y	3.4	The acronym definition of SR should be added.	Add an acronym definition of SR in clause 3.4.	2017/1/9 9:42
9238	Tomoko Adachi	225	1 3.4			E	Y	3.4	The acronym definition of SRP should be added.	Add an acronym definition of SRP in clause 3.4.	2017/1/9 9:42
9239	Tomoko Adachi	225	1			E	Y		Both "DL MU-MIMO" and "DL-MU-MIMO" are used. Terminology should be unified. Referring to 802.11ac, "DL-MU-MIMO" seems to be the one to choose.	Search for "DL MU-MIMO" and replace it with "DL-MU-MIMO" throughout the draft.	2017/1/9 9:42
9240	Tomoko Adachi	225	1			E	Y		"UL MU-MIMO" is used but referring to 802.11ac using "DL-MU-MIMO", "UL-MU-MIMO" seems to be the one to use.	Search for "UL MU-MIMO" and replace it with "UL-MU-MIMO" throughout the draft.	2017/1/9 9:42
9241	Tomoko Adachi	225	1			E	Y		Both "DL OFDMA" and "DL-OFDMA" are used. Terminology should be unified. Rererring to 802.11ac using "DL-MU-MIMO", "DL-OFDMA" seems to be the one to choose.	Search for "DL OFDMA" and replace it with "DL-OFDMA" throughout the draft.	2017/1/9 9:42
9242	Tomoko Adachi	225	1			E	Y		Both "UL OFDMA" and "UL-OFDMA" are used. Terminology should be unified. Referring to 802.11ac using "DL-MU-MIMO", "UL-OFDMA" seems to be the one to choose.	Search for "UL OFDMA" and replace it with "UL-OFDMA" throughout the draft.	2017/1/9 9:42

9243	Tomoko Adachi	225	1 3.4	7	8	E	Y	7.08 3.4	As "DL-MU-MIMO" is used in the baseline, it seems that the acronym "DL MU" should be changed to "DL-MU".	Search for "DL MU" and replace it with "DL-MU" throughout the draft.	2017/1/9 9:42
9244	Tomoko Adachi	225	1 3.4	7	20	E	Y	7.20 3.4	As "DL-MU-MIMO" is used in the baseline, it seems that the acronym "UL MU" should be changed to "UL-MU".	Search for "UL MU" and replace it with "UL-MU" throughout the draft.	2017/1/9 9:42
9245	Tomoko Adachi	225	1			E	Y		"Trigger frame" is already used for other than triggering STAs to start UL-MU. See such as 2nd paragraph in 10.29.4, 4th paragraph in 11.2.3.5.1 of 802.11-2016. The name of the frame should be revisited, so that it can be deferentiated with the frames used for other purposes. Also, there are places using lower-letter "trigger" and it is better to capitalize the frame name throughout the draft.	Search for "trigger frame" and "Trigger frame" where it is used to trigger STAs to start UL-MU and replace it with "UL-MU Trigger frame" throughout the draft.	2017/1/9 9:42
9246	Tomoko Adachi	225	1 4.3.14a	9		T	Y	9.00 4.3.14a	Optional support for UL-MU-MIMO should be mentioned here.	Add such description in clause 4.3.14a.	2017/1/9 9:42
9247	Tomoko Adachi	225	1 4.3.14a	9		E	N	9.00 4.3.14a	All the items except the one in line 51 end without periods. Unify the expression.	Check the style guide and unify the expression of the items in clause 4.3.14a.	2017/1/9 9:42
9248	Tomoko Adachi	225	1 4.3.14a	9	54	T	Y	9.54 4.3.14a	Multi-STA BlockAck is said to be optional here. However from p.l. 157.25 in clause 27.4.1, as UL OFDMA is mandatory, it is mandatory for HE STAs.	Change the item "Optional support for Multi-STA BlockAck" in clause 4.3.14a to "Mandatory support for Multi-STA BlockAck".	2017/1/9 9:42
9249	Tomoko Adachi	225	1 4.3.14a	9	63	T	Y	9.63 4.3.14a	It says "Multi-STA BlockAck frames are used by the AP to acknowledge the transmissions from multiple non-AP STAs." But Multi-STA BlockAck can be also used by non-AP STAs. See 9.3.1.9.1 and 27.4.1 for example. I am not sure of the intention of this sentence, but assume it was written to describe the UL-MU sequence in accordance with the previous two sentences. And the AP can also acknowledge STAs with Compressed BlockAck frames using DL-MU transmission.	Change the sentence "Multi-STA BlockAck frames are used by the AP to acknowledge the transmissions from multiple non-AP STAs." to "Multi-STA BlockAck frames may be used by the AP to acknowledge the UL-MU transmissions. " Or delete this sentence.	2017/1/9 9:42
9250	Tomoko Adachi	225	1 4.3.14a	9	64	E	N	9.64 4.3.14a	The sentence "Scheduled Trigger frames are sent by the AP to allow for non-AP STA power save." should be reconsidered.	Change the sentence "Scheduled Trigger frames are sent by the AP to allow for non-AP STA power save." to "Scheduled Trigger frames are sent by the AP to allow non-AP STAs to be in power save."	2017/1/9 9:42
9251	Tomoko Adachi	225	1 9.2.4.6.4.2	23	59	E	N	23.59 9.2.4.6.4.2	The sentence "The UL PPDU Length subfield indicates the length of the HE trigger-based PPDU response and is set to the number of OFDM symbols the Data field of the HE trigger-based PPDU minus 1." should be reconsidered. A preposition needed between "the number of OFDM symbols" and "the Data field". Don't think "response" is needed after "trigger-based PPDU".	Change the sentence "The UL PPDU Length subfield indicates the length of the HE trigger-based PPDU response and is set to the number of OFDM symbols the Data field of the HE trigger-based PPDU minus 1." to "The UL PPDU Length subfield indicates the length of the HE trigger-based PPDU and is set to the number of OFDM symbols in the Data field of the HE trigger-based PPDU minus 1.	2017/1/9 9:42
9252	Tomoko Adachi	225	1 9.2.4.6.4.2	23	65	E	N	23.65 9.2.4.6.4.2	Don't think "reponse" is necessary after "trigger-based PPDU".	Delete "response" after "the HE trigger-based PPDU".	2017/1/9 9:42
9253	Tomoko Adachi	225	1 9.3.1.9.7	38	36	E	N	38.36 9.3.1.9.7	VHT Single MPDU is changed to S-MPDU from 802.11ah.	Change "Sent as a response to an MPDU or VHT Single MPDU that solicits an immediate acknowledgement" appearing in the right hand column of Table 9-24b to "Sent as a response to an MPDU or S-MPDU that solicits an immediate acknowledgement".	2017/1/9 9:42
9254	Tomoko Adachi	225	1 9.3.1.20	40	32	T	Y	40.32 9.3.1.20	The AID11 subfield in the HE NDPA frame needs to be explained.	Add the following sentence before line 40: "The AID11 subfield contains the 11 least significant bits of the AID of a STA expected to process the following HE NDP and prepare the sounding feedback. Equal to 0 if the STA is an AP, mesh STA, or STA that is a member of an IBSS."	2017/1/9 9:42
9255	Tomoko Adachi	225	1 9.3.1.23	41	59	E	N	41.59 9.3.1.23	Space is missing between the sentences. It is also better to mark off an if-clause with a comma.	Add space before the sentence starting with "If the Trigger frame has one User Info field...". Also, add a comma after "one User Info field".	2017/1/9 9:42

9256 Tomoko Adachi	225	1 9.3.1.23	41	61	E	N	41.61 9.3.1.23	It is better to mark off an if-clause with a comma.	Add a comma after "If the Trigger frame has multiple User Info fields".	2017/1/9 9:42
9257 Tomoko Adachi	225	1 9.3.1.23	41	61	E	N	41.61 9.3.1.23	Space is missing between the sentences.	Add space before the sentence starting with "If the Trigger Type field is GCR MU-BAR, ...".	2017/1/9 9:42
9258 Tomoko Adachi	225	1 9.3.1.23	41	59	T	Y	41.59 9.3.1.23	How to set the RA field of the Trigger frame when it carries STA Info fields for OFDMA-based random access needs to be specified.	Add the following sentence to the end of the paragraph starting from page 41 line 59: "When at least one of the RU in the User Info field is allocated to UL-OFDMA-based random access, then the RA field of the Trigger frame is set to the broadcast address."	2017/1/9 9:42
9259 Tomoko Adachi	225	1 9.3.1.23	45	35	T	Y	45.35 9.3.1.23	It should be clarified that, even though the RA field of the Trigger frame is an unicast address, the AID12 subfield of the Trigger frame is set to a valid AID.	Add the following sentence after the first sentence starting from page 45 line 35: "The AID12 subfield is set to a valid AID value not equal to 0 regardless of the RA field being set to a unicast address."	2017/1/9 9:42
9260 Tomoko Adachi	225	1 9.3.1.23	45	37	E	N	45.37 9.3.1.23	Space is missing between the sentences.	Add space before the sentence starting with "User Info fields with AID = 0 ...".	2017/1/9 9:42
9261 Tomoko Adachi	225	1 9.3.1.23	45	37	E	N	45.37 9.3.1.23	Normative expression should not be used in clause 9.	Change the part "User Info fields with AID = 0 shall be allocated only after ..." to "User Info fields with AID = 0 are allocated only after ...".	2017/1/9 9:42
9262 Tomoko Adachi	225	1 9.3.1.23	47	7	T	Y	47.07 9.3.1.23	Encoding of the Starting Spatial Stream subfield should be specified.	Add the following sentence and table after Figure 9-52f: The encoding of the Starting Spatial Stream subfield is defined in Table 9-xx (Starting Spatial Stream subfield encoding). Table 9-xx - Starting Spatial Stream subfield encoding Value | Description 0 | 1st spatial stream 1 | 2nd spatial stream 2 | 3rd spatial stream 3 | 4th spatial stream 4 | 5th spatial stream 5 | 6th spatial stream 6 | 7th spatial stream 7 | 8th spatial stream	2017/1/9 9:42
9263 Tomoko Adachi	225	1 9.3.1.23	47	7	T	Y	47.07 9.3.1.23	Encoding of the Number Of Spatial Streams subfield should be specified.	Add the following sentence and table after Figure 9-52f: The encoding of the Number Of Spatial Streams subfield is defined in Table 9-xy (Number Of Spatial Streams subfield encoding). Table 9-xy - Number Of Spatial Streams subfield encoding Value | Description 0 | Nss=1 1 | Nss=2 2 | Nss=3 3 | Nss=4 4 | Nss=5 5 | Nss=6 6 | Nss=7 7 | Nss=8	2017/1/9 9:42
9264 Tomoko Adachi	225	1 9.3.1.23	49	1	T	Y	49.01 9.3.1.23	It should be clarified that, the value to be compared withn the TID Aggregation Limit subfield value in the Trigger frame is the value of the Multi-TID Aggregation Support field + 1.	Change the sentence starting from page 49 line 1 to read "The value in the TID Aggregation Limit subfield in Trigger frame is less than or equal to the value indicated in the Multi-TID Aggregation Support field in the HE Capabilities element (see 9.4.2.218 (HE Capabilities element)) plus 1.	2017/1/9 9:42
9265 Tomoko Adachi	225	1 9.4.1.63	60	54	T	Y	60.54 9.4.1.63	The values for RU Index 8 in 20 MHz are missing in Table 9-76c.	Add "+96, +122" in the right hand column of the row where 20 MHz 26-tone RU Index is 8.	2017/1/9 9:42
9266 Tomoko Adachi	225	1 9.4.1.63	62	25	T	Y	62.25 9.4.1.63	The values for RU Index 8 in 20 MHz are missing in Table 9-76d.	Add "+96, +122" in the right hand column of the row where 20 MHz 26-tone RU Index is 8.	2017/1/9 9:42
9267 Tomoko Adachi	225	1 9.4.2.1	67	16	E	N	67.16 9.4.2.1	Wrong reference number.	Change "9.4.2.213 (HE Capabilities element)" to "9.4.2.218 (HE Capabilities element)".	2017/1/9 9:42
9268 Tomoko Adachi	225	1 9.4.2.1	67	19	E	N	67.19 9.4.2.1	Wrong reference number.	Change "9.4.2.214 (HE Operation element)" to "9.4.2.219 (HE Operation element)".	2017/1/9 9:42

9269	Tomoko Adachi	225	1 9.4.2.218.3	85	48	T	Y	85.48 9.4.2.218.3	B56 now indicates support of reception of SU-Type partial *and* full bandwidth feedback in the Tx Beamforming Feedback With Trigger Frame Capability subfield in Table 9-262aa. This means it is set to 1 only if both the partial and the full bandwidth feedback is supported. The indication for the partial and for the full bandwidth feedback should be divided.	Change the definition to read as follows: If the transmitting STA is an AP STA: Bxx: indicates support of reception of SU-Type full bandwidth feedback Bxx: indicates support of reception of SU-Type partial bandwidth feedback Bxx: indicates support of reception of MU-Type partial bandwidth feedback Bxx: indicates support of reception of CQI-Only partial and full bandwidth feedback If the transmitting STA is a non-AP STA: Bxx: indicates support of transmission of SU-Type full bandwidth feedback Bxx: indicates support of transmission of SU-Type partial bandwidth feedback Bxx: indicates support of transmission of MU-Type partial bandwidth feedback Bxx: indicates support of transmission of CQI-Only partial and full bandwidth feedback	2017/1/9 9:42
9270	Tomoko Adachi	225	1 9.4.2.220	93	18	E	N	93.18 9.4.2.220	Unify the terminology whether to include "UL" before "OFDMA-based random access". All the places other than here, in page 9 line 58, and in page 413 line 12 include "UL". And if "UL" is added, referring to 802.11ac, it should be "UL-OFDMA-based".	Search for "OFDMA-based random access" not having "UL" before it and where it is used as the name of the mechanism, replace it with "UL-OFDMA-based random access." Also search for "UL OFDMA-based random access" and replace it with "UL-OFDMA-based random access".	2017/1/9 9:42
9271	Tomoko Adachi	225	1 9.7.3	108	56	E	N	108.56 9.7.3	"Multi-STA BlockAck" is the correct terminology.	Change "Multi-STA BA" in the middle column in the row for Control Response in Table 9-424 to "Multi-STA BlockAck".	2017/1/9 9:42
9272	Tomoko Adachi	225	1 9.7.3	109	28	E	N	109.28 9.7.3	"Multi-STA BlockAck" is the correct terminology.	Change "Multi-STA BA" in the middle column in the row for Multi-STA BlockAck in Table 9-425 to "Multi-STA BlockAck".	2017/1/9 9:42
9273	Tomoko Adachi	225	1 10.3.2.4	114	49	T	Y	114.49 10.3.2.4	There is no need to differentiate between whether the STA is solicited for an immediate response or not. Even if the STA is solicited for an immediate response and updated its intra-BSS NAV, the STA can still respond to the Trigger frame because the condition of intra-BSS NAV won't matter. It will just make the condition complex with no meaning.	Delete the sentence "If the STA is an HE STA and the STA is solicited for an immediate response by the PPDU carrying the received frame, the STA shall not update its NAV."	2017/1/9 9:42
9274	Tomoko Adachi	225	1 10.3.2.8a			T	N	10.3.2.8a	The MU-RTS/CTS procedure is limited among HE APs and HE STAs. Isn't it better to move under such as 27.5?	Move clause 10.3.2.8a and its subclauses between 27.5.2 and 27.5.3. Describe somewhere appropriate in 10.3.2 that the MU-RTS/CTS procedure is described in 27.5.	2017/1/9 9:42
9275	Tomoko Adachi	225	1 10.3.2.8a.1	116	3	E	N	116.03 10.3.2.8a.1	The acknowledgement responses here are responses to the DL MU PPDU. And they are achieved by UL-MU. There is also an extra period at the end of the sentence.	Change "... to protect DL MU PPDU and acknowledgement responses.." to "... to protect DL-MU PPDU and its acknowledgement responses that are achieved by UL-MU."	2017/1/9 9:42
9276	Tomoko Adachi	225	1 10.3.2.8a.1	116	29	E	N	116.29 10.3.2.8a.1	Referring to the sentence starting from line 1, the Multi-STA BlockAdk frame here is also acknowledgement responses.	Change "... to protect the scheduled HE trigger-based PPDU and Multi-STA BlockAck frame." to "... to protect the scheduled HE trigger-based PPDU and its acknowledgement responses that are achieved by a Multi-STA BlockAck frame."	2017/1/9 9:42
9277	Tomoko Adachi	225	1 10.3.2.8a.1	116	37	E	Y	116.37 10.3.2.8a.1	An acronym "TB" is not defined.	Search for "TB" and replace it with "trigger-based" throughout the draft. Or, define the acronym in clause 3.4.	2017/1/9 9:42
9278	Tomoko Adachi	225	1 10.3.2.10.3	120	7	E	N	120.07 10.3.2.10.3	Space is missing between the sentences.	Add space before the sentence starting with "Specifically, when an AP transmits ...".	2017/1/9 9:42
9279	Tomoko Adachi	225	1 10.3.2.10.3	120	22	E	N	120.22 10.3.2.10.3	The explanation of Figure 10-12b starting from line 14 says the BlockAck frames are sent by DL OFDMA. So, like in Figure 10-12a, the BlockAck frames should be described that they are sent by OFDMA.	Add "OFDMA BA" above the "BA" frames in Figure 10-12b.	2017/1/9 9:42

9280 Tomoko Adachi	225	1 10.3.2.10.3	120	39	E	N	120.39 10.3.2.10.3	The explanation of Figure 10-12b starting from line 14 says the BlockAck frames are sent by DL OFDMA. The title of Figure 10-12b should align with it.	Change the title of Figure 10-12b to "An example of an UL MU transmission with an immediate DL OFDMA transmission containing individually addressed BlockAck frames acknowledging the frames received from the respective STAs".	2017/1/9 9:42
9281 Tomoko Adachi	225	1 10.3.2.10.3	121	43	E	N	121.43 10.3.2.10.3	Figure 10-12d has only 4 STAs but Figures 10-12a to 10-12c have n STAs. There is no reason the number of STAs should be limited to 4 for this case.	Change Figure 10-12d to show n STAs are involved in the sequence.	2017/1/9 9:42
9282 Tomoko Adachi	225	1 10.22.2.9	133	37	T	Y	133.37 10.22.2.9	In clause 27.2.2, it is said that an HE AP doesn't need to maintain two NAVs. How the truncation rule described in clause 10.22.2.9 is applied to such AP is not clear. Even if the behavior described in clause 27.2.1 is also applied to such AP, such AP doesn't need to remember whether the most recent NAV update was due to an intra-BSS frame or an inter-BSS frame.	Clarify in clause 27.2.1 that an HE AP maintaining only one NAV doesn't need to hold the cause information of the most recent NAV update and that an HE STA maintaining two NAVs doesn't need to to hold the cause information of the most recent NAV updated of the basic NAV. Add a sentence in clause 10.22.2.9 to refer to clause 27.2.1. Or change the title of subclause 27.2.2 to "Operation of two NAVs" and describe the truncation rule which is specific to HE STAs maintaining two NAVs there.	2017/1/9 9:42
9283 Tomoko Adachi	225	1 10.28.3	136	27	E	N	136.27 10.28.3	VHT Single MPDU is changed to S-MPDU from 802.11ah.	Change "..., as a VHT single MPDU, ..." to "..., as an S-MPDU, ..."	2017/1/9 9:42
9284 Tomoko Adachi	225	1 27.2.2	150	58	T	Y	150.58 27.2.2	There is no need to differentiate between whether the STA is solicited for an immediate response or not. Even if the STA is solicited for an immediate response and updated its intra-BSS NAV, the STA can still respond to the Trigger frame because the condition of intra-BSS NAV won't matter. It will just make the condition complex with no meaning.	Delete the item "The STA is not solicited an immediate response by the PPDU carrying the frame."	2017/1/9 9:42
9285 Tomoko Adachi	225	1 27.2.2	151	42	T	Y	151.42 27.2.2	NOTE 2 should be a baseline text, not a note.	Move the content of NOTE 2 to a baseline text and remove NOTE 2.	2017/1/9 9:42
9286 Tomoko Adachi	225	1 27.4.1	157	22	T	Y	157.22 27.4.1	UL OFDMA is mandatory at HE STAs. Therefore the support of Multi-STA BlockAck frame is mandatory at HE STAs. And the generation of Multi-STA BlockAck frames is under the operation of HT-immediate BA.	Change the sentences "An HE STA shall support generation of Compressed BlockAck frames if HT-immediate BA is supported in the role of recipient (see 10.24.7.1 (Introduction). An HE STA shall support generation of Multi-STA BlockAck frame if either UL MU operation (see 27.5.2 (UL MU operation)) or multi-TID A-MPDU operation (27.10.4 (A-MPDU with multiple TIDs)) is supported in the role of recipient." to "An HE STA shall support generation of Compressed BlockAck frames and Multi-STA BlockAck frames if HT-immediate BA is supported in the role of recipient (see 10.24.7.1 (Introduction)."	2017/1/9 9:42
9287 Tomoko Adachi	225	1 27.4.4.4	161	36	E	Y	161.36 27.4.4.4	A Trigger frame always solicit an immediate response. The part "that intents to solicit an immediate response" is redundant and confusing.	Change the sentence "A non-AP STA that sends an HE trigger-based PPDU as a response to a Basic variant Trigger frame that intends to solicit an immediate response shall set the Ack Policy to Normal Ack/Implicit BAR ..." to "A non-AP STA that sends an HE trigger-based PPDU as a response to a Basic variant Trigger frame shall set the Ack Policy to Normal Ack/Implicit BAR ...".	2017/1/9 9:42
9288 Tomoko Adachi	225	1 27.4.4.4	161	38	T	Y	161.38 27.4.4.4	The referred clause number is wrong.	Change "... 10.3.2.11.4 (MU acknowledgement procedure for an UL MU transmission) ..." to "... 10.3.2.10.3 (Acknowledgement procedure for an UL MU transmission) ...".	2017/1/9 9:42
9289 Tomoko Adachi	225	1 27.5.1.1	161	57	E	Y	161.57 27.5.1.1	There is no reason that "with" needs to start with an upper letter.	Change "A STA shall not transmit a DL OFDMA With MIMO PPDU that contains ..." to "A STA shall not transmit a DL OFDMA within MIMO PPDU that contains ...".	2017/1/9 9:42
9290 Tomoko Adachi	225	1 27.5.1.1	161	58	T	Y	161.58 27.5.1.1	There is no DL OFDMA With MIMO Support field defined. It should be DL MU-MIMO on Partial BW field.	Change "... with the DL OFDMA With MIMO Support field set to 1." to "... with the DL MU-MIMO Partial BW field set to 1."	2017/1/9 9:42

9291	Tomoko Adachi	225	1 27.5.2.2.1	164	57	E	N	164.57 27.5.2.2.1	"BlockAck" is the correct terminology.	Change "immediate Multi-STA BA frame" in line 57 to "immediate Multi-STA BlockAck frame".	2017/1/9 9:42
9292	Tomoko Adachi	225	1 27.5.2.2.2	166	11	E	Y	166.11 27.5.2.2.2	The rules described in this paragraph are especially for the trigger frames in the same MU PPDU. The intention will be more clear if "MU" is added between "same" and "PPDU".	Add "MU" between "same" and "PPDU" where they appear in the paragraph starting from line 11. (3 appearances.)	2017/1/9 9:42
9293	Tomoko Adachi	225	1 27.5.2.2.2	166	65	E	N	166.65 27.5.2.2.2	Space is missing between the sentences.	Add space before the sentence starting with "A value 0 indicates to the STA that ...".	2017/1/9 9:42
9294	Tomoko Adachi	225	1 27.5.2.2.2	167	1	T	Y	167.01 27.5.2.2.2	As in p.l. 48.60, the TID Aggregation Limit is to limit the maximum number of TIDs. The sentence here does not align with that definition.	Change the sentence "A value 0 indicates to the STA that it shall not solicit any immediate response for the MPDUs that the STA aggregates in the HE trigger-based PPDU." to "A value 0 indicates to the STA that it shall not transmit any QoS Data MPDUs in the HE trigger-based PPDU." Or change the definition of the TID Aggregation Limit to only apply to the number of TIDs transmitted in QoS Data frames with implicit BAR (i.e., don't care No Ack frames) and update the sentences in p.l. 48.60 and 167.01 to align with it.	2017/1/9 9:42
9295	Tomoko Adachi	225	1 27.5.2.2.2	167	1	E	N	167.01 27.5.2.2.2	Space is missing between the sentences.	Add space before the sentence starting with "A value greater than 0 indicates ...".	2017/1/9 9:42
9296	Tomoko Adachi	225	1 27.5.2.3	168	51	T	Y	168.51 27.5.2.3	There is no SS Allocation field in Common Info field. The Starting Spatial Stream subfield is a value based on Nss and the STARTING_STS_NUM is a value based on Nsts. So it is not proper to set exactly the same value of Starting Spatial Stream subfield to the STARTING_STS_NUM. Also "shall be set to" is repeated.	Change the item "The STARTING_STS_NUM parameter shall be set to shall be set to the value of the Starting Spatial Stream subfield of the SS Allocation field in the Common Info field of the eliciting Trigger frame" to "The STARTING_STS_NUM parameter shall be set to the starting STS number indicated by the Starting Spatial Stream subfield of the SS Allocation field of the User Info field and STBC field in the Common Info field of the Trigger frame".	2017/1/9 9:42
9297	Tomoko Adachi	225	1 27.5.2.4	170	37	T	Y	170.37 27.5.2.4	The contents of this paragraph is already mentioned in clause 27.2.2, from page 150 line 27. Also, as the CS after the Trigger frame doesn't case the intra-BSS NAV, emphasizing the general interpretation under two NAVs by setting this paragraph after the paragraph starting from line 26 is misleading.	Describe that the CS for UL-MU is done during SIFS after the reception of the Trigger frame and refer clause 27.2.2 for the virtual CS operation for HE STAs. Delete the paragraph starting from line 37 in page 170.	2017/1/9 9:42
9298	Tomoko Adachi	225	1 27.5.2.6.2	173	18	E	N	173.18 27.5.2.6.2	M-BA is not defined as an acronym.	Change "M-BA" to "Multi-STA BlockAck" in Figure 27-1. (2 appearances.)	2017/1/9 9:42
9299	Tomoko Adachi	225	1 27.5.3	175	12	E	N	175.12 27.5.3	"Multi-STA BlockAck" is the correct terminology.	Change "Multi-STA BA" to "Multi-STA BlockAck" in Figure 27-2.	2017/1/9 9:42
9300	Tomoko Adachi	225	1 27.6.2	176	25	T	Y	176.25 27.6.2	Make the description of AID11 subfield in the HE NDP Announcement frame more accurate.	Change the sentence "If the HE NDP Announcement frame includes more than one STA Info field, the RA field of the HE NDP Announcement frame shall be set to the broadcast address, otherwise it shall be set to the MAC address of the STA whose AID is included in the STA Info field." to "If the HE NDP Announcement frame includes more than one STA Info field, the RA field of the HE NDP Announcement frame shall be set to the broadcast address, otherwise it shall be set to the MAC address of the STA whose 11 least significant bits of the AID is included in the AID11 subfield of the STA Info field. If the intended STA is other than an AP, mesh STA, or STA that is a member of an IBSS, the AID11 subfield shall be set to a valid AID value not equal to 0 regardless of the RA field being set to a unicast address."	2017/1/9 9:42

9301 Tomoko Adachi	225	1 27.6.2	176	48	T	Y	176.48 27.6.2	There is no subfield named Rx HE-MCS Map. It should be the Rx MCS NSS Descriptors subfield.	Change "Rx HE-MCS Map subfield" to "Rx MCS NSS Descriptors subfield" in page 176 line 48, in page 203 line 14, in page 205 line 10, and in page 205 line 12.	2017/1/9 9:42
9302 Tomoko Adachi	225	1 27.6.2	176	48	T	Y	176.48 27.6.2	There is no field named supported HE-MCS and NSS set. It should be the Tx Rx HE MCS NSS Support field.	Change "supported HE-MCS and NSS set field" to "Tx Rx HE MCS NSS Support field" in page 176 line 48. Change "Supported HE-MCS and NSS set field" to "Tx Rx HE MCS NSS Support field" in page 179 line 34, in page 202 line 29, in page 202 line 30, in page 203, line 8, in page 203 line 35, in page 204 line 38, in page 205 line 10, in page 373 line 5, and in page 373 line 6.	2017/1/9 9:42
9303 Tomoko Adachi	225	1 9.4.2.218.4	86	34	E	Y	86.34 9.4.2.218.4	The HE Capabilities element is described that it includes the Tx Rx HE MCS NSS Support field in subclause 9.4.2.218.1, not Tx Rx HE MCS Support field.	Change the subclause title from "Tx Rx HE MCS Support field" to "Tx Rx HE MCS NSS Support field". Change "Tx Rx HE MCS Support field" to "Tx Rx HE MCS NSS Support field" in page 86 line 37. Change the caption of Figure 9-589cm from "Tx Rx HE MCS Support field format" to "Tx Rx HE MCS NSS Support field format". Change "Tx Rx HE MCS Support field" to "Tx Rx HE MCS NSS Support field" in page 87 line 58, in page 191 line 55, in page 191 line 59, in page 238 line 41, and in page 240 line 26.	2017/1/9 9:42
9304 Tomoko Adachi	225	1 27.6.2	176	56	T	Y	176.56 27.6.2	There is no subfield named Received Operating Mode Indication. This should be the HE variant HT Control field when Control ID subfield is 1.	Change "... that carried a Received Operating Mode Indication subfield ..." to "... that carried the HE variant HT Control field with Control ID subfield set to 1 ...".	2017/1/9 9:42
9305 Tomoko Adachi	225	1 27.6.2	176	62	T	Y	176.62 27.6.2	There is no field named Beamformee STS Capability. The target subfields should be the Beamformee STS For <= 80 MHz, Beamformee STS For > 80 MHz, NSTS Total For <= 80 MHz, and NSTS Total For > 80 MHz in the HE PHY Capabilities Information field.	Change "... through the Beamformee STS Capability field." to "... through the HE PHY Capabilities Information field." in page 176 line 62.	2017/1/9 9:42
9306 Tomoko Adachi	225	1 9.4.2.218.3	84	49	T	Y	84.49 9.4.2.218.3	From its name, Beamformee STS For <= 80 MHz, this subfield should apply for up to 80 MHz channel width.	Add in the description for Beamformee STS For <= 80 MHz subfield that it applies when the channel width is eual to or less than 80 MHz.	2017/1/9 9:42
9307 Tomoko Adachi	225	1 9.4.2.218.3	84	56	T	Y	84.56 9.4.2.218.3	From its name, NSTS Total For <= 80 MHz, this subfield should apply for up to 80 MHz channel width.	Add in the description for NSTS Total For <= 80 MHz subfield that it applies when the channel width is eual to or less than 80 MHz.	2017/1/9 9:42
9308 Tomoko Adachi	225	1 9.4.2.218.3	85	6	T	Y	85.06 9.4.2.218.3	From its name, Beamformee STS For > 80 MHz, this subfield should apply for more than 80 MHz channel width.	Add in the description for Beamformee STS For > 80 MHz subfield that it applies when the channel width is more than 80 MHz.	2017/1/9 9:42
9309 Tomoko Adachi	225	1 9.4.2.218.3	85	13	T	Y	85.13 9.4.2.218.3	From its name, NSTS Total For > 80 MHz, this subfield should apply for more than 80 MHz channel width.	Add in the description for NSTS Total For > 80 MHz subfield that it applies when the channel width is more than 80 MHz.	2017/1/9 9:42
9310 Tomoko Adachi	225	1 9.4.2.218.3	85	14	E	Y	85.14 9.4.2.218.3	It is "a DL-MU-MIMO transmission" not "an DL MU-MIMO transmission".	Change "an DL MU-MIMO transmission" to "a DL-MU-MIMO transmission".	2017/1/9 9:42
9311 Tomoko Adachi	225	1 9.4.2.218.3	85	20	T	Y	85.20 9.4.2.218.3	From its name, Number Of Sounding Dimensions For <= 80 MHz, this subfield should apply for up to 80 MHz channel width.	Add in the description for Number Of Sounding Dimensions For <= 80 MHz subfield that it applies when the channel width is equal to or less than 80 MHz.	2017/1/9 9:42
9312 Tomoko Adachi	225	1 9.4.2.218.3	85	26	T	Y	85.26 9.4.2.218.3	From its name, Number Of Sounding Dimensions For > 80 MHz, this subfield should apply for more than 80 MHz channel width.	Add in the description for Number Of Sounding Dimensions For > 80 MHz subfield that it applies when the channel width is more than 80 MHz.	2017/1/9 9:42
9313 Tomoko Adachi	225	1 27.7.3.2	185	19	T	Y	185.19 27.7.3.2	AM is not defined as an acronym. It seems to be used for "active mode".	Change "AM" in page 185 line 19 to "active mode".	2017/1/9 9:42
9314 Tomoko Adachi	225	1 27.7.3.3	185	62	T	Y	185.62 27.7.3.3	The sentence starting from line 62 seems to be one of the early TXT SP termination events.	Move the sentence from line 62 to be the 3rd item in the previous paragraph.	2017/1/9 9:42

9315	Tomoko Adachi	225	1 27.9.2.2	191		T	Y	191.00 27.9.2.2	The TXPWR can be a short term value and can be any value during CS as nothing will be transmitted. So adjusting the OBSS_PD level by the TXPWR seems not to be the right direction. It seems better to unify the mechanism to adjust the TXPWRmax by the OBSS_PD level.	Unify the mechanism to adjust the TXPWRmax by the OBSS_PD level, not adjusting the OBSS_PD level by the TXPWR.	2017/1/9 9:42
9316	Tomoko Adachi	225	1 27.11.2	196	11	T	Y	196.11 27.11.2	It is unclear why the UPLINK_FLAG needs to be set to 0 for RTS/CTS frames sent with TXOP Duration set to all 1s. When the AP transmits an RTS frame with the UPLINK_FLAG set to 0 in an Extended Range SU PPDU, and the receiver STA transmits a CTS frame with the UPLINK_FLAG to 1 in an Extended Range SU PPDU, as all the HE STAs within the BSS receives that RTS frame from the AP, the 3rd party HE STA can set the NAV by the RTS frame. Therefore, even if the UPLINK_FLAG in the CTS frame is set to 1 and the 3rd party HE STAs go to PPDU Power Save, the 3rd party HE STAs will hold the NAV value. Next when the STA transmits an RTS frame with the UPLINK_FLAG set to 1 in an Extended Range SU PPDU, and the AP which is the receiver of the RTS frame transmits a CTS frame with the UPLINK_FLAG set to 0 in an	Delete "except when the HE PPDU is an HE extended range SU PPDU with the TXOP Duration field set to all 1s and contains an RTS or CTS frame in which case the STA may set the TXVECTOR parameter UPLINK_FLAG to 0" from the first item starting from line 11 in page 196.	2017/1/9 9:42
9317	Tomoko Adachi	225	1 27.15.4.1	203	18	E	Y	203.18 27.15.4.1	Wrong reference number.	Change 9.4.2.213.3 to 9.4.2.218.4 and show the subclause title in brackets.	2017/1/9 9:42
9318	Tomoko Adachi	225	1 28.3.3.8.2	238	37	E	Y	238.37 28.3.3.8.2	The sentence "An HE STA shall support reception of DL MU-MIMO transmissions on full bandwidth with maximum number of space-time streams (per user) equal to minimum of 4 and the maximum number of space-time streams supported for reception of HE SU PPDUs." should be reconsidered to be more clear.	Change the sentence "An HE STA shall support reception of DL MU-MIMO transmissions on full bandwidth with maximum number of space-time streams (per user) equal to minimum of 4 and the maximum number of space-time streams supported for reception of HE SU PPDUs." to "An HE STA shall support reception of DL MU-MIMO transmissions on full bandwidth with maximum number of space-time streams (per user) which is the minimum of 4 and the maximum number of space-time streams supported for reception of HE SU PPDUs."	2017/1/9 9:42
9319	Tomoko Adachi	225	1 28.3.3.10.4	240	21	E	Y	240.21 28.3.3.10.4	The sentence "A STA capable of UL MU-MIMO transmission shall support UL MU-MIMO transmissions on full bandwidth with maximum number of space-time streams (per user) equal to minimum of 4 and the maximum number of space-time streams supported for transmission of HE SU PPDUs." should be reconsidered to be more clear.	Change the sentence "A STA capable of UL MU-MIMO transmission shall support UL MU-MIMO transmissions on full bandwidth with maximum number of space-time streams (per user) equal to minimum of 4 and the maximum number of space-time streams supported for transmission of HE SU PPDUs." to "A STA capable of UL MU-MIMO transmission shall support UL MU-MIMO transmissions on full bandwidth with maximum number of space-time streams (per user) which is the minimum of 4 and the maximum number of space-time streams supported for transmission of HE SU PPDUs."	2017/1/9 9:42
9320	Tomoko Adachi	225	1 28.3.3.8.2	238	35	T	Y	238.35 28.3.3.8.2	In the SFD, there was the following requirement: "For an 11ax AP, support for DL MU-MIMO transmission, where MU-MIMO is being done on the entire PPDU BW, shall be mandatory if the AP supports TxNss >= 4." This is mentioned in subclause 4.3.14a but should be also mentioned in subclause 28.3.3.8.2, as other similar requirements are mentioned here.	As in comment.	2017/1/9 9:42
9321	Tomoko Adachi	225	1 28.5	373	4	T	Y	373.04 28.5	There is no subfield named Tx or Rx Highest Supported Long GI Data Rate.	Update the subfield name "Tx or Rx Highest Supported Long GI Data Rate" which appears in line 4 and line 6 in page 373.	2017/1/9 9:42

9322 Tomoko Adachi	225	1 28.5	373	24	E	Y	373.24 28.5	It seems that NBPCS appearing in Tables 28-47 to 28-102 should be NBPSCS.	Change NBPCS to NBPSCS in Tables 28-47 to 28-102.	2017/1/9 9:42
9323 Tomoko Adachi	225	1 28.3.12	340	13	T	Y	340.13 28.3.12	T_{HE-SIG-A-R} is described as HE-SIG-A field duration in an HE extended range SU PPDU and its value is 16 ++s = 4 +- 4 ++s in Table 28-9. Also t_{HE-STF} for an HE extended range SU PPDU is defined as t_{HE-SIG-A}+T_{HE-SIG-A-R} on p.263. In these two places, T_{HE-SIG-A-R} includes both the original HE-SIG-A field duration and the repeated HE-SIG-A field duration. But for T_{HE-PREAMBLE} for an HE extended range SU PPDU in eq. (28-117), T_{HE-SIG-A-R} is interpreted to be only for the repeated part and added with T_{HE-SIG-A}. To be consistent with the usage in Table 28-9 and in p.263, T_{HE-SIG-A-R} should be the full HE-SIG-A field duration including the repeated part and "+T_{HE-SIG-A}" should be removed from the expression.	Change the expression for an HE extended range SU PPDU in line 13 to T_{HE-PREAMBLE} = T_{RL-SIG}+T_{HE-SIG-A-R}+T_{HE-STF-NT}+N_{HE-LTF}T_{HE-LTF, SYM}.	2017/1/9 9:42
9324 Tomoko Adachi	225	1 B.4.10	410	21	T	Y	410.21 B.4.10	B.4.10 is for functionality, so dividing into transmission and reception for Multi-STA BlockAck is not necessary here. (If such division is necessary, the place will be B.4.4.2. However, referring to other examples, it is not required up to that level.)	Delete the rows for OB4.5.1 and OB4.5.2. Add "CFHE:M" (or "CFHEW:M", see the other comment relating to B.4) in the Status column for OB4.5 and fill in its Support column.	2017/1/9 9:42
9325 Tomoko Adachi	225	1 27.5.2.6.2	173	46	E	Y	173.46 27.5.2.6.2	Period and space are missing between the sentences.	Change the part "... selects one of the RUs assigned to AID value 0If the selected RU is idle ..." to "... selects one of the RUs assigned to AID value 0. If the selected RU is idle ...".	2017/1/9 9:42
9326 Tomoko Adachi	225	1 27.5.2.6.2	173	51	T	Y	173.51 27.5.2.6.2	Those STAs that had their CS busy and not transmitted should reselect OCW to avoid collision with new STAs whose OBO counter decremented to zero in the next Trigger frame.	Change "... and it randomly selects any one of the RUs that are assigned to AID value 0 in the subsequent Trigger frame." to "... and it shall initialize its OBO counter to a random value in the range of 0 and OCWmin"	2017/1/9 9:42
9327 Tomoko Adachi	225	1 10.9	127	12	T	Y	127.12 10.9	The "<reference>" should be specified.	Change "<reference>" to "10.3.2.4".	2017/1/9 9:42
9328 Tomoko Adachi	225	1 27.4.4.5	162	14	E	Y	162.14 27.4.4.5	The "individually addressed Multi-STA BlockAck frame" is followed by "to each of the STAs" and "individually addressed" is redundant. Also, the other Multi-STA BlockAck frames appearing in the same item with the same usage doesn't have "individually addressed" and are just followed by "to each of the STAs".	Change "... with Ack frame or an individually addressed Multi-STA BlockAck frame to each of the STAs from which ..." to "... with an Ack frame or a Multi-STA BlockAck frame to each of the STAs from which ...".	2017/1/9 9:42
9329 Tomoko Adachi	225	1			E	Y		Does "Single MPDU" have a special meaning. Don't think so.	Search for "Single MPDU" and replace it with "single MPDU" throughout the draft.	2017/1/9 9:42
9330 Tomoko Adachi	225	1 27.4.4.5	162	24	T	Y	162.24 27.4.4.5	The support of reception of MU Multi-STA BlockAck frame should be specified by a subfield.	Change the part "... if the receivers of group-addressed Multi-STA BlockAck frame announce the support the reception of MU Multi-STA BlockAck frame." to "... if the receivers of group-addressed Multi-STA BlockAck frame announce the support the reception of MU Multi-STA BlockAck frame by the Group Addressed Multi-STA BlockAck In DL MU Support subfield in the HE MAC Capabilities Information field."	2017/1/9 9:42
9331 Tomoko Adachi	225	1			E	N		Not "a S-MPDU" but "an S-MPDU".	Search for "a S-MPDU" and replace it with "an S-MPDU".	2017/1/9 9:42

9332	Tomoko Adachi	225	1 27.5.2.6			T	Y	27.5.2.6	Currently, it is considered that both the associated STAs and unassociated STAs are allowed to join the UL OFDMA-based random access. However, the real state that the STA is in and the state that the AP thinks the STA is in according to the association may be different. This is because there is no complete mechanism for the AP to syncrhonize with the STA. Therefore, when the AP acknowledges to those STAs that the AP thinks they are still associated with the Multi-STA BlockAck, some of the STAs that already disassociated may not distinguish the AIDs that the AP used for those STAs. The opposite perception gap may also occur. And as the unassociated STAs don't have their AIDs assigned, the AP can't acknowledge those unassociated STAs with the regular Multi-STA BlockAck procedure.	If both the associated STAs and unassociated STAs are handled together in the UL OFDMA-based random access, the way to solve the problems described in the comment will be to have the STAs responding to the UL OFDMA-based random access to set their AIDs if they are associated and temporary AIDs if they are unassociated in the Duration/ID field of the MPDUs. The temporary AIDs will be selected randomly from the range other than the one for AIDs. The AP will use the AIDs and/or temporary AIDs set in the Duration/ID fields for the Multi-STA BlockAck to respond to those transmission sent through UL OFDMA-based random access. For the probability of temporary AIDs colliding, as the unassociated STAs will only transmit management request frames and have timeout to wait for management response frames, the unassociated STAs can solve by themselves.		2017/1/9 9:42
9333	Tomoko Adachi	225	1 9.3.1.23			T	N	9.3.1.23	Most of the User Info subfields in the Trigger frame can be the same for RUs for UL OFDMA-based random access. This means the Trigger frame can be shorter and more efficient.	Limit the RU size that can be used for UL OFDMA-based random access in each Trigger frame and reduce the redundancy.		2017/1/9 9:42
9334	Tomoko Adachi	225	1 11.1.3.10			T	Y	11.1.3.10	When the AP transmits beacons in an HE_EXT_SU PHY format, it uses the dual beacon mechanism. However, the dual beacon mechanism is deprecated in the baseline (see Table 9-168 and subclause 11.1.3.2 in 802.11-2016). There is no need to reintroduce this again. Just allowing the beacons to be transmitted in an HE_EXT_SU PHY format is enough.	Add in subclause 10.7.5.3 a condition to allow beacon frames and group addressed frames to be transmitted in an HE_EXT_SU PHY format if the BSSBasicRateSet, the Basic HT-MCS Set, and the basic VHT-MCS and NSS set are all empty and only the Basic HE MCS And NSS Set is not empty. Delete subclause 11.1.3.10, delete the definition of high efficient (HE) dual beacon from subclause 3.2, replace the Dual Beacon subfield in the HE Operation Parameters field to reserved and delete the description of the Dual Beacon subfield in subclause 9.4.2.219.		2017/1/9 9:42
9335	Tomoko Adachi	225	1 B.4.4.2	409	28	T	Y	409.28 B.4.4.2	The References column is not filled in for the Trigger frame. As most of the other examples have "9" here, just filling in "9" seems to be enough.	Add "9" to the References column for FT43.		2017/1/9 9:42
9336	Tomoko Adachi	225	1 B.4			T	Y	B.4	"CFHEW" is not defined but used in the Status columns. It should be "CFHE" in line 42 of page 407.	Change all those appearing as "CFHEW" to "CFHE". Or change the item name "CFHE" to "CFHEW" in line 42 of page 407 and replace all those written as "CFHE" in the Status columns to "CFHEW", if any.		2017/1/9 9:42
9337	Tomoko Adachi	225	1 9.4.2.219	91	39	T	Y	91.39 9.4.2.219	The content of the paragraph starting from line 39 is repeated in the next paragraph. The next paragraph also the other cases and should be kept.	Delete the paragraph starting from line 39 of page 91.		2017/1/9 9:42
9338	Tomoko Adachi	225	1 9.4.2.219	93	11	T	Y	93.11 9.4.2.219	It is better to define a channel width indication exclusive for HE STAs. There is a case when the AP wants to limit the channel width of the legacy STAs narrower than the HE STAs. This is because the HE STAs can coexist with the OBSS STAs in the secondary channels better than the legacy STAs.	Add "The content of the VHT Operation Information field in the HE Operation element may be different from the content notified in the VHT Operation element. The HE STAs follow the information specified in the VHT Operation Information field of the HE Operation element." after the sentence starting fom line 11 in page 93.		2017/1/9 9:42

9339	Tomoko Adachi	225	1 27.5.2.4			T	Y	27.5.2.4	As aSIFSTime is defined in 10.3.7 as aSIFSTime = aRxPHYDelay + aMACProcessingDelay + aTxPHYDelay + aRxTxSwitchTime + aTxRampOnTime and it doesn't include aCCATime (8.3.5.12), in the original 802.11 SIFS, STAs that even have enough processing time for CCA don't have to sense the medium during SIFS from the definition point of view. But now the HE STAs are required to perform ED-based CCA if they didn't require MAC padding in a Trigger frame.	Add "HE STAs that did not require the MAC padding field in the Trigger frame shall secure a time to perform ED-based CCA during aSIFSTime. HE STAs that required the MAC padding field in the Trigger frame shall secure a time to perform ED-based CCA during MinTrigProcTime+aSIFSTime." after eq. (10-4) in subclause 10.3.7.	2017/1/9 9:42
9340	Tomoko Adachi	225	1 9.3.1.23	45	26	E	Y	45.26 9.3.1.23	The same field name "RU Allocation" appears in the User Info field of the Trigger frame and in the Common Block subfield of the HE-SIG-B field but they are completely different. They should have a different name to avoid confusion.	Change the RU Allocation subfield in the User Info field of the Trigger frame to something different, such as Allocated RU subfield throughout the draft.	2017/1/9 9:42
9341	Tomoko Adachi	225	1 10.9	127	47	T	Y	127.47 10.9	"At most one Control subfield with a given Control ID value shall be present in the A-Control field of QoS Data or Management frames carried in an (A-)MPDU." Does this mean that at most one Control subfield with a given Control ID value shall be present in the A-Control field and the A-Control field with no Control subfield is also allowed? Or does it mean that at most one Control subfield can be present in an (A-)MPDU? I think if a frame carried an A-Control field, a single Control subfield with a given Control ID value shall be contained in the A-Control field, and any of the frames that carried the A-Control field in an A-MPDU shall have the same Control subfield.	Reconsider the sentence to be more clear. Have the same content appear in all of the A-Control fields within the same A-MPDU.	2017/1/9 9:42
9342	Tomoko Adachi	225	1 9.2.4.6.4.4	25	9	E	Y	25.09 9.2.4.6.4.4	Wrong reference number.	Change "9.31.4" to "27.13" and update the title of the subclause in brackets.	2017/1/9 9:42
9343	Tomoko Adachi	225	1 9.4.2.200	73	14	E	Y	73.14 9.4.2.200	Wrong reference number.	Change "25.14" to "27.13" and update the title of the subclause in brackets.	2017/1/9 9:42
9344	Tomoko Adachi	225	1 9.4.2.200	73	40	E	Y	73.40 9.4.2.200	Wrong reference number.	Change "25.14" to "27.13" and update the title of the subclause in brackets.	2017/1/9 9:42
9345	Tomoko Adachi	225	1 10.9	127	27	E	Y	127.27 10.9	Wrong reference number.	Change "10.31.4" to "27.13" and update the title of the subclause in brackets.	2017/1/9 9:42
9346	Tomoko Adachi	225	1 10.22.2.8	133	18	T	Y	133.18 10.22.2.8	Link adaptation through the HE variant HT Control field is specified in 27.13 and it should be also included.	Add "and 27.13 (Link adaptation using the HE variant HT Control field)" at the end of item e).	2017/1/9 9:42
9347	Tomoko Adachi	225	1 9.3.1.23	47	44	T	Y	47.44 9.3.1.23	"The Padding field extends the frame length to give the recipient STAs more time to prepare a response." More time than SIFS.	Add "than SIFS" after "more time".	2017/1/9 9:42
9348	Tomoko Adachi	225	1 9.7.1	106	32	T	Y	106.32 9.7.1	The "EOF" subfield is no longer an end of frame indication. This is used by HE STAs to let the responder know in acknowledging the frame in Ack, not in BlockAck bitmap, through the Multi-STA BlockAck.	Update the description of "EOF" subfield in Table 9-422 to cover the usage described in subclause 27.10.4. An S-MPDU should be destinguished by EOF set to 1 and no subframes other than with MPDU Length field equal to 0 following. Change the subfield name from "EOF" to "EOF/Ack indication".	2017/1/9 9:42
9349	Tomoko Adachi	225	1 27.10.3	193	19	T	Y	193.19 27.10.3	"The STA shall not add an A-MPDU subframe with EOF equal to 0 after any A-MPDU subframe with EOF set to 1." This should not be correct. With the usage described in subclause 27.10.4, there can be A-MPDU subframes with EOF equal to 0 coming after an A-MPDU subframe with EOF set to 1.	Change the sentence to "The STA shall not add an A-MPDU subframe with EOF equal to 0 after any A-MPDU subframe with EOF set to 1 and with MPDU Length field equal to 0."	2017/1/9 9:42
9350	Tomoko Adachi	225	1 9.3.1.23.1	48	61	T	Y	48.61 9.3.1.23.1	Count Action Ack frame as one TID (TID=15) when considering the TID Aggregation Limit subfield.	Add "Action Ack frame is also treated to consume one TID (TID=15)." after the sentence starting from line 61 in page 48.	2017/1/9 9:42

9351	Tomoko Adachi	225	1 27.4			T	Y	27.4	How does the STA respond if the AP transmits in a DL-SU PPDU with a Trigger frame, an Action Ack frame, and a QoS Data frame in implicit BAR aggregated, but the STA only received the Action Ack frame? The correct answer will be to not respond for this case. But in the current rule, it is not restricted to aggregate a Trigger frame, so the STA cannot determine whether it can respond or not. The same question will arise when the AP transmits a DL-SU PPDU with a Trigger frame and an Action Ack frame aggregated (but with no QoS data frame) and the STA only received the Action Ack frame.	Specify that whenever an Action Ack frame is aggregated with other frames soliciting immediate response, a Trigger frame shall be aggregated, too. Or, restrict DL-SU PPDU to a single receiver not to include a Trigger frame.		2017/1/9 9:42
9352	Weimin Xing	225	1 3.2	4	28	E	Y	4.28 3.2	Change Clause "26" to Clause "28"	As in comment		2017/1/9 9:42
9353	Weimin Xing	225	1 4.3.14a	9	60	E	Y	9.60 4.3.14a	Change "MU OFDMA" to "OFDMA"	As in comment		2017/1/9 9:42
9354	Weimin Xing	225	1 6.3.3.3.2	11	41	E	Y	11.41 6.3.3.3.2	Add the text as the following: "Otherwise,this parameter is not present"	As in comment		2017/1/9 9:42
9355	Weimin Xing	225	1 9.2.4.1.8	19	40	T	Y	19.40 9.2.4.1.8	In 802.11 baseline, the Bit 7 of QoS Info field when sent by an AP is reserved. In 802.11ax, we allow that AP can set the More Data Ack subfield to 1 in the QoS Info field of frames it transmits. Please change the meanings of the Bit7 in the QoS Info when sent by an AP.	As in comment		2017/1/9 9:42
9356	Weimin Xing	225	1 9..2.4.1.10	19	57	E	Y	19.57 9..2.4.1.10	Change "two purposes" to "three purposes"	as in comment		2017/1/9 9:42
9357	Weimin Xing	225	1 9.2.4.6.4.1	23	37	E	Y	23.37 9.2.4.6.4.1	Missing the description of Reverse Direction Protocol (RDP)	Please add "See 9.2.4.6.4.8┤+ΩReverse Direction Protocol (RDP)┤+δ"		2017/1/9 9:42
9358	Weimin Xing	225	1 9.2.4.6.4.5	26	51	E	Y	26.51 9.2.4.6.4.5	The discription of Queue Size subfields is not accurate. Change "Queue Size subfields" to "Queue Size High subfield and Queue Size All subfield"	As in comment		2017/1/9 9:42
9359	Weimin Xing	225	1 9.2.4.7.1	30	37	E	Y	30.37 9.2.4.7.1	Wrong reference. Change "9.3.3.1(Beacon frame format)" to "9.3.3.2(Format of Management frames)".	As in comment		2017/1/9 9:42
9360	Weimin Xing	225	1 9.3.1.9.1	34	10	E	Y	34.10 9.3.1.9.1	Change "B6" to "B5"	As in comment		2017/1/9 9:42
9361	Weimin Xing	225	1 9.3.1.9.3	37	16	T	Y	37.16 9.3.1.9.3	Fragmentation is allowed in an A-MSDU when dot11AMSDUFragmentationOptionImplemented is true. Delete the sentence "For an A-MSDU, only the first bit of the subbitmap is used, as fragmentation is not allowed in an A-MSDU "	As in comment		2017/1/9 9:42
9362	Weimin Xing	225	1 9.3.1.9.7	39	62	T	Y	39.62 9.3.1.9.7	Fragmentation is allowed in an A-MSDU when dot11AMSDUFragmentationOptionImplemented is true. Delete the sentence "For an A-MSDU, only the first bit of the subbitmap is used, as fragmentation is not allowed in an A-MSDU "	As in comment		2017/1/9 9:42
9363	Weimin Xing	225	1 9.3.1.9.7	37	23	T	Y	37.23 9.3.1.9.7	The Multi-STA Block variant can also used for single-STA multi-TID and single-STA single-TID BlockAck variant.	Please add the cases for single-STA multi-TID and single-STA single-TID BlockAck variant.		2017/1/9 9:42
9364	Weimin Xing	225	1 9.3.1.9.7	38	54	T	Y	38.54 9.3.1.9.7	Change "N/A" to "Block Ack Bitmap"	As in comment		2017/1/9 9:42
9365	Weimin Xing	225	1 9.3.1.23	41	48	E	Y	41.48 9.3.1.23	change (RA) to RA	change (RA) to RA		2017/1/9 9:42
9366	Weimin Xing	225	1 9.3.1.23	44	51	E	Y	44.51 9.3.1.23	change "61" to "60"	As in comment		2017/1/9 9:42
9367	Weimin Xing	225	1 9.3.3.5	52	47	E	Y	52.47 9.3.3.5	Change "9.3.3.5" to "9.3.3.6"	As in comment		2017/1/9 9:42
9368	Weimin Xing	225	1 9.3.3.5	52	65	T	Y	52.65 9.3.3.5	The TWT element is optionally present if dot11TWTOptionActivated is true; otherwise it is not present.	Please add the TWT element in Table 9-29		2017/1/9 9:42
9369	Weimin Xing	225	1 9.3.3.7	53	58	T	Y	53.58 9.3.3.7	The TWT element is optionally present if dot11TWTOptionActivated is true; otherwise it is not present.	Please add the TWT element in Table 9-31		2017/1/9 9:42
9370	Weimin Xing	225	1 9.4.2.218.2	76	47	E	Y	76.47 9.4.2.218.2	Change "4" to "1" for B24 Group Addressed Multi-STA BlockAck in DL MU Support	As in comment		2017/1/9 9:42
9371	Weimin Xing	225	1 9.4.2.218.2	77	43	G	Y	77.43 9.4.2.218.2	Change "Single MPDU" to "S-MPDU"	As in comment		2017/1/9 9:42
9372	Weimin Xing	225	1 9.4.2.218.2	81	35	E	Y	81.35 9.4.2.218.2	Bits for "Number of Sounding Dimensions for 80 MHz is 3 not 1;Bits for NSTS Total <=80MHz is 3 not 1;Bits for Number of Sounding Dimensions for <=80MHz is 3 not 1.	As in comment		2017/1/9 9:42
9373	Weimin Xing	225	1 9.4.2.220	93	60	E	Y	93.60 9.4.2.220	Change EOCW_max to EOCWmax	As in comment		2017/1/9 9:42

9374	Weimin Xing	225	1 9.7.1	107	2	E	Y	107.02 9.7.1	Change "VHT PPDU" to "VHT or HE PPDU"	As in comment	2017/1/9 9:42
9375	Weimin Xing	225	1 9.7.1	107	15	E	Y	107.15 9.7.1	Change "VHT PPDU" to "VHT or HE PPDU"	As in comment	2017/1/9 9:42
9376	Weimin Xing	225	1 10.22.2.5	130	62	E	Y	130.62 10.22.2.5	Change "and" to "or"	As in comment	2017/1/9 9:42
9377	Weimin Xing	225	1 10.24.10.3	134	40	G	Y	134.40 10.24.10.3	Change "MU BAR" to "GCR MU BAR" in 10.24.10.3 GCR block ack BlockAckReq and BlockAck frame exchanges	As in comment	2017/1/9 9:42
9378	Weimin Xing	225	1 27.2.1	149	35	T	Y	149.35 27.2.1	Add the case for the Multiple BSSID Set.	Please change the text to "The RXVECTOR parameter PARTIAL_AID in the received VHT PPDU with the RXVECTOR parameter GROUP_ID equal to 0 is the same as the BSSID[39:47] of the AP to which the STA is associated or the BSSID[39:47] of any member of the Multiple BSSID Set."	2017/1/9 9:42
9379	Weimin Xing	225	1 27.2.1	150	4	T	Y	150.04 27.2.1	Add the case for the Multiple BSSID Set.	Please change the text to "The RXVECTOR parameter PARTIAL_AID of the received VHT PPDU frame with the RXVECTOR parameter GROUP_ID equal to 0 is different from the BSSID[39:47] of the AP to which the STA is associated and the BSSID[39:47] of any member of the Multiple BSSID Set."	2017/1/9 9:42
9380	Weimin Xing	225	1 27.2.1	150	13	T	Y	150.13 27.2.1	A non-AP HE STA can also send an HE MU PPDU. When an HE AP receives an HE MU PPDU, the AP can not determine whether the PPDU is an inter-BSS or an intra-BSS PPDU.	Please change the text to "An HE AP receives either a VHT MU PPDU or a DL HE MU PPDU	2017/1/9 9:42
9381	Weimin Xing	225	1 27.2.2	150	58	T	Y	150.58 27.2.2	Based on current text, if a STA is solicited an immediate respsonse by the PPDU carrying the frame, the STA shall not update the intra-BSS NAV by the received frame. However, when the STA can not respond the frame due to CS busy, How to update the NAV?	Please Clarify.	2017/1/9 9:42
9382	Weimin Xing	225	1 27.4.1	157	49	E	Y	157.49 27.4.1	Change "Multi-STA" to "Multi-STA BA"	As in comment	2017/1/9 9:42
9383	Weimin Xing	225	1 8.3.5.3.2	15	47	E	Y	15.47 8.3.5.3.2	This session discribes the PHY-DATA.indication. Change "PHY-DATA.request" to "PHY-DATA.indication"	Please change "PHY-DATA.request" to "PHY-DATA.indication"	2017/1/9 9:42
9384	Weimin Xing	225	1 9.3.3.1	52	24	E	Y	52.24 9.3.3.1	MU EDCA Parameter Set element is missing in Beacon frame. Please add MU EDCA Parameter Set element in Beacon frame.	As in comment	2017/1/9 9:42
9385	Weimin Xing	225	1 10.3.2.4	114	33	T	Y	114.33 10.3.2.4	What is a valid TXOP_DURATION? Setting to all 1s is valid or not?	Please Clarify it.	2017/1/9 9:42
9386	Weimin Xing	225	1 10.3.2.4	114	62	T	Y	114.62 10.3.2.4	Which NAV shall be updated? In 27.2.2, updating two NAVs are described, therefore it is not necessary to describe NAV updating here	Please remove it.	2017/1/9 9:42
9387	Woojin Ahn	225	1 9.7.3	109	3	T	Y	109.03 9.7.3	In a Multi-TID A-MPDU of data enabled immediate response context, QoS Data with Ack policy set to No Ack may also be aggregated with QoS Data soliciting immediate response of other TID.	Add a row for QoS Data with Ack Policy set to No Ack in Table 9-425	2017/1/9 9:42
9388	Woojin Ahn	225	1 9.7.3	109	3	T	Y	109.03 9.7.3	In Multi-TID A-MPDUs of data enabled immediate response, Action No Ack can be aggregated as well.	Add a row for Action No Ack in Table 9-425	2017/1/9 9:42
9389	Woojin Ahn	225	1 9.7.3	111	3	T	Y	111.03 9.7.3	In data enabled no immediate response context, Data frames without block ack agreement from multiple different TIDs can be aggregated.	Change to: QoS Data frames with multiple TIDs that does not correspond to a block ack agreement. These have the Ack Policy field equal to No Ack and the A-MSDU Present subfield equal to 0.	2017/1/9 9:42
9390	Woojin Ahn	225	1 9.7.3	111	3	T	Y	111.03 9.7.3	In HE BSS, TXOP holder may transmit Ack, HT-immediate BlockAck, M-BA in an A-MPDU of data enabled no immediate response context (e.g., MU cascading).	Add rows for Ack, HT-immediate BlockAck, M-BA in Table 9-426	2017/1/9 9:42
9391	Woojin Ahn	225	1 9.7.3	108	60	E	Y	108.60 9.7.3	Table 9-429 is not present	Add the table	2017/1/9 9:42
9392	Woojin Ahn	225	1 27.10.4	193	54	T	Y	193.54 27.10.4	The baseline says "The STA shall not add an A-MPDU subframe with EOF equal to 0 after any A-MPDU subframe with EOF set to 1." It is better to clarify MPDU aggregation rule for consistency and receiver's procedure	MPDUs with EOF 1 and non-zero length should not be present before MPDUs with EOF 0	2017/1/9 9:42

9393	Woojin Ahn	225	1 27.10.4	193	32	T	Y	193.32 27.10.4	An MPDU with EOF 1 and non-zero length may be aggregated with other MPDUs not soliciting immediate responses (QoS Data No Ack, Action No Ack, QoS Null) in an A-MPDU. Is the A-MPDU an S-MPDU or a single TID A-MPDU or a Multi TID A-MPDU?	Need to clarify	2017/1/9 9:42
9394	Woojin Ahn	225	1 27.4.4	160	27	T	Y	160.27 27.4.4	If an askedforack MPDU was aggregated with another askedforack MPDU in an A-MPDU and one of the askedforack MPDU was the only MPDU successfully received by the intended recipient, than the recipient may respond with an Ack frame in which case the originator cannot process the acknowledgement	The recipient should respond with an M-BA frame unless it received the whole A-MPDU successfully	2017/1/9 9:42
9395	Woojin Ahn	225	1 27.4.4	160	27	T	Y	160.27 27.4.4	If an MPDU with EOF 1 and non-zero length is aggregated with Action No Ack in an A-MPDU, then the A-MPDU is neither an S-MPDU nor a multi-TID A-MPDU, in which case, the A-MPDU must be responded by compressed BA that doesn't have Ack type field.	If there is only one MPDU that solicits an immediate response in an A-MPDU, the recipient should respond with an Ack frame even if the MPDU was not the only MPDU in the A-MPDU	2017/1/9 9:42
9396	Woojin Ahn	225	1 9.2.4.6.4.7	27	47	E	Y	27.47 9.2.4.6.4.7	HE DL HE MU	HE DL MU	2017/1/9 9:42
9397	Woojin Ahn	225	1 9.2.4.6.4.7	28	5	T	Y	28.05 9.2.4.6.4.7	When a non-AP STA transmits unsolicited BQR A-control, what kind of encoding type should the STA select? All encoding types other than 160 and 80+80 doesn't seem necessary.	Please clarify	2017/1/9 9:42
9398	Woojin Ahn	225	1 27.5.1.3	163	49	T	Y	163.49 27.5.1.3	The HE STA shall not solicit an immediate response for the frames carried in the trigger-based PPDU (e.g., by setting the Ack Policy subfield of the frame to Normal Ack or Implicit BAR). --> MPDUs transmitted in HE TB PPDU shall not set Ack type subfield to BlockAck either. Only No Ack is possible in this case.	The HE STA shall set the Ack Policy subfield of the frames carried in the trigger-based PPDU to No Ack	2017/1/9 9:42
9399	Woojin Ahn	225	1 27.3.2	152	53	T	Y	152.53 27.3.2	Static fragmentation allows only one outstanding fragment per TID. However, level 3 Dynamic fragmentation allows multiple outstanding fragments per TID per SN with different sizes. It is necessary to define an appropriate Fragment Number Space in order for an level 3 originator to refer when it generates a new fragment	Define Fragment Number Space	2017/1/9 9:42
9400	Woojin Ahn	225	1 27.3.3.1	153	19	E	Y	153.19 27.3.3.1	two periods	Remove period	2017/1/9 9:42
9401	Woojin Ahn	225	1 27.3.3.1	153	29	T	Y	153.29 27.3.3.1	When an originator receives an explicit indication of transmission failure, it may resize the transmitted fragment as long as the recipient hasn't received any fragments of higher FN successfully.	As per comment	2017/1/9 9:42
9402	Woojin Ahn	225	1 9.4.2.218.2	79	42	E	Y	79.42 9.4.2.218.2	(Table 9-262z) No contents in Maximum A-MPDU Length Exponent	Fill the blanks	2017/1/9 9:42
9403	Woojin Ahn	225	1 27.2.3	152	20	T	Y	152.20 27.2.3	If an EDCAF reported that its buffer is empty during a UL MU procedure, that EDCAF cannot expect to be scheduled by AP for the following UL MU transmissions. The EDCAF should be exempted from entering MU mode	As per comment	2017/1/9 9:42
9404	Woojin Ahn	225	1 27.5.2.6.2	173	55	T	Y	173.55 27.5.2.6.2	What happens to the OBO value after a STA succeeded a random access procedure? Should the OBO remain the same, the STA will have another opportunity at the subsequent TF-R	The OBO value shall be reset by randomly chosen between 0 and OCW-1 after a STA succeeded UL OFDMA random access procedure	2017/1/9 9:42
9405	Woojin Ahn	225	1 27.5.2.6.2	173	36	T	Y	173.36 27.5.2.6.2	Does a random access capable STA without Data to transmit decrements its OBO value upon a reception of TF-R?	Please clarify	2017/1/9 9:42

9406 Woojin Ahn	225	1 27.5.2.6.2	173	45	T	Y	173.45 27.5.2.6.2	p170.1 says "If the Trigger Type field of the soliciting Trigger frame is Basic Trigger and the STA does not have a frame of the required type, the STA shall either not transmit a response or transmit one or more QoS Null frames." It is better to prevent an HE STA whose OBO is 0 and has no data from transmitting QoS Null in order to reduce unnecessary collision.	As per comment	2017/1/9 9:42
9407 Woojin Ahn	225	1 27.5.2.6.2	173	46	E	Y	173.46 27.5.2.6.2	AID value 0If	Insert period and space	2017/1/9 9:42
9408 Woojin Ahn	225	1 27.5.2.6.2	173	45	T	Y	173.45 27.5.2.6.2	Is it possible for STAs to choose not participate UL OFDMA random access upon the reception of TF-R?	Allow STA to choose not to participate random access in which case the STA does not decrement its OBO	2017/1/9 9:42
9409 Woojin Ahn	225	1 27.8.3	189	35	T	Y	189.35 27.8.3	OMI responder shall not transmit an action frame in HE MU PPDU to an OMI initiator with UL MU Disable subfield is set to 1	As per comment	2017/1/9 9:42
9410 Woojin Ahn	225	1 9.3.1.23	42	8	E	Y	42.08 9.3.1.23	GIAnd --> GI And	As per comment	2017/1/9 9:42
9411 Woojin Ahn	225	1 27.5.2.2.1	164	46	E	Y	164.46 27.5.2.2.1	(indicating a random access allocation).. --> Two periods	Remove a period	2017/1/9 9:42
9412 Woojin Ahn	225	1 10.22.2.8	133	25	T	Y	133.25 10.22.2.8	In the baseline, there are several exceptions that allows a STA to exceed the TXOP limit which can be avoided in HE BSS (regarding dynamic fragmentation). For better channel utilization of HE AP, the TXOP limit exception rules must be further clarified for HE STAs.	As per comment	2017/1/9 9:42
9413 Woojin Ahn	225	1 27.3.2	152	52	T	Y	152.52 27.3.2	It is not allowed to generate a dynamic fragment from an MSDU of service class QoSNoAck, since it requires BA agreement. It is necessary to allow it for better efficiency	As per comment	2017/1/9 9:42
9414 Woojin Ahn	225	1 27.2.2	150	57	T	Y	150.57 27.2.2	If a STA is solicited by a Trigger Frame and the scheduled RU is considered busy by the UL MU CS mechanism, then the STA shall not transmit TB PPDU. Therefore the STA shall update its NAV as defined in the Trigger Frame.	As per comment	2017/1/9 9:42
9415 Woojin Ahn	225	1 27.5.2.6.2	173	31	T	Y	173.31 27.5.2.6.2	A STA might receive both normal Beacon and Dual Beacon. If both of the two beacons included RAPS elements, the STA might reset its OBO and OCW twice.	If a STA receives a normal Beacon and a Dual beacon including RAPS elements, it shall initialize its OBO and OCW only for the normal Beacon	2017/1/9 9:42
9416 Woojin Ahn	225	1 27.5.2.6.2	173	37	T	Y	173.37 27.5.2.6.2	Does an HE STA decrement its OBO for a random access RU that is not available? (e.g., MCS, BW constraints)	Please clarify	2017/1/9 9:42
9417 Woojin Ahn	225	1 27.5.2.6.2	173	36	T	Y	173.36 27.5.2.6.2	Does a scheduled STA decrement its OBO if there exists other User Info Fields soliciting random access?	Please clarify	2017/1/9 9:42
9418 Woojin Ahn	225	1 28.3.17.6.4	349	7	T	Y	349.07 28.3.17.6.4	In order to support BQR bitmap of 20MHz units, more granular PHY-CCA.indication primitives are necessary	Define more PHY-CCA.indication primitives	2017/1/9 9:42
9419 Xiaofei Wang	225	1 10.3.2.4	114	51	T	Y	114.51 10.3.2.4	The sentence "If the STA is an HE STA, the STA is a TXOP holder, and the frame is solicited by the STA, then the STA shall not update its NAV." is not well written and is confusing. It should be rephrased.	change the sentence "If the STA is an HE STA, the STA is a TXOP holder, and the frame is solicited by the STA, then the STA shall not update its NAV." into "If the STA is an HE STA and a TXOP holder, and if the received frame is solicited by the STA, then the STA shall not update its NAV."	2017/1/9 9:42
9420 Xiaofei Wang	225	1 10.3.2.4	115	2	T	Y	115.02 10.3.2.4	The RXVECTOR parameter TXOP_DURATION is not carried by the frame. Instead, RXVECTOR is generated by the receiving STA when receiving the frame. This sentence is not correct and should be rephrased.	change the phrase "the PPDU carrying the RXVECTOR parameter TXOP_DURATION" into "the PPDU that is associated with the RXVECTOR parameter TXOP_DURATION"	2017/1/9 9:42
9421 Xiaofei Wang	225	1 10.3.2.4	114	62	T	Y	114.62 10.3.2.4	Since this is for HE STAs, which NAV would the STA be updating? Also, since this is specifically for HE STAs, should this be clearly stated?	please revise and clearly indicate which NAV to update and this is for HE STAs only.	2017/1/9 9:42
9422 Xiaofei Wang	225	1 10.3.2.4a	115	50	T	N	115.50 10.3.2.4a	It is unclear which "network situation" it is referring to. This sentence is also unnecessary. Please consider to remove or rephrase.	Remove this sentence.	2017/1/9 9:42

9423	Xiaofei Wang	225	1 10.3.2.8a.1	116	29	T	Y	116.29 10.3.2.8a.1	why is "scheduled" used in "scheduled HE trigger-based PPDU"? This "scheduled" seems to be unnecessary and should be removed. Especially since "scheduled" is not mentioned anywhere else in the figure or title.	remove "scheduled"	2017/1/9 9:42
9424	Xiaofei Wang	225	1 10.3.2.8a.2	116	55	T	Y	116.55 10.3.2.8a.2	It is strange to start the MU-RTS procedure by stating what the MU-RTS should not request a STA to send a CTS frame in a 20 MHz channel not occupied by the PPDU. Such a ""not doing something" comment normally follows the positive normative behavior. Such a normative behavior should be added.	add description first on the normative procedure on MU-RTS should request responding CTS to transmit on certain resources at the beginning of the paragraph. Or alternatively, change the order of the two sentences of this paragraph.	2017/1/9 9:42
9425	Xiaofei Wang	225	1 10.3.2.8a.2	117	5	T	Y	117.05 10.3.2.8a.2	It is unclear which STA "the recipient" is of the MU-RTS, it should be changed to "a recipient".	change "the recipient" to "a recipient" or to "one or more recipients"	2017/1/9 9:42
9426	Xiaofei Wang	225	1 10.3.2.8a.2	117	6	T	Y	117.06 10.3.2.8a.2	A CTS is not a "successful response" to a MU-RTS, rather, it is a valid response, showing that the transmission of the MU-RTS has succeeded. This sentence needs revision to make it correct.	change the phrase "as successful response" into "as a valid response"	2017/1/9 9:42
9427	Xiaofei Wang	225	1 10.3.2.8a.2	117	11	T	Y	117.11 10.3.2.8a.2	Would a MU-RTS be carried in HE Trigger-based PPDU? If not, it should be stated here together with HE MU PPDU.	add "or in an HE Trigger-Based PPDU" before the period if MU-RTS is also not carried in a HE Trigger-Based PPDU.	2017/1/9 9:42
9428	Xiaofei Wang	225	1 10.3.2.8a.3	117	25	T	Y	117.25 10.3.2.8a.3	If RU allocation in a MU-RTS to a STA is limited to only "primary 20 MHz channel, primary 40 MHz channel, primary 80 MHz channel, 160 MHz channel, or 80+80 MHz channel." and a STA is not allowed to transmit a CTS if any of the 20 MHz channel is busy, then how would punctured transmissions be supported? For example, when the secondary 20 MHz channel is not used in non-contiguous transmissions?	Allow STAs to transmit CTS in response to a MU-RTS on each of 20 MHz channels that is not busy.	2017/1/9 9:42
9429	Xiaofei Wang	225	1 10.3.2.10.3	121	55	T	Y	121.55 10.3.2.10.3	The sentence "A STA may use a BlockAckReq frame to solicit the acknowledgment frame(s), to whom the STA sent the QoS Data frame(s) with Ack Policy subfield equal to Block Ack or from whom the STA did not receive the immediate acknowledgement frames after sending QoS Data frame(s) in a HE trigger-based PPDU with Ack Policy subfield equal to Normal Ack or Impilcit BAR." is confusing and not clear. It should be rewritten. Also "impilcit" is spelled wrong.	change the sentence "A STA may use a BlockAckReq frame to solicit the acknowledgment frame(s), to whom the STA sent the QoS Data frame(s) with Ack Policy subfield equal to Block Ack or from whom the STA did not receive the immediate acknowledgement frames after sending QoS Data frame(s) in a HE trigger-based PPDU with Ack Policy subfield equal to Normal Ack or Impilcit BAR." into " A STA may send a BlockAckReq frame to solicit the acknowledgment frame(s) from a STA, to whom it sent the QoS Data frame(s) with Ack Policy subfield equal to Block Ack. A STA may send a BlockAckReq frame to solicit the acknowledgement frame(s) from a STA if it did not receive the immediate acknowledgement frames after sending QoS Data frame(s) in a HE trigger-based PPDU with Ack Policy subfield equal to Normal Ack or Implicit BAR."	2017/1/9 9:42
9430	Xiaofei Wang	225	1 10.9	127	15	T	Y	127.15 10.9	The sentence "The HE variant HT Control field carried in the frame may contain a Control subfield supported by the intended receiver that has:" is not clear and confusing.	Change the sentence "The HE variant HT Control field carried in the frame may contain a Control subfield supported by the intended receiver that has:" into "The HE variant HT Control field carried in a frame may contain a Control subfield that has:"	2017/1/9 9:42

9431 Xiaofei Wang	225	1 10.22.2.2	130	1	T	Y	130.01 10.22.2.2	there is no difference in behavior regardless whether the STA has received the acknowledgement in response to MPDU sent in HE TB PPDU, is this correct? If so, there is no need to have two paragraphs. It would be more clear to have one paragraph describing the normative behavior after a STA transmits MPDU in HE TB PPDU, and states clearly that regardless of whether the STA has received acknowledgement.	Check whether the normative behavior is correct regardless whether the STA has successfully received acknowledgement. If the normative behavior is correct, then combine the two paragraphs together.		2017/1/9 9:42
9432 Xiaofei Wang	225	1 10.22.2.7	132	1	T	Y	132.01 10.22.2.7	The sentence "A Trigger frame or a frame carrying an UL MU Response Scheduling A-Control subfield followed after SIFS by the requested immediate response" is not clear and should be rephrased.	Change the sentence "A Trigger frame or a frame carrying an UL MU Response Scheduling A-Control subfield followed after SIFS by the requested immediate response" into "A Trigger frame or a frame carrying an UL MU Response Scheduling A-Control subfield followed by the requested immediate response transmitted after SIFS"		2017/1/9 9:42
9433 Xiaofei Wang	225	1 10.43.1	137	47	E	Y	137.47 10.43.1	"tha" should be "that"	change "tha" to "that"		2017/1/9 9:42
9434 Xiaofei Wang	225	1 10.43.1	137	57	E	Y	137.57 10.43.1	In Table 10-19a, there are track changes, although the table is inserted as a completely new table. It is rather confusing, is this a redlined version or just these changes indicated by track change is by mistake?	remove all track changes in Table 10-19a		2017/1/9 9:42
9435 Xiaofei Wang	225	1 10.43.1	137	57	T	Y	137.57 10.43.1	The TWT Setup exchange comment interpretation shown in Table 10-19a seems to be overly complicated and should be simplified. Otherwise, it can lead to very complicated implementation.	simplify the TWT setup exchange procedure to ensure it is simple, straightforward.		2017/1/9 9:42
9436 Xiaofei Wang	225	1 27.1	149	10	T	Y	149.10 27.1	the language of "banned" seems not appropriate for specification language and should be revised.	change the sentence into "HE STAs shall not use HCCA and the TSPEC mechanism.".		2017/1/9 9:42
9437 Xiaofei Wang	225	1 27.1	149	10	T	Y	149.10 27.1	The introduction section should contain descriptions and summaries for HE MAC instead of banning of certain behavior. Such descriptions and summaries should be added.	Provide descriptions and summaries for HE MAC in this section.		2017/1/9 9:42
9438 Xiaofei Wang	225	1 27.2.1	149	16	T	Y	149.16 27.2.1	frame detection doesn't belong to a section called Channel Access. This section should be moved to become a separate section.	Move this section to be a separate section since frame detection doesn't belong in a section called channel access		2017/1/9 9:42
9439 Xiaofei Wang	225	1 27.2.1	149	30	E	Y	149.30 27.2.1	"to which" is incorrect and should be changed to "with which"	change "to which" to "with which"		2017/1/9 9:42
9440 Xiaofei Wang	225	1 27.2.1	149	58	E	Y	149.58 27.2.1	"to which" is incorrect and should be changed to "with which"	change "to which" to "with which"		2017/1/9 9:42
9441 Xiaofei Wang	225	1 27.2.1	149	62	E	Y	149.62 27.2.1	"to which" is incorrect and should be changed to "with which"	change "to which" to "with which"		2017/1/9 9:42
9442 Xiaofei Wang	225	1 27.2.2	151	50	T	Y	151.50 27.2.2	There are no rules in Section 10.4.3.3 regarding setting or resetting the intra-BSS NAV or basic NAV, which are newly defined in 11ax, the reference is incorrect and should be rephrased.	Correct the reference to 10.4.3.3 or add additional text in section 10.4.3.3 regarding setting and resetting intra-BSS NAV or basic NAV.		2017/1/9 9:42
9443 Xiaofei Wang	225	1 27.4.1	157	48	T	Y	157.48 27.4.1	"BlockAck" is missing after "Multi-STA".	insert "BlockAck" after "received Multi-STA"		2017/1/9 9:42
9444 Xiaofei Wang	225	1 27.4.1.	158	11	T	Y	158.11 27.4.1.	The sentence "If an HE AP does not receive an HE Capabilities element with the Rx Control Frame To MultiBSS set to 1 from a STA, then the HE AP shall not send a Multi-STA Block Ack frame whose destination STAs associate with more than one APs to the STA." is not clear and very confusing; not sure which normative behavior it is describing.	Please clarify and rephrase the sentence so that it is clear which normative behavior it is describing.		2017/1/9 9:42
9445 Xiaofei Wang	225	1 27.4.1	158	16	T	Y	158.16 27.4.1	It is unclear what the HE non-AP STA is responding to? Is it a MU-BAR? Such behavior needs to clearly stated.	Please provide missing trigger to which the HE non-AP STA is responding to.		2017/1/9 9:42
9446 Xiaofei Wang	225	1 27.4.2	158	25	T	Y	158.25 27.4.2	It is unclear what "a recipient" is receiving; a recipient of a data frame, control frame, management frame, or beacon? Lack of description of such a recipient is confusing and impact the clarity of the described normative behavior	please provide clarification of this sentence so that the normative behavior is clear.		2017/1/9 9:42

9447	Xiaofei Wang	225	1 27.4.2	158	33	T	Y	158.33 27.4.2	is the limitation of Multi-STA BlockAck frame contains only one Per STA info for both all ACK context, regardless whether all MPDUs are successfully received? The normative behavior is not clear as stated by the text	please clarify and rephrase the sentence	2017/1/9 9:42
9448	Xiaofei Wang	225	1 27.5.2.6.2	173	45	T	Y	173.45 27.5.2.6.2	The current random access procedure requires the STA to choose a second random number to select a random access RU to transmit when the STA already uses a first random number to determine that it can conduct random access. Using a second random number is redundant; since the first random number is sufficient to determine both whether the STA is allowed to conduct random access and which RU to use. OBO counter can be used to choose RU if the OBO counter is smaller than the number of RUs assigned to AID value 0	Simplify the random access procedure by using use just the OBO counter for both determination whether a STA is allowed to conduct random access and which RU to use for random access.	2017/1/9 9:42
9449	Xiaofei Wang	225	1 27.5.2.6.2	173	46	E	Y	173.46 27.5.2.6.2	A period sign is missing between 0 and If.	Change "0If" to "0. If"	2017/1/9 9:42
9450	Xiaofei Wang	225	1 27.5.2.7	174	24	T	Y	174.24 27.5.2.7	There is no detailed procedure and normative behavior for NDP feedback and how to use them.	Either adding more details on NDP feedback procedure or remove this section	2017/1/9 9:42
9451	Xiaofei Wang	225	1 27.5.2.1	164	14	T	Y	164.14 27.5.2.1	there is no definition of 'UL OFDMA PPDU'	Define UL OFDMA PPDU or use other defined terminology.	2017/1/9 9:42
9452	Xiaofei Wang	225	1 27.5.2.1	164	24	T	Y	164.24 27.5.2.1	there is no definition of 'UL OFDMA PPDU'	Define UL OFDMA PPDU or use other defined terminology	2017/1/9 9:42
9453	Xiaofei Wang	225	1 27.5.1.1	162	56	E	Y	162.56 27.5.1.1	With' should not be capitalized and should be 'with'	Replace 'With' with 'with'	2017/1/9 9:42
9454	Xiaofei Wang	225	1 27.5.1.1	162	56	T	Y	162.56 27.5.1.1	There is no definition of "UL OFDMA with MIMO PPDU"	Either define "UL OFDMA with MIMO PPDU" or use other defined terminology	2017/1/9 9:42
9455	Xiaofei Wang	225	1 27.5.1.1	162	58	E	Y	162.58 27.5.1.1	With' should not be capitalized and should be 'with'	Replace 'With' with 'with'	2017/1/9 9:42
9456	Xiaofei Wang	225	1 27.5.2.2.2	165	56	T	Y	165.56 27.5.2.2.2	The Note is about how to set RA address in Trigger based PPDUs and it seems to be unrelated to the text above, which is on the setting of the trigger frame. It should be removed or moved to the related sections.	Remove the Note	2017/1/9 9:42
9457	Xiaofei Wang	225	1 27.5.1	162	44	T	Y	162.44 27.5.1	There are two occurrence of "STA" in this sentence, it is unclear to which "the STA" is referring. Please rephrase and clarify.	Change the sentence "An AP shall not transmit to a STA an HE MU PPDU with the HE-SIG-B allocating spatial streams to more than one recipient STA, unless the STA sets the Downlink MU-MIMO On Partial Bandwidth Rx subfield of the HE Capabilities element to 1." into "Unless a STA sets the Downlink MU-MIMO On Partial Bandwidth Rx subfield of the HE Capabilities element to 1, an AP shall not transmit to that STA an HE MU PPDU with the HE-SIG-B allocating spatial streams to more than one recipient STA."	2017/1/9 9:42
9458	Xiaofei Wang	225	1 27.16.2	206	24	T	Y	206.24 27.16.2	It may be possible that an OBSS using the same BSS Color may be only visible to STAs, but may or may not be visible to the AP. A mechanism is needed for a STA to report a visible OBSS with the same BSS Color to its AP. The AP may then make decisions whether to change the BSS Color.	Provide a mechanism for STAs to report to AP an OBSS that is visible to the STAs that uses the same BSS Color as the AP that the STAs are associated with.	2017/1/9 9:42
9459	Xiaofei Wang	225	1 27.9.2.1	190	19	T	Y	190.19 27.9.2.1	In the procedure stated for spatial reuse, a STA should not ignore any CTS frames, even if it is below OBSS_PD. The OBSS STA may be at the edge of its BSS, and any transmissions may easily destroy its receptions from its AP, being either HE MU PPDU or HE/legacy SU PPDU.	revise the spatial reuse procedure, to at least obey CTS, which may be a part of MU-RTS/CTS exchange or RTS/CTS exchange.	2017/1/9 9:42
9460	Xiaofei Wang	225	1 27.9.2.1	190	50	T	Y	190.50 27.9.2.1	This sentence seems to be out of place; it may be a wrongly formatted title.	remove this sentence or provide the correct formatting.	2017/1/9 9:42
9461	Xiaofei Wang	225	1 27.9.2.1	190	36	T	Y	190.36 27.9.2.1	When should a STA issue a PHYCCARESET.request if the received PPDU is a legacy STA? The normative behavior seems to be lacking.	provide normative behavior on when the PHYCCARESET.request should be issued for legacy PPDUs.	2017/1/9 9:42

9462	Xiaofei Wang	225	1 28.3.10.7.2	274	10	T	Y	274.10 28.3.10.7.2	This note is another form of TBD and should not be in Draft 1.0. Either provide detailed procedures for SRP or remove entirely.	provide detailed procedure for SRP or remove entirely.	2017/1/9 9:42
9463	Xiayu Zheng	225	1 28.3.15.1	343	17	E	Y	343.17 28.3.15.1	In Equation (28-121), the sub-index for Q_k,N_user-1 should be corrected as Q_k,N_user,r -1	As in comment	2017/1/9 9:42
9464	Xiayu Zheng	225	1 28.3.15.2	343	59	E	Y	343.59 28.3.15.2	The index of the angle phi(k,v), should be corrected to phi(k,u) for the Beamformee u	As in comment	2017/1/9 9:42
9465	Xiayu Zheng	225	1 28.3.15.2	344	8	E	Y	344.08 28.3.15.2	The index of the angle phi(k,v), should be corrected to phi(k,u) for the Beamformee u	As in comment	2017/1/9 9:42
9466	xun yang	225	1 27.5.1.3	163	20	T	Y	163.20 27.5.1.3	"A non-AP STA with A-BQR Support subfield of its HE Capabilities element equal to 1 delivers bandwidth query reports (BQRs) to assist the AP in allocating DL MU and UL MU resources in an efficient way." But this sentence is under the subclause of "HE bandwidth query report operation for DL MU". Then it is confusing that BQR is only for DL MU or it can be used for both DL MU and UL MU.	Please clarify.	2017/1/9 9:42
9467	xun yang	225	1 27.5.1.3	163	20	T	Y	163.20 27.5.1.3	"A non-AP STA with A-BQR Support subfield of its HE Capabilities element equal to 1 delivers bandwidth query reports (BQRs) to assist the AP in allocating DL MU and UL MU resources in an efficient way." "Asist" here is not clear. How does BQR information "asist" AP allocate the MU resources?	Please clarify.	2017/1/9 9:42
9468	xun yang	225	1 27.5.1.3	163	35	T	Y	163.35 27.5.1.3	Can AP solicit BQR more than one time by sending BQRP variant trigger frame? Consider the case that the availabe channels at the triggered STAs are few or the primary 20MHz is not available at all the triggered STAs, is it allowed that AP sending trigger to other STAs to know channel availability of them?	Please clarify.	2017/1/9 9:42
9469	xun yang	225	1 28.3.10.1	267	41	T	Y	267.41 28.3.10.1	"The HE portion of HE format preamble consists of pre-HE modulated fields and HE modulated fields. The HE modulated fields consist of HE-STF, HE-LTF and Data fields." Does this mean the HE portion of HE format preamble includes data fields? How can the preamble includes data fields?	Please clarify.	2017/1/9 9:42
9470	xun yang	225	1 9.3.1.23	42	32	T	Y	42.32 9.3.1.23	There is no definition of each subfield of Trigger variant.	Please define each subfield of trigger variant to make them clear somewhere.	2017/1/9 9:42
9471	xun yang	225	1 10.3.2.10.2	119	23	T	Y	119.23 10.3.2.10.2	"A non-AP STA that is the recipient, within an HE MU PPDU, of a QoS Data frame or QoS Null frame that solicits an immediate response with Ack Policy equal to MU Ack in the QoS Control field, of an MU-BAR frame, or of an MMPDU that solicits an immediate response, shall send the immediate response according to the scheduling information defined by the UL trigger information that is carried either in the Trigger frame(s) or UL MU Response Scheduling A-Control field." Is the immediate response in OFDMA only?	Please clarify.	2017/1/9 9:42
9472	xun yang	225	1 10.28	136	18	T	Y	136.18 10.28	Is HE MU PPDU allowed to be transmit by AP in RDP initiated by non-AP STA? Is HE trigger-based PPDU allowed to be triggered by AP in RDP initiated by non-AP STA?	It is natural to follow 11ac to allow AP to transmit HE MU PPDU or trigger HE trigger-based PPDU in RDP initiated by non-AP STA.	2017/1/9 9:42
9473	xun yang	225	1 9.3.1.23	47	61	T	Y	47.61 9.3.1.23	What is the definition of "max TF MAC Padding Duration"? Where is this parameter from at the Tx side?	Please clarify.	2017/1/9 9:42
9474	xun yang	225	1 9.3.1.23	48	5	T	Y	48.05 9.3.1.23	In HE PPDU, Padding field of trigger frame is not necessary if there is PE at the end of HE PPDU or EOF paddings in AMPDU.	Please clarify that padding field is not necessary or how to pad is an implementation issue in HE PPDU.	2017/1/9 9:42

9475	xun yang	225	1 9.2.4.5.4	20	49	E	Y	20.49 9.2.4.5.4	The procedure should be defined in 10.3.2.10.2. The title of 10.3.2.10.2 should be "Acknowledgement procedure for DL MU PPDU in MU format"	Make the changes accordingly.		2017/1/9 9:42
9476	xun yang	225	1 9.3.1.3	33	1	T	Y	33.01 9.3.1.3	For simultaneous CTS (MU RTS/CTS procedure), the CTS transmitted by non-AP STA shall be the same. However, the values of several subfields in Frame Control of CTS are unclear, e.g., power management subfield is reserved, no text on how to set More Data field, etc.This does not matter when CTS is transmitted one by one; but different values will causes interference when these CTSs are transmited simultaneously.	Please ensure that all the CTS frame are the same when they are triggered by MU-RTS.		2017/1/9 9:42
9477	xun yang	225	1 27.5.2.7	174	21	T	Y	174.21 27.5.2.7	There is no definition of NDP feedback, e.g., no format of NDP feedback, no procedure of its transmission, no text on how it works, etc.	Please add text to make the concept clear.		2017/1/9 9:42
9478	xun yang	225	1 27.5.2.2.2	167	12	T	Y	167.12 27.5.2.2.2	"The AP may assign any value in the AC Preference Level subfield in the Trigger Dependent User Info field for an HE STA identified by the AID12 subfield of the User Info field of a Basic Trigger frame". Since trigger can be sent in any AC, it is possible that AP use any AC to contend the channel, and use trigger another AC in the UL transmissions. That is, the primary AC in AP's TXOP is not the AC of the TXOP. Not sure if there is any unfair issue.	It is safer to limit the preferred AC field in trigger to be the AC in which the trigger is sent to contend the channel.		2017/1/9 9:42
9479	xun yang	225	1 9.4.2.218.2	76	42	E	Y	76.42 9.4.2.218.2	B22 should be "MU Cascading Support"	As in the comment.		2017/1/9 9:42
9480	xun yang	225	1 10.3.1	113	45	T	Y	113.45 10.3.1	Is MU-RTS under control of dot11RTSThreshold? If yes, please add the related text; if not, please clarify which parameter to control MU-RTS.	As in the comment.		2017/1/9 9:42
9481	xun yang	225	1 10.3.2.8a.1	116	37	T	Y	116.37 10.3.2.8a.1	What is TB in Figure 10-9b?	Change to the name consitent with other parts of the draft.		2017/1/9 9:42
9482	Yan Zhang	225	1 9.3.1.23	44	44	T	Y	44.44 9.3.1.23	In Table 9-25e AP Tx Power subfield encoding, Values 0 to 61 maps to -20dBm to 40dBm cannot be one to one mapping. It should be Values 0 to 60 maps to -20dBm to 40dBm.	As in comment		2017/1/9 9:42
9483	Yan Zhang	225	1 9.3.1.23	47	35	T	Y	47.35 9.3.1.23	In Table 9-25g Target RSSI subfield encoding, Values 0 to 90 maps to -100dBm to -20dBm contradicts with PHY motion #156. It says that values 0 to 90 maps to -110dBm to 20dBm.	As in comment		2017/1/9 9:42
9484	Yan Zhang	225	1 28.3.9	266	53	T	Y	266.53 28.3.9	Sentence "Note that the multiplication matrices Ak_HE-LTF are included in the calculation of X(iseg,m)_k,r,u for the HE-STF and HE-LTF fields" is not completely accurate. The multiplication matrices Ak_HE-LTF should not included in the calculation of X(iseg,m)_k,r,u for HE-STF.	Change to "Note that the multiplication matrices Ak_HE-LTF are included in the calculation of X(iseg,m)_k,r,u for HE-LTF field".		2017/1/9 9:42
9485	Yan Zhang	225	1 28.3.10.10	313	23	T	Y	313.23 28.3.10.10	TGI in equations (28-58) should be replaced by TGI,HE-LTF. TGI is not defined.	As in comment		2017/1/9 9:42
9486	Yan Zhang	225	1 28.3.10.10	313	38	T	Y	313.38 28.3.10.10	TGI in equations (28-59) should be replaced by TGI,HE-LTF. TGI is not defined.	Either define the PHY mechanism for NDP feedback report, or remove this subclause and other related placehodlers.		2017/1/9 9:42
9487	Yan Zhang	225	1 28.3.10.4	270	14	T	Y	270.14 28.3.10.4	TGI,LegacyPreamble in equations (28-10) should be replaced by TGI,L-LTF, which is double value of TGI,LegacyPreamble.	Replace TGI,LegacyPreamble in equation (28-10) to TGI,L-LTF.		2017/1/9 9:42
9488	Yan Zhang	225	1 28.3.12	339	25	T	Y	339.25 28.3.12	In Table 28-39 Pre-FEC Padding Factor subfield encoding, bxx did not specify which bit is LSB and which bit is MSB. This may not be clear enough for all spec readers. Please specify it	Replace "b" with "B1B0".		2017/1/9 9:42
9489	Yan Zhang	225	1 28.3.10.10	302	5	T	Y	302.05 28.3.10.10	HELTF4x,TGI1,Data is missing from "The optional combinations of HE-LTF mode and GI duration"	Add a new bullet 4xLTF, TGI1,Data for HE SU PPDU or HE SU extended PPDU or HE MU PPDU		2017/1/9 9:42
9490	Yan Zhang	225	1 28.4.2	371	58	T	Y	371.58 28.4.2	"TPE is given by Equation (28-113)." quoted wrong equation. It should be Equation (28-117).	Replace (28-113) with (28-117)		2017/1/9 9:42

9491	Yanchun Li	225	1 27.2.3	152	10	T	Y	152.10 27.2.3	When AP has acknowledged STA's uplink buffer status report (BSR), AP will allocate trigger based transmission resource to this STA soon. Similar to the current case that STA slow down its EDCA contention after being provided trigger-based UL transmission opportunity, STA shall also slow down its EDCA contention and use MU EDCA Parameter Set after uplink BSR. Otherwise, there will be too many legacy SU transmissions. And the whole system performance just degrades to legacy SU system. It will be hard for AP to organize MU transmission. Actually, 11ax shall take advantage from MU transmission as much as possible.	Insert condition "that receives an immediate response from the AP for the transmitted BSR" to the paragraph. The paragraph is changed to: An UL MU capable non-AP HE STA that receives a Basic Trigger frame that contains a Per User Info field with the AID of the STA, and that receives an immediate response from the AP for the transmitted Trigger based PPDU, or that receives an immediate response from the AP for the transmitted BSR, shall update its CWmin[AC], CWmax[AC], AIFSN[AC] and HEMUEDCATimer[AC] state variables to the values contained in the most recently received MU EDCA Parameter Set element sent by the AP to which the STA is associated, for all the ACs from which QoS Data frames were transmitted in the HE trigger-based PPDU.	2017/1/9 9:42
9492	Yanchun Li	225	1 10.3.2.8	115	63	T	Y	115.63 10.3.2.8	Current MU-RTS/CTS uses a fundamental assumption that a STA only need to have available 20MHz channel set which is a subset of AP's available 20MHz channel set. It considers the case of AP initiated RTS. It lacks the consideration over the case that, STA may also initiate RTS which occupies a subset of AP's available 20MHz channels. Without considering this case, the adavantage of MU transmission can't be full utilized and the system proformance will be degraded. On receiving RTS from HE-STA, AP shall be able to reply with CTS to occupy AP's available 20MHz/40MHz/80MHz/160MHz. Then AP can to RDG to trigger MU transmission.	Insert "On receiving RTS from HE-STA, AP shall be able to reply with CTS to occupy AP's available 20MHz/40MHz/80MHz/160MHz. Then AP can to RDG to trigger MU transmission."	2017/1/9 9:42
9493	Yanchun Li	225	1 27.5.2.6.2	173	48	T	Y	173.48 27.5.2.6.2	"If the selected RU is considered busy as a result of either physical or virtual carrier sensing, then the HE STA shall not transmit its HE trigger-based PPDU in the randomly selected RU and it randomly selects any one of the RUs that are assigned to AID value 0 in the subsequent Trigger frame." It will cause both the STAs finishing backoff in next trigger and current trigger to contend for random access RUs in next trigger. The over-crowd attempts cause low channel access efficiency.	Change this sentense to: If the selected RU is considered busy as a result of either physical or virtual carrier sensing, then the HE STA shall transmit its HE trigger-based PPDU in the randomly selected idle RU or it backoffs again and randomly selects any one of the RUs that are assigned to AID value 0 in the subsequent Trigger frame.	2017/1/9 9:42
9494	Yanchun Li	225	1 9.3.1.23.5	51	26	T	Y	51.26 9.3.1.23.5	"the Trigger Dependent User Info field is not present" causes degraded trigger based UL random access performance. 11ax is designed to work under high dense environment with large number of STAs which have diverse application demands. When BSRP variant Trigger frame triggers random access BSRs, the BSR from the STA with high priority AC shall not contend with low priority AC BSR. Need to reuse the AC-aware design in Basic Trigger variant.	Trigger Dependent User Info field for BSRP variant reuses Figure 9-52g--Trigger Dependent User Info field for the Basic Trigger variant. B0-B4 bits are discarded and reserved.	2017/1/9 9:42
9495	Yanchun Li	225	1 9.2.4.6.4.3	24	58	T	Y	24.58 9.2.4.6.4.3	Current ROM shall be improved to settle the case with large number of STA in narrow band ROM mode. Current ROM requires all STAs to occupy primary 20MHz and causes low channel utility. Need to allocate some narrow band ROM STA to RU in non-primary portion.	The Channel Width field shall support indication of specific 20MHz channel which STA prefers in this ROM mode.	2017/1/9 9:42

9496	Yanchun Li	225	1 28.3.11.9	327	14	E	Y	327.14 28.3.11.9	A typo in DCM description. Miss some word between 'a' and 'and'.	The suggested words for the missing part are highlighted in quote mark. When DCM is employed, bit sequences are ... in order to exploit frequency diversity for a "RU with subcarrier number smaller or equal to 996" , and "where k is in the range of" 0<=k<=N_{SD}/2-1 ...	2017/1/9 9:42
9497	Yasuhiko Inoue	225	1 3.2	3	40	T	Y	3.40 3.2	Definition of "20 MHz physical layer (PHY) protocol data unit (PPDU)" should not include the clause 15 (DSSS PHY specification for the 2.4 GHz band designated for ISM applications) PPDU and the clause 16 (High rate direct sequence spread spectrum (HR/DSSS) PHY specification) PPDU since they occupy more than 20 MHz.	Remove clause 15 (DSSS PHY specification for the 2.4 GHz band designated for ISM applications) PPDU and the clause 16 (High rate direct sequence spread spectrum (HR/DSSS) PHY specification) PPDU.	2017/1/9 9:42
9498	Yasuhiko Inoue	225	1 3.2	3		G	Y	3.00 3.2	RU should be defined in clause 3.2	As in the comment.	2017/1/9 9:42
9499	Yasuhiko Inoue	225	1 3.2	6		T	Y	6.00 3.2	"non-orthogonal frequency division multiple access (non-OFDMA): A full bandwidth HE transmission with 242-tone RU, 484-tone RU, 996-tone RU, 2-├Θ*996-tone RU, or 2-├Θ*996-tone RU allocated for 20 MHz, 40 MHz, 80 MHz, 160 MHz, or 80+80 MHz transmission, respectively." RU should be defined in this subclause.	As in the comment.	2017/1/9 9:42
9500	Yasuhiko Inoue	225	1 3.4	7	15	E	Y	7.15 3.4	"OMI Operation mode indication" According to 27.8, OMI stands for "Operating mode indication." Please use the consistent term.	Change "Operation mode indication" to "Operating mode indication"	2017/1/9 9:42
9501	Yasuhiko Inoue	225	1 4.3.14a	9	57	T	Y	9.57 4.3.14a	"- Optional support for OFDMA-based random access" OFDMA-based random access should be defined in clause 3.2.	As in the comment.	2017/1/9 9:42
9502	Yasuhiko Inoue	225	1 4.3.14a	9	60	E	N	9.60 4.3.14a	"An HE AP uses the Trigger frame to initiate MU OFDMA or MU-MIMO transmissions in the UL direction." MU OFDMA should be OFDMA.	As in the comment.	2017/1/9 9:42
9503	Yasuhiko Inoue	225	1 9.2.4.6.4.2	23	59	E	Y	23.59 9.2.4.6.4.2	"... and is set to the number of OFDM symbols the Data field of the HE trigger-based PPDU minus 1" This text seems to have grammatical mistake.	For example, " ,,, and is set to the number of OFDM symbols in the Data field of the HE trigger-based PPDU minus 1."	2017/1/9 9:42
9504	Yasuhiko Inoue	225	1 9.2.4.6.4.6	27	19	E	N	27.19 9.2.4.6.4.6	"... power pre-correction (see 26.3.13.2 (Power pre-correction)." Wrong reference. It should be "(see 28.3.14.2 (Power pre-correction))."	As in the comment.	2017/1/9 9:42
9505	Yasuhiko Inoue	225	1 9.2.4.6.4.7	27	65	E	N	27.65 9.2.4.6.4.7	"... to assist DL HE MU transmission (see 25.5.1.3. (Bandwidth query report operation)." Wrong reference. It should be 27.5.1.3 (HE bandwidth query report operation for DL MU)"	As in the comment.	2017/1/9 9:42
9506	Yasuhiko Inoue	225	1 9.3.1.23.1	48	41	G	Y	48.41 9.3.1.23.1	"The MPDU MU Spacing Factor subfield indicates the value by which the minimum MPDU start spacing defined in Table 8-159 is multiplied." Table 8-159 missing.	Refer to the correct table. (Maybe Table 9-25h?)	2017/1/9 9:42
9507	Yasuhiko Inoue	225	1 9.4.2.218.2	79	41	T	Y	79.41 9.4.2.218.2	"Maximum AMPDU Length Exponent" in the Table 9-262z-- Subfields of the HE MAC Capabilities Information field: Definition and Encoding for this entry is blank.	Definition and Encoding for this entry should be provided.	2017/1/9 9:42
9508	Yasuhiko Inoue	225	1 9.4.2.218.3	81	40	T	Y	81.40 9.4.2.218.3	SRP-based SR Support: SRP-based SR is not defined.	Define the SRP-based SR in clause 3.2 and provide text in 27.9.	2017/1/9 9:42

9509 Yasuhiko Inoue	225	1 9.4.2.218.3	83	40	T	Y	83.40 9.4.2.218.3	"Doppler" in Table 9-262aa--Subfields of the HE PHY Capabilities Information field: "B20 indicates transmitting STA supports transmitting HE PPDUs with Doppler procedure B21 indicates transmitting STA supports receiving HE PPDUs with Doppler procedure" Doppler procedure is not defined.	Define the Doppler procedure.		2017/1/9 9:42
9510 Yasuhiko Inoue	225	1 9.4.2.219	91	39	T	N	91.39 9.4.2.219	"The BSS Color field is an unsigned integer whose value is the BSS color of the BSS corresponding to the AP which transmitted this element, except that a value of 0 in this field indicates that there is no BSS color for this BSS. The BSS Color field is an unsigned integer whose value is the BSS Color of the BSS corresponding to the AP, IBSS STA, mesh STA or TDLS STA that transmitted this element, except that a value of 0 in this field is used if one or more intended recipient STAs of an HE PPDU is not a member of a transmitting STA's BSS." Similar sentences. These senetnces can be merged.	As in the comment.		2017/1/9 9:42
9511 Yasuhiko Inoue	225	1 9.4.2.220	93	25	E	N	93.25 9.4.2.220	Figure 9-589ct–RAPS element format: Typo: Length	Fix		2017/1/9 9:42
9512 Yasuhiko Inoue	225	1 9.4.2.220	93	46	E	N	93.46 9.4.2.220	Figure 9-589cu–OCW Range field format: "Octets" should be "Bits"	Fix		2017/1/9 9:42
9513 Yasuhiko Inoue	225	1 94.4.2.222	95	43	E	N	95.43 94.4.2.222	"Announce-ment" should be "Announcement"	Fix		2017/1/9 9:42
9514 Yasuhiko Inoue	225	1 9.6.5.1	99	22	T	Y	99.22 9.6.5.1	9.6.5 Block Ack Action frame details 9.6.5.1 General There are new entries in the Table 9-302 (Block Ack Action field value). The formats of the new Block Ack frames should be explained as in the base standard.	Add text for the new Block Ack formats.		2017/1/9 9:42
9515 Yasuhiko Inoue	225	1 10.3.2.8a.3	117	22	T	Y	117.22 10.3.2.8a.3	"The ED-based CCA during the SIFS after receiving an MU-RTS frame and ..." The ED-based CCA should be defined.	As in the comment.		2017/1/9 9:42
9516 Yasuhiko Inoue	225	1 10.12	128	8	E	N	128.08 10.12	"An A-MSDU may be fragmented and each fragment transmitted within a single QoS Data frame, ..." should be modified to "An A-MSDU may be fragmented and each fragment is transmitted within a single QoS Data frame, ..."	As in the comment.		2017/1/9 9:42
9517 Yasuhiko Inoue	225	1 27.1	149	10	T	Y	149.10 27.1	"The use of HCCA and TSPEC are banned at HE STAs." Two thoughts: (1) This sentence is ambiguous. If we ban HCCA, it will be reasonable to disallow TSPEC negotiation for HCCA. However the TSPEC negotiation can be used for admission control for the EDCA which will be beneficial for the schduling purpose at the AP. Therefore, I do not think it will be good to disallow all of the TSPEC negotiation. (2) This sentence is not the introduction of HE MAC. It should be stated somewhere in 27.2.	(1) The sentence should be modified to: "The use of HCCA is banned at HE STAs." (2) Move this sentence somewhere in 27.2.		2017/1/9 9:42

9518	Yasuhiko Inoue	225	1 27.2.1	149	24	E	Y	149.24 27.2.1	"A frame received by the STA is an intra-BSS frame if one of the following conditions is true: - The RXVECTOR parameter BSS_COLOR in the received PPDU carrying the frame is the same as the BSS color announced by the AP to which the STA is associated - The RA field, TA field or BSSID field of the received frame with the Individual/Group bit forced to the value 0 is the same as the BSSID of AP to which the STA is associated ..." The STA here seems to mean the HE non-AP STA while these conditions also seem to be true for the HE AP.	The text should be modified so that it can be applied to the AP as well.		2017/1/9 9:42
9519	Yasuhiko Inoue	225	1 27.2.1	149	38	T	Y	149.38 27.2.1	"The value of RXVECTOR parameter PARTIAL_AID [5:8] in the received VHT PPDU ..." PARTIAL_AID [5:8] is not clear enough.	PARTIAL_AID [5:8] should be rephrased, or define this expression in 1.5 Terminology for mathematical, logical, and bit operations.		2017/1/9 9:42
9520	Yasuhiko Inoue	225	1 27.2.1	150	5	T	Y	150.05 27.2.1	"... is different from the BSSID[39:47] of the AP ..." BSSID[39:47] is not clear enough.	BSSID[39:47] should be rephrased, or define this expression in 1.5 Terminology for mathematical, logical, and bit operations.		2017/1/9 9:42
9521	Yasuhiko Inoue	225	1 27.2.3	152	13	T	Y	152.13 27.2.3	HEMUEDCATimer[AC] not defined.	Define HEMUEDCATimer[AC].		2017/1/9 9:42
9522	Yasuhiko Inoue	225	1 27.3.4.1	155	22	E	N	155.22 27.3.4.1	"Set to 3 if the STA supports reception of dynamic fragments following the procedure defined in 227.3.3.4 (Level 3 dynamic fragmentation)" Wrong reference.	227.3.3.4 should be 27.3.3.4.		2017/1/9 9:42
9523	Yasuhiko Inoue	225	1 27.3.4.2	155	56	T	Y	155.56 27.3.4.2	"Upon reception of an MPDU or S-MPDU that carries one or more dynamic fragments, the recipient STA ..." It is not clear whether an MPDU or S-MPDU can carry more than one dynamic fragments.	Clarify		2017/1/9 9:42
9524	Yasuhiko Inoue	225	1 27.3.4.4	156	62	E	N	156.62 27.3.4.4	"... the sequence numbers are performed module 4096" module should be modulo	As in the comment.		2017/1/9 9:42
9525	Yasuhiko Inoue	225	1 27.4.4.5	162	27	T	Y	162.27 27.4.4.5	broadcast RU should be defined.	As in the comment.		2017/1/9 9:42
9526	Yasuhiko Inoue	225	1 27.5.1.1	162	56	T	Y	162.56 27.5.1.1	There is no field named "DL OFDMA With MIMO Support" in HE Capabilities.	Assign one reserved bit in the HE PHY Capabilities Information field of HE Capabilities element to indicate this capability.		2017/1/9 9:42
9527	Yasuhiko Inoue	225	1 27.5.2.2.2	167	15	T	Y	167.15 27.5.2.2.2	"The AP may assign any value defined in Table 9-25i (Preferred AC subfield encoding) in the AC Preference Level subfield in ..." AC Preference Level subfield should be Preferred AC subfield.	As in the comment.		2017/1/9 9:42
9528	Yasuhiko Inoue	225	1 27.5.2.3	167	59	T	Y	167.59 27.5.2.3	"If the STA is not associated with the AP, TBD." TBD should be removed.	Remove the last sentence of this bullet.		2017/1/9 9:42
9529	Yasuhiko Inoue	225	1 27.5.2.3	168	32	T	Y	168.32 27.5.2.3	"The NUMBER_HE_LTF_SYM parameter shall be set to the value ..." There is no such a parameter in TXVECTOR nor RXVECTOR.	Clarify which parameter is referred to.		2017/1/9 9:42
9530	Yasuhiko Inoue	225	1 27.5.2.3	169	7	T	Y	169.07 27.5.2.3	"UL_TARGET_RSSI, DL_TX_POWER, RU_ALLOCATION, and MCS parameters shall be set to ..." Could not find UL_TARGET_RSSI nor DL_TX_POWER in the TXVECTOR parameters in table 28-1.	Clarify which parameters are referred to.		2017/1/9 9:42

9531	Yasuhiko Inoue	225	1 27.5.2.3	169	15	T	Y	169.15 27.5.2.3	"MU_MIMO_LTF_MODE, LDPC_EXTRA, NSTS, STBC, CODING TYPE, SS_ALLOCATION shall all be set to 0." (1) Could not find MU_MIMO_LTF_MODE in Table 28-1. (2) LDPC_EXTRA should be LDPC_EXTRA_SYMBOL (3) NSTS may be NUM_STS (4) CODING TYPE may be FEC_CODING (5) Could not find SS_ALLOCATION in the TXVECTOR and RX VECTOR parameters in Table 28-1.	Use the consistent terms with other part of the draft. And clarify the parameters which are not in the table 28-1.	2017/1/9 9:42
9532	Yasuhiko Inoue	225	1 27.5.2.3	169	25	T	Y	169.25 27.5.2.3	"CP_LTF_TYPE parameter shall be set to ..." There is no such a parameter in TXVECTOR and RXVECTOR in table 28-1.	Clarify which parameter is referred to.	2017/1/9 9:42
9533	Yasuhiko Inoue	225	1 27.5.2.6.2	173	11	T	Y	173.11 27.5.2.6.2	Figure 27-1--Illustration of the UL OFDMA-based random access procedure is ambiguous. (1) IFS except the left side one is not specified. (2) Not clear why the OBO value of a STA changes depending on the height of a Trigger frame. (3) Not clear the timing of decrementing the OBO value.	The figure should be modified to explain the change of the OBO in relation to time.	2017/1/9 9:42
9534	Yasuhiko Inoue	225	1 27.5.2.7	174	21	T	Y	174.21 27.5.2.7	"The NDP feedback report is a mechanism for an HE AP to collect short feedbacks from a very high number of HE STAs, in an efficient manner. The feedbacks (e.g. resource requests) are sent without data payloads in response to a Trigger frame. The feedbacks are not for channel sounding. This mechanism is optional for non-AP STA." It is impossible to implement this feature only with this text.	Add more normative text in this subclause.	2017/1/9 9:42
9535	Yasuhiko Inoue	225	1 27.5.3	175		G	Y	175.00 27.5.3	It is not clear what happens if a transmission error occurs during the cascading sequence.	Detailed specification is needed.	2017/1/9 9:42
9536	Yasuhiko Inoue	225	1 27.6.2	177	19	T	Y	177.19 27.6.2	"..., for 80 MHz full bandwidth feedback the RU Start Index and RU End Index is set to 0 and 36, respectively as shown in Table YY-1." The table number should be specified.	As in the comment.	2017/1/9 9:42
9537	Yasuhiko Inoue	225	1 27.9			E	Y	27.9	There is no normative text for SRP based spatial reuse while related information is defined in clause 28.	Add normative text for SRP based spatial reuse.	2017/1/9 9:42
9538	Yasuhiko Inoue	225	1 27.9.1	190	50	E	N	190.50 27.9.1	"SR Backoff procedure for SR delayed case." This text looks like a title of a subclause.	Make appropriate arrangement for this text.	2017/1/9 9:42
9539	Yasuhiko Inoue	225	1 27.9.2.1	190	55	T	Y	190.55 27.9.2.1	"NOTE--The countdown of an existing backoff procedure is suspended until the end of the PPDU carrying the SR delay entry since the medium is busy during the duration of the PPDU carrying the SR delay entry." This implies that there will be backoff counter for spatial reuse transmission. If it is true, it should be defined.	Define the backoff counter for SR transmission.	2017/1/9 9:42
9540	Yasuhiko Inoue	225	1 27.9.2.2	191	7	T	Y	191.07 27.9.2.2	OBSS_PD_{level}, OBSS_PD_{max}, OBSS_PD_{min}, TXPWR_{ref} not defined.	Define them before they apprear.	2017/1/9 9:42
9541	Yasuhiko Inoue	225	1 27.9.2.2	192	7	T	Y	192.07 27.9.2.2	"If a STA chooses a specific OBSS_PD_{level} during its operation under SR mode, ..." SR mode undefined.	Define SR mode.	2017/1/9 9:42
9542	Yasuhiko Inoue	225	1 27.11.6	198	22	G	Y	198.22 27.11.6	It should be stated that the criteria of setting the SPATIAL_REUSE parameter in the TXVECTOR is out of the scope of this standard.	As in the comment.	2017/1/9 9:42

9543	Yasuhiko Inoue	225	1 28.1.1	210	39	E	Y	210.39 28.1.1	"1.6 ++s GI duration on both HE-LTF and data symbols when the HE-LTF is 1x (transmit and receive) for full bandwidth UL MU-MIMO if the STA supports UL MU-MIMO" "1x" should be "1x LTF"	As in the comment.	2017/1/9 9:42
9544	Yasuhiko Inoue	225	1 28.1.1	212	36	E	Y	212.36 28.1.1	... -- MU-MIMO transmit on an RU in an HE trigger-based PPDU where the RU spans the entire PPDU bandwidth (UL MU-MIMO). If it is supported then a total of up to 8 space-time streams are supported -- MU-MIMO transmit on an RU in an HE_TRIG PPDU where the RU does not span the entire PPDU bandwidth (UL MU-MIMO with OFDMA). If it is supported then a total of up to 8 space-time streams are supported ..." Inconsistent expressions: "HE trigger-based PPDU" and "HE_TRIG PPDU"	For the consitency with the other part, HE_TRIG PPDU should be HE trigger-based PPDU.	2017/1/9 9:42
9545	Yasuhiko Inoue	225	1 28.2.2	216	11	T	Y	216.11 28.2.2	TXVECTOR and RXVECTOR parameter N_TX is defined for HE_SU, HE_MU, HE_EXT_SU and HE_TRIG format to indicate the number of transmit chains. However, in the Table 28-1, it is set to "N" (not present) for both TXVECTOR and RXVECTOR.	It should be Y for TXVECTOR.	2017/1/9 9:42
9546	Yasuhiko Inoue	225	1 28.2.2	216	47	T	Y	216.47 28.2.2	CHAN_MAT_TYPE for HE_SU, HE_MU, HE_EXT_SU, or HE_TRIG formats are defined to be "COMPRESSED_SV" in the first low while CHAN_MAT_TYPE for HE_MU, HE_EXT_SU, HE_TRIG or HE_SU and PSDU_LENGTH is greater than 0 is defined to be "Not present" in the second low. Not sure how to set this parameter in HE_MU, HE_EXT_SU and HE_TRIG formats.	Double check the conditions on the format.	2017/1/9 9:42
9547	Yasuhiko Inoue	225	1 28.3.4	241	53	E	Y	241.53 28.3.4	"The fields of the HE PPDU formats are summarized in Figure 28-8 (HE PPDU fields)." Figure 28-8 should be Table 28-8.	As in the comment.	2017/1/9 9:42
9548	Yasuhiko Inoue	225	1 28.3.4	242	27	T	Y	242.27 28.3.4	"The L-STF, L-LTF, L-SIG, RL-SIG, HE-SIG-A, HE-SIG-A-R, and HE-SIG-B fields are ..." HE-SIG-A-R not defined.	It should be described that the HE-SIG-A-R is repeated HE-SIG-A.	2017/1/9 9:42
9549	Yasuhiko Inoue	225	1 28.3.5	249	6	T	Y	249.06 28.3.5	The Figure 28-17--Transmitter block diagram for the Data field of an HE SU PPDU in 80+80 MHz with LDPC encoding needs to be fixed.	Will come up with a proposed change.	2017/1/9 9:42
9550	Yasuhiko Inoue	225	1 28.3.8	259	34	T	Y	259.34 28.3.8	Table 28-12, Explanation of N_{CBPS}, N{CBPS, u} N_{user, total} not deifned.	Define N_{user, total}.	2017/1/9 9:42
9551	Yasuhiko Inoue	225	1 28.3.10.7.2	275	8	T	Y	275.08 28.3.10.7.2	Table 28-16 B8 of HE-SIG-A2 (HE SU PPDU) or HE-SIG-A3 (HE extended range SU PPDU): "Indicates the presence of the extra OFDM symbol for LDPC. Set to 1 if an extra OFDM symbol for LDPC is present Set to 0 if an extra OFDM symbol for LDPC is present ..." Value 1 or 0 should indicate that an extra OFDM symbol for LDPC is not present.	As in the comment.	2017/1/9 9:42

9552	Yasuhiko Inoue	225	1 28.3.10.7.2	275	33	T	Y	275.33 28.3.10.7.2	Table 28-16 B15 of HE-SIG-A2 (HE SU PPDU) or HE-SIG-A3 (HE extended range SU PPDU): "Set to 0 if Doppler mode is not used Set to 1 if Doppler mode is used" Doppler mode is not defined in the draft.	Doppler mode should be defined, or make this bit reserved.		2017/1/9 9:42
9553	Yasuhiko Inoue	225	1 28.3.10.7.2	277	35	T	Y	277.35 28.3.10.7.2	Table 28-17, B25 of HE-SIG-A1 (Doppler): "Set to 0 if Doppler mode is not used Set to 1 if Doppler mode is used" Doppler mode is not defined in the draft.	Doppler mode should be defined, or make this bit reserved.		2017/1/9 9:42
9554	Yasuhiko Inoue	225	1 28.3.10.8.4	292	41	T	Y	292.41 28.3.10.8.4	Table 28-21, Number of entries for 011111x1x0 The value 8 should be 4.	As in the comment.		2017/1/9 9:42
9555	Yasuhiko Inoue	225	1 28.3.12	339	1	E	N	339.01 28.3.12	Editor's Note: The HE-SIG-A bits definition below should be moved into 28.3.10.7 (HE-SIG-A) Resolve the editor's note.	As in the comment.		2017/1/9 9:42
9556	Yasuhiko Inoue	225	1 B.4.27	410	34	G	N	410.34 B.4.27	B.4.27 High Efficiency WLAN (HEW) features HEW should be HE since we have agreed to use High Efficiency (HE) for this amendment.	Replace HEW with HE in this subclause.		2017/1/9 9:42
9557	Yonggang Fang	225	1 10.3.2.8a.2	116	64	T	Y	116.64 10.3.2.8a.2	When a HE STA does not receive the simultaneous CTS response to the MU-RTS, it indicates the radio condition of MU-RTS receiving STAs does not allow those STAs to send CTS responses. Therefore the transmitting STA of MU-RTS may perform re-transmission of MU-RTS later or start a new transmisson to other STAs after backoff procedure.	change to "… and this STA shall invoke its backoff procedure upon expiration of the CTSTimeout interval to re-transmit the MU-RTS or start new transmissions to other STAs."		2017/1/9 9:42
9558	Yonggang Fang	225	1 10.3.2.8a.3	118	8	E	Y	118.08 10.3.2.8a.3	As a MU-RTS is sent in duplicated PPDU over 40MHz channel, it may be clearer to show in separate frames of MU-RTS, each of them occupies 20MHz in the Figure 10-9c. Similar to CTS frame over 40MHz channel.	see the comment.		2017/1/9 9:42
9559	Yonggang Fang	225	1 10.7.	123		T	Y	123.00 10.7.	As 11ax introduces new HE-MCS, it would be necessary to update the MCS rate set for management frame including HE beacon frame.	update the corresponding text of management frame with HE-MCS		2017/1/9 9:42
9560	Yonggang Fang	225	1 11.1.3.10	141	32	E	Y	141.32 11.1.3.10	Add the following sentence in the beginning: As the OFDMA may improve the UL transmission coverage significantly, an	as in the comment		2017/1/9 9:42
9561	Yonggang Fang	225	1 11.1.3.10	141	44	T	Y	141.44 11.1.3.10	Using a half value of Beacon Interval of legacy beacon frames as offset of HE beacon may not be flexisible in deployment. Suggest to add HE Beacon Offset in the HE Operation element, or remove this restriction.	as in the comment		2017/1/9 9:42
9562	Yonggang Fang	225	1 9.4.2.219	91		T	Y	91.00 9.4.2.219	In order to improve the deployment flexibility, it may require to independently control legacy beacon and HE beacon transmission. Increase the size Dual Beacon field to 2 bits	as in the comment		2017/1/9 9:42
9563	Yonggang Fang	225	1 9.4.2.219	92	30	T	Y	92.30 9.4.2.219	Modify the definition of Dual Beacon field.	00: Legacy Beacon only, 01: HE beacon only, 10: L+HE beacon with duplicated system info. 11: L+HE with non-duplicated system info		2017/1/9 9:42
9564	Yonggang Fang	225	1 11.2.2.6	142	30	T	Y	142.30 11.2.2.6	When a HE AP sets the More Data subfield to 1 in Multi-STA BA to indicate the pending buffered data for a STA identified by RA, it would cause other STAs to be awake and increase power consumption of STAs, as RA in Multi-STA BA is a broadcast address.			2017/1/9 9:42
9565	Yonggang Fang	225	1 27.4.1	157	37	E	Y	157.37 27.4.1	The "An HE STA" here mentions "An HE AP STA" as it responds to the trigger-based PPDU. Suggest to clarify this.	Suggest to change "An HE STA ..." to "An HE AP STA ...."		2017/1/9 9:42
9566	Yonggang Fang	225	1 27.4.4.5	162	6	E	Y	162.06 27.4.4.5	10.3.2.11.4 is not in the specification	Map the reference to the corresponding section.		2017/1/9 9:42

9567	Yonggang Fang	225	1 27.4.4.5	162	1	T	Y	162.01 27.4.4.5	A non-AP STA that sends a trigger-based PPDU as a UL MU transmission should not select the acknowledgement rule independently. For example, one STA intends to be acknowledged immediately, while another wants to be deferred acknowledgement. This will increase the implementation complexity of HE AP. Suggest the non-AP STAs that send a trigger-based PPDU use the same acknowledgement rule.	define a new rule of acknowledgement to the entire trigger based PPDUs.	2017/1/9 9:42
9568	Yonggang Fang	225	1 27.5.1.3	163	16	E	Y	163.16 27.5.1.3	The HE Bandwidth Query Report message is used to report the channel availability of HE STA. Suggest to change the name of BQR to "Channel Availability Report" (CAR) as it is more clear for the intention.	suggest to change "BQR" to "Channel Availability Report".	2017/1/9 9:42
9569	Yonggang Fang	225	1 27.5.2.2.3	167	26	E	Y	167.26 27.5.2.2.3	9.22.2.7 is not in the spec	Map the reference to the corresponding section.	2017/1/9 9:42
9570	Yonggang Fang	225	1 27.5.2.2.3	167	30	E	Y	167.30 27.5.2.2.3	9.22.2.2 is not in the spec	Map the reference to the corresponding section.	2017/1/9 9:42
9571	Yonggang Fang	225	1 27.5.2.6.1	172	45	T	Y	172.45 27.5.2.6.1	If HE STA can use OFDMA based random access for any AC traffic, it may create fairness concern on the higher priority AC.	suggest random access transmission is separated according to the Access Category	2017/1/9 9:42
9572	Yonggang Fang	225	1 27.5.2.6.3	174	15	T	Y	174.15 27.5.2.6.3	A HE STA may use OFDMA RA for UL transmission. However, if the OFDMA RA transmission fails, it has to double its CW for backoff. Comparing to the legacy access, the STA may allow to repeat the transmission for a couple of time in PIFS if it does not receive ACK. Therefore the OFDMA based RA may cause extra latency of UL transmission.	define a mechanism to allow HE STAs to distinguish reasons of OFDMA RA failure.	2017/1/9 9:42
9573	Yonggang Fang	225	1 27.5.2.7	174	24	T	Y	174.24 27.5.2.7	It is not clear how to trigger the NDP feedback report as there is no trigger variant for triggering this NDP type of feedback frame.	Need to clarify this or define a new trigger variant for the NDP type of feedback.	2017/1/9 9:42
9574	Yonggang Fang	225	1 27.7.2	181	1	T	Y	181.01 27.7.2	If a TWT STA is not required to listen to beacon frame, it may need a mechanism to update the BSS information when AP udpates BSS info in the beacon frames.	define a rule or mechanism for TWT stations to synchronize the BSS information change when AP updates the BSS information in beacon frame.	2017/1/9 9:42
9575	Yonggang Fang	225	1 27.2.2	181	12	T	Y	181.12 27.2.2	Assume the TWT requesting STA is an HE non-AP STA. Why the TWT requesting STA should not initiate transmission of frames to TWT responding STA outside of negotiated TWT SP? When an HE STA has a pending data for AP, it should be able to send at any time after sensing the channel is clear.	Suggest to the remove this sentence	2017/1/9 9:42
9576	Yonggang Fang	225	1 27.7.3.2	183	57	E	Y	183.57 27.7.3.2	"The TWT scheduled STA may include a TWT element ...." is to describe the behavior of TWT scheduled STA. It should not be in the "Rule for TWT scheduling STA section.	Move this sentence to 27.7.3.3	2017/1/9 9:42
9577	Yonggang Fang	225	1 27.7.3.4	186	48	T	Y	186.48 27.7.3.4	The TWT responding STA may not agree the TWT/TBTT proposal from the TWT requesting STAs. Therefore it needs a way for the TWT responding STA (AP) to provide the recommended TWT/TBTT values in the TWT response frame. We may use the similar mechanism defined in 11ah for HE TWT/TBTT negotiation.	Suggest to add the following in the section: A TWT scheduling STA that receives a TWT request frame from a HE STA whose value of the TWT/TBTT Negotiation subfield is 1 may send a TWT response frame that contains the TWT Command of Alternate TWT or TWT Grouping. If the TWT Command field of TWT scheduling STA's response contains Alternate TWT or TWT Grouping, the TWT requesting STA may send a new TWT request frame for negotiation with a new proposal of TWT/TBTT parameters.	2017/1/9 9:42
9578	Yonggang Fang	225	1 27.14.2	199	60	T	Y	199.60 27.14.2	An HE AP can schedule a TWT SP for TWT scheduled STA and TWT for random access. It is not clear whether the TWT STA should wake up at both scheduled TWT SP and TWT RA period?	Need to clarify in the spec	2017/1/9 9:42

9579	Yonggang Fang	225	1 27.16	204		T	Y	204.00 27.16	In the HE BSS operation, it needs to consider the HE AP change the TBTT when deployed in the dense environment.	describe the rule for change of TBTT operation in the existing section or a new section.	2017/1/9 9:42
9580	Yonggang Fang	225	1 28.1.1	211	5	E	Y	211.05 28.1.1	This clause is to address STA capable of receiving ....; not transmitting.	change "transmitting" to receiving.	2017/1/9 9:42
9581	Yonggang Fang	225	1 27.5.2.6.2	173	45	T	Y	173.45 27.5.2.6.2	The HE STA may sense multiple carriers in the same time depending on implementation. Therefore HE STA may randomly select an "idle" RU from assigned RUs by trigger frame for random access to avoid the sensing after selection. The spec should allow this flexibility in the implementation.	For an HE STA, if the OBO counter is 0 or if the OBO counter decrements to 0, then the STA randomly selects one of the RUs assigned to AID value 0. The HE STA may randomly select one "idle" RU from RUs assigned to AID value 0 and from the result of physical and virtual CS.	2017/1/9 9:42
9582	Yongho Kim	225	1 9.4.2.218.2	77	40	E	N	77.40 9.4.2.218.2	S-MPDU is not defined in 11ax_D1.0 and MC document.	Define the term	2017/1/9 9:42
9583	Yongho Kim	225	1 9.4.2.220	93	46	E	N	93.46 9.4.2.220	Octets' shall be replaced by 'Bits'.	As in comment.	2017/1/9 9:42
9584	Yongho Kim	225	1 10.3.2.4	115	13	T	Y	115.13 10.3.2.4	NAV reset procedure needs to be described if the NAV is set by Trigger frame	As in comment.	2017/1/9 9:42
9585	Yongho Kim	225	1 27.2.1	149	47	T	Y	149.47 27.2.1	A CTS frame transmited by an associated AP would be considered as a inter-BSS frame.	If an RTS sender STA is an HE STA, RA field of CTS frame shall be set to AP's MAC address.	2017/1/9 9:42
9586	Yongho Kim	225	1 27.2.3	152	19	T	Y	152.19 27.2.3	For some applications using 802.11ax, some value of HEMUEDCATimer in EDCA Parameter Set element need to provide some special feature.	Define it.	2017/1/9 9:42
9587	Yongho Kim	225	1 27.5.1.3	163	26	T	Y	163.26 27.5.1.3	If a non-AP STA has no capabilities on some channels, what value need to be set? And, If a non-AP STA's channel bandwidth is regulated by OMI procedure, what value need to be set?	Define it.	2017/1/9 9:42
9588	Yongho Kim	225	1 27.5.2.2.1	164	64	T	Y	164.64 27.5.2.2.1	Not only Trigger frame, but also Trigger A-contol shall follow same rule.	As in comment.	2017/1/9 9:42
9589	Yongho Kim	225	1 27.5.2.2.2	165	64	T	N	165.64 27.5.2.2.2	GCR-MU-BAR also need to be included.	Instead of using 'MU-BAR', use '(GCR)MU-BAR)'.	2017/1/9 9:42
9590	Yongho Kim	225	1 27.5.2.2.2	167	16	T	Y	167.16 27.5.2.2.2	There are no specific information and instruction about using preferred AC.	Define it.	2017/1/9 9:42
9591	Yongho Kim	225	1 27.5.2.3	167	52	T	N	167.52 27.5.2.3	OFDMA random access (AID 0) case is not included.	Describe it.	2017/1/9 9:42
9592	Yongho Kim	225	1 27.8	188	18	T	N	188.18 27.8	Could an HE AP STA be an OMI initiator? If it is not possible, add 'non-AP'.	As in comment.	2017/1/9 9:42
9593	Yongho Kim	225	1 27.16.3	208	27	T	Y	208.27 27.16.3	Specific method of setting QTP by QTP setup frame is not described. Specific procedure for STAs received QTP setup frame need to be described.	Define it.	2017/1/9 9:42
9594	Yongho Seok	225	1 G.5	427	34	T	Y	427.34 G.5	"dl-mu-sequence | ul-mu-sequence | cascading-mu-sequence" An dl-mu-sequence, ul-mu-sequence and cascading-mu-sequence are not defined.	An dl-mu-sequence, ul-mu-sequence and cascading-mu-sequence have to be defined in Annex G.5.	2017/1/9 9:42
9595	Yongho Seok	225	1 G.5	427	29	T	Y	427.29 G.5	The usage case of the He-mu-sequence is not inclued in the basic sequence.	Include the He-mu-sequence to the basic sequence.	2017/1/9 9:42
9596	Yongho Seok	225	1 G.5	427	38	T	Y	427.38 G.5	"(Trigger) | (Trigger +a-mpdu + mu-user-respond + a-mpdu-end) 1{Data[+HTC]+QoS+(no-ack | block-ack)+a-mpdu} + a-mpdu-end; [+mu-user-respond other-users];" Syntax of the above formula is not correct.	Fix any syntax error in Annex G.	2017/1/9 9:42
9597	Yongho Seok	225	1 B.4.3	407	35	T	Y	407.35 B.4.3	For CFVHT (Very High Throughput (VHT) Features) item, the STATUS column shall include "CFHEW80:M". Because an HE STA supporting the HEW Operation with capability of 80 MHz or higher channel width shall implement the VHT Features.	As per comment.	2017/1/9 9:42
9598	Yongho Seok	225	1 B.4.3	407	28	T	Y	407.28 B.4.3	The CFHEW item is not defined. Between CFHEW and CFHE, which one is correct term? Please use the defined terminology.	As per comment.	2017/1/9 9:42

9599	Yongho Seok	225	1 10.3.2.3.7	114	27	T	Y	114.27 10.3.2.3.7	"Reception of an error-free frame during the EIFS or EIFS-DIFS+AIFS[AC] resynchronizes the STA to the actual busy/idle state of the medium, so the EIFS or EIFS-DIFS+AIFS[AC] is terminated..." On the above EIFS termination, a receptation of an HE PPDU containing a valid TXOP_DURATION parameter shall be also included.	As per comment.		2017/1/9 9:42
9600	Yongho Seok	225	1 10.22.2.7	132	51	T	Y	132.51 10.22.2.7	"If there is no non-HT duplicate frame exchange in a TXOP, the TXOP holder shall set the TXVECTOR parameter CH_BANDWIDTH of a non-initial PPDU to be the same or narrower than the TXVECTOR parameter CH_BANDWIDTH of the preceding PPDU that it has transmitted in the same TXOP." When an HE AP transmits an HE DL MU PPDU with preamble puncture, the TXVECTOR parameter CH_BANDWIDTH selection rule should be seperately defined. Because the above current rule does not cover it.	As per comment.		2017/1/9 9:42
9601	Yongho Seok	225	1 27.9.2.1	190	19	T	Y	190.19 27.9.2.1	"If the PHY of a STA issues a PHY-CCA.indication with a value equal to BUSY followed by an RXSTART.indication due to a PPDU reception then the STA's MAC sublayer may a) issue a PHYCCARESET.request primitive and b) not update its NAV timers based on frames carried in the PPDU if all the following conditions are met:" If the STA newly receives an inter-BSS PPDU while decoding an intra-BSS PPDU (for example, as a capture effect), the OBSS_PD-based spatial reuse operation shall not be allowed.	At the first paragraph of 27.9.2.1, replace "If the PHY of a STA issues a PHY-CCA.indication with a value equal to BUSY followed by an RXSTART.indication due to a PPDU reception" with "If a PHY-CCA.indication transition from IDLE to BUSY occures followed by an RXSTART.indication due to a PPDU reception..."		2017/1/9 9:42
9602	Yongho Seok	225	1 27.14.1	199	28	T	Y	199.28 27.14.1	When the RXVECTOR parameter BSS_COLOR is not the BSS color of the BSS with which the STA is associated and the RXVECTOR parameters SPATIAL_REUSE is SR_Delay Entry, An HE non-AP STA that is in intra-PPDU power save mode can be enter the doze state.	Insert the following condition: "The RXVECTOR parameter BSS_COLOR is not the BSS color of the BSS with which the STA is associated and the RXVECTOR parameters SPATIAL_REUSE is SR_Delay Entry."		2017/1/9 9:42
9603	Yongho Seok	225	1 27.9.2.2	192	20	T	Y	192.20 27.9.2.2	When an HE trigger-based PPDU is triggered by a Trigger frame having the CS Required subfield set to 0, an SR STA is not required to follow the SR_maximum_transmit_power rule.	Change the following sentence "...for the transmissions of any PPDU (including UL TB PPDU)..." to "...for the transmissions of any PPDU (except when an HE trigger-based PPDU triggered by a Trigger frame having the CS Required subfield set to 0)..."		2017/1/9 9:42
9604	Yongho Seok	225	1 27.6.4	179	15	T	Y	179.15 27.6.4	The TXVECTOR parameter TXOP_DURATION of an HE NDP should be described as well.	As per comment.		2017/1/9 9:42
9605	Yongho Seok	225	1 10.7.9	124	25	T	Y	124.25 10.7.9	On Table 10-6 (Modulation classes), Clause 28 (High Efficiency (HE) PHY specification) can select DSSS, HR/DSSS and ERP-OFDM, like Clause 19 (High Throughput (HT) PHY specification) PHY.	As per comment.		2017/1/9 9:42
9606	Yongho Seok	225	1 10.7.10	126	10	T	Y	126.10 10.7.10	On Table 10-7 (Non-HT reference rate), when the DCM is used, the non-HT reference rate shall be reduced to a half. For example, if the modulation is QPSK and the coding rate is 1/2 and the DCM is not used, the non-HT reference rate is 12 Mb/s. But, if the modulation is QPSK and the coding rate is 1/2 and the DCM is used, the non-HT reference rate is 6 Mb/s.	On Table 10-7, insert the exceptation cases for the non-HT reference rate when the DCM is used.		2017/1/9 9:42

9607 Yongho Seok	225	1 27.11.6	198	29	T	Y	198.29 27.11.6	If a Trigger frame having the CS Required subfield set to 0 is carried in an HE SU PPDU, the TXVECTOR parameter SPATIAL_REUSE of the HE SU PPDU should not be SR_Delay entry.	Change the second paragraphs 27.11.6 as the following: "...set the TXVECTOR parameter SPATIAL_REUSE to SR_Delay entry only if a Trigger frame having the CS Required subfield set to 1 is carried in the HE SU PPDU...".	2017/1/9 9:42
9608 Yongho Seok	225	1 27.11.6	198	33	T	Y	198.33 27.11.6	If a Trigger frame having the CS Required subfield set to 0 is carried in an HE MU PPDU, the TXVECTOR parameter SPATIAL_REUSE of the HE SU PPDU should not be SR_Restricted.	Change the second paragraphs 27.11.6 as the following: "...set the TXVECTOR parameter SPATIAL_REUSE to SR_Restricted entry only if a Trigger frame having the CS Required subfield set to 1 is carried in the HE MU PPDU...".	2017/1/9 9:42
9609 Yongho Seok	225	1 28.3.20	369	46	T	Y	369.46 28.3.20	"The PHY entity shall maintain PHY-CCA.indication(BUSY, channellist) primitive for the predicted duration of the transmitted PPDU, as defined by RXTIME in Equation (28-128), for all supported modes, unsupported modes, Reserved HE-SIG-A Indication, and invalid HE-SIG-A CRC." The RXTIME in Equation (28-128) does work only if an STA can know the RXVECTOR parameter (such as GI_TYPE and HE_LTF_TYPE) from the HE-SIG fields. But, the HE-SIG fields in the HE trigger-based PPDU do not have the RXVECTOR parameter required for calcuating the RXTIME in Equation (28-128). In such case, the RXTIME should be based on the L-SIG (i.e., Equation (21-106)). Please insert this exceptation case.	As per comment.	2017/1/9 9:42
9610 Yongho Seok	225	1 28.3.20	369	46	T	Y	369.46 28.3.20	"The PHY entity shall maintain PHY-CCA.indication(BUSY, channellist) primitive for the predicted duration of the transmitted PPDU, as defined by RXTIME in Equation (28-128), for all supported modes, unsupported modes, Reserved HE-SIG-A Indication, and invalid HE-SIG-A CRC." The RXTIME in Equation (28-128) does work only if an STA can know the RXVECTOR parameter (such as GI_TYPE and HE_LTF_TYPE) from the HE-SIG fields. In the case of the HE-SIG-A error (e.g., CRC failure), the RXTIME should be based on the L-SIG of the received HE SU PPDU (i.e., Equation (21-106)). Please insert this exceptation case.	As per comment.	2017/1/9 9:42
9611 Yongho Seok	225	1 9.7.3	107	56	T	Y	107.56 9.7.3	The TXVECTOR parameter TXOP_DURATION of an HE trigger-based PPDU is based on the Duration/ID field in the MAC header. If the Duration/ID fields of one or more HE trigger-based PPDUs addressed to same AP are not identical, the TXVECTOR parameter TXOP_DURATIONs of those HE trigger-based PPDUs can be different. In such case, 3rd party HE STA can't obtain the TXOP_DURATION value from the HE-SIG-A of the received HE trigger-based PPDU. Please clearly specify how the Duration/ID field in the MAC header of an HE trigger-based PPDU is calculated.	As per comment.	2017/1/9 9:42

9612	Yongho Seok	225	1 10.22.2.2	129	62	T	Y	129.62 10.22.2.2	"For an HE STA, if CW[AC] is greater than CWmax[AC], CW[AC] shall be set to CWmax[AC]." If the above sentence is necessary, in the same logic, the following is also necessary. "For an HE STA, if CW[AC] is less than CWmin [AC], CW[AC] shall be set to CWmin[AC]." The above condtion can be happened when a new EDCA parameter set is updated.	Insert the following at the end of the 10.22.2.2. "For an HE STA, if CW[AC] is less than CWmin [AC], CW[AC] shall be set to CWmin[AC]." Or, remove the following for a consistency. "For an HE STA, if CW[AC] is greater than CWmax[AC], CW[AC] shall be set to CWmax[AC]."	2017/1/9 9:42
9613	Yongho Seok	225	1 4.3.14a	9	42	T	Y	9.42 4.3.14a	Remove the following: "Optional support for 1024-QAM on 242-, 484- and 996-tone RUs" Because it is a redundant sentence with the following: "Optional support for HE-MCSs 10 and 11"	Remove the following sentence, "Optional support for 1024-QAM on 242-, 484- and 996-tone RUs"	2017/1/9 9:42
9614	Yongho Seok	225	1 4.3.14a	9	53	T	Y	9.53 4.3.14a	What does the dynamic fragmentation level 0 mean? I can't find any description about the dynamic fragmentation level 0.	Please clarify the dynamic fragmentation level 0.	2017/1/9 9:42
9615	Yongho Seok	225	1 4.3.14a	9	55	T	Y	9.55 4.3.14a	From Annex B, Transmission of Multi-STA BlockAck is a mandatory feature on HE AP side. Receptation of Multi-STA BlockAck is a mandatory feature on HE non-AP side. Please change it as the following: Mandatory support for Multi-STA BlockAck	As per comment.	2017/1/9 9:42
9616	Yongho Seok	225	1 4.3.14a	9	48	T	Y	9.48 4.3.14a	The other important HE MAC features are not included. For example, two NAV operation, Spatial reuse operation, Operating mode indication mechanism.	Please include other important HE MAC features.	2017/1/9 9:42
9617	Yongho Seok	225	1 27.16.3.2	207	18	T	Y	207.18 27.16.3.2	The following MLME primitives are not defined in 6.3 MLME SAP interface. - MLME-QTP.request - MLME-QTP.indication - MLME-QTP.response - MLME-QTP.confirm	Define MLME-QTP.request, MLME-QTP.indication, MLME-QTP.response and MLME-QTP.confirm in 6.3 MLME SAP interface.	2017/1/9 9:42
9618	Yongho Seok	225	1 9.2.4.1.8	19	40	T	Y	19.40 9.2.4.1.8	"An HE AP indicates that it can set the More Data subfield to 1 by setting the More Data Ack subfield to 1 in the QoS Info field of frames it transmits." This is a procedure of an HE non-AP STA. Change "HE AP" to HE non-AP STA".	As per comment.	2017/1/9 9:42
9619	Yongho Seok	225	1 9.2.4.6.4.4	25	28	T	Y	25.28 9.2.4.6.4.4	The HE-MCS defined in 28.5 varies depending on DCM. The HE link adaptation mechanism should also include a recommendation of the DCM.	As per comment.	2017/1/9 9:42
9620	Yongho Seok	225	1 9.2.4.6.4.5	26	47	T	Y	26.47 9.2.4.6.4.5	"The ACI High subfield indicates the ACI of the AC for which the BSR is indicated in the Queue Size High subfield." Current description of the ACI High subfield does not represent the AC having the highest amount of buffered traffic. Since current name of the subfield can miscommunicate, change the subfield name to "Reported ACI subfield". Otherwise justify the meaning of High in the subfield name.	change the subfield name from "ACI High subfield" to "Reported ACI subfield".	2017/1/9 9:42
9621	Yongho Seok	225	1 9.2.4.6.4.5	26	60	T	Y	26.60 9.2.4.6.4.5	"The Queue Size High subfield indicates the amount of buffered traffic, in units of SF octets, for the AC identified by the ACI High subfield." Current description of the Queue Size High subfield does not represent the AC having the highest amount of buffered traffic. Since current name of the subfield can miscommunicate, change the subfield name to "Reported Queue Size subfield". Otherwise justify the meaning of High in the subfield name.	Change the subfield name from "Queue Size High subfield" to "Reported Queue Size subfield".	2017/1/9 9:42

9622	Yongho Seok	225	1 9.3.1.9.1	34	25	T	Y	34.25 9.3.1.9.1	"The RA field of the BlockAck frame that is not a Multi-STA BlockAck variant is set to the TA field of the soliciting frame or the address of the recipient STA whose data/management frames are acknowledged." Because a management frame does not any block ack agreement, the BlockAck frame can't be used for an acknowledgment of a management frame. Remove "management frame".	As per comment.		2017/1/9 9:42
9623	Yongho Seok	225	1 9.3.1.9.1	34	27	T	N	34.27 9.3.1.9.1	"An HE AP that transmits a Multi-STA BlockAck frame with a single AID subfield or with the same values of the AID subfield in Per STA Info subfields sets..." For more clarification, change it as the following: "An HE AP that transmits a Multi-STA BlockAck frame with a single Per STA Info subfield or..."	As per comment.		2017/1/9 9:42
9624	Yongho Seok	225	1 9.3.1.9.1	34	31	T	Y	34.31 9.3.1.9.1	"An HE non-AP STA transmits a Multi-STA BlockAck frame with a single AID subfield or with the same values of the AID subfield in Per STA Info subfields and sets the RA field to the TA field of the soliciting frame or the address of the recipient STA whose data/management frames are acknowledged." For more clarification, change it as the following: "An HE non-AP STA that transmits a Multi-STA BlockAck frame with a single Per STA Info subfield or with the same values of the AID subfield in Per STA Info subfields sets the RA field to either the TA field of the soliciting frame or the address of the recipient STA whose data/management frames are acknowledged."	As per comment.		2017/1/9 9:42
9625	Yongho Seok	225	1 9.3.1.9.7	37	23	T	Y	37.23 9.3.1.9.7	"The format defined below is used for multi-STA multi-TID, and multi-STA single TID BlockAck variant." It is conflicted with the following Note. "NOTE–One or more Per STA Info subfields with same value of the AID subfield and different values of the TID subfields can be present in the Multi-STA BlockAck frame." The Multi-STA BlockAck format can be used for single STA multi-TID as well.	Change it as the following: "The format defined below is used for single STA multi-TID, multi-STA multi-TID, and multi-STA single TID BlockAck variant."		2017/1/9 9:42
9626	Yongho Seok	225	1 9.3.1.9.7	37	59	T	Y	37.59 9.3.1.9.7	"When Multi-STA BlockAck variant is intended for a non-AP STA,..." The case when Multi-STA BlockAck variant is intended for multiple non-AP STAs is missing.	Change it as the following: "When Multi-STA BlockAck variant is intended for one or more non-AP STA(s),..."		2017/1/9 9:42
9627	Yongho Seok	225	1 9.3.1.20	40	53	T	Y	40.53 9.3.1.20	Please describe how to encode the RU Start Index and RU End Index subfields.	As per comment.		2017/1/9 9:42
9628	Yongho Seok	225	1 9.3.1.20	41	28	T	Y	41.28 9.3.1.20	The Disambiguation subfield is not a variable because it is always to set to 1. Please change B27 of STA Info subfield to Reserved subfield as the following. "The B27 of the STA Info subfield is reserved and is set to 1."	As per comment.		2017/1/9 9:42
9629	Yongho Seok	225	1 9.3.1.23	43	51	T	Y	43.51 9.3.1.23	"The AP shall set the MU-MIMO LTF Mode subfield to..." Remove "shall" from clause 9 according 802.11 Editorial Style Guide.	As per comment.		2017/1/9 9:42
9630	Yongho Seok	225	1 9.3.1.23	45	37	T	Y	45.37 9.3.1.23	"User Info fields with AID = 0 shall be allocated only after User Info fields with AID not equals to 0, if any, and before the MAC padding field, if present." Remove "shall" from clause 9 according 802.11 Editorial Style Guide.	As per comment.		2017/1/9 9:42
9631	Yongho Seok	225	1 9.3.1.23	46	23	T	Y	46.23 9.3.1.23	Add the following into the last row of Table 9-25f. 1000101 - 1111111 | Reserved | 59	As per comment.		2017/1/9 9:42

9632	Yongho Seok	225	1 9.3.1.23	47	3	T	Y	47.03 9.3.1.23	"A value of 1 indicates that the HE trigger-based PPDU response shall use DCM as defined in 28.3.11.15 (Dual carrier modulation)." Remove "shall" from clause 9 according 802.11 Editorial Style Guide.	As per comment.	2017/1/9 9:42
9633	Yongho Seok	225	1 9.3.1.23	47	20	T	Y	47.20 9.3.1.23	On Figure 9-52f, the encoding mechanism of the Starting Spatial Stream and the Number Of Spatial Streams is missing.	As per comment.	2017/1/9 9:42
9634	Yongho Seok	225	1 9.3.1.23	47	47	T	Y	47.47 9.3.1.23	"Padding field starts with special STAID[11:0] as 0xFFF and the rest bits of the Padding field are all set to one. 0xFFF is reserved as the special value to indicate the start of the MAC padding." Because the Padding field are all set to one, special STAID[11:0] as 0xFFF does not have any meaning. Remove an unnecessary wording and just say the following:"The Padding field are all set to one."	As per comment.	2017/1/9 9:42
9635	Yongho Seok	225	1 9.3.1.23	48	4	T	Y	48.04 9.3.1.23	What is a NDBPS,SHORT in Equation (9-ax2)?	Define NDBPS,SHORT.	2017/1/9 9:42
9636	Yongho Seok	225	1 27.2.2	150	30	T	Y	150.30 27.2.2	"...if one of the two NAV timers is nonzero, the virtual CS indication is that the medium is busy." Exceptaionally, when the TXOP responder transmits a response frame (for example, HE trigger-based PPDU transmission in a response of trigger frame, CTS frame transmission in a response of RTS frame), the virtual CS indication is that the medium is busy only if the basic NAV is busy, regardless of the intra-BSS NAV.	Change it as the following: "...if one of the two NAV timers is nonzero, the virtual CS indication is that the medium is busy except for a TXOP responder. In such case, the TXOP responder considers only the basic NAV for determining the virtual CS indication."	2017/1/9 9:42
9637	Yongho Seok	225	1 27.5.2.4	170	61	T	Y	170.61 27.5.2.4	"The AP shall set the CS Required subfield to 1 except when all solicited HE trigger-based PPDUs contain an Ack or BlockAck frame and the Length subfield in the Common Info field of the Trigger frame is less than or equal to 418." When AP transmits a Trigger frame with the CS Required subfield set to 0 and QoS DATA frame with the Ack Policy subfield set to MU ACK within a same PPDU, if a target STA receives only the Trigger frame, what is happened? Probably, the target STA can transmit a QoS Null frame without having any Ack or BlockAck frame in an HE trigger-based PPDU. So, current spec text is nonsense. Because AP transmitting a Trigger frame with the CS Required subfield set to 0 can't predicts that all solicited HE trigger-based PPDUs contain an Ack or BlockAck frame.	Change it as the following: "The AP shall set the CS Required subfield to 1 except when it solicits an Ack or BlockAck frame in all scheduled HE trigger-based PPDUs and the Length subfield in the Common Info field of the Trigger frame is less than or equal to 418."	2017/1/9 9:42
9638	Yongho Seok	225	1 9.3.1.23	47	62	T	Y	47.62 9.3.1.23	When HT/VHT PPDU containing a Trigger frame with a Padding field is transmitted by using a short GI, additional two OFDM symbols (3.6usx2=7.2us)do not meet the Trigger Frame MAC Padding Duration of 8us. Please either disallow to use a short GI or add the mPAD values for a short GI as the following: mPAD = 0, max TF MAC Padding Duration among receiving STAs = 0 uss mPAD = 3, max TF MAC Padding Duration among receiving STAs = 8 uss mPAD = 5, max TF MAC Padding Duration among receiving STAs = 16 uss	As per comment.	2017/1/9 9:42
9639	Yongho Seok	225	1 9.3.1.23	48	17	T	Y	48.17 9.3.1.23	"STBC is disallowed for Trigger Frame transmission." This normative sentence should be moved to clause 27.5.2.2.	As per comment.	2017/1/9 9:42

9640	Yongho Seok	225	1 9.3.1.23.1	48	40	T	Y	48.40 9.3.1.23.1	"The MPDU MU Spacing Factor subfield indicates the value by which the minimum MPDU start spacing defined in Table 8-159 is multiplied." Any normative behavior of the STA transmitting A-MPDU is not defined for this MPDU MU Spacing Factor subfield.	Add some normative behavior of the STA using the MPDU MU Spacing Factor subfield in 10.13.3 (Minimum MPDU Start Spacing field).	2017/1/9 9:42
9641	Yongho Seok	225	1 9.3.1.23.6	51	33	T	Y	51.33 9.3.1.23.6	"The Trigger Dependent Common Info field of the GCR MU-BAR variant Trigger frame is defined in Figure 9-52j (Trigger Dependent Common Info field for the GCR MU-BAR variant)." Each recipent GCR STAs can have different block bitmap that is started from different starting sequence. For the BAR Control Information and BAR Information, please change the Trigger Dependent Common Info field to the Trigger Dependent User Info field.	As per comment.	2017/1/9 9:42
9642	Yongho Seok	225	1 9.3.1.8.2	33	54	T	Y	33.54 9.3.1.8.2	The 802.11-2016 spec is clearly stating that the Fragment Number subfield is set to 0. Changing Figure 9-28 without revising this sentence is meaningless.	Remove the changes on Figure 9-28 or clarify how to set the Fragment Number if it can be set to a non-zero value.	2017/1/9 9:42
9643	Yongho Seok	225	1 9.3.1.23	41	47	E	Y	41.47 9.3.1.23	Remove a bracket shown on RA field from Figure 9-52c because RA field is always present in the Trigger frame.	As per comment.	2017/1/9 9:42
9644	Yongho Seok	225	1 9.3.1.23	45	43	T	Y	45.43 9.3.1.23	"The first bit, B12, indicates the allocated RU is located in the primary or non-primary 80 MHz (zero for primary and one for non-primary)." What do a primary and a non-primary 80 MHz indicates? Non-primary 80 MHz is not defined in Clause 3.	Change it as the following: "The first bit, B12, is set to 0 for indicating that the allocated RU is located in a primary 80 MHz channel or set to 1 for indicating that the allocated RU is located in a secondary 80 MHz channel."	2017/1/9 9:42
9645	Yongho Seok	225	1 9.3.1.23	46	27	T	Y	46.27 9.3.1.23	"B12 is set to 0 for a 20 MHz, 40 MHz and 80 MHz PPDU. For the 2x996-tone RU case, B12 is set to 1." An interpretation of B12 shown in above is different with the previous paragraph. Probably, it may be for a case when the triggered PPDU is a non-OFDMA PPDU. But, even though it is a non-OFDMA case, current B12 definition is useless. Because B19-B13 has a complete information for indicating a 20/40/80/160/80+80MHz non-OFDMA PPDU. Please explain how current B12 encoding is utilized by a non-AP STA. Otherwise, change it as the following: "When a non-OFDMA PPDU is triggered, B12 is reserved and set to 0."	As per comment.	2017/1/9 9:42
9646	Yongho Seok	225	1 9.3.1.23.4	50	57	T	Y	50.57 9.3.1.23.4	"B12 of the RU Allocation subfield is set to 0 for indication of primary 20 MHz/40 MHz/80 MHz. For 160 MHz/80+80 MHz indication, B12 of the RU Allocation subfield is set to 1." B12 is not utilized by a non-AP STA when determining the resonse channel of the CTS. Like to the MCS, Coding Type, DCM, SS Allocation and Target RSSI fields, change it as the following: "B12 of the RU Allocation subfield is reserved."	As per comment.	2017/1/9 9:42

9647	Yongho Seok	225	1 9.3.1.23.4	50	64	T	Y	50.64 9.3.1.23.4	"If the BW subfield indicates 20 MHz, then the 242-tone RU entry 0111101 for B19-B13 indicates primary 20 MHz channel. ... If the Bandwidth field indicates 80+80 MHz or 160 MHz, then the entry 1000100 for B19-B13 indicates primary and secondary 80 MHz." The RU Allocation subfield in the MU-RTS frame is independent of BW field. For simplifying it, change it as the following: "The 242-tone RU entry 0111101 for B19-B13 indicates the primary 20 MHz channel. The 484-tone RU entry 1000001 for B19-B13 indicates the primary 40 MHz channel. The 996-tone RU entry 1000011 for B19-B13 indicates the primary 80 MHz channel. The 2x996-tone RU entry 1000100 for B19-B13 indicates the primary 80 MHz channel and secondary 80 MHz channel."	As per comment.		2017/1/9 9:42
9648	Yongho Seok	225	1 9.3.1.23.7	52	5	T	Y	52.05 9.3.1.23.7	"The CS Required subfield is set to 1." For consistency with other Trigger frame description, please move this sentence to 27.5.2.4. For example, remove above sentence and change P170 L58 as the following "The CS Required subfield in the MU-RTS variant and the BQRP variant of the Trigger frame shall be set to 1."	As per comment.		2017/1/9 9:42
9649	Yongho Seok	225	1 9.3.3.11	55	17	T	Y	55.17 9.3.3.11	"The TWT element is optionally present when dot11TWTOptionActivated and dot11HEOptionImplemented is true; otherwise it is not present." From 27.7.3.1 (General), the broadcast TWT element is present if it is included in only a broadcast Probe Response frame. Because a broadcast Probe Response frame is allowed only when dot11FILSOmitReplicateProbe Responses is true, change it as the following: "The TWT element is optionally present within broadcast Probe Response frames when dot11TWTOptionActivated, dot11HEOptionImplemented and dot11FILSOmitReplicateProbe Responses are true and ; otherwise it is not present."	As per comment.		2017/1/9 9:42
9650	Yongho Seok	225	1 9.3.3.11	55	26	E	Y	55.26 9.3.3.11	Remove a hyphone from "pre-sent".	As per commment.		2017/1/9 9:42
9651	Yongho Seok	225	1 9.4.1.62	56	38	T	Y	56.38 9.4.1.62	When the Feedback Type is the CQI feedback, Nr Index shall be reserved. Please add this missing statement.	As per comment.		2017/1/9 9:42
9652	Yongho Seok	225	1 9.4.1.62	56	53	T	Y	56.53 9.4.1.62	When the Feedback Type is the CQI feedback, Grouping shall be reserved. Please add this missing statement.	As per comment.		2017/1/9 9:42
9653	Yongho Seok	225	1 9.4.1.62	57	4	T	Y	57.04 9.4.1.62	When the Feedback Type is the CQI feedback, Codebook Information shall be reserved. Please add this missing statement.	As per comment.		2017/1/9 9:42
9654	Yongho Seok	225	1 9.4.1.62	57	21	E	Y	57.21 9.4.1.62	Change "VHT Compressed Beamforming frame" to "HE Compressed Beamforming And CQI frame".	As per comment.		2017/1/9 9:42
9655	Yongho Seok	225	1 9.4.1.62	57	34	E	Y	57.34 9.4.1.62	Change "VHT Compressed Beamforming Report field and MU Exclusive Beamforming Report field" to "HE Compressed Beamforming Report field and HE MU Exclusive Beamforming Report field".	As per commnet.		2017/1/9 9:42

9656	Yongho Seok	225	1 9.4.1.62	57	46	T	Y	57.46 9.4.1.62	"The ending RU index indicates the last RU26 for which the HE beamformer is requesting feedback." Above explantion about the Sounding Dialog Token Number is not correct. Change it as the following: "The sounding dialog token from the VHT/HE NDP Announcement frame soliciting feedback"	As per comment.	2017/1/9 9:42
9657	Yongho Seok	225	1 9.4.1.62	57	52	T	Y	57.52 9.4.1.62	"In an HE Compressed Beamforming frame not carrying all or part of an HE Compressed Beamforming report, the Nc Index, Nr Index, Channel Width, Grouping, Codebook Information, Feedback Type and Sounding Dialog Token Number subfields are reserved, the First Feedback Segment subfield is set to 0 and the Remaining Feedback Segments subfield is set to 7." The HE Compressed Beamforming frame does not exist. It shall be changed to the HE Compressed Beamforming And CQI frame. And, when Feedback Type is CQI feedback, an HE Compressed Beamforming report is not present in the HE Compressed Beamforming And CQI frame. But, in such case, the Nc Index, the BW and the Feedback Type are needed in the HE MIMO Control field.	As per commnet.	2017/1/9 9:42
9658	Yongho Seok	225	1 28.3.13	340	32	T	Y	340.32 28.3.13	Please clarify how to set the "The L-STF, L-LTF, and L-SIG fields shall be transmitted in the same way as in the HE transmission when the TXVECTOR parameter BEAM_CHANGE is 0" Non-HT duplicate transmission shall be equal to the HE transmission when the TXVECTOR parameter BEAM_CHANGE is 1.	Change "BEAM_CHANGE is 0" to "BEAM_CHANGE is 1".	2017/1/9 9:42
9659	Yongho Seok	225	1 27.7.3.1	182	31	T	Y	182.31 27.7.3.1	"The TWT scheduling STA may also include the broadcast TWT element in broadcast Probe Response frames." The broadcast Probe Response frames are allowed only when the TWT scheduling STA has dot11FILSOmitReplicateProbeResponses set to true. Please insert this constraint.	As per comment.	2017/1/9 9:42
9660	Yongho Seok	225	1 9.4.2.6	67	57	T	Y	67.57 9.4.2.6	"When included in TIM frames and FILS discovery frames at the beginning of a broadcast TWT SP by an HE AP:" The TIM element is differently interpreted according to the reception timing of it. If an HE non-AP STA in a doze state wakes up after long time, it can loss any timing information related with TBTT from its associated AP. In such case, when the HE non-AP STA receives a FILS discovery frame transmitted at the beginning of a broadcast TWT SP, it can't determine a content of TIM between an original TIM element and opportunistic power save TIM element.	Instead of redefining a TIM element, make a new information element for an opportunistic power save operation.	2017/1/9 9:42
9661	Yongho Seok	225	1 9.4.2.27	68	19	T	Y	68.19 9.4.2.27	When dot11S1GOptionImplemented is true, the TWT Requester Support is signalled through the S1G Capabilities element. Change it as the following: "A STA sets the TWT Requester Support field to 1 when dot11TWTOptionActivated is true and dot11S1GOptionImplemented is false, and sets it to 0 otherwise. See 11.11.9.9 (TWT section)."	As per comment.	2017/1/9 9:42

9662 Yongho Seok	225	1 9.4.2.27	68	25	T	Y	68.25 9.4.2.27	When dot11S1GOptionImplemented is true, the TWT Responder Support is signalled through the S1G Capabilities element. Change it as the following: "A STA sets the TWT Responder Support field to 1 when dot11TWTOptionActivated is true and dot11S1GOptionImplemented is false, and sets it to 0 otherwise. See 11.11.9.9 (TWT section)."	As per commnet.		2017/1/9 9:42
9663 Yongho Seok	225	1 9.4.2.219	91	39	T	Y	91.39 9.4.2.219	"The BSS Color field is an unsigned integer whose value is the BSS color of the BSS corresponding to the AP which transmitted this element, except that a value of 0 in this field indicates that there is no BSS color for this BSS." This paragraph has not been removed yet differently with the comment resolution document (11-16/0862r3) of CC23.	Remove the following paragraph: "The BSS Color field is an unsigned integer whose value is the BSS color of the BSS corresponding to the AP which transmitted this element, except that a value of 0 in this field indicates that there is no BSS color for this BSS."		2017/1/9 9:42
9664 Yongho Seok	225	1 9.4.2.219	91	60	T	Y	91.60 9.4.2.219	"The HE Duration Based RTS Threshold field enables an HE AP to manage RTS/CTS usage by HE non-AP STAs that are associated with it." Does the HE Duration Based RTS Threshold field manage the MU-RTS/CTS usage as well? Please clarify it.	As per commnet.		2017/1/9 9:42
9665 Yongho Seok	225	1 9.4.2.219	91	64	T	Y	91.64 9.4.2.219	"The value 0 indicates that RTS/CTS must be used for all frame exchanges." First comment is that any normative text is not allowed in Clause 9. Second comment is that all frame exchanges can not use RTS/CTS. The value 0 can be applied only for an HE STA.	As per comment.		2017/1/9 9:42
9666 Yongho Seok	225	1 9.4.2.218.2	77	27	T	Y	77.27 9.4.2.218.2	The TWT Requester Support field is not defined in the Extended Capabilities element. Remove either one. For a general purpose, please keep The TWT Requester Support field in the Extended Capabilities element.	As per comment.		2017/1/9 9:42
9667 Yongho Seok	225	1 9.4.2.218.2	77	33	T	Y	77.33 9.4.2.218.2	The TWT Responder Support field is not defined in the Extended Capabilities element. Remove either one. For a general purpose, please keep The TWT Responder Support field in the Extended Capabilities element.	As per comment.		2017/1/9 9:42
9668 Yongho Seok	225	1 9.4.2.218.2	79	4	T	Y	79.04 9.4.2.218.2	"Indicates whether the STA supports reception of a Multi-STA BlockAck frame that has a 32-bit BlockAck Bitmap intended to it." In additional to 32-bit Block Ack Bitmap, 128-bit Block Ack Bitmap and 256-bit Block Ack Bitmap also need a capability field.	As per comment.		2017/1/9 9:42
9669 Yongho Seok	225	1 9.4.2.218.2	79	42	T	Y	79.42 9.4.2.218.2	For the Maximum AMPDU Length Exponent field, explain the definition and encoding way.	As per comment.		2017/1/9 9:42
9670 Yongho Seok	225	1 9.4.2.218.2	79	26	T	Y	79.26 9.4.2.218.2	"Indicates support by a non-AP STA for the reception of a group-addressed Multi-STA BlockAck frame that is sent in a DL MU PPDU in a non-broadcast RU." A group-addressed Multi-STA BlockAck frame is not sent in a non-broadcast RU of an HE MU PPDU. Change it as the following: "Indicates support by a non-AP STA for the reception of a group-addressed Multi-STA BlockAck frame that is sent in a broadcast RU of a DL MU PPDU."	As per comment.		2017/1/9 9:42
9671 Yongho Seok	225	1 9.4.2.218.2	79	14	T	Y	79.14 9.4.2.218.2	The below subfield name is wrong. "Ack-enabled Multi-TID Aggregation Support" It shall be replaced with the following: "Ack Enabled Multi-TID A-MPDU Support"	As per comment.		2017/1/9 9:42

9672 Yongho Seok	225	1 9.4.2.218.2	79	14	T	Y	79.14 9.4.2.218.2	Regarding the "Ack Enabled Multi-TID A-MPDU Support" subfield, TGax draft 1.0 says the following: "An HE transmitter shall not aggregate MPDU that asks for Ack in a multiple-TID A-MPDU to the HE recipient unless the recipient sets Ack Enabled Multi-TID A-MPDU Support subfield to 1 in its announced HE Capabilities element." The definition of subfield should be changed as the following: "Indicates support by a STA to receive a multi-TID A-MPDU that can solicit Ack, as described in 27.10.4 (A-MPDU with multiple TIDs)."	As per comment.		2017/1/9 9:42
9673 Yongho Seok	225	1 9.4.2.219	92	27	T	Y	92.27 9.4.2.219	Any normative texts can not be placed on Clause 9. Please remove the following paragraph or move it to Clause 27. "If a HE non-AP STA receives from associated AP a BSS Color Disabled subfield value equal to 1 in the HE Operation element the HE non-AP STA should not exclusively use BSS Color parameter in making decision related to Intra-PPDU power save and for setting Intra BSS NAV. Instead, the non-AP STA should use the MAC header to make such decisions (see 27.11.4 (BSS_COLOR)). HE non-AP STA may (re)enable BSS Color related features once it receives from the associated AP a BSS Color Disabled subfield equal to 0 in an HE Operation element."	As per comment.		2017/1/9 9:42
9674 Yongho Seok	225	1 9.4.2.219	93	10	T	Y	93.10 9.4.2.219	The addition of the VHT Operation Information field to the HE Operation element does not remove dependency from the VHT Operation element. If it is needed, the Basic VHT-MCS And NSS Set field also be added to the HE Operation element. Second comment is that it shall be placed as an optional field. When an HE AP supports both VHT STAs and HE STAs, it have to include an VHT Operation element. In such case, the addition of the VHT Operation Information field to the HE Operation element is just overhead. Third comment is that on 2.4GHz 80MHz operation is not allowed. Then, why do you think that the VHT Operation Information should be added to the HE Operation element? Are you considering the HE BSS consisting of only HE STAs? Please clarify above comments.	As per commnet.		2017/1/9 9:42
9675 Yongho Seok	225	1 9.6.5.1	99	1	T	Y	99.01 9.6.5.1	The below frames are not defined. - L3 FRAG ADDBA Request - L3 FRAG ADDBA Response - L3 FRAG DELBA Please define the above frames or remove them.	As per comment.		2017/1/9 9:42
9676 Yongho Seok	225	1 9.4.2.222	95	43	E	Y	95.43 9.4.2.222	Remove hyphen from "Announce-ment"	Remove hyphen from "Announce-ment"		2017/1/9 9:42
9677 Yongho Seok	225	1 9.7.1	107	1	T	Y	107.01 9.7.1	"Llow + Lhigh x 4096, VHT PPDU" HE PPDU is missing.	Add HE PPDU as well.		2017/1/9 9:42
9678 Yongho Seok	225	1 9.7.3	110	37	T	Y	110.37 9.7.3	What does "AckRequest" mean? Remove "/AckRequest".	As per comment.		2017/1/9 9:42

9679	Yongho Seok	225	1 9.7.3	110	11	T	Y	110.11 9.7.3	"Of these, at most one of the following is present in a non-DMG BSS except HE BSS: – One or more QoS Data frames with the Ack Policy field equal to Implicit Block Ack Request – A BlockAckReq frame" A downlink transmission of an HE BSS also needs a same restriction. Change it as the following: "Of these, at most one of the following is present in a non-DMG BSS except for an UL MU transmission in an HE BSS:"	As per commnet.		2017/1/9 9:42
9680	Yongho Seok	225	1 10.3.2.4	115	8	T	Y	115.08 10.3.2.4	"The PPDU that carried information of the RXVECTOR parameter is not HE trigger-based PPDU triggered by the STA" A control response frame can be sent in an HE PPDU. For example, if a control frame is sent as a response to a soliciting HE extended range SU PPDU, the frame shall be carried in an HE extended range SU PPDU. Above rule for the NAV update does not cover this case. So, change it as the following: "The PPDU that carried information of the RXVECTOR parameter is not an HE extended range SU PPDU, HE SU PPDU, or HE trigger-based PPDU solicited by the STA"	As per commnet.		2017/1/9 9:42
9681	Yongho Seok	225	1 10.3.2.8a.2	117	8	T	Y	117.08 10.3.2.8a.2	What is a procedure after a failure of the MU-RTS frame transmission? Add the following setence (same rule defined in 802.11 base spec): "In this instance, the STA shall invoke its backoff procedure at the PHY-RXEND.indication primitive and may process the received frame."	As per comment.		2017/1/9 9:42
9682	Yongho Seok	225	1 10.3.2.8a.3	117	39	T	Y	117.39 10.3.2.8a.3	"The data rate to be used for the non-HT PPDU response shall be 6 Mb/s (see 17.1.1 General)." A non-HT duplicate PPDU is missing. Change it as the following: "The data rate to be used for the non-HT or non-HT duplicate PPDU response shall be 6 Mb/s (see 17.1.1 General)."	As per commnet.		2017/1/9 9:42
9683	Yongho Seok	225	1 10.3.2.8a.3	118	34	T	Y	118.34 10.3.2.8a.3	Current TGax D1.0 is not indicating when TXVECTOR parameter TRIGGER_RESPONDING is present. Add the following sentence at the end of subclause 10.3.2.8a.3. "The TXVECTOR parameter TRIGGER_RESPONDING shall be present in a non-HT or non-HT duplicate PPDU transmitted by an HE STA. It is set to true if the non-HT or non-HT duplicate PPDU carries a CTS frame sent in response to an MU-RTS frame. Otherwise, it is set to false."	As per comment.		2017/1/9 9:42
9684	Yongho Seok	225	1 10.3.2.10.3	120	3	T	Y	120.03 10.3.2.10.3	"Multi-STA BlockAck frame transmissions are allowed in a non-HT Duplicate PPDU, HT PPDU, VHT PPDU, HE SU PPDU, HE extended range SU PPDU and OFDMA HE MU PPDU." The non-HT PPDU is missing. Add the non-HT PPDU. However, if the non-HT PPDU is also added, all possible downlink PPDU can carry an Multi-STA BlockAck frame. Then, this sentence does not have any meaning. Please remove this sentence.	As per comment.		2017/1/9 9:42
9685	Yongho Seok	225	1 10.3.2.10.3	120	8	T	Y	120.08 10.3.2.10.3	The PSDU of HE PPDU is always an A-MPDU. Change it as the following "...in response to A-MPDU sent in HE trigger-based PPDU..."	As per commnet.		2017/1/9 9:42

9686	Yongho Seok	225	1 10.3.2.10.3	122	1	T	Y	122.01 10.3.2.10.3	"When HE duration-based RTS is enabled, a non-AP STA using the DCF or EDCA shall use an RTS/CTS exchange for individually addressed frames when the duration of the TXOP is greater than the duration threshold indicated by dot11DurationRTSThreshold." When HE duration-based RTS is enabled, what is a rule of an AP STA? Probably, same rule should be used. Change it as the following: "When HE duration-based RTS is enabled, a STA using the DCF or EDCA shall use an RTS/CTS exchange..."	As per comment.	2017/1/9 9:42
9687	Yongho Seok	225	1 10.9	126	65	T	Y	126.65 10.9	The MIB variable conditions for Buffer Status Report (BSR), UL Power Headroom, Bandwidth Query Report (BQR) and Reverse Direction Protocol (RDP) are missing.	For setting dot11HEControlFieldOptionImplemented to true, add the MIB variable conditions of Buffer Status Report (BSR), UL Power Headroom, Bandwidth Query Report (BQR) and Reverse Direction Protocol (RDP).	2017/1/9 9:42
9688	Yongho Seok	225	1 10.9	127	48	T	Y	127.48 10.9	Please clarify whether the A-Control field can be present in a non-HT PPDU. A PSDU of an HE PPDU is always an A-MPDU. If an intention of this sentence is not addressing a non-HT PPDU case, please change it as the following: "...of QoS Data or Management frames carried in an A-MPDU."	As per comment.	2017/1/9 9:42
9689	Yongho Seok	225	1 10.9	127	38	E	Y	127.38 10.9	"If the HT Control field is present in an MPDU aggregated in an A-MPDU, then all MPDUs of the same frame type (i.e., having the same value for the Type subfield of the Frame Control field) aggregated in the same A-MPDU shall contain an HT Control field. The HT Control field of all MPDUs containing the HT Control field aggregated in the same A-MPDU shall be set to the same value." The cited paragraph is an existing paragraph of 802.11 base specification.	Remove an editing instruction (underline).	2017/1/9 9:42
9690	Yongho Seok	225	1 10.12	128	11	T	Y	128.11 10.12	The Fragmented A-MSDU Support bit is a wrong field name.Change it as the following: "...is indicated with the A-MSDU Fragmentation Support field of the HE Capabilities element."	As per comment.	2017/1/9 9:42
9691	Yongho Seok	225	1 10.22.2.2	130	1	T	Y	130.01 10.22.2.2	"When an HE STA successfully receives the corresponding acknowledgement frame in response to the MPDU sent in HE trigger based PPDU, the backoff for the associated EDCAF resumes the backoff counter countdown. When an HE STA does not receive the corresponding acknowledgement frame in response to the MPDU sent in HE trigger based PPDU, the backoff for the associated EDCAF resumes the backoff counter countdown." The above two paragraphs are independent on the reception status of the acknowledgement frame. Because the same rule is applied on the backoff procedure. Please merge two paragraphs as the following. "After completing an HE trigger-based PPDU transmission sequence, the backoff for the associated EDCAF resumes the backoff counter countdown."	As per commnet.	2017/1/9 9:42
9692	Yongho Seok	225	1 10.22.2.4	130	25	E	Y	130.25 10.22.2.4	"If a non-VHT non-HE STA receives..." "or" between non-VHT and non-HE STA is missing.	Change it as the following: "If a non-VHT or a non-HE STA receives..."	2017/1/9 9:42
9693	Yongho Seok	225	1 10.22.2.5	130	45	T	Y	130.45 10.22.2.5	Channels indicated idle by the channel-list parameter (shown on Table 10-10) shall supports an HE punctured PPDU.	Add new channel-list parameter for supporting an HE punctured PPDU.	2017/1/9 9:42

9694 Yongho Seok	225	1 10.22.2.7	132	6	T	Y	132.06 10.22.2.7	"-- a VHT NDP Announcement frame followed after SIFS by a VHT NDP followed after SIFS by a PPDU containing one or more VHT Compressed Beamforming frames..." The HE sounding procedure should be included. Insert the following: "-- an HE NDP Announcement frame followed after SIFS by an HE NDP optionally followed after SIFS by a PPDU containing one or more HE Compressed Beamforming And CQI frames or,"	As per comment.		2017/1/9 9:42
9695 Yongho Seok	225	1 10.24.10.3	134	23	T	Y	134.23 10.24.10.3	"If the originator has a GCR block ack agreement with one or more of the HE STAs for this group address, the originator may send an MU-BAR frame (MU-BAR variant Trigger frame) or GCR MU-BAR frame (GCR MU-BAR variant Trigger frame) to one or more of the HE STAs." Two mechanisms (first is MU-BAR and second is GCR MU-BAR) for soliciting an UL MU based GCR Block ACK are defined.Remove GCR MU-BAR procedure from 10.24.10.3 (also remove 9.3.1.23.6).	As per commnet.		2017/1/9 9:42
9696 Yongho Seok	225	1 11.1.3.10	141	32	T	Y	141.32 11.1.3.10	Remove 11.1.3.10 because there is no evidence of the coverage improvement through the Beacon frame transmitted in an HE extended range SU PPDU. Please provide a simulation result of the Beacon transmission in an HE extended range SU PPDU. If it is proven, the rate selection rule of the Beacon transmission in an HE extended range SU PPDU shall be added. Insert a new subclause in 10.7.5 (Rate selection for Data and Management frames) for a rate selection of an HE extended range Beacon frame.	As per comment.		2017/1/9 9:42
9697 Yongho Seok	225	1 11.2.2.17	143	49	T	Y	143.49 11.2.2.17	A critical update should include the following case: "Inclusion of BSS Color Change Announcement element"	As per commnet.		2017/1/9 9:42
9698 Yongho Seok	225	1 11.49.1	144	29	T	Y	144.29 11.49.1	Move subclause 11.49.1 into a new subclause of 27.16 (HE BSS operation).	As per comment.		2017/1/9 9:42
9699 Yongho Seok	225	1 27.2.2	150	24	T	Y	150.24 27.2.2	"An HE non-AP STA shall maintain two NAV timers." When an HE non-AP STA is not associated with an HE AP, it is not required to maintain two NAV timers. Because the HE trigger-based PPDU is not used. Change it as the following: "An HE non-AP STA associated with an HE AP STA shall maintain two NAV timers."	As per comment.		2017/1/9 9:42
9700 Yongho Seok	225	1 27.2.2	151	20	T	Y	151.20 27.2.2	"The PPDU that carried information of the RXVECTOR parameter is not an HE trigger-based PPDU triggered by the STA" A control response frame can be sent in an HE PPDU. For example, if a control frame is sent as a response to a soliciting HE extended range SU PPDU, the frame shall be carried in an HE extended range SU PPDU. Above rule for the NAV update does not cover this case. So, change it as the following: "The PPDU that carried information of the RXVECTOR parameter is not an HE extended range SU PPDU, HE SU PPDU, or HE trigger-based PPDU solicited by the STA"	As per commnet.		2017/1/9 9:42

9701	Yongho Seok	225	1 27.2.2	151	56	T	Y	151.56 27.2.2	"A STA that maintains two NAVs has the capability to maintain NAV set by intra-BSS PPDU and inter-BSS PPDU separately. Maintaining two NAV is beneficial in dense deployment scenarios where a STA requires protection from frames transmitted by STAs within its BSS, i.e., intra-BSS, and avoid interference from frames transmitted by STAs in neighboring BSS, i.e., inter-BSS. For example, in a TXOP initiated by the associated AP for UL MU transmission, the intra-BSS NAV of the STA can be set by the AP to prevent the STA from contending the channel, and the basic NAV will not be updated by the associated AP so that NAV set by inter-BSS PPDU can be considered in UL MU CS as described in 27.5.2.4 (UL MU CS mechanism)." The above paragraph is a general introduction of two NAVs.	As per comment.		2017/1/9 9:42
9702	Yongho Seok	225	1 27.2.3	152	8	T	Y	152.08 27.2.3	Move the above paragraph to The definition of an UL MU capable STA is as the following (see 27.5.2.1): "A non-AP STA with dot11ULMUMIMOOptionImplemented equal to true is referred to as an UL MU capable STA." So, an UL MU capable STA represents a non-AP STA supporting an UL MU-MIMO. See the title of 27.2.3: "Obtaining an EDCA TXOP for UL MU capable STAs" When a non-AP STA does not support an UL MU-MIMO, it is not an UL MU capable STA. So, an EDCA TXOP rule defined in 27.2.3 is not appilied to that STA. Probably, it is not an intention of the proposed EDCA TXOP rule. Replace "UL MU capable STA(s)" with "HE non-AP STA(s)" throughout the TGax draft 1.0	As per commnet.		2017/1/9 9:42
9703	Yongho Seok	225	1 27.16.2	206	58	T	Y	206.58 27.16.2	"A HE non-AP STA in an infrastructure BSS shall not transmit the BSS Color Change Announcement element." In an TDLS/DLS, mesh cases, an HE non-AP STA should be allowed to transmit the BSS Color Change Announcement element. See the issue happened in an TDLS/DLS case. An HE non-AP STA1 has 1st TDLS connection with an HE non-AP STA2. And, the BSS Color of 1st TDLS connection is set to 1. Then, the HE non-AP STA1 has 2nd TDLS connection with an HE non-AP STA3. If the HE non-AP STA3 is a TDLS initiator STA, the HE non-AP STA1 can not know the BSS color of 2nd TDLS connection before receiving the TDLS confirm frame from the HE non-AP STA3. When the BSS color of 2nd TDLS connection is set to 2, the HE non-AP STA1 shall consider two BSS colors (1 and 2) as an intra-BSS color. It is very complicated	As per comment.		2017/1/9 9:42
9704	Yongho Seok	225	1 27.5.1.1	162	45	T	Y	162.45 27.5.1.1	"An AP shall not transmit to a STA an HE MU PPDU with the HE-SIG-B allocating spatial streams to more than one recipient STA, unless the STA sets the Downlink MU-MIMO On Partial Bandwidth Rx subfield of the HE Capabilities element to 1." The Downlink MU-MIMO On Partial Bandwidth Rx subfield is not defined in the HE Capabilities element. Probably, DL MU-MIMO on Partial BW subfield should be used.	As per commnet.		2017/1/9 9:42

9705 Yongho Seok	225	1 27.5.1.1	162	44	T	Y	162.44 27.5.1.1	"An AP shall not transmit to a STA an HE MU PPDU with the HE-SIG-B allocating spatial streams to more than one recipient STA, unless the STA sets the Downlink MU-MIMO On Partial Bandwidth Rx subfield of the HE Capabilities element to 1." Even though a STA does not support a reception of the DL MU-MIMO on a partial bandwidth, it can receive the DL MU-MIMO PPDU having the HE-SIG-B that allocates multiple spatial streams from a full bandwidth. Change it as the following: "An AP shall not transmit to a STA an HE MU PPDU with the TXVECTOR parameter SIG_B_COMPRESSION_MODE set to 1 and the HE-SIG-B allocating spatial streams to more than one recipient STA, unless the STA sets the DL MU-MIMO On Partial Bandwidth subfield of the HE Capabilities element to 1."	As per comment.		2017/1/9 9:42
9706 Yongho Seok	225	1 27.5.1.1	162	57	T	Y	162.57 27.5.1.1	"A STA shall not transmit a DL OFDMA With MIMO PPDU that contains a unicast RA that corresponds to a STA from which it has not received an HE Capabilities element with the DL OFDMA With MIMO Support field set to 1." What does "DL OFDMA With MIMO Support" field mean? It is not defined in the HE Capabilities element. Delete the corresponding paragraph.	As per comment.		2017/1/9 9:42
9707 Yongho Seok	225	1 27.5.2.1	164	25	T	Y	164.25 27.5.2.1	"A STA that is a class A device shall set the Class A subfield in HE Capabilities elements that it transmits to 1. A STA that is a class B device shall set the Class A subfield in HE Capabilities elements that it transmits to 0." There is no Class A subfield in HE Capabilities element. Change it as the following: "A STA that is a class A device shall set the Device Class subfield in HE Capabilities elements that it transmits to 1. A STA that is a class B device shall set the Device Class subfield in HE Capabilities elements that it transmits to 0."	As per comment.		2017/1/9 9:42
9708 Yongho Seok	225	1 27.5.2.2.1	164	46	T	Y	164.46 27.5.2.2.1	"A value of 0 also indicates that non-associated STAs can transmit on the allocated resource using the random access procedure as described in 27.5.2.6 (UL OFDMA-based random access)." Allowing a non-associated STA to an UL OFDMA-based random access is not defined in TGax draft 1.0. Remove the corresponding paragraph.	As per comment.		2017/1/9 9:42
9709 Yongho Seok	225	1 27.5.2.2.2	165	53	T	Y	165.53 27.5.2.2.2	"...that have indicated reception support for this Trigger frame in the Multiple BSSID Control Support field of the HE Capabilities element it transmits..." The Multiple BSSID Control Support field is not defined. Replace "Multiple BSSID Control Support" with "Rx Control Frame To MultiBSS".	As per comment.		2017/1/9 9:42
9710 Yongho Seok	225	1 27.5.2.2.2	166	62	T	Y	166.62 27.5.2.2.2	The Multi-TID Support field is not defined in the HE MAC Capabilities Information field of the HE Capabilities element. Replace "Multi-TID Support" with "Multi-TID Aggregation Support". Also replace the same on Page 167 Line 7.	As per comment.		2017/1/9 9:42
9711 Yongho Seok	225	1 27.5.2.3	167	58	T	Y	167.58 27.5.2.3	"If the STA is not associated with the AP, TBD." Remove TBD sentence. Otherwise, define any UL MU random access behavior for a non-associated STA.	As per comment.		2017/1/9 9:42

9712 Yongho Seok	225	1 27.5.2.4	170	31	T	Y	170.31 27.5.2.4	"The NAV was set by an intra-BSS frame" Because an HE non-AP STA always maintains two NAVs, the above sentence shall be re-writtend for two NAVs. Change it as the following: "The value of the basic NAV is 0."	As per comment.	2017/1/9 9:42
9713 Yongho Seok	225	1 27.5.2.3	169	61	T	Y	169.61 27.5.2.3	"If the Trigger Type field of a Trigger frame is not Basic Trigger, then the STA shall include in the response A-MPDU at least one MPDU of the required type. A Beamforming Report Poll Trigger frame solicits HE Compressed Beamforming Feedback frames (see 27.6 (HE sounding protocol), an MU BAR Trigger frame solicits BlockAck frames (see 27.4 (Block acknowledgement)), and a BSRP Trigger frame solicits QoS Null frames (see 27.5.2.5 (HE buffer status feedback operation for UL MU). The MPDUs included in the response shall not solicit a response." The HE Compressed Beamforming Feedback frame is a wrong frame name. And, the above paragraph is missing the Bandwidth Query Report Poll variant Trigger frame. Change it as the following: "...A Beamforming Report Poll Trigger frame solicits HE	As per comment.	2017/1/9 9:42
9714 Yongho Seok	225	1 27.5.2.6.3	174	10	T	Y	174.10 27.5.2.6.3	"If an HE trigger-based PPDU soliciting an immediate response that is sent by a STA in its randomly selected RU (see 27.5.2.6.2 (Random access procedure)) fails, then the STA may attempt to retransmit the HE trigger-based PPDU using random access." If the STA does not attempt to retransmit it after a failure of an HE trigger-based PPDU in a randomly selected RU, what is a value of OCW? Probably, in such case, the STA shall set its OCW to OCWmin. Please clarify it.	As per comment.	2017/1/9 9:42
9715 Yongho Seok	225	1 27.5.2.7	174	22	T	Y	174.22 27.5.2.7	The NDP feedback report procedure is a blank. Delete this feature or define it.	As per comment.	2017/1/9 9:42
9716 Yongho Seok	225	1 27.5.3	174	36	T	Y	174.36 27.5.3	What does "a cascading sequence of MU PPDUs in a TXOP" mean? In my understanding, a cascading sequence of MU PPDU is as the following: An HE MU PPDU transmitted by the AP a SIFS after an HE trigger-based PPDU has the following A-MPDU contents: – One or more Ack, BlockAck or Multi-STA BlockAck frames for the preceding HE trigger-based PPDU and, – Zero or more MPDUs and, – One or more Trigger frames or UL MU Response Scheduling A-Control fields Please clarify a cascading sequence of MU PPDUs in a TXOP.	As per comment.	2017/1/9 9:42
9717 Yongho Seok	225	1 27.5.3	175	57	T	Y	175.57 27.5.3	"The cascading sequence may have different UL transmitters within each HE trigger-based PPDU. The cascading sequence may have a different set of transmitters in HE trigger-based PPDUs as compared to the HE MU PPDU that immediately follows the HE trigger-based PPDUs within the same TXOP." Is this paragraph an unique feature of the cascading sequence? In my understanding, this paragraph is comonly applied to an UL MU sequence. If this paragraph is needed, please move it to 27.5.2.1 (General).	As per comment.	2017/1/9 9:42

9718	Yongho Seok	225	1 27.4.3	159	54	T	Y	159.54 27.4.3	"A recipient shall not include in a transmitted Multi-STA BlockAck frame a BlockAck Bitmap field of size 32 bits that is intended to a STA that has not declared support of its reception in the HE Capabilities element it transmits." For using the BlockAck Bitmap length of 128 or 256 bits, a STA needs to check the declared HE Capabilities element of its peer STA. Insert the missing constraint for the BlockAck Bitmap length of 128 or 256 bits.	As per comment.		2017/1/9 9:42
9719	Yongho Seok	225	1 27.4.4.3	161	14	T	Y	161.14 27.4.4.3	"An Action frame in the DL MU PPDU is always responded with an HE trigger-based PPDU." The MMPDU is missing. Change it as the following: "An Action frame or a MMPDU in the DL MU PPDU is always responded with an HE trigger-based PPDU."	As per comment.		2017/1/9 9:42
9720	Yongho Seok	225	1 27.6.3	179	3	T	Y	179.03 27.6.3	Rules for segmented feedback in HE sounding protocol sequences is not defined. Define the following sequnce: HE NDPA | HE NDP | HE Compressed Beamforming And CQI frame (segmented) | Beamforming Report Poll frame | HE Compressed Beamforming And CQI frame (segmented)	As per comment.		2017/1/9 9:42
9721	Yongho Seok	225	1 28.2.2	218	5	T	Y	218.05 28.2.2	Because HE STA can operate in 2.4GHz band, parameter NO_SIG_EXTN is present when FORMAT is HE_SU, HE_MU, HE_EXT_SU or HE_TRIG.	As per comment.		2017/1/9 9:42
9722	Yongho Seok	225	1 27.16	204	27	G	Y	204.27 27.16	I think that 27.16 (HE BSS operation) specifies an MLME for an HE STA. It means that Clause 27 has both a MAC sublayer functional description for an HE STA (from 27.1 to 27.5) and an MLME for an HE STA. But, on IEEE 802.11-2016, a MAC sublayer functional description and an MLME are described in seperate clauses. For consistency with IEEE 802.11-2016, it is appropriate to move all MLME texts of an HE STA (e.g., subclause 27.16) to clause 11.	As per comment.		2017/1/9 9:42
9723	Yongho Seok	225	1 27.8.2	189	8	T	Y	189.08 27.8.2	"After transmitting the acknowledgement frame immediate response immediate acknowledgement for the frame containing the OMI A-Control field..." It is a wrong sentence. Change it as the following: "After transmitting the immediate acknowledgement for the frame containing the OMI A-Control field..."	As per comment.		2017/1/9 9:42
9724	Yongho Seok	225	1 27.8.2	189	3	T	Y	189.03 27.8.2	"The OMI responder shall use the values indicated by the Rx Channel Width and Rx NSS subfields of the most recently received OMI A-Control field sent by the OMI initiator to send PPDUs to the OMI initiator in subsequent TXOP." Please specify how to use the values indicated by the Rx Channel Width and Rx NSS subfields of the most recently received OMI A-Control field.	Replace the corresponding paragraph with the following: "The OMI responder shall not transmit non-OFDMA PPDUs to the OMI initator in subsequent TXOP that uses a bandwidth that is greater than the channel width indicated by Rx Channel Width subfield in the most recently received OMI A-Control field from that OMI initator. The OMI responder shall not transmit OFDMA PPDUs to the OMI initator in subsequent TXOP that allocates an RU outside of the channel width indicated by Rx Channel Width subfield in the most recently received OMI A-Control field from that OMI initator. The OMI responder shall not transmit PPDUs to the OMI initator in subsequent TXOP that uses a greater number of spatial streams than indicated by Rx NSS subfield in the most recently received OMI A-Control field from that OMI initator."		2017/1/9 9:42

9725	Yongho Seok	225	1 27.8.3	189	29	T	Y	189.29 27.8.3	"NOTE--The Channel Width subfield indicates the maximum channel width that the STA will use in response to Trigger frames" It is a normative text. Please covert from NOTE to a next bullet of the "Tx NSS subfield" bullet.	As per comment.		2017/1/9 9:42
9726	Yongho Seok	225	1 27.8.3	189	55	T	Y	189.55 27.8.3	"Shall indicate a channel width in the RU Allocation subfield of the Per User Info field of a Trigger frame, containing the AID of the OMI initiator, that is less than or equal to the value specified in the Channel Width subfield of the OMI A-Control field received by the OMI initiator" A channel width in the RU Allocation subfield of the Per User Info field is ambiguous.	Replace the corresponding paragrph with the following: "Shall indicate the RU Allocation subfield of the Per User Info field of a Trigger frame, containing the AID of the OMI initiator, by which the occupied channel is subset of the channel supported in the Channel Width subfield of the OMI A-Control field received by the OMI initiator"		2017/1/9 9:42
9727	Yongho Seok	225	1 27.2.1	150	15	T	Y	150.15 27.2.1	"If the received frame satisfies both intra-BSS and inter-BSS conditions, the decision made by using the MAC address takes precedence over the decision made by using the RXVECTOR parameter BSS_COLOR." There exist several further cases that satisfie both intra-BSS and inter-BSS conditions. For example, an HE AP receives an HE MU PPDU having the same BSS_COLOR. Above cited spec text is covering only single specific case. For generalizing it, please change it as the following. "If the received frame satisfies both intra-BSS and inter-BSS conditions, the decision made by using the RXVECTOR parameter BSS_COLOR is overridden by the decision made by using the other parameter."	As per comment.		2017/1/9 9:42
9728	Yongho Seok	225	1 27.9.2.1	190	21	T	Y	190.21 27.9.2.1	"If the PHY of a STA issues a PHY-CCA.indication with a value equal to BUSY followed by an RXSTART.indication due to a PPDU reception then the STA's MAC sublayer may a) issue a PHY-CCARESET.request primitive and b) not update its NAV timers based on frames carried in the PPDU if all the following conditions are met:" The above rule is missing how long the STA's MAC sublayer can issue a PHY-CCARESET.request primitive, if the conditions are met. Change it as the following: "...may a) issue a PHY-CCARESET.request primitives before the end of the PPDU and..."	As per comment.		2017/1/9 9:42
9729	Yongho Seok	225	1 27.9.2.1	190	50	E	Y	190.50 27.9.2.1	"SR Backoff procedure for SR delayed case" Probably, it is a title of a previous CR motion.	Delete the corresponding sentence.		2017/1/9 9:42
9730	Yongho Seok	225	1 27.9.1	190	11	T	Y	190.11 27.9.1	"When the conditions specified in 27.9 (Spatial reuse operation) are met that allow the transmission of an SR PPDU, an HE STA may transmit an SR PPDU to either an HE STA or a non-HE STA." What is a definition of a SR PPDU? Also, it is saying that an HE STA can transmit a SR PPDU to all STA (an HE STA or a non-HE STA). Such rule is not needed.	Delete the second paragraph of 27.9.1.		2017/1/9 9:42

9731	Yongho Seok	225	1 27.10.4	195	6	T	Y	195.06 27.10.4	"When the AP specifies a value defined in Table 9-25i (Preferred AC subfield encoding) in the Preferred AC subfield and a value of 1 in the AC Preference Level subfield in the Trigger Dependent User Info field of a Basic Trigger variant Trigger frame, then an HE STA with dot11AMPDUwithMultipleTIDOptionImplemented set to true may aggregate MPDUs from any other TID." The above paragraph is conflicted with the previous paragraph. Remove the corresponding paragraph.	As per comment.		2017/1/9 9:42
9732	Yongho Seok	225	1 27.15.2	201	37	T	Y	201.37 27.15.2	"An HE non-AP STA may transmit an HE trigger-based PPDU to a peer STA if it has received from the peer STA an HE Capabilities element with the UL MU PPDU Support field equal to 1; otherwise the STA shall not transmit an HE trigger-based PPDU to the peer STA." Does a peer STA mean a non-AP STA? If it is yes, it does not make sense. An HE trigger-based PPDU is always addressed to an AP STA. Does a peer STA mean an AP STA? If it is yes, it still does not make sense. For an HE trigger-based PPDU transmission, any capability check is not needed. Please clarify it.	As per comment.		2017/1/9 9:42
9733	Yongho Seok	225	1 28.3.20	371	11	T	Y	371.11 28.3.20	"The receiving procedures are subject to further changes depending on the decisions of spatial reuse and 20 MHz only devices." On the spatial reuse operation, when the STA's MAC sublayer issues a PHY-CCARESET.request primitive, the PHY receive procedure (e.g, issue a PHY-RXEND.indication primitive) shall be explained.	As per comment.		2017/1/9 9:42
9734	Yongho Seok	225	1 28.4	371	15	T	Y	371.15 28.4	The PHY MIB for HE PLME is missing. Also update the PHY MIB in Annex C.	As per comment.		2017/1/9 9:42
9735	Yongho Seok	225	1 28.4.3	372	36	T	Y	372.36 28.4.3	aRxPHYStartDelay is missing.	Add the following aRxPHYStartDelay value into Table 28-46. - 32 us for HE SU PPDU and HE trigger-based PPDU - 40 us for HE ER SU PPDU - 96 us for HE MU PPDU		2017/1/9 9:42
9736	Yongho Seok	225	1 27.4.1	158	6	T	Y	158.06 27.4.1	"...the length of each Block Ack Bitmap subfields shall be equal to the solicited Bitmap length (i.e., FN subfields in solicited Block Ack Request Starting Sequence Control and responding Block Ack Starting Sequence Control for the same TID are equal)." Why does the block ack originator decide the Block Ack Bitmap length? In a case of an implicit Block Ack Request, the block ack recipient decides the Block Ack Bitmap length. Please remove the corresponding sentences for the consistent protocol design.	As per comment.		2017/1/9 9:42
9737	Yongho Seok	225	1 27.4.4.1	160	45	T	Y	160.45 27.4.4.1	"(Multi-TID) BlockAckReq, BlockAckReq, and MU-BAR variant Trigger frames indicate the length of the soliciting block ack responses according to the FN settings defined in 9.3.1.9 (BlockAck frame format)." Why does the block ack originator decide the Block Ack Bitmap length? In a case of an implicit Block Ack Request, the block ack recipient decides the Block Ack Bitmap length. Please remove the corresponding sentences for the consistent protocol design.	As per comment.		2017/1/9 9:42

9738	Yongho Seok	225	1 27.13	199	3	T	Y	199.03 27.13	"The transmission properties, RU_ALLOCATION, DCM, NUM_STS, FEC_CODING, BEAMFORMED, BEAM_CHANGE, and STBC, are determined by the RXVECTOR of the PPDU used to estimate recommended MFB." Is the recommended MFB for a solicited link adaptation? Or, is it for an unsolicited link adaptation? Please clarify it.	As per comment.	2017/1/9 9:42
9739	Yongho Seok	225	1 27.2.1	149	48	T	Y	149.48 27.2.1	"The RXVECTOR parameter BSS_COLOR of the PPDU carrying the frame is not 0 and does not match the BSS color announced by the AP to which the STA is associated" When an HE STA that is associated to a legacy AP receives an HE PPDU with the RXVECTOR parameter BSS_COLOR, the received HE PPDU is an inter-BSS frame. Add the following condition for an inter-BSS frame determination. "The RXVECTOR parameter BSS_COLOR of the PPDU carrying the frame is present and the STA is associated to the legacy AP."	As per comment.	2017/1/9 9:42
9740	Yongho Seok	225	1 27.14.2	200	25	T	Y	200.25 27.14.2	"If random access allocations are made in a sequence of Trigger frames within a trigger-enabled TWT SP, then all the Trigger frames in the sequence shall have the Cascade Indication field set to 1, except for the last Trigger frame in the sequence, which shall have the Cascade Indication field set to 0." The same normative text is already included in 27.7.3.2 (Rules for TWT scheduling STA). Please remove the corresponding paragraph.	As per comment.	2017/1/9 9:42
9741	Yongho Seok	225	1 27.14.2	200	30	T	Y	200.30 27.14.2	"If the OBO counter decrements to a non-zero value with the random access procedure in a Trigger frame with Cascade Indication field set to 0, it may enter the doze state immediately." The OBO counter having a non-zero value does not mean that a STA did not exchange a PS-Poll frame or an APSD trigger frame with an AP. After exchanging a PS-Poll frame or an APSD trigger frame, the STA still can continoue to be in the UL OFDMA-based random access if it has some pending frame. So, it is very odd that a STA is permitted to enter the doze state immediately after receiving a Trigger frame with Cascade Indication field set to 0. Please remove the corresponding sentence.	As per comment.	2017/1/9 9:42
9742	Yongho Seok	225	1 27.14.2	200	32	T	Y	200.32 27.14.2	The following is a behavior of the TWT scheduled STA (see 27.7.3.3) "The TWT scheduled STA shall be in the awake state for AdjustedMinimumTWTWakeDuration time that corresponds to that TWT parameter set, except that the STA may go to doze state when a TWT SP termination event occurs." And, the following is not listed in the TWT SP termination event. "If the OBO counter decrements to a non-zero value with the random access procedure in a Trigger frame with Cascade Indication field set to 1..." So, please change "may" to "shall" as the following: "..., it shall remain awake for random access in the cascaded Trigger frame."	As per comment.	2017/1/9 9:42

9743	Yongho Seok	225	1 27.7.2	182	2	T	Y	182.02 27.7.2	A TWT requesting STA in PS mode that is awake for a TWT SP may transition to the doze state after an early TWT SP termination event if there is at least one frame exchange with the STA during AdjustedMinimumTWTWakeDuration. But, I think that the below early TWT SP termination event requires no frame exchange. "The reception of a Trigger frame with the Cascade Indication field equal to 0 that is not intended to the STA and does not allocate any random RU during an unannounced TWT" If a frame exchange like a PS-Poll frame or an APSD trigger frame was occured, the AP will attempt to transmit a DL BU frame to the TWT requesting STA.	Change as the following: "...or after an early TWT SP termination event 2) and 3) if there is at least one frame exchange with the STA during AdjustedMinimumTWTWakeDuration, or after an early TWT SP termination event 1) if there is no frame exchange with the STA from the TWT SP start time."		2017/1/9 9:42
9744	Yongho Seok	225	1 27.7.3.3	185	51	T	Y	185.51 27.7.3.3	A TWT requesting STA in PS mode that is awake for a TWT SP may transition to the doze state after an early TWT SP termination event if there is at least one frame exchange with the STA during AdjustedMinimumTWTWakeDuration. But, I think that the below early TWT SP termination event requires no frame exchange. "The reception from the TWT scheduling STA of a Trigger frame with a Cascade Indication field equal to 0 that is not intended to the STA and does not allocate any random RU." If a frame exchange like a PS-Poll frame or an APSD trigger frame was occured, the AP will attempt to transmit a DL BU frame to the TWT requesting STA.	Change as the following: "...or after an early TWT SP termination event 2) and 3) if there is at least one frame exchange with the STA during AdjustedMinimumTWTWakeDuration, or after an early TWT SP termination event 1) if there is no frame exchange with the STA from the TWT SP start time."		2017/1/9 9:42
9745	Yongho Seok	225	1 27.7.3.3	185	48	T	Y	185.48 27.7.3.3	Probably, "AdjustedMinimumWakeDuration" is a typo. "AdjustedMinimumTWTWakeDuration" is right.	Change "AdjustedMinimumWakeDuration" to "AdjustedMinimumTWTWakeDuration".		2017/1/9 9:42
9746	Yongho Seok	225	1 27.7.3.3	185	62	T	Y	185.62 27.7.3.3	"The reception of a frame sent by the TWT responding STA that has either the EOSP subfield equal to 1 or the More Data field equal to 0 when the frame does not contain an EOSP subfield." Because the above paragraph is one of the early TWT SP termination events, it shall be move to bullet 3).	As per comment.		2017/1/9 9:42
9747	Yongho Seok	225	1 27.2.1	149	55	T	Y	149.55 27.2.1	"If the BSSID field is not available, both the RA and TA fields exist, and none of the address fields of the received frame with Individual/Group bit forced to the value 0 match the BSSID of AP to which the STA is associated" When a STA knows the BSSID of an OBSS AP (e.g., through a active or passive scanning), it can identify a received frame as an inter-BSS frame through the BSSID of the OBSS AP. Insert the following additional conditions: "If the BSSID field is not available and the address field of the received frame with Individual/Group bit forced to the value 0 match the BSSID of an OBSS AP to which the STA is not associated" "If the BSSID field is not available, both the RA and TA fields exist, and none of the address fields of the received frame with Individual/Group bit forced to the value 0 match the BSSID of AP to which the STA is associated"	As per comment.		2017/1/9 9:42

9748	Yongho Seok	225	1 10.3.2.4	115	31	T	Y	115.31 10.3.2.4	Regarding the NAVTimeout period, the base specification explains it as the following: "In non-DMG BSS, NAVTimeout period is equal to (2 x aSIFSTime) + (CTS_Time) + aRxPHYStartDelay + (2 x aSlotTime). The CTS_Time shall be calculated using the length of the CTS frame and the data rate at which the RTS frame used for the most recent NAV update was received." In here, there are two issues. First issue, when an HE STA received a MU-RTS frame, CTS_Time for calculating the NAVTimeout period of the received MU-RTS frame is fixed to 6Mbps. Second issue, aRxPHYStartDelay is quite different depending on whether an received RTS or MU-RTS is an intra-BSS frame or an inter-BSS frame. When an received RTS or MU-RTS is an intra-BSS frame, aRxPHYStartDelay is 96 us. But, when an received RTS or MU-RTS is an inter-BSS	As per comment.	2017/1/9 9:42
9749	Yongho Seok	225	1 28.3.10.9	298	41	T	Y	298.41 28.3.10.9	"The tone indices for HE-STF field for HE PPDUs except HE trigger-based PPDUs is defined in Equation (28-21)." The HE-STF tone index (iSTF) is never used in any other places. Delete the corresponding sentence and Equation (28-21).	As per comment.	2017/1/9 9:42
9750	Yongho Seok	225	1 28.3.10.9	298	48	T	Y	298.48 28.3.10.9	"The tone indices for HE-STF fields for an HE trigger-based PPDU are defined in Equation (28-22)." The HE-STF tone index (iSTF) is never used in any other places. Delete the corresponding sentence and Equation (28-22).	As per comment.	2017/1/9 9:42
9751	Yongho Seok	225	1 27.15.3	202	24	T	Y	202.24 27.15.3	"NSS and BW selection is further constrained as defined in 27.8 (Operating mode indication) and 11.42 (Notification of operating mode changes)." The BW selection is also constrained by 27.15.2 (PPDU format selection). Add 27.15.2 as additional constraint and specify additional BW selection caused by 27.15.2.	As per comment.	2017/1/9 9:42
9752	Yongho Seok	225	1 28.3.10.10	314	1	T	Y	314.01 28.3.10.10	"When a 1x, 2x or 4x HE-LTF is transmitted,..." There is no other HE-LTF mode in addition to 1x, 2x and 4x.Please change it as the following: "It is recommended that the spatial mapping matrix applied to..."	As per comment.	2017/1/9 9:42
9753	Yongho Seok	225	1 27.14.3.1	200	51	T	Y	200.51 27.14.3.1	"At the beginning of these periodic TWT SPs, the AP shall transmit a TIM frame or a FILS Discovery frame that includes a TIM element (see 9.4.2.6 (TIM element))." The use case of a frame transmitted at the beginnng of the periodic TWT SPs is totally different with the original use of the TIM frame and the FILS Discovery frame. If it is needed, please define a new action frame.	As per comment.	2017/1/9 9:42
9754	Yongho Seok	225	1 28.3.11.8	324	23	T	Y	324.23 28.3.11.8	"N_ROT(2<=N_SS<=4)" When the N_SS is equal to 1, the same N_ROT parameter is used.	Change it as the following: "N_ROT(N_SS<=4)"	2017/1/9 9:42
9755	Yongho Seok	225	1 28.3.4	242	22	T	Y	242.22 28.3.4	"The RL-SIG, HE-SIG-A, HE-SIG-B, HE-STF, HE-LTF, and PE fields exist only in HE PPDUs." Isn't it too much obvious?	Remove this sentence.	2017/1/9 9:42

9756 Yongho Seok	225	1 9.4.2.46	68	28	T	Y	68.28 9.4.2.46	"The Timestamp and Beacon Interval fields, DSSS Parameter Set, IBSS Parameter Set, Country, Channel Switch Announcement, Extended Channel Switch Announcement, Wide Bandwidth Channel Switch, Transmit Power Envelope, Supported Operating Classes, IBSS DFS, ERP Information, HT Capabilities, HT Operation, VHT Capabilities, and VHT Operation elements are not included in the Nontransmitted BSSID Profile subelement; the values of these elements for each nontransmitted BSSID are always the same as the corresponding transmitted BSSID element values." The HE Capabilities, HE Operation elements, and BSS Color Change Announcement element are not included in the Nontransmitted BSSID Profile subelement. Please insert those elements into exclusive elements of the Nontransmitted BSSID Profile	As per comment.		2017/1/9 9:42
9757 Yongho Seok	225	1 9.4.2.219	92	9	T	Y	92.09 9.4.2.219	When the multiple BSSID capability is supported, the TA field of a Beacon frame is set to the transmitted BSSID. Please refer the below definition of the transmitted BSSID from Clause 3. "transmitted basic service set identifier (BSSID): The BSSID included in the medium access control (MAC) header transmitter address field of a Beacon frame when the multiple BSSID capability is supported." So, based on the current definitions of the transmitted BSSID and nontransmitted BSSID, an AP supporting multiple BSSID capability does not transmit a Beacon frame with the TA field set to the nontransmitted BSSID. The Tx BSSID Indicator fields to signal whether an AP corresponds to transmitted BSSID) is not necesary.	Remove the Tx BSSID Indicator field and the MaxBSSID Indicator Tx field.		2017/1/9 9:42
9758 Yoshio Urabe	225	1 9.3.1.23	47	47	T	Y	47.47 9.3.1.23	STAID[11:0] is not defined in the Trigger frame format.	Change "Padding field starts with special STAID[11:0] as 0xFFF .." to "Padding field starts with an AID12 subfield having a special value 0xFFF ..."		2017/1/9 9:42
9759 Yoshio Urabe	225	1 27.5.2.2.1	165	35	T	Y	165.35 27.5.2.2.1	The value of AID12 subfield for MAC padding of a Trigger frame is not clear. The special AID value is 2047 (i.e. 0x7FF) in 27.5.2.2.1 while the special value of STAID[11:0] is 0xFFF in 9.3.1.23.	Change "a value of the AID equal to 2047" to "a value of the AID12 subfield equal to 0xFFF".		2017/1/9 9:42
9760 Yoshio Urabe	225	1 27.9.2.1	190	11	T	Y	190.11 27.9.2.1	SR PPDU' is not defined.	Define 'SR PPDU' in Section 3		2017/1/9 9:42
9761 Yoshio Urabe	225	1 27.9.2.1	190	30	T	Y	190.30 27.9.2.1	Non-HT Public Action frame should be exempted from SR operation regardless with its RA because of the following reason. Even if an RA of a Public Action frame is an indivudual address other than the receiving STA, it may be intended to a STA in the BSS that the receiving STA belongs to.	Replace lines 30-33 with the following text: -- The PPDU is not a non-HT PPDU that carries a Public Action frame.		2017/1/9 9:42
9762 Yoshio Urabe	225	1 27.9.2.1	190	50	T	Y	190.50 27.9.2.1	The text in P190L50-54 is redundant because this condition and operation is covered by P190L36-37 and P190L56-57.	Remove lines 50-54. Move the NOTE in lines 56-57 after the next paragraph, that is, the end of the subclause 27.9.2.1.		2017/1/9 9:42
9763 Yoshio Urabe	225	1 9.3.1.23	41	47	E	Y	41.47 9.3.1.23	In Figure 9-52c, parentheses in the RA field is not necessary.	Remove parentheses of (RA) in Figure 9-52c.		2017/1/9 9:42
9764 Yoshio Urabe	225	1 27.9.2.1	190	53	E	Y	190.53 27.9.2.1	SR delay' should be 'SR_Delay' for consistency with HE-SIG-A definition in 28.3.10.7.2.	In lines 53, 56 and 57, replace 'SR delay' with 'SR_Delay'.		2017/1/9 9:42

9765	Youhan Kim	225	1 28.3.3.5	237	30	T	Y	237.30 28.3.3.5	The most important restriction is that 20 MHz operation STAs shall not be assigned RUs 'outside' the Primary20 subchannel. This restriction is missing (P237L30). Also, P237L58 says there is no restriction on 242-tone RU, but that is not correct. Only the 242-tone RU corresponding to the Primary20 can be allocated to the 20 MHz operating STA.	Change P237L30 "An AP shall not assign the following RUs to 20 MHz operating STAs" to "An AP shall not allocate RUs which cannot be signalled as part of the HE-SIG-B RU Allocation subfield corresponding to the Primary 20 MHz subchannel to 20 MHz operating non-AP STAs in HE MU or HE trigger based PPDUs. In additional, an AP shall not allocate the following RUs to 20 MHz operation STAs in HE MU or HE trigger based PPDUs:" Also, delete "If supported, there is no restriction on 242-tone RUs." from P237L58.	2017/1/9 9:42
9766	Youhan Kim	225	1 28.3.3.5	237	32	T	Y	237.32 28.3.3.5	It is not clear to readers why "[Table 28-4 and Table 28-5]" are written on L32. It is probably there to specify what, say, "RU 5" is, but it is not clearly written. Next, DL/UL OFDMA is not a valid PPDU type. Also, phrases like "(2 26-tone RUs are restricted)" do not seem necessary in the standard (probably was needed during discussion phase).	Delete "[Table 28-4 (Subcarrier indices for RUs in a 40 MHz HE PPDU) and Table 28-5 (Subcarrier indices for RUs in an 80 MHz HE PPDU)]" on P237L32. On P237L34, change "RU 5 and 14 in 40 MHz DL/UL OFDMA (2 26-tone Rus are restricted)" to "RU #5 and #14 in 40 MHz HE MU or HE trigger based PPDUs". Similar changes throughout P237L35~L52.	2017/1/9 9:42
9767	Youhan Kim	225	1 28.3.3.6	238	9	T	Y	238.09 28.3.3.6	This section (20 MHz only HE STAs) does not seem to be the appropriate place to state the requirement that an HE AP in 5 GHz must support 80 MHz channel width.	Move the statement "An HE AP in 5 GHz shall be 80 MHz capable" to a more appropriate section.	2017/1/9 9:42
9768	Youhan Kim	225	1 28.3.3.6	238	9	T	Y	238.09 28.3.3.6	An 80 MHz HE AP must also interoperate with 160/80+80 MHz capable non-AP STAs. Also, what does "operate for ... 20 MHz only non-AP HE STAs" mean?	Either add statement that HE APs must interop w/ 160/80+80 MHz capable non-AP STAs as well, or simply delete the state that HE AP must operate w/ 80 MHz capable non-AP STAs. Also, clarify what "operate for ... 20 MHz only non-AP HE STAs" means.	2017/1/9 9:42
9769	Youhan Kim	225	1 28.3.10.7.2	274	33	T	Y	274.33 28.3.10.7.2	4xLTF+0.8 for HE_EXT_SU as well? THe capability bit is for HE_SU only, not for HE_MU or HE_EXT_SU But HE_SIG_A change is for HE_EXT_SU as well (also for HE_MU) The HE PHY Capabilities Information field (P86L24) defines 4x HE-LTF and 0.8 usec GI only for HE SU PPDUs, not HE extended range SU.	Change at P274L33 "a 4x HE-LTF and 0.8 us GI" to "if HE extended SU PPDU format, a 4x HE-LTF and 0.8 us GI"	2017/1/9 9:42
9770	Youhan Kim	225	1 28.3.10.7.2	277	20	T	Y	277.20 28.3.10.7.2	Number of MU-MIMO users cannot be 1 (value 0x0) in HE-SIG-A of HE_MU PPDU because the Spatial Config subfield in HE-SIG-B has Nuser >= 2.	Make the value 0x0 reserved for the Number of HE-SIG-B Symbolf Or MU-MIMO Users field of HE-SIG-A for HE_MU PPDU if the SIGB Compression field is 1.	2017/1/9 9:42
9771	Youhan Kim	225	1 28.3.16	344	56	T	Y	344.56 28.3.16	A beamformer may choose to apply certain spatial mapping matrix to the NDP PPDU where channel smoothing at the receiver side is not desired. Hence, if the Beamformed bit is set to 1 in an NDP PPDU, the receiver shall not perform channel smoothing in generating the sounding feedback.	Add to P344L56 "If the Beamformed bit in the HE-SIG-A of an HE NDP PPDU is set to 1, then the receiver of the HE NDP PPDU shall not perform channel smoothing when generating the compressed beamforming feedback report."	2017/1/9 9:42
9772	Youhan Kim	225	1 28.5	397	1	E	Y	397.01 28.5	Typo. 969-tone RU should be 996-tone RU.	Change "969-tone RU" to "996-tone RU" in the headings of Tables 28-88~94.	2017/1/9 9:42
9773	Youhan Kim	225	1 9.3.1.23	48	17	T	Y	48.17 9.3.1.23	HE trigger based PPDU needs to be sent exactly SIFS (or Signal Extension + SIFS) after the end of reception of the Trigger Frame. If HT/VHT PPDU w/ SGI was used to transmit the Trigger Frame, then the receiver is supposed to align to 4 usec boundary before counting down SIFS, which could introduce ambiguity in the HE trigger based PPDU transmission timing. Also, since DSSS/CCK PPDU formats do not have Signal Extension, HE trigger based PPDUs may need to be sent only 10 usec after the reception of Trigger Frame if the Trigger Frame was sent using DSSS/CCK format.	Add the following to P48L17. "SGI is disallwed for Trigger Frame transmission if the Trigger Frame is sent using the HT or VHT PPDU format. DSSS and CCK PPDU formats are disallwed for Trigger Frame transmission."	2017/1/9 9:42

9774	Youhan Kim	225	1 9.4.2.218.3	84	6	T	Y	84.06 9.4.2.218.3	Suggest to add separate DCM capability bits for larger RU sizes.	Add separate capability bits for DCM TX/RX for different RU sizes.	2017/1/9 9:42
9775	Youhan Kim	225	1 3.2	3	5	T	Y	3.05 3.2	"20 MHz only" STA is undefined, while it is being used multiple in the draft. Also, the terminology is inconsistent - "20 MHz only HE STA", "20 MHz only device", "20 MHz only non-AP HE STA", "20 MHz only non-AP STA", "20 MHz only HE device".	Come up with a single unified terminology for "20 MHz only" xyz. Then, add the definition to clause 3.2. Also, search the draft for "20 MHz only", and replace w/ the unified terminology where applicable.	2017/1/9 9:42
9776	Youhan Kim	225	1 9.3.1.23	44	56	T	Y	44.56 9.3.1.23	Description for the Packet Extension field is not clear. What is the first two bits? B34-35? What is the definition of the pre-FEC padding factor? Is it the same as Table 28-39?	Clarify the definition of the Packet Extension field.	2017/1/9 9:42
9777	Youhan Kim	225	1 28.1.1	209	42	T	Y	209.42 28.1.1	"Channel puncturing" should be "preamble puncturing"	Change "channel puncturing" to "preamble puncturing". Same on P353L55.	2017/1/9 9:42
9778	Youhan Kim	225	1 28.1.1	209	44	T	Y	209.44 28.1.1	"RU" is not defined.	Define the term "RU".	2017/1/9 9:42
9779	Youhan Kim	225	1 28.1.1	209	50	T	Y	209.50 28.1.1	"Symbol duration" has different meaning throughout the draft. P209L51-52 uses it to refer to duration excluding the GI duration. But Table 28-9 and P339L50 use it to refer to duration including the GI duration. 802.11-2016 also uses symbol duration to refer to duration including the GI. Note that Table 28-9 and 11ac uses the term "DFT period" to refer to the duration excluding GI.	Change "symbol durations (symobl duration not including the guard interval" to "DFT periods". Similar changes on P209L52, P302L8 and P302L9.	2017/1/9 9:42
9780	Youhan Kim	225	1 28.1.1	209	58	T	Y	209.58 28.1.1	QPSK DCM is missing. On the other hand, do we need to call out DCM in this list of 'modulations'? DCM does not use a 'separate' modulation/constellation, but simply maps bits to multiple subcarriers using the existing BPSK/QPSK/16-QAM modulations. For example, we don't call out BPSK STBC, QPSK STBC, etc in this list of modulation.	Either remove BPSK DCM and 16-QAM DCM from the list, or add QPSK DCM.	2017/1/9 9:42
9781	Youhan Kim	225	1 28.3.2.1	227	60	T	Y	227.60 28.3.2.1	An RU with a single HE-SIG-B user field ("SU" RU) may be destined to multiple 'users' when the RU is used for broadcast/multicast purposes. Hence, 'transmissions to one user' may be misleading.	Use a more appropriate terminology than 'one user' in "single stream transmissions to one user os spatial multiplexing to one user".	2017/1/9 9:42
9782	Youhan Kim	225	1 28.3.2.1	227	61	T	Y	227.61 28.3.2.1	What is a "full bandwidth" DL MU-MIMO?	Define the phrase "full bandwdith" MU-MIMO	2017/1/9 9:42
9783	Youhan Kim	225	1 28.3.3.1	228	16	T	Y	228.16 28.3.3.1	Table 28-15 does not illustrate the difference between OFDM and OFDMA.	Fix the sentence "The difference between OFDM and OFDMA is illustrated in Table 28-15 (CH_BANDWIDTH and for pre-HE modulated fields)."	2017/1/9 9:42
9784	Youhan Kim	225	1 28.3.3.1	228	20	T	Y	228.20 28.3.3.1	The term "subchannel" seems a bit confusing. In 802.11-2016, subchannel is used to describe 20 MHz or 80 MHz portions of the PPDU. In 11ax D1.0, subchannel is used to describe both 20 MHz subchannels as well as RUs.	Consider using a different term than "subchannelization" and "subchannel" when referring to RUs.	2017/1/9 9:42
9785	Youhan Kim	225	1 28.3.3.2	229	7	E	Y	229.07 28.3.3.2	"may be used" would be a better phrase than "are used"	Change "242-tone RU are used in" to "242-tone RU may be used in". Similar changes on L17, L18, L20, L24, L25, L26.	2017/1/9 9:42
9786	Youhan Kim	225	1 28.3.3.2	229	8	E	Y	229.08 28.3.3.2	There is only one HE MU PPDU format and only one HE trigger-based PPDU format.	Change "HE MU PPDU formats" to "HE MU PPDU format". Also change "HE trigger-based PPDU formats" to "HE trigger-based PPDU format". Similar changes throughout 28.3.3.2.	2017/1/9 9:42
9787	Youhan Kim	225	1 28.3.3.2	229	8	T	Y	229.08 28.3.3.2	HE MU and HE trigger-based PPDU formats are also used for full BW MU-MIMO. In this case, 242-tone RU, for example is used for HE20 MU/TRIG even though it is not an 'OFDMA' transmissions.	Delete "using OFDMA transmission". Also on L18, 19, 22.	2017/1/9 9:42
9788	Youhan Kim	225	1 28.3.3.2	229	9	T	Y	229.09 28.3.3.2	"DFS channel" is not a defined term.	Change "if an HE AP operates in a DFS channel" to "if an HE AP STA operates in a channel requiring DFS behavior".	2017/1/9 9:42
9789	Youhan Kim	225	1 28.3.3.2	229	9	T	Y	229.09 28.3.3.2	Clarify how the existence of non-HE OBSS is determined.	Clarify how the existence of non-HE OBSS is determined.	2017/1/9 9:42
9790	Youhan Kim	225	1 28.3.3.2	229	29	T	Y	229.29 28.3.3.2	106-tone and 242-tone RUs may also be used in HE extended range SU PPDU format.	Add a paragraph stating that the 106-tone and 242-tone RUs may also be used in HE extended range SU PPDU format.	2017/1/9 9:42

9791	Youhan Kim	225	1 28.3.3.2	229	30	T	Y	229.30 28.3.3.2	Table 28-2 is applicable only for HE MU and HE trigger-based PPDU formats	Clarify that Table 28-2 is applicable only for HE MU and HE trigger-based PPDU formats	2017/1/9 9:42
9792	Youhan Kim	225	1 28.3.3.2	230	10	T	Y	230.10 28.3.3.2	Is there an explanation of what "RU 1", "RU 2", etc. means in Tables 28-3~5? Also, "[-121:-96]" is supposedly a Matlab style notation which is used w/o any explanation.	Clarify the various notations used in Table 28-3~5.	2017/1/9 9:42
9793	Youhan Kim	225	1 28.3.3.2	232	17	T	Y	232.17 28.3.3.2	What do the numbers "13" represent in Figures 28-2 and 28-4? In general, Figures 28-2~4 are not easy to understand for a first time reader.	Update figures 28-2~4 to be more readable.	2017/1/9 9:42
9794	Youhan Kim	225	1 28.3.3.2	236	6	T	Y	236.06 28.3.3.2	Do we need to list out the null subcarrier indices as shown in Table 28-6? In other words, how does one interprete/use Table 28-6? If one transmits any RU26 in a 20 MHz HE PPDU, then it shall not modulate tones +-69, +-122? But what if right side of 20 MHz HE PPDU is using RU106? Isn't it sufficient to specify which tones are modulated (as in Table 28-3~5), and state that all other tones are not modulated?	Consider removing Table 28-6.	2017/1/9 9:42
9795	Youhan Kim	225	1 28.3.3.5	236	16	T	Y	236.16 28.3.3.5	"when operating 20 MHz" is awkward	Update the section title of 28.3.3.5 to be more readable.	2017/1/9 9:42
9796	Youhan Kim	225	1 28.3.3.5	237	18	T	Y	237.18 28.3.3.5	What does "operate with 20 MHz" mean?	Change "STA can operate with 20 MHz" to "STA may operate in 20 MHz channel width mode".	2017/1/9 9:42
9797	Youhan Kim	225	1 28.3.3.5	237	18	E	Y	237.18 28.3.3.5	"20 MHz-only HE device" is used only here.	Change "20 MHz-only HE device" to "20 MHz-only non-AP STA".	2017/1/9 9:42
9798	Youhan Kim	225	1 28.3.3.5	237	19	E	Y	237.19 28.3.3.5	ROM is a part of OMI.	Change "to 20 MHz by ROM" to "to 20 MHz using OMI".	2017/1/9 9:42
9799	Youhan Kim	225	1 28.3.3.5	237	21	T	Y	237.21 28.3.3.5	"20 MHz operating non-AP STA" is not defined.	Define "20 MHz operating non-AP STA".	2017/1/9 9:42
9800	Youhan Kim	225	1 28.3.3.5	237	21	T	Y	237.21 28.3.3.5	It is not necessary to explain why we are restricting the RU locations for 20 MHz operating STAs participating in wider BW OFDMA packets in the standard. Besides the current explanation is probably not quite clear enough for first time readers anyway (e.g. why is there performance penalty?).	Delete "When a 20 MHz operating ... OFDMA operation." (L21~L28)	2017/1/9 9:42
9801	Young Hoon Kwon	225	1 9.2.4.6.4.1	22	60	T	Y	22.60 9.2.4.6.4.1	Control subfield with Control ID subfield equal to 0 implies UL MU response scheduling, where the length of the Control information subfield is 26 bits, which is the maximum available. Therefore, in case Control ID subfield equalt to 0, there can be one and only one Control subfield in the A-Control subfield. So, the sentence "Control subfield with Control ID subfield equal to 0, if present, is the first subfield of the sequence." is meaningless.	Delete the sentence "Control subfield with Control ID subfield equal to 0, if present, is the first subfield of the sequence.".	2017/1/9 9:42
9802	Young Hoon Kwon	225	1 9.2.4.6.4.2	24	21	E	Y	24.21 9.2.4.6.4.2	"RSSI" should be a subscipt.	Make "RSSI" in the word "TRSSI" be subscripts.	2017/1/9 9:42
9803	Young Hoon Kwon	225	1 9.2.4.6.4.3	24	58	T	Y	24.58 9.2.4.6.4.3	Operating channel width for transmission of Trigger based PPDU also needs to be indicated, and the Channel Width subfield can be used for this purpose too.	Modify the text to "The Channel Width subfield indicates the operating channel width supported by the STA in reception and transmission, and is ...".	2017/1/9 9:42

9804	Young Hoon Kwon	225	1 9.2.4.6.4.3	25	1	T	Y	25.01 9.2.4.6.4.3	Main purpose of including Tx NSS in OMI is to use less number of Tx RF chains for power savings. However, different from Rx NSS, the number of Tx RF chains is more closely related with the number of space-time streams (N_STS) compared to the number of spatial streams (N_SS). For example, even in case a STA indicates Tx NSS to be 1, an serving AP can still allocate the STA single spatial stream with STBC, which requires at least two transmit RF chains to be turned on. Because this is still possible, even if a STA supporting STBC indicates Tx NSS = 1 to the serving AP, the STA shall have at least two Tx RF chains on, which defeats the original purpose of having Tx NSS subfield in OMI. For this issue, a simple remedy is to change Tx NSS subfield to indicate the maximum number of space-time streams (N_STS) and modify the related operation accordingly.	As in the comment.			2017/1/9 9:42
9805	Young Hoon Kwon	225	1 9.2.4.6.4.4	25	30	T	Y	25.30 9.2.4.6.4.4	For link adaptation to work properly, NSS and HE-MCS is not enough. For example, for soliced case, MRQ, MSI, and MFSI also need to be included. To further cover unsolicited case, there needs even more subfields. So, at least MRQ, MSI, and MFSI needs to be included into the A-Control field.	Per comment			2017/1/9 9:42
9806	Young Hoon Kwon	225	1 9.2.4.6.4.5	26	2	T	Y	26.02 9.2.4.6.4.5	In case all ACs have traffic, it is possible to set ACI bitmap is set to 0000 (when there are traffic for all 8 TIDs.). This needs to be described in this line, too.	Per comment			2017/1/9 9:42
9807	Young Hoon Kwon	225	1 9.2.4.6.4.7	27	64	T	Y	27.64 9.2.4.6.4.7	Duplicated sentence.	Delete the sentence "Bandwidth Query Report used for bandwidth query report operation to assist DL HE MU transmission (see 25.5.1.3. (Bandwidth query report operation).".			2017/1/9 9:42
9808	Young Hoon Kwon	225	1 9.2.4.6.4.7	28	6	T	Y	28.06 9.2.4.6.4.7	In Table 9-18d, each bit is set to 1 when corresponding channel is available. However, there's no clear definition in which case the channel is available. For example, it is not clear which CCA rule is applied in determining the channel availability. (ED, SD, Mid-Pkt detection, OBSS-PD based SR, etc). Also, it is not clear the measurement period for the decision on this. (E.g., Use of ED results measured during SIFS before transmitting a PPDU that contains this A-Control field.)	Per comment, please clarify how to determine the channel availability.			2017/1/9 9:42
9809	Young Hoon Kwon	225	1 9.2.4.6.4.8	28	60	T	Y	28.60 9.2.4.6.4.8	This is not for a Trigger frame.	Modify the sentence to "The Control Information subfield for Reverse Direction Protocol (RDP) is shown in Figure 9-15i ...".			2017/1/9 9:42
9810	Young Hoon Kwon	225	1 9.2.4.6.4.8	29	12	T	Y	29.12 9.2.4.6.4.8	It is not clear how to decide the AC for response frame if the last Data frames are from multiple TIDs. Need to clarify how to decide the available ACs when the last data frame is multi-TID frame.	Per comment.			2017/1/9 9:42
9811	Young Hoon Kwon	225	1 92.4.6.4.8	29	15	T	Y	29.15 92.4.6.4.8	In legacy RDG case, as RDG/More PPDU subfield is included in every HT Control field, so it is needed to explicitly indicate RDG status. However, for 11ax device, RDP variant A-Control field does not need to exist in every A-Control field. Therefore, having RDP variant A-Control field itselt can implicitly indicate. For example, if RDP variant A-Control field is included in the A-Control field from an RD initiator can indicate that "An RDG is present." Otherwise, "No reverse grant.". In this sense, having additional bit for "RDG/More PPDU" is not helpful.	Per comment.			2017/1/9 9:42

9812	Young Hoon Kwon	225	1 9.2.4.6.4.8	29	8	T	Y	29.08 9.2.4.6.4.8	It is not clear why this field needs 6 reserved bits. This field only has 2 meaningful bits. And having 6 bits of reserved bits is somewhat overkill. Also, as is shown in other variant A-Control field, byte-matching is not needed.	Per comment.	2017/1/9 9:42
9813	Young Hoon Kwon	225	1 9.2.5.2	31	10	T	Y	31.10 9.2.5.2	Single protection settings for MU-RTS frame transmission can be used for two different cases: 1) DL MU transmission, and 2) UL MU transmission. Current text in subbullet 1a) only describes the case for UL MU transmission. Therefore, the description needs to include these two cases.	Modify the bullet 1a) to "In an MU-RTS frame, the Duration/ID field is set to the estimated time, in microseconds, required for the pending frame, plus one CTS frame, plus the time for the solicited HE triggerbased PPDU if required, plus the time for an acknowledgement if required, plus applicable IFSs.".	2017/1/9 9:42
9814	Young Hoon Kwon	225	1 9.3.1.9.7	37	23	T	Y	37.23 9.3.1.9.7	Not clear what "the format defined below" means here. It's better to have figure that describes the format for Multi-STA BlockAck, instead. Or, it can also refer to Figure 9-32.	Per comment.	2017/1/9 9:42
9815	Young Hoon Kwon	225	1 9.3.1.9.7	37	24	T	Y	37.24 9.3.1.9.7	Normative descript is not appropriate in clause 9.	Delete the sentence "Multi-STA BlockAck frames shall be supported if either UL MU or multi-TID A-MPDU operation is supported.", and describe the normative behavior in Clause 10 or Clause 27.	2017/1/9 9:42
9816	Young Hoon Kwon	225	1 9.3.1.9.7	38	1	T	Y	38.01 9.3.1.9.7	First, the first sentence should start with a "NOTE". And, the sentence is somewhat misleading as there's no acknowledgement contained in the Per AID TID Info subfield.	Modify the first sentence to "NOTE – The TID subfield contains the TID for which the acknowledgment or block acknowledgment contained in the Per STA Info subfield applies.".	2017/1/9 9:42
9817	Young Hoon Kwon	225	1 9.3.1.9.7	38	4	T	Y	38.04 9.3.1.9.7	Does the TID value set to 15 imply a management frame or an action frame? In this note, it is said to be a management frame, but in Table 9-24b and in sub-clause 27.4, it is said to be an action frame. Clarification is needed.	As in the comment.	2017/1/9 9:42
9818	Young Hoon Kwon	225	1 9.3.1.9.7	39	62	T	Y	39.62 9.3.1.9.7	In subclause 10.12, it says "An A-MSDU may be fragmented and each fragment transmitted within a single QoS Data frame, when the recipient has indicated support for reception of fragmented A-MSDUs.", which implies that A-MSDU can be fragmented. Therefore, text in 10.12 and text in line 62 contradict each other. Need clarification.	As in the comment.	2017/1/9 9:42
9819	Young Hoon Kwon	225	1 9.3.1.20	40	53	T	Y	40.53 9.3.1.20	How to encode RU Start/End index to 7 bit needs to be described. Please add the rule.	As in the comment.	2017/1/9 9:42
9820	Young Hoon Kwon	225	1 9.3.1.23	41	47	E	Y	41.47 9.3.1.23	In Figure 9-52c, there's no reason to use parenthesis for RA field.	In Figure 9-52c, remove the parenthesis for RA field	2017/1/9 9:42
9821	Young Hoon Kwon	225	1 9.3.1.23	41	65	T	Y	41.65 9.3.1.23	Clarification is need on how to set TA field in case multiple BSSID is supported. Especially for the case that the Trigger frame schedules STAs in different virtual APs under the same physical AP.	As in the comment.	2017/1/9 9:42
9822	Young Hoon Kwon	225	1 9.3.1.23	41	62	T	Y	41.62 9.3.1.23	How about MU-BAR frame with GCR bit in BAR Control field is set to 1? Need further clarification.	As in the comment.	2017/1/9 9:42
9823	Young Hoon Kwon	225	1 9.3.1.23	43	52	T	Y	43.52 9.3.1.23	Normative behavior such as "The AP shall set .." is not appropriate in clause 9. Move this part to sub-clause related with AP behavior for UL MU transmission.	As in the comment.	2017/1/9 9:42
9824	Young Hoon Kwon	225	1 9.3.1.23	44	26	T	Y	44.26 9.3.1.23	There's no "Number of HE-LTF Symbols" defined in Table 28-18. Need clarification	As in the comment.	2017/1/9 9:42
9825	Young Hoon Kwon	225	1 9.3.1.23	45	1	T	Y	45.01 9.3.1.23	It needs further clarification which SR subfield corresponds which 20MHz out of 40/80/160/80+80 channel bandwidth.	As in the comment.	2017/1/9 9:42
9826	Young Hoon Kwon	225	1 9.3.1.23	45	38	T	Y	45.38 9.3.1.23	It should be Padding subfield in the Trigger frame, and is different from MAC padding field.	Modify the sentence to "User Info fields with AID = 0 is allocated only after User Info fields with AID not equals to 0, if any, and before the Padding subfield of the Trigger frame, if present.".	2017/1/9 9:42

9827	Young Hoon Kwon	225	1 9.3.1.23	45	37	T	Y	45.37 9.3.1.23	Normative behavior such as "User Info fields with AID = 0 shall be..." is not appropriate in clause 9. Move this part to sub-clause related with AP behavior for UL MU transmission.	As in the comment.	2017/1/9 9:42
9828	Young Hoon Kwon	225	1 9.3.1.23	47	35	T	Y	47.35 9.3.1.23	"Values 0 to 90" has 91 elements. However, -100dBm to -20dBm with 1dB resolution only has 81 element. So, this mapping is not correct.	Modify the description to "Values 0 to 90 map to -100dBm to -10dBm".	2017/1/9 9:42
9829	Young Hoon Kwon	225	1 9.3.1.23	47	39	T	Y	47.39 9.3.1.23	It is not clear why we need Target RSSI subfield set to 127 if it implies maximum transmit power for the assigned MCS, because the AP sets the target RSSI value to reasonably high such that the STA needs to use its maximum power. Rather, it may be better to imply that no restriction on STA's transmit power.	Modify the description to "Indicates to the STAthat the target received signal power of the HE trigger-based PPDU response is not applied.".	2017/1/9 9:42
9830	Young Hoon Kwon	225	1 9.3.1.23	47	56	T	Y	47.56 9.3.1.23	In case a Trigger frame is carried within an A-MPDU, it is possibe that padding can be done by EOF padding instead of Padding subfield in the Trigger frame. Therefore, the required duration for Padding subfield does not need to follow the equation here as long as total padding (Padding subfield in the trigger frame, EOF paddings, packet extension, etc) satisfies the processint time requirements. In this sense, equations 9-ax1 and 9-1x2 is not needed.	Delete Eq. 9-ax1, 9-ax2.	2017/1/9 9:42
9831	Young Hoon Kwon	225	1 9.3.1.23.1	48	61	T	Y	48.61 9.3.1.23.1	How to encode the TID Aggregation Limit subfield is not defined. In HE Capabilities element, Multi-TID Aggregation Support subfield is set to the number of TIDs minum 1 of QoS Data frames that can be aggregated. If the same rule is applied, it is not clear the meaning of value 0 in the TID Aggregation Limit subfield. If the TID Aggregation Limit subfield is set to the number of TIDs of frames that can be aggregated, the text shown in P49L1 "The value in the TID Aggregation Limit subfield in Trigger frame is less than or equal to the value indicated in the Multi-TID Aggregation Support field in the HE Capabilities element" is not valid. Further clarification is needed.	As in the comment.	2017/1/9 9:42
9832	Young Hoon Kwon	225	1 9.3.1.23.1	48	64	T	Y	48.64 9.3.1.23.1	Then, how to indicate the STA can aggregate frames from 7 different TIDs? Need further clarification.	As in the comment.	2017/1/9 9:42
9833	Young Hoon Kwon	225	1 9.3.1.23.3	50	16	T	Y	50.16 9.3.1.23.3	Table 9-24c is for Multi-STA BA variant and is not for Multi-TID BA variant. Instead, in the baseline RevMC spec., it says "The Fragment Number subfield of the Block Ack Starting Sequence Control subfield is set to 0.". Therefore, this sentence is not in line with baseline rule. It needs clarification.	As in the comment.	2017/1/9 9:42
9834	Young Hoon Kwon	225	1 9.3.1.23.4	50	43	T	Y	50.43 9.3.1.23.4	The sentence "The Trigger Dependent Common Info field is not present in the MU-RTS frame." should not be a note.	Delete "NOTE --" and adjust font size accordingly in line 43.	2017/1/9 9:42
9835	Young Hoon Kwon	225	1 9.3.1.23.4	50	57	T	Y	50.57 9.3.1.23.4	As it is already mentioned that The RU Allocation subfield in the User Info field addressed to the STA follows the same definition as described in 9.3.1.23, additional explanation is not necessary.	Delete the paragraph (line 57 - 61).	2017/1/9 9:42
9836	Young Hoon Kwon	225	1 9.3.1.23.4	51	15	T	Y	51.15 9.3.1.23.4	The sentence "The Trigger Dependent User Info field is not present in the MU-RTS frame." should not be a note.	Delete "NOTE --" and adjust font size accordingly in line 15.	2017/1/9 9:42
9837	Young Hoon Kwon	225	1 9.3.1.23.7	52	5	T	Y	52.05 9.3.1.23.7	Currently, an AP can set the CS Required subfield to 0 only if the Trigger frame solicits Ack/BA and the length is shorter than some threshold value. As the BQRP does not solicits Ack/BA frame, the CS Required subfield is supposed to be set to 1. Therefore, there's no need to mention this.	Delete the sentence "The CS Required subfield is set to 1.".	2017/1/9 9:42

9838	Young Hoon Kwon	225	1 9.4.1.62	56	45	T	Y	56.45 9.4.1.62	Current spec allows preamble puncturing for DL MU transmission. If an AP is using preamble puncturing for DL MU transmission, it is not clear how to indicate compressed beamforming measurement. Thus, further clarification is needed for BW indication for preamble puncturing.	As in the comment.	2017/1/9 9:42
9839	Young Hoon Kwon	225	1 9.4.1.62	56	47	T	Y	56.47 9.4.1.62	Wrong description. Description for RU End Index is used for describing Sounding Dialog Token Number. Correct it.	As in the comment.	2017/1/9 9:42
9840	Young Hoon Kwon	225	1 9.4.1.63	58	28	T	Y	58.28 9.4.1.63	Wrong equation referral. Correct it.	As in the comment.	2017/1/9 9:42
9841	Young Hoon Kwon	225	1 9.4.2.6	67	57	T	Y	67.57 9.4.2.6	TIM frames and FILS frames may have different meaning depending on the timing of the frame sent, and this make cause wrong interpretation from STAs. For example, if TIM frames or FILS discovery frames are received from an HE non-AP STA that don't support broadcast TWT, these STAs don't know if these frames are at the beginning of a broadcast TWT SP or not, and thus, cannot figure out correct status. It needs further clarification.	Modify the third bullet to "Bit number N in the traffic indication virtual bitmap that corresponds to a broadcast TWT scheduled HE non-AP STA with AID N is determined as follows:".	2017/1/9 9:42
9842	Young Hoon Kwon	225	1 9.4.2.6	68	2	T	Y	68.02 9.4.2.6	The first bullet is wrong. In case an AP schedules for DL transmission, but not intends to schedule UL MU transmission for a STA with bit number N, the AP shall set the bit number N to 1. But, based on current sentence, that bit is set to 0 in this case.	Modify the first bullet to "Bit number N in the traffic indication virtual bitmap is 0 if the AP does not intend to transmit to the STA and does not intend to trigger the STA for an UL MU transmission during the TWT SP and before the next TWT SP.".	2017/1/9 9:42
9843	Young Hoon Kwon	225	1 9.4.2.200	69	63	T	Y	69.63 9.4.2.200	It is not clear the meaning when the Wake TBTT Negotiation subfield is set to 0 or 1. Need further clarification.	As in the comment.	2017/1/9 9:42
9844	Young Hoon Kwon	225	1 9.4.2.200	73	30	E	Y	73.30 9.4.2.200	Typo: STAT -> STA	As in the comment.	2017/1/9 9:42
9845	Young Hoon Kwon	225	1 9.4.2.219	91	39	T	Y	91.39 9.4.2.219	Paragraph in line 39 - 42 needs to be deleted.	Delete the paragraph in line 39 - 42.	2017/1/9 9:42
9846	Young Hoon Kwon	225	1 10.3.2.3.7	114	32	T	Y	114.32 10.3.2.3.7	As the granularity of TXOP_DURATION parameter is coarse and the TXOP_DURATION value shall be less than or equal to actual remaining Duration value, when TXOP_DURATION value expires there's chance that packet transmission under ongoing TXOP duration is still going on, especially for the case that the most recent NAV update is based on TXOP_DURATION with granularity of 128 us. In this case, not invoking EIFS may result in high chance of packet collision. Further clarification is needed.	As in the comment.	2017/1/9 9:42
9847	Young Hoon Kwon	225	1 10.3.2.4	115	8	T	Y	115.08 10.3.2.4	It is not clear how to check if the received PPDU is not triggered by the STA. Need further clarification.	Modify the third bullet in P115L8 to "The RXVECTOR parameter FORMAT is not HE_TRIG or the RXVECTOR parameter BSS_COLOR is different from the BSS Color of the STA.".	2017/1/9 9:42
9848	Young Hoon Kwon	225	1 10.3.2.4a	115	46	T	Y	115.46 10.3.2.4a	Description in this new sub-clause is very vague, and it does not give clear recommended behavior to AP or non-AP STA. Need further clarification.	Describe specific operation for AP and non-AP STA. Or, delete the sub-clause 10.3.2.4a.	2017/1/9 9:42
9849	Young Hoon Kwon	225	1 10.3.2.8a.1	116	3	E	Y	116.03 10.3.2.8a.1	Typo: there are two periods at the end of the sentence.	Delete one period at the end of the sentence.	2017/1/9 9:42
9850	Young Hoon Kwon	225	1 10.3.2.8a.3	117	25	T	Y	117.25 10.3.2.8a.3	As shown in 9.3.1.23.4, the RU Allocation subfield for MU-RTS frame is set to indicate P20/P40/P80/P160/80+80. In other words, once the MU-RTS is received correctly, there's no way that the RU Allocation is set to other values. In this sense, it is meaningless to add the third bullet.	Delete the third bullet.	2017/1/9 9:42
9851	Young Hoon Kwon	225	1 10.3.2.8a.3	117	32	T	Y	117.32 10.3.2.8a.3	In 2.4GHz band, non-HT PPDU may indicate not only Clause 17 PPDU but also other PPDU formats (e.g., 802.11b). So, it's better to clearly mention that the non-HT PPDU here implies Clause 17 PPDU format.	As in the comment.	2017/1/9 9:42
9852	Young Hoon Kwon	225	1 10.3.2.10.1	118	55	E	Y	118.55 10.3.2.10.1	Need a space between transmission and that.	change "transmisstionthat" to "transmission that".	2017/1/9 9:42

9853	Young Hoon Kwon	225	1 10.3.2.10.1	119	9	T	Y	119.09 10.3.2.10.1	Response to an MU-BAR frame shall use a trigger-based PPDU format. Therefore, this is not the case for this sub-clause.	Delete "or MU-BAR frame with multi-TID BAR variant" from the sentence.	2017/1/9 9:42
9854	Young Hoon Kwon	225	1 10.3.2.10.3	121	55	T	Y	121.55 10.3.2.10.3	The case "to whom the STA sent the QoS Data frame(s) with Ack Policy subfield equal to Block Ack" is not for UL MU PPDU transmission. Therefore, it's better to exclude this explanation in this subclause, as this sub-clause describes acknowledgement procedure for UL MU PPDU.	Delete ", to whom the STA sent the QoS Data frame(s) with Ack Policy subfield equal to Block Ack or" from the paragraph.	2017/1/9 9:42
9855	Young Hoon Kwon	225	1 10.7.9	124	25	T	Y	124.25 10.7.9	In 11ac, these are not applicable because these frames don't exist in 5GHz band, but 11ax can be operated in both 2.4GHz and 5GHz. HE STA may also need to support DSSS/ERP format for response frame. So, modulation class for DSSS/ERP-OFDM needs to be defined similar to 11n.	Change "N/A" in "DSSS and HR/DSSS" and "ERP-OFDM" case to the same as conditions in Clause 19.	2017/1/9 9:42
9856	Young Hoon Kwon	225	1 10.9	127	22	T	Y	127.22 10.9	OMI indicates operating mode for both transmit and receive.	Modify the second bullet to "A value of 1 in the Control ID subfield when the transmitting STA changes the receive or transmit operating mode, as described in 27.8 (Operating mode indication).".	2017/1/9 9:42
9857	Young Hoon Kwon	225	1 10.22.2.2	129	23	T	Y	129.23 10.22.2.2	There's no case that an MPDU requires more than one immediate response. In case of MU transmission, more than one MPDUs are carried in a PPDU, but even in case each MPDU may solicit upto 1 immediate response. So, clarification is needed here.	As in the comment.	2017/1/9 9:42
9858	Young Hoon Kwon	225	1 10.22.2.2	130	1	T	Y	130.01 10.22.2.2	The first two paragraphs are acward and meaningless. For example, transmission of a frame using trigger based PPDU is not a case for events that a STA invokes backoff procedure. (For example it is not within the conditions a) - f) shown in 10.22.2.2 of the baseline spec.). Also, it is not a case for a slot boundary. (For example, it is not within the conditions a) - f) shown in 10.22.2.4 of the baseline spec.). Therefore, based on baseline procedure, there's nothing supposed to happen in terms of backoff counter even under current baseline spec. These two paragraphs only makes confusion without having any additional clarification.	Delete the first two paragraphs or make clarification.	2017/1/9 9:42
9859	Young Hoon Kwon	225	1 10.22.2.2	130	11	T	Y	130.11 10.22.2.2	This is not appropriate sub-clause for describing the retry counter issue.	Move the paragraph to appropriate part in sub-clause 10.22.2.11.	2017/1/9 9:42
9860	Young Hoon Kwon	225	1 10.22.2.6	131	34	T	Y	131.34 10.22.2.6	As described in P131L27, this mode applies only to an AP that supports MU transmission. However, sub-clause 27.10.4 is not related with MU transmission. In this sense, this is a wrong reference.	Change the reference to an appropriate sub-clause.	2017/1/9 9:42
9861	Young Hoon Kwon	225	1 10.22.2.8	132	64	T	Y	132.64 10.22.2.8	Multiple HE trigger-based PPDU can be sent as long as all the trigger-based PPDUs are sent as immediate response to same Trigger frame. Need further clarification	As in the comment.	2017/1/9 9:42
9862	Young Hoon Kwon	225	1 10.22.2.8	133	5	E	Y	133.05 10.22.2.8	Missing article.	Trigger frame -> A Trigger frame	2017/1/9 9:42
9863	Young Hoon Kwon	225	1 10.22.2.10	133	47	T	Y	133.47 10.22.2.10	In 10.22.2.10 of the baseline spec., rule fortermination of TXOP is defined for all PPDU format cases. Here, a TXOP holder should transmit a short control frame as the final transmission in a TXOP to prevent 3rd party STA from invoking EIFS. However, in HE PPDU case, as the TXOP_DURATION is indicated in the PHY header, there's no reason to have this rule unless TXOP_DURATION field is set to all 1s. Clarification is needed for TXOP termination rule for HE PPDU format.	As in the comment.	2017/1/9 9:42

9864	Young Hoon Kwon	225	1 10.24.10.3	134	24	T	Y	134.24 10.24.10.3	It is not clear if both MU-BAR and GCR MU-BAR are allowed to request BA for GCR frames. If MU-BAR can be used, why GCR MU-BAR is additionally defined? Need further clarification.	As in the comment.	2017/1/9 9:42
9865	Young Hoon Kwon	225	1 10.28.3	136	50	T	Y	136.50 10.28.3	Non-HE STA does not solicit Multi-STA BlockAck as it is newly defined in 11ax. Therefore, if this rule is applied only to non-HE STA, we don't need to mention Multi-STA BlockAck. Also, if we define a rule for non-HE RD initiator, we also need to define a rule for HE RD initiator.	As in the comment.	2017/1/9 9:42
9866	Young Hoon Kwon	225	1 10.28.4	137	11	T	Y	137.11 10.28.4	Description is needed in case the last frame received from the RD initiator is Multi-TID A-MPDU.	As in the comment.	2017/1/9 9:42
9867	Young Hoon Kwon	225	1 10.43.1	137	42	T	Y	137.42 10.43.1	Currently TWT setup frame is defined under S1G Action frame. However, as TWT is going to be used not only for S1G STA but also for HE STA, it's better to categorize TWT setup frame in other way.	As in the comment.	2017/1/9 9:42
9868	Young Hoon Kwon	225	1 11.1.3.10	141	38	T	Y	141.38 11.1.3.10	When Beacon frames are transmitted in two PHY formats, it says one of the format shall be non-HE format. However, as baseline spec. says the beacon frame to be carried in non-HE (duplicate) format, it shall be non-HT format instead of non-HE format.	As in the comment.	2017/1/9 9:42
9869	Young Hoon Kwon	225	1 11.2.2.6	142	36	T	Y	142.36 11.2.2.6	In baseline spec., there's no More Data Ack subfield in the QoS Info field of a frame when sent by an AP. Further clarification is needed.	As in the comment.	2017/1/9 9:42
9870	Young Hoon Kwon	225	1 11.2.2.17	143	48	T	Y	143.48 11.2.2.17	One Broadcast TWT element can have multiple broadcast TWT schedules. Therefore, even in case there'sa Broadcast TWT element included in a Beacon frame, its scheduled access can be modified at any time. In this sense, any change/modification in Broadcast TWT element may be considered as a critical update.	Change the item n) to "Inclusion or modification of a Broadcast TWT element"	2017/1/9 9:42
9871	Young Hoon Kwon	225	1 11.2.2.17	143	49	T	Y	143.49 11.2.2.17	Similar to item l), modification of the HE Operation element needs to be considered as a critical update	At the end of the paragraph, add another bullet that says "Modification of the HE Operation element".	2017/1/9 9:42
9872	Young Hoon Kwon	225	1 27.2.1	150	13	T	Y	150.13 27.2.1	A non-AP HE STA can transmit HE MU PPDU. Therefore, receiving an HE MU PPDU by an HE AP does not guarantee that the received frame is an inter-BSS frame. Moreover, if an HE AP receives an HE MU PPDU, it can check if the received frame is an inter/intra-BSS frame by RXVECTOR BSS_COLOR, which is already mentioned in the first bullet. Therefore, adding HE MU PPDU does not need to be added here.	Delete "or an HE MU PPDU" in the last bullet.	2017/1/9 9:42
9873	Young Hoon Kwon	225	1 27.2.1	150	16	T	Y	150.16 27.2.1	If a received frame is considered to be intra-BSS frame based on the RXVECTOR parameter PARTIAL_AID, it is possible that the STA can determine that the frame is an inter-BSS frame based on the MAC address. This case needs to be clarified, too.	Modify the sentence in P150L16 to "If the received frame satisfies both intra-BSS and inter-BSS conditions, the decision made by using the MAC address takes precedence over the decision made by using the RXVECTOR parameter BSS_COLOR or PARTIAL_AID.".	2017/1/9 9:42

9874	Young Hoon Kwon	225	1 27.2.2	151	20	T	Y	151.20 27.2.2	It is not limited to the case of receiving an HE trigger-based PPDU triggered by the STA. For example, if an AP transmits an HE extended-range SU PPDU and expecting a response frame in the HE extended-range SU PPDU, the AP shall not update intra-BSS NAV by the response frame (even if the AP fails to decode the payload). Therefore, if the STA is a TXOP holder and receives an intra-BSS frame without any valid payload, the STA shall update the intra-BSS NAV based on the RXVECTOR parameter TXOP_DURATION. Clarification is needed.	As in the comment.	2017/1/9 9:42
9875	Young Hoon Kwon	225	1 27.4.1	157	21	E	Y	157.21 27.4.1	There's open paranthesis.	Modify the sentence to "... (see 10.24.7.1 (Introduction))."	2017/1/9 9:42
9876	Young Hoon Kwon	225	1 27.4.1	157	29	T	Y	157.29 27.4.1	Clarification is needed in case the AP is a member of multi-BSSID set.	As in the comment.	2017/1/9 9:42
9877	Young Hoon Kwon	225	1 27.4.1	157	45	T	Y	157.45 27.4.1	The sentence "An HE non-AP STA shall transmit a Multi-STA BlockAck frame with a single AID subfield or with the same values of the AID subfield in Per STA Info subfields and shall set the RA field to the address of the recipient STA that requested the Block Ack frame." is misleading because in P157L28 already mentioned that "An HE non-AP STA that sends a Multi-STA BlockAck frame shall set the AID subfield in the Per STA Info field of the Multi-STA BlockAck frame to 0 and the RA field to the BSSID when the intended receiver of the frame is the AP.". So, delete this sentence or clarification is needed.	As in the comment.	2017/1/9 9:42
9878	Young Hoon Kwon	225	1 27.4.1	157	48	T	Y	157.48 27.4.1	What does "each received Multi-STA" mean? Clarification is needed.	As in the comment.	2017/1/9 9:42
9879	Young Hoon Kwon	225	1 27.4.2	158	36	T	Y	158.36 27.4.2	As it is a single MPDU, it shall not be a plural.	Modify the sentence to "... and the TID field to the TID value of that MPDU to indicate ...".	2017/1/9 9:42
9880	Young Hoon Kwon	225	1 27.4.2	159	5	T	Y	159.05 27.4.2	Not sure what does "each received Multi-STA BlockAck frame" mean. For a soliciting PPDU, there's only one Multi-STA BlockAck frame available. However, the Multi-STA BlockAck frame may include multiple Per STA Info field. Clarification is needed.	As in the comment.	2017/1/9 9:42
9881	Young Hoon Kwon	225	1 27.4.2	159	8	T	Y	159.08 27.4.2	The last paragraph is identical to the description shown in sub-clause 27.4.1 (P157L49), and it does not give any additional information. Also, the second and third bullets of this paragraph is not organized properly. It's better to delete this paragraph.	Delete the last paragraph of the sub-clause 27.4.2.	2017/1/9 9:42
9882	Young Hoon Kwon	225	1 27.4.3	159	34	T	Y	159.34 27.4.3	The first two sub bullets are confusing. In case the negotiated buffer size is within [1, 64] which is also within [1, 256], the first sub bullet says it shall use bitmap size of 64, but the second sub bullet sais to use either 64 or 256. Clarification is needed. The same thing applies to the Multi-STA BlockAck frame case. Clarification is needed.	As in the comment.	2017/1/9 9:42
9883	Young Hoon Kwon	225	1 27.4.4.2	160	58	T	Y	160.58 27.4.4.2	It's better to further describe that this this rule is applied for the case that the AP solicts immediate response in SU format.	Modify the text to "A non-AP STA that receives a DL MU PPDU that solicits an immediate response in SU PPDU format shall follow the following acknowledgment procedure:".	2017/1/9 9:42
9884	Young Hoon Kwon	225	1 27.4.4.3	161	16	T	Y	161.16 27.4.4.3	It's better to further describe that this this rule is applied for the case that the AP solicts immediate response in HE trigger-based format.	Modify the text to "A non-AP STA that receives a DL MU PPDU that solicits an immediate response in an HE trigger-based PPDU format shall follow the following acknowledgment procedure:".	2017/1/9 9:42

9885	Young Hoon Kwon	225	1 27.4.4.3	161	20	T	Y	161.20 27.4.4.3	In case of a S-MPDU context, isn't it possible to have Trigger frame in the A-MPDU? Maybe not.	Modify the sentence of bullet 1) to "If the DL MU PPDU carries a S-MPDU intended to it that solicits an immediate response, and an UL MU Response Scheduling A-Control field is present, ...".	2017/1/9 9:42
9886	Young Hoon Kwon	225	1 27.4.4.3	161	22	T	Y	161.22 27.4.4.3	For bullets 2) and 3), it's better to mention a non-AP STA's behavior when the STA didn't receive Trigger frame correctly.	As in the comment.	2017/1/9 9:42
9887	Young Hoon Kwon	225	1 27.4.4.4	161	51	T	Y	161.51 27.4.4.4	In bullet 2), Multi-STA BlockAck frame has two different cases: TID set to 14 with Ack Type 1, and Ack Type 0. However, in bullet 3) it just says Multi-STA BlockAck without having any details. It would be better for bullet 2) and bullet 3) to have same level of description.	Modify the sentence of bullet 3) to "... then the HE AP shall send a Multi-STA BlockAck frame with the Ack Type field set to 1 and the TID field set to 14 or a Multi-STA BlockAck frame with the Ack Type field set to 0 carried in a DL SU PPDU format.".	2017/1/9 9:42
9888	Young Hoon Kwon	225	1 27.4.4.5	162	26	E	Y	162.26 27.4.4.5	Double periods.	Change ".." to ".".	2017/1/9 9:42
9889	Young Hoon Kwon	225	1 27.5.1.1	162	44	T	Y	162.44 27.5.1.1	What does "allocating spatial streams to more than one recipient STA" mean? Poor description, and needs rewriting.	As in the comment.	2017/1/9 9:42
9890	Young Hoon Kwon	225	1 27.5.1.1	162	53	T	Y	162.53 27.5.1.1	This sub-clause is for HE DL MU operation, however, the padding procedure shown in 27.10.3 is for HE UL MU operation. Therefore, the padding procedure mentioned here is irrelevent. Need further clarification.	As in the comment.	2017/1/9 9:42
9891	Young Hoon Kwon	225	1 27.5.1.1	162	57	T	Y	162.57 27.5.1.1	DL OFDMA With MIMO Support field is not defined in HE Capabilities element. Need definition for it.	As in the comment.	2017/1/9 9:42
9892	Young Hoon Kwon	225	1 27.5.1.3	163	29	T	Y	163.29 27.5.1.3	It is not clear how to obtain the channel availability information for each 20MHz, especially for unsolicited BQR case. For example, how to measure and when to measure the channel availability for each 20MHz is not clear. It needs further clarification.	As in the comment.	2017/1/9 9:42
9893	Young Hoon Kwon	225	1 27.5.1.3	163	43	T	Y	163.43 27.5.1.3	When a STA receives a BQRP variant Trigger frame which does not schedule an RU for the STA, it is not clear if the STA shall participate random access or not. Need further clarification.	As in the comment.	2017/1/9 9:42
9894	Young Hoon Kwon	225	1 27.5.2.1	164	24	T	Y	164.24 27.5.2.1	Class A/B is not limited to an UL OFDMA PPDU. It can be applied HE trigger-based PPDU including not only OFDMA but also MU-MIMO cases.	Modify the last paragraph of 27.5.2.1 to " A STA transmitting an UL trigger-based PPDU shall operate as either ...".	2017/1/9 9:42
9895	Young Hoon Kwon	225	1 27.5.2.2.1	164	46	E	Y	164.46 27.5.2.2.1	Double periods.	Change ".." to ".".	2017/1/9 9:42
9896	Young Hoon Kwon	225	1 27.5.2.2.1	165	27	T	Y	165.27 27.5.2.2.1	This sentence is somewhat misleading. An AP shall ensure that the duration from the end of the User Info field to the end of the PPDU shall be longer than the maximum MinTrigProcTime value. However, how to achieve this is an AP's implementation issue, such as using EOF padding, Trigger frame padding, or both, etc. Therefore, it is not appropriate to mention that the AP shall apply the Trigger Frame MAC Padding field with duration corresponding to the longest value among all STAs... Further clarification is needed.	As in the comment.	2017/1/9 9:42
9897	Young Hoon Kwon	225	1 27.5.2.2.1	165	31	T	Y	165.31 27.5.2.2.1	How to determine the padding size for RU that is used for random access? As RU for random access channel is supposed to be located at the end of the Trigger frame, and any STA can utilize the RU for random access, additional padding requirement for random access channel seems to be more critical. For this purpose, an AP may need to indicate duration of Trigger frame MAC Padding that it provides in case random access RU is allocated, or non-AP STA's behavior may need to be defined in case the padding duration is not enough for a STA to transmit using random access channel.	As in the comment.	2017/1/9 9:42

9898	Young Hoon Kwon	225	1 27.5.2.2.2	166	10	T	Y	166.10 27.5.2.2.2	How about Trigger Dependent Common Info subfield? For example, if an AP sends GCR MU-BAR Trigger frame and MU-BAR Trigger frame together, it is not sure how to set the Trigger Dependent Common Info subfield of MU-BAR frame.	Change the txt "except the Trigger Type subfield," to "except the Trigger Type subfield and Trigger Dependent Common Info subfield,".	2017/1/9 9:42
9899	Young Hoon Kwon	225	1 27.5.2.2.2	167	6	T	Y	167.06 27.5.2.2.2	This sentence is not in line with sentence shown in P49L1, which says "The value in the TID Aggregation Limit subfield in Trigger frame is less than or equal to the value indicated in the Multi-TID Aggregation Support field in the HE Capabilities element". In my opinion, the text shown in P167L6 makes more sense than the other one. Anyway, further clarification is needed.	As in the comment.	2017/1/9 9:42
9900	Young Hoon Kwon	225	1 27.5.2.2.2	167	15	T	Y	167.15 27.5.2.2.2	The sentence is not written correctly.	Change the sentence to "The AP may assign any value defined in Table 9-25i (Preferred AC subfield encoding) in the Preferred AC subfield for an HE STA that the AC Preference level subfield in the Trigger Dependent User Info field is set to 1 and is identified by the AID12 subfield of the User Info field of a Basic Trigger frame.".	2017/1/9 9:42
9901	Young Hoon Kwon	225	1 27.5.2.2.3	167	25	T	Y	167.25 27.5.2.2.3	First of all, wrong sub-clause number: it should be 10.22.2.7 instead of 9.22.2.7. Moreover, sub-clause 10.22.2.7 describes overall multiple frame transmission in an EDCA TXOP that includes successful transmission cases and also unsuccessful transmission cases that requires anoher backoff or PIFS recovery. Therefore, by just mention that the same procedure is applied does not give clear description. More specifically, when an AP receives an immediate response with at least on MPDU from at least one STA solicited by a Trigger frame, it should be considered as "completion of the immediately preceding frame exchange sequence" in the context shown in 10.22.2.7. So, further description is needed.	As in the comment.	2017/1/9 9:42
9902	Young Hoon Kwon	225	1 27.5.2.2.3	167	30	E	Y	167.30 27.5.2.2.3	Wrong sub-clause number	9.22.2.2 -> 10.22.2.2	2017/1/9 9:42
9903	Young Hoon Kwon	225	1 27.5.2.2.3	167	30	T	Y	167.30 27.5.2.2.3	This sentence is not true if the AP sends more than one Trigger frame in a PPDU. For example, if the AP sends two Trigger frames and received immediate trigger-based PPDU in response to only one Trigger frame, even if the AP does not receive an immediate response with at least one MPDU from at least one STA solicited by a Trigger frame, its transmission is not failure. Further clarification is needed.	As in the comment.	2017/1/9 9:42
9904	Young Hoon Kwon	225	1 27.5.2.3	167	54	T	Y	167.54 27.5.2.3	Transmitting a trigger-based PPDU using random access resource is also available. Need further descriiption on this.	As in the comment.	2017/1/9 9:42
9905	Young Hoon Kwon	225	1 27.5.2.3	168	8	T	Y	168.08 27.5.2.3	27.2.2 does not describe rule on how to set TXOP_DURATION value.Need further clarification	As in the comment.	2017/1/9 9:42
9906	Young Hoon Kwon	225	1 27.5.2.3	168	46	E	Y	168.46 27.5.2.3	"shall be set to" is mentioned twice in a sentence	Delete one of "shall be set to" in the sentence	2017/1/9 9:42
9907	Young Hoon Kwon	225	1 27.5.2.3	168	51	E	Y	168.51 27.5.2.3	"shall be set to" is mentioned twice in a sentence	Delete one of "shall be set to" in the sentence	2017/1/9 9:42
9908	Young Hoon Kwon	225	1 27.5.2.3	169	23	T	Y	169.23 27.5.2.3	27.2.2 does not describe rule on how to set TXOP_DURATION value.Need further clarification	As in the comment.	2017/1/9 9:42
9909	Young Hoon Kwon	225	1 27.5.2.3	169	29	T	Y	169.29 27.5.2.3	It is not clear how to set TXVECTOR HE_SIGA_RESERVED as UL MU Response Scheduling A-Control subfield does not include this information. Needs clarification	As in the comment.	2017/1/9 9:42

9910	Young Hoon Kwon	225	1 27.5.2.3	169	18	T	Y	169.18 27.5.2.3	In case of SR_Disallowed setting, only SRP-based spatial reuse is disallowed, which implies that OBSS_PD based SR operation is still allowed. As NDP frame is used for channel measurement, not only SRP based spatial reuse but also OBSS_PD based spatial reuse shall be disallowed. In this sense, it's better to set to "SR_delayed" as no spatial reuse operation will be allowed during the PPDU duration.	Change the sentence to "SPATIAL_REUSE shall be set to the value indicating SR_Delayed".		2017/1/9 9:42
9911	Young Hoon Kwon	225	1 27.5.2.4	170	23	T	Y	170.23 27.5.2.4	In sub-clause 21.3.18.5.2, ED-based CCA channel status decision is made for channels of Primary 20MHz, Secondary 20MHz, Secondary 40MHz, and Secondary 80MHz only. However, for trigger-based PPDU transmission, the ED-based CCA channel status decision needs to be done only for those 20MHz channels thar RU is assigned for a STA. Therefore, we cannot just follow ED-based CCA rule defined in 21.3.18.5.2. Further clarification is needed.	As in the comment.		2017/1/9 9:42
9912	Young Hoon Kwon	225	1 27.5.2.4	170	29	T	Y	170.29 27.5.2.4	It is misleading. For a STA that is solicited by a Trigger frame needs to consider NAV if CS_Required bit is set to 1 in the Trigger frame and will not consier NAV if CS_Required bit is set to 0. So, the first bullet should be th AP's behavior on when to set the CS_Required bit to 1.	Change the first bullet to "The CS Required subfield in the Trigger frame is set to 1."		2017/1/9 9:42
9913	Young Hoon Kwon	225	1 27.5.2.4	170	31	T	Y	170.31 27.5.2.4	This is wrong. The STA may ignore intra-NAV but still needs to repect basic NAV. Therefore, even though NAV was set by an intra-BSS frame (intra-NAV is set), if there's non-zero basic NAV, the STA shall consider NAV.	Change the second bullet to "The basic NAV has non-zero value.".		2017/1/9 9:42
9914	Young Hoon Kwon	225	1 27.5.2.4	170	37	T	Y	170.37 27.5.2.4	It needs further clarification that even though virtual CS is busy, the STA is allowed to transmit if basic NAV is zero.	As in the comment.		2017/1/9 9:42
9915	Young Hoon Kwon	225	1 27.5.2.5	171	19	T	Y	171.19 27.5.2.5	As reporting the buffer status for a given TID in the Queue Size subfield is a mandatory feature, bit 4 of QoS Control field shall be set to 1, which implies that bits 8-15 of the QoS Control field represents Queue Size.	At the end of the 2nd paragraph of 10.13.1, add the following text: "HE non-AP STA shall set the bit 4 to1 across all MPDUs that contain the Qos Control fields."		2017/1/9 9:42
9916	Young Hoon Kwon	225	1 27.5.2.5	171	57	T	Y	171.57 27.5.2.5	When a STA receives a BSRP variant Trigger frame which does not schedule an RU for the STA, it is not clear if the STA shall participate random access or not. Need further clarification.	As in the comment.		2017/1/9 9:42
9917	Young Hoon Kwon	225	1 27.5.2.5	172	6	T	Y	172.06 27.5.2.5	If the AP does not support the A-BSR Support subfield, it shall not send BSRP variant Trigger frame. Therefore, "when the AP indicated its support..." is meaningless.	Delete "when the AP has indicated its support in the A-BSR Support subfield of its HE Capabilities element" in the second sub-bullet.		2017/1/9 9:42
9918	Young Hoon Kwon	225	1 27.5.2.6.2	173	30	T	Y	173.30 27.5.2.6.2	What does "initial HE trigger-based PPDU transmission" mean? If this implies the first HE trigger-based PPDU transmission within a TXOP of the serving AP, it means that OCW is reset for every TXOP, which may not be the preferred operation. Further clarification is needed.	As in the comment.		2017/1/9 9:42
9919	Young Hoon Kwon	225	1 27.5.2.6.2	173	36	T	Y	173.36 27.5.2.6.2	It is not clear if an HE STA is allowed to participate in random access procedure even in case the HE STA does not have anything to transmit. For example, if the HE STA keeps decreasing the OBO counter by participating random access procedure even in case the STA does not have anything to transmit, the STA may get advantage when the STA has something to transmit because the STA may use smaller OBO counter value. This is a cheating and shouldn't be allowed. Further clarification is needed.	As in the comment.		2017/1/9 9:42

9920	Young Hoon Kwon	225	1 27.5.2.7	174	24	T	Y	174.24 27.5.2.7	APs and non-AP STAs behavior for NDP feedback report procedure shall be defined clearly.	As in the comment.	2017/1/9 9:42
9921	Young Hoon Kwon	225	1 27.5.3	174	37	T	Y	174.37 27.5.3	Definition of a cascading sequence of MU PPDUs in a TXOP is not clear. It says "allowing alternating HE MU PPDUs and HE trigger-based PPDUs starting with an HE MU PPDU in the same TXOP". If this defines the cascaded sequence, DL MU transmission that solicits immediate response is also a cascading sequence as it has the sequence of DL MU PPDU followed by UL trigger based PPDU. If this is the case, DL MU transmission that solicits immediate response is allowed only if MU Cascading Support field in the HE Capabilities element is set to 1, which does not make sense. Further clarification is needed.	As in the comment.	2017/1/9 9:42
9922	Young Hoon Kwon	225	1 27.5.3	175	32	T	Y	175.32 27.5.3	In P174L37, it says "alternating HE MU PPDUs and HE trigger-based PPDUs starting with an HE MU PPDU in the same TXOP". It implies that cascading sequence starts from DL MU PPDU. However, in P175L33, it says "An HE MU PPDU transmitted by the AP a SIFS after an HE trigger-based PPDU has the following AMPDU contents", which implies that DL MU PPDU follows UL trigger-based PPDU. These two sentences are not clearly in line with each other. Further clarification is needed.	As in the comment.	2017/1/9 9:42
9923	Young Hoon Kwon	225	1 27.6.2	176	17	T	Y	176.17 27.6.2	Does this mean that an HE STA is not allowed to initiate VHT sounding sequnce? Further clarification is needed.	Modify the text to "The HE beamformer shall initiate an HE sounding sequence by transmitting an HE NDP Announcement frame followed by an HE NDP after a SIFS.".	2017/1/9 9:42
9924	Young Hoon Kwon	225	1 27.6.2	176	30	T	Y	176.30 27.6.2	If the NDPA frame has only one STA Info field, Ng, codebook, and Nc subfield in NDPA frame shall be reserved.	Insert the following text at the end of 9,3,1,20: "If the HE NDP Announcement frame contains only one STA Info field, Feedback Type and Ng subfield and Nc subfield are reserved.".	2017/1/9 9:42
9925	Young Hoon Kwon	225	1 27.6.2	177	1	T	Y	177.01 27.6.2	There's no separate Ng field. And, current Feedback Type and Ng subfield includes available Ng values for MU type feedback to be 4 and 16 only. Therefore, this sentence does not have any meaning.	Delete the text "An HE beamformer that sets the Feedback Type subfield of the STA Info field to MU shall set the Ng field value in the STA Info field of the HE NDP Announcement frame to either 0 (for Ng = 4) or 1 (for Ng = 16).".	2017/1/9 9:42
9926	Young Hoon Kwon	225	1 27.6.2	177	26	T	Y	177.26 27.6.2	Channel width information in Operation Mode Notification frame also needs to be considered for both starting RU index and ending RU index, similar to second bullet in P176L50.	As in the comment.	2017/1/9 9:42
9927	Young Hoon Kwon	225	1 27.6.2	177	35	T	Y	177.35 27.6.2	There's no separate Ng field. Also, as shown in Table 9-25a, Feedback Type and Ng subfield and Codebook Size subfield are jointly encoded. Therefore, it's better to say that these two subfields are reserved in an HE NDPA frame has only one STA Info field.	As in the comment.	2017/1/9 9:42
9928	Young Hoon Kwon	225	1 27.6.2	178	12	T	Y	178.12 27.6.2	In Figure 27-4, the brace on the bottom (saying "0..N times") shall include SIFS in front of the Trigger.	Modify the figure as in the comment	2017/1/9 9:42
9929	Young Hoon Kwon	225	1 27.6.2	178	32	T	Y	178.32 27.6.2	Also, CQI-only feedback needs to be added.	As in the comment.	2017/1/9 9:42
9930	Young Hoon Kwon	225	1 27.6.4	179	37	T	Y	179.37 27.6.4	By definition there's no PSDU in an NDP frame. Therefore, there's no TA/RA/SA/DA for the NDP frame. I don't understand what does "destination" or "source" of an HE NDP imply in these two sentences. Considering spec. text shown in baseline spec., these two sentences do not have any information.	Delete the last two paragraphs in 27.6.4.	2017/1/9 9:42

9931	Young Hoon Kwon	225	1 27.7.2	180	18	T	Y	180.18 27.7.2	It is not clear what "shall negotiate individual TWT agreements" mean if TWT Required subfield is set to 1. Negotiation does not imply active individual TWT agreement. For example, during the negotiation, it is possible that responding STA may not Accept TWT. So, further clarification is needed on what each STA needs to do if TWT Required subfield is set to 1.	As in the comment.		2017/1/9 9:42
9932	Young Hoon Kwon	225	1 27.7.2	180	41	T	Y	180.41 27.7.2	Definition of trigger enabled TWT may need to be present before its description, or at least reference number for operation on trigger enabled TWT may need to be inserted here.	As in the comment.		2017/1/9 9:42
9933	Young Hoon Kwon	225	1 27.7.2	181	14	T	Y	181.14 27.7.2	What will be TWT requesting STA's behavior for trigger-enabled TWT SP which is an announced TWT SP? Transmission of PS-Poll or APSD trigger frame is considered as initiating transmission of frames, current texts may not be well in line with each other. Further clarification is needed.	As in the comment.		2017/1/9 9:42
9934	Young Hoon Kwon	225	1 27.7.2	182	6	T	Y	182.06 27.7.2	Event shown in 1) only implies that the AP will not schedule any UL MU transmission during remaining TWT SP, and it does not give any information on DL transmission. Therefore, the event 1) does not prohibit an AP from sending DL transmission during the TWT SP. Then, it is not sure how can a STA go to doze state with event 1)? Further clarification is needed.	As in the comment.		2017/1/9 9:42
9935	Young Hoon Kwon	225	1 27.7.3.3	185	55	T	Y	185.55 27.7.3.3	Event shown in 1) only implies that the AP will not schedule any UL MU transmission during remaining TWT SP, and it does not give any information on DL transmission. Therefore, the event 1) does not prohibit an AP from sending DL transmission during the TWT SP. Then, it is not sure how can a STA go to doze state with event 1)? Further clarification is needed.	As in the comment.		2017/1/9 9:42
9936	Young Hoon Kwon	225	1 27.7.3.3	185	62	T	Y	185.62 27.7.3.3	The last sentence should be written as the third event for termination. Therefore, it should be enumerated as 3). Also, "TWT responding STA" need to be changed to "TWT scheduling STA".	As in the comment.		2017/1/9 9:42
9937	Young Hoon Kwon	225	1 27.8.2	189	8	E	Y	189.08 27.8.2	Wrong grammar.	Modify the sentence to "After transmitting an immediate acknowledgement for the frame containing the OMI A-Control field, ...".		2017/1/9 9:42
9938	Young Hoon Kwon	225	1 27.8.3	189	26	T	Y	189.26 27.8.3	Main purpose of including Tx NSS in OMI is to use less number of Tx RF chains for power savings. However, different from Rx NSS, the number of Tx RF chains is more closely related with the number of space-time streams (N_STS) compared to the number of spatial streams (N_SS). For example, even in case a STA indicates Tx NSS to be 1, an serving AP can still allocate the STA single spatial stream with STBC, which requires at least two transmit RF chains to be turned on. Because this is still possible, even if a STA supporting STBC indicates Tx NSS = 1 to the serving AP, the STA shall have at least two Tx RF chains on, which defeats the original purpose of having Tx NSS subfield in OMI. For this issue, a simple remedy is to change Tx NSS subfield to indicate the maximum number of space-time streams (N_STS) and modify the related operation accordingly.	As in the comment.		2017/1/9 9:42

9939	Young Hoon Kwon	225	1 27.8.3	189	54	T	Y	189.54 27.8.3	This bullet is misleading. For example, if an OMI initiator sets the Channel Width to 20MHz, and the serving AP allocates this STA for UL trigger-based PPDU transmission for RU size that is less than 20MHz but is in the secondary 20MHz channel (let us assume that the trigger frame is carried in non-HT duplicated frame and the STA received only the primary 20MHz channel), the STA may not be available to transmit the frame unless the STA switches its transmission center frequency during SIFS time, which is not a normal operation. So, further clarification is needed.	As in the comment.		2017/1/9 9:42
9940	Young Hoon Kwon	225	1 27.9.2.1	190	50	T	Y	190.50 27.9.2.1	Is it a sub-cluase name? If this is an sub-clause name, make it as a sub-clause name. If not, delete this sentence.	As in the comment.		2017/1/9 9:42
9941	Young Hoon Kwon	225	1 27.9.2.1	190	53	T	Y	190.53 27.9.2.1	In case of SR delay, as the PHYCCARESET.request primitive is issued at the end of the PPDU, it is quite straight-forward that a STA may resume its backoff procedure after the end of the PPDU if CCA is idle. This is also described in the last paragraph in page 190 again. Therefore, this sentence does not give any further information and is just redundant. It's better to delete this sentence. Same thing goes to following "NOTE".	As in the comment.		2017/1/9 9:42
9942	Young Hoon Kwon	225	1 27.9.2.1	190	59	T	Y	190.59 27.9.2.1	To make the process clearer, it's better to mention one step further details. For example, when PHY sublayer receives a PHY-CCARESET.request frimitive and performs CCA, the PHY sublayer sends PHY-CCARESET.confirm primitive before sending PHY-CCA.indication primitive.	Modify the paragraphs to "If an HE STA's MAC sublayer issues a PHY-CCARESET.request primitive and not update its NAV timer as allowed above, the HE STA's PHY sublayer issues a PHY-CCARESET.confirm primitive and the HE STA may resume its backoff procedure when the medium condition is IDLE as defined in 10.22.2.2 (EDCA backoff procedure).".		2017/1/9 9:42
9943	Young Hoon Kwon	225	1 27.9.2.1	190	48	T	Y	190.48 27.9.2.1	3dB deboost needs to be considered not only for OBSS_PD based spatial reuse but also for SRP-based spatial reuse. Further clarification is needed.	As in the comment.		2017/1/9 9:42
9944	Young Hoon Kwon	225	1 27.9.2.2	191	62	T	Y	191.62 27.9.2.2	There's no description on OBSS_PD_{min/max_default}. Please clarifiy these variables.	As in the comment.		2017/1/9 9:42
9945	Young Hoon Kwon	225	1 27.9.2.2	192	1	T	Y	192.01 27.9.2.2	the term "antenna connector" is used quite many times throughout the spec. without any confusion. Thus, this NOTE is meaningless.	Delete the sentence.		2017/1/9 9:42
9946	Young Hoon Kwon	225	1 27.9.2.2	192	11	T	Y	192.11 27.9.2.2	TXPWR_max is unconstraind if OBSS_PD_level is equal to or less than OMBSS_PD_min.	Change the condition for unconstrained case of equation 27-1 as "if OBSS_PD_{level} <= OBSS_PD_{min}".		2017/1/9 9:42
9947	Young Hoon Kwon	225	1 27.9.2.2	192	20	T	Y	192.20 27.9.2.2	If a STA regards an inter-BSS PPDU as not having been received at all using a specific transmission power and resumes backoff process, it is not clear if the STA is allowed to increase the transmission power. If the increase of the transmission power is allowed, the STA may use the lowest transmission power during the backoff process to have more chance of SR transmission and then increases the transmission power right before the backoff reaches zero. This may give unfair competition and shall not be allowed. Further clarification is needed.	As in the comment.		2017/1/9 9:42
9948	Young Hoon Kwon	225	1 27.10.4	194	26	T	Y	194.26 27.10.4	Clarification is needed in case the soliciting Trigger frame is not the Basic Trigger variant.	As in the comment.		2017/1/9 9:42

9949	Young Hoon Kwon	225	1 27.10.4	195	6	T	Y	195.06 27.10.4	Not sure the difference between this paragraph and the previous paragraph. In other words, when "should" is used and when "may" is used for the same Trigger frame setting. Further clarification is needed, or delete this paragraph.	As in the comment.	2017/1/9 9:42
9950	Young Hoon Kwon	225	1 27.10.4	195	12	T	Y	195.12 27.10.4	This sentence is somewhat misleading. The aggregation rule depends on Preferred AC subfield and AC Preference Level subfield. But, this sentence just generalize the aggregation rule. Therefore, without further clarification, this sentence only makes the non-AP STA's behaviour vague and unclear. Further clarification is needed.	As in the comment.	2017/1/9 9:42
9951	Young Hoon Kwon	225	1 27.10.4	195	15	T	Y	195.15 27.10.4	This sentence is duplicate with paragraph in P194L51.	Delete the sentence in P195L15.	2017/1/9 9:42
9952	Young Hoon Kwon	225	1 27.10.4	195	26	T	Y	195.26 27.10.4	This sentence is misleading. The behaviour mentioned is under the condition that AC Preference Level subfield is set to 1.	Modify the sentence to "An HE STA with dot11AMPDUwithMultipleTIDOptionImplemented set to false should select any one of the TID value within the AC value indicated in the Preferred AC subfield if AC Preference Level subfield is 1 in the Trigger Dependent User Info field of a Basic Trigger variant Trigger frame.".	2017/1/9 9:42
9953	Young Hoon Kwon	225	1 27.11.4	197	27	T	Y	197.27 27.11.4	Not clear what "The HE non-AP STA may use the BSS color" means. Does this imply that the HE non-AP STA may include the BSS color in its own HE PPDU transmission? Or, does this imply the STA may update intra-BSS NAV or go to power save mode when the STA receives a PPDU with the BSS color? More clarification is needed.	As in the comment.	2017/1/9 9:42
9954	Young Hoon Kwon	225	1 27.11.6	198	22	T	Y	198.22 27.11.6	There are 16 entries in SPATIAL_REUSE parameter. However, only 1 entry (SR_Delay or SR_Restricted) in this sub-clause. And, there's no description for other entries throughout this draft spec. It needs further clarification on when to use and how to use other entries.	As in the comment.	2017/1/9 9:42
9955	Young Hoon Kwon	225	1 27.13	199	60	T	Y	199.60 27.13	There's no description on how link adaptation using the HE variant HT Control field works. For example, it is not clear when to send the feedback, how to figure out the reference frame for the measurement, etc. Further clarification is needed.	As in the comment.	2017/1/9 9:42
9956	Young Hoon Kwon	225	1 27.14.2	199	60	T	Y	199.60 27.14.2	Not sure how an HE AP indicate the start times for Trigger frames. Even within a Trigger-enabled TWT SP, the AP does not specifically indicate the start time of each Trigger frame, if I remember correctly. Further clarification is needed.	As in the comment.	2017/1/9 9:42
9957	Young Hoon Kwon	225	1 27.14.2	200	32	T	Y	200.32 27.14.2	Even when Cascade Indication field is set to 0 and there's non-zero OBO counter, the STA cannot go to doze state because there's still a chance that the serving AP may send DL data to the STA. Further clarification is needed.	As in the comment.	2017/1/9 9:42
9958	Young Hoon Kwon	225	1 27.14.2	200	20	T	Y	200.20 27.14.2	When an HE STA receives a Probe Response frame with broadcast TWT element, the STA can participate in the random access based operation. Therefore, it'd be better if the description includes not only for associated STAs but also for unassociated STAs. Further clarification is needed.	As in the comment.	2017/1/9 9:42

9959	Young Hoon Kwon	225	1 27.14.3.1	201	1	T	Y	201.01 27.14.3.1	This can not be a "shall" sentence. For example, what if the buffered traffic is expired and dequeued before the start of the next TWT SP? For the non-AP STA, regardless the STA is served or not during one TWT SP, the STA will wake up and check the TIM element in the subsequent TWT SP. And, the STA will figure out if there's RU scheduled for the STA or not based on the TIM information. How to set or how to schedule each STA is totally the serving AP's implementation issue. If spec. strongly recommend the AP to serve this STA in the subsequent TWT SP, it can be at most "should" sentence.	As in the comment.		2017/1/9 9:42
9960	Young Hoon Kwon	225	1 27.14.3.2	201	7	T	Y	201.07 27.14.3.2	Actual transmission time of TIM frame can be different from target start time of a broadcast TWT SP due to lots of reasons. (One example is that wireless medium is busy at the start of the broadcast TWT SP.) Therefore, when a STA receives a TIM frame, there's no guarantee that it is sent at the beginning of a broadcast TWT SP. And, as the meaning of TIM element is different based on this, the protocol is not complete enough. Further clarification is needed.	As in the comment.		2017/1/9 9:42
9961	Young Hoon Kwon	225	1 27.15.2	201	28	T	Y	201.28 27.15.2	It is not clear in which case a non-AP STA can transmit HE MU PPDU. Need clarification	As in the comment.	2017/1/9 9:42
9962	Young Hoon Kwon	225	1 27.15.2	201	38	T	Y	201.38 27.15.2	There's no UL MU PPDU Support field defined in HE Capabilities element. Need further clarification.	As in the comment.	2017/1/9 9:42
9963	Young Hoon Kwon	225	1 27.15.2	201	57	T	Y	201.57 27.15.2	This behaviour is for responder. It is not clear how can a responder know if the most recent PPDU sent by the responding STA to the soliciting STA is successful or not. Needs further clarification.	As in the comment.	2017/1/9 9:42
9964	Young Hoon Kwon	225	1 27.15.2	202	1	T	Y	202.01 27.15.2	Based on this rule, once a responder uses ER SU PPDU format for control response frame, it shall use ER SU PPDU format forever, even if the channel condition becomes better or the responder approaches to the soliciting STA. (Even if the frame transmission fails, as ER SU PPDU format is the lowest MCS, there's no reason to switch back to non-HT frame format.) I think it's better to give a chance for the responder to switch back to non-HT PPDU format if channel conditions becomes better.	As in the comment.		2017/1/9 9:42
9965	Young Hoon Kwon	225	1 27.15.3	202	21	T	Y	202.21 27.15.3	Control response frame in response to an ER SU PPDU can be either ER SU PPDU or non-HT PPDU format based on 27.15.2. <MCS0, 1> is only applicable to ER SU PPDU. Further clarification is needed if the control response frame is using non-HT PPDU format.	As in the comment.	2017/1/9 9:42
9966	Young Hoon Kwon	225	1 27.15.3	202	53	T	Y	202.53 27.15.3	Based on this rule, once a responder uses DCM or 106-tone, it needs to use it forever even though channel conditions becomes better. I think it's better to give a chance for the responder to switch back to DCM-off or 242 tone format.	As in the comment.	2017/1/9 9:42
9967	Young Hoon Kwon	225	1 27.16.1	204	56	T	Y	204.56 27.16.1	How about 20MHz-only STA? Need further clarification.	As in the comment.	2017/1/9 9:42
9968	Young Hoon Kwon	225	1 28.2.2	214	37	T	Y	214.37 28.2.2	In 2.4GHz band, legacy format needs to include non-OFDM frame format. So, NON_HT format needs to include PPDU formats in Clause 15, 16, 17, and 18.	Modify the value description for NON_HT to: "NON_HT indicates Clause 15, Clause 16, Clause 17, or Clause 18 PPDU formats or non-HT duplicate PPDU format. In this case, the modulation is determined by the NON_HT_MODULATION parameter.".	2017/1/9 9:42

9969	Yuchen Guo	225	1 9.3.1.23	45	36	T	Y	45.36 9.3.1.23	Random access RUs have to be allocated one by one by setting AID12 field to 0. If plenty of random access RUs need to be allocated, then lots of user info fields are needed, which is a large overhead.	Devise a mechanism to allocate multiple random access RUs in an efficient way.	2017/1/9 9:42
9970	Yuchen Guo	225	1 9.4.1.62	57	46	T	Y	57.46 9.4.1.62	Definition error for the sounding dialog token number	Add a correct explanation for the sounding dialog token number	2017/1/9 9:42
9971	Yuchen Guo	225	1 9.4.2.200	70	4	T	Y	70.04 9.4.2.200	The expression "The Wake TBTT Negotiation subfield is set to 0 in TWT elements transmitted by a responding STA and by a scheduling STA." is not correct. When the TWT scheduling STA transmits a TWT response frame as a response to a TWT request frame in the negotiation procedure of wake TBTT and listen interval, The value of the Wake TBTT Negotiation subfield should be equal to 1.	The Wake TBTT Negotiation subfield is set to 1 in TWT elements transmitted by a responding STA and by a scheduling STA in the negotiation procedure of wake TBTT and listen interval, and set to 0 otherwise.	2017/1/9 9:42
9972	Yuchen Guo	225	1	137	33	T	Y	137.33	The explicit TWT related expressions should be deleted since the implicit subfield shall be set to 1 during the TWT setup procedure	As per comment	2017/1/9 9:42
9973	Yuchen Guo	225	1	138	7	E	Y	138.07	"with ... don't care" is not a formal expression	delete "with ... don't care"	2017/1/9 9:42
9974	Yuchen Guo	225	1 27.3.3.4	155	5	E	Y	155.05 27.3.3.4	Editorial: another ")" should be added at the end of the sentence	As per comment	2017/1/9 9:42
9975	Yuchen Guo	225	1 27.5.2.3	167	59	T	Y	167.59 27.5.2.3	The MU transmission procedure for unassociated STAs is not defined	Define a procedure for unassociated STAs	2017/1/9 9:42
9976	Yuchen Guo	225	1 27.5.2.6.2	173	46	E	Y	173.46 27.5.2.6.2	Editorial: add "." After "AID value 0"	As per comment	2017/1/9 9:42
9977	Yuchen Guo	225	1 27.5.2.6.2	173	52	E	Y	173.52 27.5.2.6.2	Editorial: change "decrements" to "decrement"	As per comment	2017/1/9 9:42
9978	Yuchen Guo	225	1 27.7.1	180	2	E	Y	180.02 27.7.1	"requester STA" should be "requesting STA"	As per comment	2017/1/9 9:42
9979	Yuchen Guo	225	1 27.7.3.2	185	23	T	Y	185.23 27.7.3.2	In the case of broadcast TWT, TWT scheduled STAs do not know which Beacon frame contains a TWT IE, hence they have to read every Beacon in order not to miss any TWT IE, which is not power efficient	Devise a scheme for TWT scheduled STAs to receive Beacon frames for the TWT IEs	2017/1/9 9:42
9980	Yuchen Guo	225	1 27.7.3.3	185	39	T	Y	185.39 27.7.3.3	Is the TWT scheduled STA in PS mode? If not, it seems not reasonable to suggest a TWT scheduled STA that is in the active mode not to transmit outside of broadcast TWT SP	Add "that is in PS mode" after "TWT scheduled STA"	2017/1/9 9:42
9981	Yuchen Guo	225	1 27.7.3.4	187	8	E	Y	187.08 27.7.3.4	10.44.8 does not exist in this draft	Define TWT Teardown procedure in 11ax	2017/1/9 9:42
9982	Yuchen Guo	225	1 27.7.4	187	46	E	Y	187.46 27.7.4	10.43.4 does not exist in this draft	Add implicit TWT operation	2017/1/9 9:42
9983	Yuichi Morioka	225	1 9.2.4.6	21	25	E	N	21.25 9.2.4.6	The name "HT Control Field" is misleading, as it now contains HE information. Change the name to Extension Control Field.	Change "HT Control" Field to "Extension Control" Field.	2017/1/9 9:42
9984	Yuichi Morioka	225	1 9.2.4.6.4.1	22	52	T	N	22.52 9.2.4.6.4.1	The smallest Aggregated Control subfield is 4(Control ID)+8 (Control Info)= 12 bits.	Change "4 or more" to "12 or more".	2017/1/9 9:42
9985	Yuichi Morioka	225	1 9.2.4.5.4.1	22	61	T	N	22.61 9.2.4.5.4.1	"The Control Subfield with Control ID subfield equal to 0,...". Is this restriction necessary?	Remove the restriction if it is not necessary.	2017/1/9 9:42
9986	Yuichi Morioka	225	1 9.2.4.5.4.1	23	44	T	N	23.44 9.2.4.5.4.1	Why does the A-Control subfield need to be rounded up to 30 bits if it is less than 30 bits?	Remove sentence starting with "The Padding subfield, if present, follows ..." if there is no reason for the rounding up.	2017/1/9 9:42
9987	Yuichi Morioka	225	1 9.2.4.5.4.2	24	24	E	N	24.24 9.2.4.5.4.2	The note is more appropriate in subclause 27.5.2.3 UL MU Operation.	Move the note to subclause 27.5.2.3	2017/1/9 9:42
9988	Yuichi Morioka	225	1 9.2.5.2	31	11	E	N	31.11 9.2.5.2	"required for" should be changed to "required to transmit" as with other bullets.	as suggested	2017/1/9 9:42
9989	Yuichi Morioka	225	1 9.3.1.23	41	59	E	N	41.59 9.3.1.23	missing space after "...of the recipient STA."	add space.	2017/1/9 9:42
9990	Yuichi Morioka	225	1 9.3.1.23	41	61	T	N	41.61 9.3.1.23	The sentence "If the Trigger Type field is GCR-MU BA, ..." may contradict with the previous two sentences.	add "If the Trigger Type field is not GCR-MU BA and" to the previous two sentences.	2017/1/9 9:42
9991	Yuichi Morioka	225	1 9.3.1.23	42	51	T	Y	42.51 9.3.1.23	AP should be allowed to trigger CF_End frame transmission from multiple STAs, to cancel over-reserved NAV set by MU-RTS.	Replace p.42 line 51 "7-15 Reserved" with "7 MU-CF_End" and add in the next line "8-15 Reserved"	2017/1/9 9:42
9992	Yuichi Morioka	225	1 9.3.1.23	42	61	T	N	42.61 9.3.1.23	"...follows the current Trigger frame." This implies that the Trigger frames are sent back to back. Is this the intent?	Change "follows the current Trigger frame" with "will be transmitted".	2017/1/9 9:42
9993	Yuichi Morioka	225	1 9.3.1.23	44	21	E	N	44.21 9.3.1.23	mixed use of "HE trigger-based PPDU response" and "HE trigger-based PPDU that is the response to the Trigger frame".	Unify to either terminology.	2017/1/9 9:42

9994	Yuichi Morioka	225	1 9.3.1.23	44	65	T	N	44.65 9.3.1.23	"For 20MHz one SR field..." Unclear what is 20MHz.	Replace "For 20MHz" with "If the BW subfield is set to 0,". Same for other bandwidths.	2017/1/9 9:42
9995	Yuichi Morioka	225	1 9.3.1.23	45	11	T	N	45.11 9.3.1.23	"The Doppler subfield..." Unclear how to set the field.	Replace with "The Doppler subfield is set to 1 if..."	2017/1/9 9:42
9996	Yuichi Morioka	225	1 9.3.1.23	45	37	E	N	45.37 9.3.1.23	missing space after "...RU for random access."	add space.	2017/1/9 9:42
9997	Yuichi Morioka	225	1 9.3.1.23	45	37	T	N	45.37 9.3.1.23	"User Info fields with AID = 0..." There is no AID field in the User Info fields.	change AID to AID12	2017/1/9 9:42
9998	Yuichi Morioka	225	1 9.3.1.23	45	38	T	N	45.38 9.3.1.23	"before the MAC padding field" This rule is common for AID12 not equal to 0. The rule is self explanatory from the figure 9-52c - Trigger frame.	Remove last part of the sentence starting , ", and before the MAC padding..."	2017/1/9 9:42
9999	Yuichi Morioka	225	1 9.3.1.23	46	33	E	N	46.33 9.3.1.23	"B19-B13 are 0000000 indicates..." Incorrect English.	Correct English. Similar language in the following two bullets.	2017/1/9 9:42
10000	Yuichi Morioka	225	1 9.3.1.23	46	46	E	N	46.46 9.3.1.23	"Set to 0 for BCC..." incomplete sentence.	Complete sentence	2017/1/9 9:42
10001	Yuichi Morioka	225	1 9.3.1.23	47	45	E	N	47.45 9.3.1.23	colon (:) should be a period (.)	as commented.	2017/1/9 9:42
10002	Yuichi Morioka	225	1 9.3.1.23.1	49	7	T	N	49.07 9.3.1.23.1	recommendation is useless. Either remove the recommendation or change it to a requirement.	as commented.	2017/1/9 9:42
10003	Yuichi Morioka	225	1 9.3.1.23.4	50	28	E	N	50.28 9.3.1.23.4	"The RA field of the MU-RTS frame..." and "NOTE - The TA field..." are duplicate of what is mentioned in page 41, line 59.	remove duplicate.	2017/1/9 9:42
10004	Yuichi Morioka	225	1 9.3.1.23.4	50	33	E	N	50.33 9.3.1.23.4	"The Trigger Type subfield..." Already defined in page 42 line 45.	remove duplicate.	2017/1/9 9:42
10005	Yuichi Morioka	225	1 27.2.2	150	24	T	Y	150.24 27.2.2	The specification shall allow for more than two NAVs to be managed,i.e. maintain a NAV per OBSS, in order to avoid inter-BSS collision when there are more than one OBSS.	Define an option where STA maintains NAVs per BSS/OBSS.	2017/1/9 9:42
10006	Yuichi Morioka	225	1 27.2.2	150	24	T	Y	150.24 27.2.2	In order to allow efficient spatial reuse, the specification should define a mechanism where the a STA may transmit at lowered power during NAV set by OBSS, based on the reception power of the inter-BSS PPDU.	Expand the current OBSS-PD mechanism so MAC level spatial reuse can be realized. The commenter is willing to provide details of the resolution.	2017/1/9 9:42
10007	Yuichi Morioka	225	1 27.2.1	150	61	T	Y	150.61 27.2.1	Any response frame (such as ACK/BA/CTS) sent by associated AP in legacy PPDU doesn't meet this condition, therefore third party STAs which can't receive the UL PPDU frame will not be able to update the intra NAV.	Define a way to convey BSS Color information for legacy PPDUs.	2017/1/9 9:42
10008	Yuichi Morioka	225	1 27.4.1	157	34	E	N	157.34 27.4.1	What is difference between "rate" and "MCS" ?	Remove the word "rate".	2017/1/9 9:42
10009	Yuichi Morioka	225	1 27.4.4.2	160	61	T	Y	160.61 27.4.4.2	Any response frame (such as ACK/BA/CTS) sent by associated AP in legacy PPDU doesn't meet this condition, therefore third party STAs which can't receive the UL PPDU frame will not be able to update the intra NAV.	Modify the condition in L1P150 as follows. - The frame is identified as inter-BSS or cannot be identified as intra-BSS or inter-BSS with the condition that received power is less than OBSS-PD according to the rule described in 27.2.1 (Intra-BSS and inter-BSS frame detection) Modify the condition in L53P149 as follows. - The frame is identified as intra-BSS or cannot be identified as intra-BSS or inter-BSS with the condition that received power is higher than OBSS-PD according to the rule described in 27.2.1 (Intra-BSS and inter-BSS frame detection)	2017/1/9 9:42
10010	Yuichi Morioka	225	1 27.5.2.2.1	164	46	T	Y	164.46 27.5.2.2.1	Non-associated STAs shouldn't be able to transmit at random access.	If Trigger Frame which STA receives doesn't have associated AP's TA, STA should disregard this frame.	2017/1/9 9:42
10011	Yuichi Morioka	225	1 27.5.2.4	167	51	T	Y	167.51 27.5.2.4	When STA sets the basic NAV and then receives Trigger Frame in CS required bit = 1, STA can't transmit MU PPDU. This may create inefficiency.	Add texts as follow. Upon reception of a Trigger Frame with CS Required bit = 1, if the reception power of the PPDU that set the basic NAV is lower than the OBSS-PD threshold, the STA may ignore the basic NAV and transmit an UL PPDU.	2017/1/9 9:42
10012	Yuichi Morioka	225	1 27.5.2.4	167	59	T	Y	167.59 27.5.2.4	Non associated STA should not be able to respond to the trigger frame.	Replace TBD as suggested.	2017/1/9 9:42

10013	Yuichi Morioka	225	1 27.5.2.4	170	24	T	Y	170.24 27.5.2.4	If a triggered STA observes medium busy using Energy Detection, the energy is from OBSS or other systems. The STA should be able to transmit the triggered PPDU if the required transmission power is low.	Define a rule that allows STAs to overide Energy Detection depending on the received energy level and required transmission power of the triggered PPDU, similar to that of OBSS-PD.	2017/1/9 9:42
10014	Yuichi Morioka	225	1 27.5.2.4	170	53	T	Y	170.53 27.5.2.4	HE AP may be able to more effectively allocate UL MU resource if it has knowledge of the interference level observed at the HE STA.	Add Interference Level measurement feedback operation like HE buffer status feedback operation.	2017/1/9 9:42
10015	Yuichi Morioka	225	1 27.5.2.5	172	1	T	Y	172.01 27.5.2.5	Even if STA has already reported buffer status, STA should retransmit same BSR because AP may have missed the previous BSR.	Delete the first condition.	2017/1/9 9:42
10016	Yuichi Morioka	225	1 27.5.2.6	172	28	T	Y	172.28 27.5.2.6	It should be beneficial if the AP can allocate part of the random access RUs for BSRP and partly for other UL small data.	Define a field within the trigger frame that indicates which RU set is intended for BSRP.	2017/1/9 9:42
10017	Yuichi Morioka	225	1 27.5.2.6.2	173	46	E	N	173.46 27.5.2.6.2	missing period (.).	As commented	2017/1/9 9:42
10018	Yuichi Morioka	225	1 27.9	190	1	T	Y	190.01 27.9	In dense environments, most preambles sent from OBSS STAs will not be decodable due to partially overlapping PPDUs. The spec should define a spatial reuse mechanism that is effective in dense environments.	Define an adjustable Energy Detection threshold proportional to the transmission power, similar to that of OBSS-PD.	2017/1/9 9:42
10019	Yuichi Morioka	225	1 27.9.1	190	12	E	N	190.12 27.9.1	"... to either an HE STA or a non HE STA." This is all STAs, so no meaning.	Remove the cited part of the sentence.	2017/1/9 9:42
10020	Yuichi Morioka	225	1 27.9.1	190	30	T	Y	190.30 27.9.1	"- A non-HT PPDU that carries an..." This implies that the non-HT PPDU need to be decoded up until the end of the PPDU to determine whether the PHYCCARESET.request can be issue. By that time the PPDU has already ended.	Replace bullet starting with "- The PPDU is not one of the following" with "The PPDU is not a non HT PPDU"	2017/1/9 9:42
10021	Yuichi Morioka	225	1 27.9.1	190	36	T	N	190.36 27.9.1	"The PHYCCARESET.request primitive shall be issued at the end of the PPDU..." This is normal behavior. If the PPDU also meets all the conditions mentioned in the list above (e.g. if the PPDU is a inter BSS PPDU) which rule take precedence?	Reformulate the bullets in lines 24-34 in page 190, so it includes the case of "SR_Delay".	2017/1/9 9:42
10022	Yuichi Morioka	225	1 27.9.1	190	39	T	Y	190.39 27.9.1	"If the PHYCCARESET.request primitive is issued before the end of the PPDU,..." All PPDUs sent using the SR rule should be limited to within the OBSS PPDU, as the excess portion of the SR PPDU will be prone to interference.	Remove line 41 of page 190 that says "if the PPDU is HE MU PPDU and the RXVECTOR parameter SPATIAL_REUSE indicates SR_Restricted."	2017/1/9 9:42
10023	Yuichi Morioka	225	1 27.9.1	190	39	T	Y	190.39 27.9.1	"If the PHYCCARESET.request primitive is issued before the end of the PPDU,..." If it is allowed for the TXOP to go beyond the inter-BSS PPDU, it would be beneficial to limit the length of the first PPDU such that the start of the second PPDU starts after the end of the inter-BSS PPDU. This way the preamble of the second PPDU can be detected from third party.	Add rule as commented so preamble detection is still useful.	2017/1/9 9:42
10024	Yuichi Morioka	225	1 27.9.2.1	190	43	T	Y	190.43 27.9.2.1	In order to allow efficient use of SR resource, STA should be allowed to subtract the time it took to determine that the received PPDU is an inter-BSS PPDU from its BO timer.	Add "If the PHYCCARESET.request primitive is issued before the end of the PPDU, the Back off counter of the STA may be decremented by the time it took from the beginning of the PPDU until the PHYCCARESET.request primitive was issued"	2017/1/9 9:42
10025	Yuichi Morioka	225	1 27.9.2.1	190	43	T	Y	190.43 27.9.2.1	The specification needs to define a way for a STA to detect other PPDUs after PHYCCARESET.request is issued before the end of the inter-BSS PPDU.	Define a threshold at which a STA's PHY will issue PHY-CCA.indication with a value equal to BUSY upon detection of energy above the threshold during the inter-BSS PPDU. The threshold shall be relative to the reception power of the inter-BSS PPDU.	2017/1/9 9:42
10026	Yuichi Morioka	225	1 27.9.2.1	190	50	T	Y	190.50 27.9.2.1	SR backoff procedure should be defined.	Add texts as follow. Before SR transmission, STA should wait for random time as special backoff. This random time should be determined by received interference level.	2017/1/9 9:42

10027	Yuichi Morioka	225	1 27.9.2.1	190	53	T	Y	190.53 27.9.2.1	"The STA may resume its backoff procedure..." This seems to be normal procedure after PHYCCARESET.request primitive is issued	Remove sentence and NOTE.	2017/1/9 9:42
10028	Yuichi Morioka	225	1 27.9.2.2	191	3	T	Y	191.03 27.9.2.2	When a HE STA lowers the transmission power based on OBSS-PD, the transmission may not be heard by another STA in the BSS, i.e. could be hidden within the BSS. Transmission of RTS could solve this problem.	Define a mechanism where the AP can request for the transmission of RTS if the transmission power of the STA is below a determined threshold.	2017/1/9 9:42
10029	Yuichi Morioka	225	1 27.9.2.2	191	7	E	N	191.07 27.9.2.2	OBSSPD should be OBSS_PD	replace OBSSPD with OBSS_PD	2017/1/9 9:42
10030	Yuichi Morioka	225	1 27.9.2.2	191	52	E	N	191.52 27.9.2.2	TXPWR should be TX_PWR	replace TXPWR with TX_PWR	2017/1/9 9:42
10031	Yuichi Morioka	225	1 27.9.2.2	191	62	T	Y	191.62 27.9.2.2	How OBSS_PDmin_default is used is not defined.	Specify how this value is used.	2017/1/9 9:42
10032	Yuichi Morioka	225	1 27.9.2.2	191	62	T	Y	191.62 27.9.2.2	"OBSS_PDmin_default = -82 dBm and OBSS_PDmax_default = -62 dBm." Second entry in this equation does not make sense.	Rewrite the second entry of this equation.	2017/1/9 9:42
10033	Yuichi Morioka	225	1 27.9.2.2	192	16	T	Y	192.16 27.9.2.2	If STA sets a low TXPWRmax after calculating with Equation (27-1), transmitted frame may not be receive at the receiver. STA should have information about link budget such as pathloss so that STA can judge if transmitted frame will be received successfully or not.	In HE SU PPDU, Acceptable Receiver Interference level of SRP in HE-SIG-A will be set as fixed value (such as -50dBm). STA that received HE SU PPDU frame can calculate pathloss by subtracting Acceptable Receiver Interference level as fixed value from SRP.	2017/1/9 9:42
10034	Yuichi Morioka	225	1 27.9.2.2	192	21	T	Y	192.21 27.9.2.2	"The STA may increase the OBSS_PDlevel during the backoff procedure, its maximum transmit power being adjusted as defined above." Incomplete sentence.	Correct sentence.	2017/1/9 9:42
10035	yujin noh	225	1 28.3.8	259	6	E	Y	259.06 28.3.8	to keep consistency in the Table 28-11, description of parameters could be modified such as NSD: Number of complex data tones (or subcarriers) per frequency segment. NSP: Number of pilot tones (or subcarriers) per frequency segment ...	As in the comment.	2017/1/9 9:42
10036	yujin noh	225	1 28.3.8	259	61	T	Y	259.61 28.3.8	There is no TXVECTOR parameter NUM_RUS defined in the spec. If needed, add the descripion of the parameter of TXVECTOR parameter NUM_RUS in Table 28-1 (TXVECTOR and RXVECTOR parameters)	As in the comment.	2017/1/9 9:42
10037	yujin noh	225	1 28.3.8	260	15	T	Y	260.15 28.3.8	add definition of max operation for HE MU PPDU in the Table 28-12 (definition could be placed in NOTE) for readers.	As in the comment.	2017/1/9 9:42
10038	yujin noh	225	1 28.3.9	263	7	E	Y	263.07 28.3.9	in order to be consistent through the spec, NHE-SIG-B (italic HE-SIG-B) needs to be replaced with NHE-SIG-B (non-italic HE-SIG-B subscripted)	As in the comment.	2017/1/9 9:42
10039	yujin noh	225	1 28.3.10.7.2	274	6	T	Y	274.06 28.3.10.7.2	clarify SRP-based spatial reuse operation with a new sub-clause as 27.9.3.	As in the comment.	2017/1/9 9:42
10040	yujin noh	225	1 28.3.10.7.2	274	12	T	Y	274.12 28.3.10.7.2	clarify SRP-based spatial reuse operation with a new sub-clause as 27.9.3.	As in the comment.	2017/1/9 9:42
10041	yujin noh	225	1 28.3.10.7.2	274	6	T	Y	274.06 28.3.10.7.2	defind the rest values except for SR Disallowed and SR_Delay.	As in the comment.	2017/1/9 9:42
10042	yujin noh	225	1 28.3.10.7.2	273	48	E	Y	273.48 28.3.10.7.2	to be consistent of description between Bandwidth field and MCS field in the table, "P20" needs to be replaced with "primary 20MHz"	As in the comment.	2017/1/9 9:42
10043	yujin noh	225	1 28.3.10.7.2	276	41	T	Y	276.41 28.3.10.7.2	defind the rest values except for SR Disallowed and SR_Restricted.	As in the comment.	2017/1/9 9:42
10044	yujin noh	225	1 28.3.10.7.2	277	26	E	Y	277.26 28.3.10.7.2	"full BW MU-MIMO" is only used as description in this table. "full BW MU-MIMO" could be replaced with "full bandwidth MU-MIMO transmission" to be consistent through the spec.	As in the comment.	2017/1/9 9:42
10045	yujin noh	225	1 28.3.10.7.3	282	51	T	Y	282.51 28.3.10.7.3	"User Specific field" needs to be replaced with "User Block field" to be consistent through the spec. "User Specfic field", "User field" and "User Block field" are mixed in use in the current version of spec. It needs to be consistent with proper terminologies.	As in the comment.	2017/1/9 9:42

10046	yujin noh	225	1 28.3.10.7.3	282	51	T	Y	282.51 28.3.10.7.3	value of L for the HE-SIG-B User block field should be different depending on assigned number of users which could be odd or even.	As in the comment.	2017/1/9 9:42
10047	yujin noh	225	1 28.3.10.7.4	285	21	E	Y	285.21 28.3.10.7.4	add HE-SIG-A2, HE-SIG-A3 and HE-SIG-A4 in the Figure 28-19.	As in the comment.	2017/1/9 9:42
10048	yujin noh	225	1 28.3.11.2	314	32	T	Y	314.32 28.3.11.2	In order to reduce misunderstanding on the cencept of post-FEC PHY padding, "applied on" could be replaced with proper text such as "appended right after or appended to" .	As in the comment.	2017/1/9 9:42
10049	yujin noh	225	1 28.3.11.2	314	42	E	Y	314.42 28.3.11.2	to be consistent through the spec, "a = 1" needs to be modified with "a = 1" (italic a)	As in the comment.	2017/1/9 9:42
10050	yujin noh	225	1 28.3.11.2	316	1	E	Y	316.01 28.3.11.2	When refering to Table 28-25 (NSD,SHORT values) in the sentence, "SD,SHORT" should be subscripted and italic. Table 28-25 (NSD,SHORT values) needs to be modified with Table 28-25 (NSD,SHORT values) to be consistent through the spec.	As in the comment.	2017/1/9 9:42
10051	yujin noh	225	1 28.3.11.5.1	317	56	E	Y	317.56 28.3.11.5.1	"user u" should be replaced with "user u" as italic u to be consistent through the spec.	As in the comment.	2017/1/9 9:42
10052	yujin noh	225	1 28.3.11.5.3	319	45	E	Y	319.45 28.3.11.5.3	In NPAD.POST-FEC, "." should be changed with "," to be consistent through the spec.	As in the comment.	2017/1/9 9:42
10053	yujin noh	225	1 28.3.11.5.4	319	59	E	Y	319.59 28.3.11.5.4	"user u" should be replaced with "user u" as italic u to be consistent through the spec.	As in the comment.	2017/1/9 9:42
10054	yujin noh	225	1 28.3.11.5.4	320	6	E	Y	320.06 28.3.11.5.4	in NSYM.init, "." should be replaced with ","	As in the comment.	2017/1/9 9:42
10055	yujin noh	225	1 28.3.11.6	322	40	T	Y	322.40 28.3.11.6	Clarify the meaning of "the output of the FEC encoder" in the sentence. It could mislead to understand that output of the FEC encoder may not include post-FEC padding bit.	As in the comment.	2017/1/9 9:42
10056	yujin noh	225	1 28.3.11.9	327	34	T	Y	327.34 28.3.11.9	add the meaning of conj() for non-expert readers.	As in the comment.	2017/1/9 9:42
10057	yujin noh	225	1 28.3.11.9	327	34	T	Y	327.34 28.3.11.9	To be consistent with other modulation with DCM, add the text as "The NSD here refers to the NSD with DCM = 1, which is half the value of NSD with DCM = 0"	As in the comment.	2017/1/9 9:42
10058	yujin noh	225	1 28.3.11.9	327	45	E	Y	327.45 28.3.11.9	"he" is shown. "The" missed "T" in the text "he NSD here refers..."	As in the comment.	2017/1/9 9:42
10059	yujin noh	225	1 28.3.11.10	327	54	E	Y	327.54 28.3.11.10	There is "no STBC bit field" in HE-SIG-A in the spec. "STBC bit" should be replaced with "STBC field" to be consistent through the spec.	As in the comment.	2017/1/9 9:42
10060	yujin noh	225	1 28.3.10.8	285	55	T	Y	285.55 28.3.10.8	HE-SIG-B section mixes some terminologies in use when refering to "Common Block field" vs "Comon field" and "User Specific field" vs "User Block field" vs "User field". It can make readers confused to understand this section. For rest sections, those terminologies are mixed up as well when refered. A Common Block field should be used when describing on the encoding process through the spec if it is refered. A Common field should be used when describing on the whole content through the spec if it is refered. A User Block field should be used when describing on the encoding process through the spec if it is refered. A User specific field should be used when describing on the whole content through the spec if it is refered. A User field should be used when describing on each user content through the spec if it is	As in the comment.	2017/1/9 9:42
10061	yujin noh	225	1 28.3.10.8	286	55	T	Y	286.55 28.3.10.8	Different texts as "RU Allocation subfield", "RU Allocation signalling field", "RU allocation signalling" and so on are used to indicate RU Allocation field through HE-SIG-B section. Those different texts need to be replaced with "RU Allocation field" through the spec when it is refered.		2017/1/9 9:42

10062	yujin noh	225	1 28.3.10.8.1	286	13	T	Y	286.13 28.3.10.8.1	Figure 26-20 shows BCC block, which does not exist in the draft specification any more.	1 BCC Block in Common Field needs to be changed Common Block Field. 1 BCC Blcok in User Specfic Field needs to be changed as 1 User Block Field.	2017/1/9 9:42
10063	yujin noh	225	1 28.3.10.8	286	55	E	Y	286.55 28.3.10.8	"common field" with the small letter c and "Common field" with the capital letter C are mixed in use in HE-SIG-B section. If it is refered for rest sections through the spec, the same terminology should be used.	To be consistent, common field needs to be replaced with Common field	2017/1/9 9:42
10064	yujin noh	225	1 28.3.10.8	286	55	E	Y	286.55 28.3.10.8	"user field" with the small letter u and "User field" with the capital letter U are mixed in use in HE-SIG-B section. If it is refered for rest sections through the spec, the same terminology should be used.	To be consistent, user field needs to be replaced with User field	2017/1/9 9:42
10065	yujin noh	225	1 28.3.10.8.4	290	27	E	Y	290.27 28.3.10.8.4	subfield and field are mixed in use in HE-SIG-B section. Refer to Table 28-20 and Table 28-22/23	In table 28-20, subfield needs to be replaced with field. For example, in P294L1, "RU allocation signaling" needs to be replaced with "RU Allocation field."	2017/1/9 9:42
10066	yujin noh	225	1 28.3.10.8.4	293	8	T	Y	293.08 28.3.10.8.4	y2y1y0 is not limited to be used to indicate only 106-tone RU in the table. Looking at the last 5 rows in the table, y2y1y0 indicates the number of STAs multiplexed in one RU with 106/242/484/996/2x996-tone RU.	y2y1y0 = 000-111 indicates number of STAs multiplexed in one RU (e.g., 106 / 242 / 484 / 996 / 2x996-tone RU) or the left 106-tone RU if there are two 106-tone RUs(#2035). The binary vector y2y1y0 is indexed as [y[3]y[2]y[1]] indicates 22 +· y[3] + 21 +· y[2] + y[1] + 1 STAs multiplexed in the RU.	2017/1/9 9:42
10067	yujin noh	225	1 28.3.10.8.5	295	6	T	Y	295.06 28.3.10.8.5	In Table 28-22, "non-MU-MIMO allocation" means "SU-MIMO allocation in the signaled RU" assignment. The terminology as "non-MU-MIMO is used only in the chapter".	"non-MU-MIMO allocation" should be replaced with "SU-MIMO allocation in the signaled RU"	2017/1/9 9:42
10068	yujin noh	225	1 28.3.10.8.5	297	20	E	Y	297.20 28.3.10.8.5	No field named as "SIGB Number of Symbols/Number of MU-MIMO Users field" in the spec. The "SIGB Number of Symbols/Number of MU-MIMO Users field" needs to be replaced with "Number Of HE-SIG-B Symbols Or MU-MIMO Users" as defined in Table 28-17.	As in the comment.	2017/1/9 9:42
10069	yujin noh	225	1 28.3.18.4.4	359	2	T	Y	359.02 28.3.18.4.4	contentwise, e) is a wrong reference. The average unoccupied subcarrier error vector magnitude for each unoccupied 26-tone RU is calculated with step f) not step e).	As in the comment.	2017/1/9 9:42
10070	yujin noh	225	1 28.3.18.4.4	359	19	T	Y	359.19 28.3.18.4.4	step h) is not present as approved texts in 16/1427. Since mask-like EVM is decided to use with step g), step h) is not necessary.	remove step h) and Equation (28-127)	2017/1/9 9:42
10071	yujin noh	225	1 27.6.4	179	24	T	Y	179.24 27.6.4	4x HE-LTF and 0.8us has been introduced in the spec in order to make sure the channel estimation accuary with small delay spread for MIMO or MU-MIMO scenarios. TXVECTOR parameter in HE NDP should include GI_TYPE set to 0.8 when HE_LTF_TYPE is set to 4x HE-LTF	GI_TYPE set to either 0.8 us or 1.6 us when HE_LTF_TYPE is set to 2x HE-LTF; otherwise GI_TYPE set to either 0.8us or 3.2 us.	2017/1/9 9:42
10072	yujin noh	225	1 28.3.12	340	3	T	Y	340.03 28.3.12	Once the receiver calculate the number of data symbol, the receiver doesn't need to calculate T_PE. It can recognize the actual ending time of the PPDU since the PE field, when present, shall be transmitted with the same average power as the Data field. remove Equation (28-117) and corresponding texts in spec.	As in the comment.	2017/1/9 9:42
10073	yujin noh	225	1 9.4.2.218.2	76	48	T	Y	76.48 9.4.2.218.2	There is no agreed HE link adaptation operation such that it's not clear whether to have unsolicited HE MFB. Depending on the decision, the number of bits corresponding link adaptation capability needs to be modified.	As in the comment.	2017/1/9 9:42
10074	yujin noh	225	1 9.4.2.218.2	78	27	T	Y	78.27 9.4.2.218.2	There is no agreed HE link adaptation operation such that it's not clear whether to have unsolicited HE MFB. Depending on the decision, its decription needs to be modified.	As in the comment.	2017/1/9 9:42

10075	yujin noh	225	1 28.3.11.9	327	14	T	Y	327.14 28.3.11.9	Clarify the text "in order to exploit frequency diversity for a and ... for a 2x996-tone RU" in spec	As in the comment.	2017/1/9 9:42
10076	yujin noh	225	1 27.5.2.6.2	173	46	E	Y	173.46 27.5.2.6.2	In the middle of sentence, "0If" is shown as a typo.	... AID value 0. If the selected RU....	2017/1/9 9:42
10077	yujin noh	225	1 9.4.2.220	93	46	E	Y	93.46 9.4.2.220	wrong unit in Figur 9-589cu. "Octets" needs to be replaced with "bits"	As in the comment.	2017/1/9 9:42
10078	yujin noh	225	1 9.4.2.220	93	60	E	Y	93.60 9.4.2.220	field name as "EOCWmax field" is not consistent between Figure 9-589cu and its description. EOCW_max and OCW_max need to replaced with EOCWmax and OCWmax, respectively	As in the comment.	2017/1/9 9:42
10079	yujin noh	225	1 27.9.2.1	190	59	T	Y	190.59 27.9.2.1	A PHY-CCARESET.request primitive needs to be acknowledged with a PHY-CCARESET.confirm primitive from the PHY. PHY-CCARESET.confirm primitive is issued by the PHY to the local MAC entity to confirm that the PHY has reset the CCA state machine when the PHY has received a PHY-CCARESET.request primitive.	As in the comment.	2017/1/9 9:42
10080	yujin noh	225	1 27.9	190	1	T	Y	190.01 27.9	specify SRP-based SR mechanism with a new subclause 27.9.3.	As in the comment.	2017/1/9 9:42
10081	yujin noh	225	1 28.1.1	209	43	T	Y	209.43 28.1.1	channel puncturing and preamble puncturing are mixed in use through the spec. In order to be consistent, preamble puncturing could be used instead of channel puncturing.	As in the comment.	2017/1/9 9:42
10082	yujin noh	225	1 28.1.1	209	59	T	Y	209.59 28.1.1	add QPSK DCM. QPSK modulation with DCM is defined in 28.3.11.9 Constellation mapping	As in the comment.	2017/1/9 9:42
10083	yujin noh	225	1 28.2.2	221	18	T	Y	221.18 28.2.2	The definition of channel bonding is not existed in the spec. In order to be consistent through the spec, channel bonding should be replaced with preamble puncturing.	As in the comment.	2017/1/9 9:42
10084	yujin noh	225	1 28.3.3.2	229	31	E	Y	229.31 28.3.3.2	".." is shown at the end of the sentence as a typo. remove "." at the end of the sentence.	As in the comment.	2017/1/9 9:42
10085	yujin noh	225	1 28.3.3.2	230	6	T	Y	230.06 28.3.3.2	add descrption on [a:b] used in Table 28-3, Table 28-4 and Table 28-5.	As in the comment.	2017/1/9 9:42
10086	yujin noh	225	1 28.3.3.2	235	47	E	Y	235.47 28.3.3.2	in "Nx4x26 subcarriers", "x" as alphabet needs to replaced with "*" as equation symbol.	As in the comment.	2017/1/9 9:42
10087	yujin noh	225	1 28.3.3.2	230	9	E	Y	230.09 28.3.3.2	add descrption with "Subcarrier indices" in Table 28-3, 28-4 and 28-5 in the first row as identical as Null Subcarrier Indices in the first row in Table 28-6	As in the comment.	2017/1/9 9:42
10088	yujin noh	225	1 28.3.3.4	237	6	T	Y	237.06 28.3.3.4	Through the spec, "lower/upper" 80MHz is used generally rather than "first/second" 80MHz. The "first/second" 80MHz needs to be replaced with "lower" 80MHz and "upper" 80MHz to be consistent in the spec.	As in the comment.	2017/1/9 9:42
10089	yujin noh	225	1 28.3.3.5	237	18	E	Y	237.18 28.3.3.5	wrong reference. 28.3.9 needs to be modified to 28.3.3.6 20 MHz only HE STAs	As in the comment.	2017/1/9 9:42
10090	yujin noh	225	1 28.3.3.5	237	34	E	Y	237.34 28.3.3.5	"2 26-tone RUs" should be modified with "2 of 26-tone RUs" in order to be consistent with description of 52- and 106-tone RUs such as "2 of 52-tone RUs are restricted"	As in the comment.	2017/1/9 9:42
10091	yujin noh	225	1 28.3.3.5	237	35	E	Y	237.35 28.3.3.5	"7 26-tone RUs" should be modified with "7 of 26-tone RUs" in order to be consistent with description of 52- and 106-tone RUs such as "2 of 52-tone RUs are restricted"	As in the comment.	2017/1/9 9:42
10092	yujin noh	225	1 28.3.3.5	237	38	E	Y	237.38 28.3.3.5	"14 26-tone RUs" should be modified with "14 of 26-tone RUs" in order to be consistent with description of 52- and 106-tone RUs such as "2 of 52-tone RUs are restricted"	As in the comment.	2017/1/9 9:42
10093	yujin noh	225	1 28.3.3.8.3	238	60	T	Y	238.60 28.3.3.8.3	no defintion of "SIGB Common field" in the spec. "SIGB Common field" needs to be replaced with "Common field of HE-SIG-B" to be consistent through the spec.	As in the comment.	2017/1/9 9:42

10094 yujin noh	225	1 28.3.3.8.3	238	61	T	Y	238.61 28.3.3.8.3	no defintion of "HE-SIGB Common field" in the spec. "HE-SIG-B Common field" needs to be replaced with Common field of HE-SIG-B to be consistent through the spec	As in the comment.	2017/1/9 9:42
10095 yujin noh	225	1 28.3.3.8.3	238	61	E	Y	238.61 28.3.3.8.3	RU allocation signaling is not a field name in the Common field of the HE-SIG-B. RU allocation signaling needs to be replaced with RU Allocation field.	As in the comment.	2017/1/9 9:42
10096 yujin noh	225	1 28.3.3.8.3	239	1	T	Y	239.01 28.3.3.8.3	HE-SIG-B common field needs to be replaced with Common field of HE-SIG-B to be consistent in the spec	As in the comment.	2017/1/9 9:42
10097 yujin noh	225	1 28.3.3.8.3	239	2	T	Y	239.02 28.3.3.8.3	HE-SIG-B consists of Common field and User specfic field. Remove s from fields. No plurality of User Specific fields defind in the spec. Or it meant to be User fields.	As in the comment.	2017/1/9 9:42
10098 yujin noh	225	1 28.3.3.8.3	239	5	T	Y	239.05 28.3.3.8.3	User block fields in this chapter should be modified with User fields. User Block field should be used only when describing on the encoding process.	As in the comment.	2017/1/9 9:42
10099 yujin noh	225	1 28.3.3.8.3	239	5	E	Y	239.05 28.3.3.8.3	"SIG-B channels" should be replaced with "HE-SIG-B content channels" to be consistent through the spec.	As in the comment.	2017/1/9 9:42
10100 yujin noh	225	1 28.3.3.8.3	239	8	T	Y	239.08 28.3.3.8.3	"user specific block" should be modified with "User field" to be consistent through the spec. A User field should be used when describing on each user content through the spec if it is refered.	As in the comment.	2017/1/9 9:42
10101 yujin noh	225	1 28.3.3.8.3	239	12	E	Y	239.12 28.3.3.8.3	"spatial configuration field" should be replaced with "Spatial Configuration field" to be consistent through the spec.	As in the comment.	2017/1/9 9:42
10102 yujin noh	225	1 28.3.3.8.3	239	19	T	Y	239.19 28.3.3.8.3	no definition of "user specific blocks" in the spec. all user specific blocks in this chapter should be replaced with User fields to be consistent through the spec. A User field should be used when describing on each user content	As in the comment.	2017/1/9 9:42
10103 yujin noh	225	1 28.3.3.8.3	239	19	E	Y	239.19 28.3.3.8.3	There is the field name indicating 11-bit field. "Each user specific block has an 11-bit field indicating the STA ID" should be modified with "Each user specific block has an 11-bit field as STA-ID field indicating the AID described in 9.4.1.8 (AID field)"	As in the comment.	2017/1/9 9:42
10104 yujin noh	225	1 28.3.3.8.3	239	22	T	Y	239.22 28.3.3.8.3	clarify the meaning of block index in "The user position is indicated by the block index". There is no definition of block index in the spec.	As in the comment.	2017/1/9 9:42
10105 yujin noh	225	1 28.3.3.8.3	239	22	T	Y	239.22 28.3.3.8.3	add the reference of "a multiplexing information lookup table" with Table 28-24 (Spatial Configuration subfield encoding).	As in the comment.	2017/1/9 9:42
10106 yujin noh	225	1 28.3.3.8.3	239	38	E	Y	239.38 28.3.3.8.3	RU r should be modified with RU r (italic r) to be consistent through the spec	As in the comment.	2017/1/9 9:42
10107 yujin noh	225	1 28.3.3.8.3	239	39	T	Y	239.39 28.3.3.8.3	no definition of "HE-SIG-B user specific blocks" in the spec. It should be replaced with "User field in HE-SIG-B".	As in the comment.	2017/1/9 9:42
10108 yujin noh	225	1 28.3.3.10.3	240	12	T	Y	240.12 28.3.3.10.3	it is not necessary to have two mandatory technologies having the identical purpose. 1) Have single stream pilot as mandatory on top of mask LTF sequence as optional. 2) Or A STA capable of UL MU-MIMO transmission on full bandwidth shall support either single stream pilot or masking LTF sequence of each spatial stream by a distinct orthogonal code depending on its capabilities. Or 3) give the option of implemention and its capability to AP when associated with	1) define Mask LTF Sequence subfield in the HE PHY Capabilities Information field: definition: indicates support of Mask LTF sequence. Set to 0 if not supported. Set to 1 if supported. or 2) define MU-MIMO LTF Mode subfield in the HT PHY Capabilities information field: definition: Bx: Indicates support of single stream pilot By: Indicates support of mask LTF sequence. or 3) define MU-MIMO LTF Mode subfield in the HT PHY Capabilities information field: definition: Set to 0 if single stream pilot is supported. Set to 1 if mask LTF sequence is supported	2017/1/9 9:42

10109	yujin noh	225	1 9.3.1.23	42	7	E	Y	42.07 9.3.1.23	as a subfield name, "GIAnd LTF Type" is shown as a typo. It should be "GI And LTF Type" field.	As in the comment.	2017/1/9 9:42
10110	yujin noh	225	1 28.3.3.10.3	240	50	E	Y	240.50 28.3.3.10.3	There are no "RU allocation info field" and "SS allocation field" in Uer Info field. RU allocation info and SS allocation needs to be modified with "RU Allocation field" and "SS Allocation field" which are the name of subfields in User Info field.	As in the comment.	2017/1/9 9:42
10111	yujin noh	225	1 28.3.3.10.3	240	51	E	Y	240.51 28.3.3.10.3	There is no field named as "Address field". "Address field" needs to be modified with "AID12 subfield" which is the name of subfield in User Info field.	As in the comment.	2017/1/9 9:42
10112	yujin noh	225	1 28.3.3.10.3	240	54	E	Y	240.54 28.3.3.10.3	There is no field named as "Address field". "Address field" needs to be modified with "AID12 subfield" which is the name of subfield in User Info field.	As in the comment.	2017/1/9 9:42
10113	yujin noh	225	1 28.3.4	242	27	T	Y	242.27 28.3.4	In Table 28-9, THE-SIG-A and THE-SIG-A-R are defined as 8us and 16us, respectively. Then in Figure 28-7, HE-SIG-A should be replaced with HE-SIG-A-R. add the definition of HE-SIG-A-R and modify the Figure 29-7 and Table 28-8 to present HE-SIG-A-R field in HE extended range SU PPDU	As in the comment.	2017/1/9 9:42
10114	yujin noh	225	1 28.3.6.7	252	34	T	Y	252.34 28.3.6.7	"User Specific field" needs to be replaced with "User Block field" in this capter. User Block field should be used when describing on the encoding process	As in the comment.	2017/1/9 9:42
10115	yujin noh	225	1 28.3.6.7	252	50	E	Y	252.50 28.3.6.7	wrong reference. 28.3.10.8.1 needs to be replaced with 28.3.10.8.2 in order to describe the 1212 HE-SIG-B content channel mapping depending on the bandwidth.	As in the comment.	2017/1/9 9:42
10116	yujin noh	225	1 28.3.7	256	10	E	Y	256.10 28.3.7	no termonology of "HE-SIG-B-MCS" except for this chapter with Line 10, 11 and 12. HE-SIG-B-MCS needs to be replaced with "SIGB MCS" to be consistent in the spec. "SIGB MCS" is the field name defined in HE-SIG-A field.	As in the comment.	2017/1/9 9:42
10117	yujin noh	225	1 28.3.7	257	61	T	Y	257.61 28.3.7	If there is no use of "THE-LTF-SYM" through the spec, remove the unnecessary paramter in th table.	As in the comment.	2017/1/9 9:42
10118	yujin noh	225	1 28.3.8	258	20	E	Y	258.20 28.3.8	to keep consistency in the Table 28-10, some description of parameters could be modified such as NSD: Number of complex data tones (or subcarriers) per frequency segment.(instead of "number of complex data numbers") NSP: Number of pilot tones (or subcarriers) per frequency segment (instead of "number of pilot values") ...	As in the comment.	2017/1/9 9:42
10119	yujin noh	225	1 28.3.8	258	49	E	Y	258.49 28.3.8	In order to keep consistency between NGuard,Left and NGuard,Right in the same table, "side" could be replaced with "end" such that "Numbr of guard tons at the lower end of the spectrum". To describe the guard tone position, lower/higher end could be much clear for readers.	As in the comment.	2017/1/9 9:42
10120	yujin noh	225	1 28.3.11.11	328	41	E	Y	328.41 28.3.11.11	in 2x996, alphabet x should be modifid with symbol +- in lines 40, 47 and 59 at P328 and in lines 12, 19, 34 and 58 at P329 and in lines 3 at P330	As in the comment.	2017/1/9 9:42
10121	yujin noh	225	1 28.3.11.11	329	47	E	Y	329.47 28.3.11.11	"Error! Reference source not found. and Error! Reference source not found" is shown. fix the reference	As in the comment.	2017/1/9 9:42
10122	yujin noh	225	1 28.3.11.13	333	28	E	Y	333.28 28.3.11.13	Equation (28-105) misses baskets where n + 1 mod 8, n + 2 mod 8 and n + 3 mod 8 should be replaced with (n + 1) mod 8, (n + 2) mod 8 and (n + 3) mod 8, respectively	As in the comment.	2017/1/9 9:42
10123	yujin noh	225	1 28.3.11.13	334	17	E	Y	334.17 28.3.11.13	Equation (28-106) misses baskets where n + 1 mod 8, n + 2 mod 8 and n + 3 mod 8 should be replaced with (n + 1) mod 8, (n + 2) mod 8 and (n + 3) mod 8, respectively	As in the comment.	2017/1/9 9:42

10124	yujin noh	225	1 28.3.11.13	335	6	E	Y	335.06 28.3.11.13	in KR2x996i, alphabet x should be modifid with symbol +· in lines 6, 14 and 28 at P355	As in the comment.	2017/1/9 9:42
10125	yujin noh	225	1 28.3.14.3	342	37	T	Y	342.37 28.3.14.3	clarify the meaning of consecutive HE trigger-based PPDU. For example, is it the HE tirrger-based PPDU followed by another HE trigger-based PPDU without the Trigger frame?	As in the comment.	2017/1/9 9:42
10126	yujin noh	225	1 28.3.15.1	343	4	T	Y	343.04 28.3.15.1	add the definition of SU-MIMO and DL MU-MIMO beamforming to be consistent with 21.3.11.1 in 11ac. For example, SU-MIMO and DL-MU-MIMO beamforming are techniques used by a STA with multiple antennas (the beamformer) to steer signals using knowledge of the channel to improve throughput. With SU-MIMO beamforming all space-time streams in the transmitted signal are intended for reception at a single STA. With DL MU-MIMO beamforming, disjoint subsets of the space-time streams are intended for reception at different STAs.	As in the comment.	2017/1/9 9:42
10127	yujin noh	225	1 28.3.15.2	343	59	E	Y	343.59 28.3.15.2	+¬(k,v)should be replaced with +¬(k,u)because it is the angle information to build Vk,u	As in the comment.	2017/1/9 9:42
10128	yujin noh	225	1 28.3.15.2	344	8	E	Y	344.08 28.3.15.2	+¬(k,v)should be replaced with +¬(k,u)because it is the angle information to build Vk,u	As in the comment.	2017/1/9 9:42
10129	yujin noh	225	1 28.3.15.2	344	11	E	Y	344.11 28.3.15.2	"For MU-MIMO beamforming" should be replaced with "For DL MU-MIMO beamforming" since 28.3.15.2 is a sub-clause of 28.3.15 SU-MIMO and DL MU-MIMO beamforming.	As in the comment.	2017/1/9 9:42
10130	yujin noh	225	1 28.3.19	360	40	E	Y	360.40 28.3.19	to be consistent through the spec, "HE-SIG-A Sym 1", and "HE-SIG-A Sym 2" should be replaced with "HE-SIG-A1"and "HE-SIG-A2"	As in the comment.	2017/1/9 9:42
10131	yujin noh	225	1 28.3.19	361	20	E	Y	361.20 28.3.19	to be consistent through the spec, "HE-SIG-A Sym 1", "HE-SIG-A Sym 2", "HE-SIG-A Sym 3" and "HE-SIG-A Sym 4" should be replaced with "HE-SIG-A1", "HE-SIG-A2", "HE-SIG-A3" and "HE-SIG-A4"	As in the comment.	2017/1/9 9:42
10132	yujin noh	225	1 28.3.19	361	47	E	Y	361.47 28.3.19	to be consistent through the spec, "HE-SIG-A Sym 1", and "HE-SIG-A Sym 2" should be replaced with "HE-SIG-A1"and "HE-SIG-A2"	As in the comment.	2017/1/9 9:42
10133	yujin noh	225	1 28.3.19	362	21	E	Y	362.21 28.3.19	to be consistent through the spec, "HE-SIG-A Sym 1", and "HE-SIG-A Sym 2" should be replaced with "HE-SIG-A1"and "HE-SIG-A2"	As in the comment.	2017/1/9 9:42
10134	yujin noh	225	1 28.3.19	363	40	T	Y	363.40 28.3.19	Considering not following the 4us boundary rule for TX/RXTIME anymore in 11ax, in order to reduce the confusion when PHY issues the PHY-TXEND.confirm primitive, "the PHY-TXEND.confirm primitive is generated at the end of last symbol of the PPDU" should be clarified with "the PHY-TXEND.confirm primitive is generated at the actual end of last symbol of the PPDU".	As in the comment.	2017/1/9 9:42
10135	yujin noh	225	1 28.3.19	364	14	T	Y	364.14 28.3.19	RL-SIG should not be classified into L-Preamble. Move TX RL-SIG(BPSK) into the next steps with TX HE-Preamble.	As in the comment.	2017/1/9 9:42
10136	yujin noh	225	1 28.3.19	364	42	E	Y	364.42 28.3.19	In NSYM, "SYM" needs to be subscripted.	As in the comment.	2017/1/9 9:42
10137	yujin noh	225	1 9.4.1.62	56	1	T	Y	56.01 9.4.1.62	wrong reference is shown. The reference should be 9.6.28.2 HE Compressed Beamforming And CQI frame format.	As in the comment.	2017/1/9 9:42
10138	yujin noh	225	1 9.4.1.63	58	18	E	Y	58.18 9.4.1.63	Nc Index "field" should be replaced with Nc Index "subfield" as described in Table 9-76a	As in the comment.	2017/1/9 9:42
10139	yujin noh	225	1 9.4.1.63	58	19	E	Y	58.19 9.4.1.63	Nr Index "field" should be replaced with Nr Index "subfield" as described in Table 9-76a	As in the comment.	2017/1/9 9:42

10140	yujin noh	225	1 9.2.4.6.4.4	25	18	T	Y	25.18 9.2.4.6.4.4	complete the control information subfield format when Control ID subfield is 2 if needed	As in the comment.	2017/1/9 9:42
10141	yujin noh	225	1 9.2.4.6.4.4	25	8	E	Y	25.08 9.2.4.6.4.4	wrong reference is shown. The reference 9.31.4 should be 27.13 (Link adaptation using the HE variant HT Control field)	As in the comment.	2017/1/9 9:42
10142	yujin noh	225	1 9.4.2.200	73	14	E	Y	73.14 9.4.2.200	wrong reference is shown. The reference 25.14 should be 27.13 (Link adaptation using the HE variant HT Control field)	As in the comment.	2017/1/9 9:42
10143	yujin noh	225	1 9.4.2.200	73	40	E	Y	73.40 9.4.2.200	wrong reference is shown. The reference 25.14 should be 27.13 (Link adaptation using the HE variant HT Control field)	As in the comment.	2017/1/9 9:42
10144	yujin noh	225	1 10.9	127	27	E	Y	127.27 10.9	wrong reference is shown. The reference 10.31.4 should be 27.13 (Link adaptation using the HE variant HT Control field)	As in the comment.	2017/1/9 9:42
10145	yujin noh	225	1 27.13	198	60	T	Y	198.60 27.13	complete HE link adaptation operation in sub-clause 27.13 if needed	As in the comment.	2017/1/9 9:42
10146	yujin noh	225	1 28.4	371	15	T	Y	371.15 28.4	add PHY MIB in new sub-clause in 28.4 HE PLME	As in the comment.	2017/1/9 9:42
10147	yujin noh	225	1 9.3.1.20	40	7	E	Y	40.07 9.3.1.20	"STA info field" should be replaced with "STA Info field" use the capital letter "I" in "Info" in order to keep consistency throught the spec.	As in the comment.	2017/1/9 9:42
10148	yujin noh	225	1 27.6.2	176	29	E	Y	176.29 27.6.2	"receiver STAs" should be replaced with "recipient STAs" or "recipients" in order to keep consistency through the spec.	As in the comment.	2017/1/9 9:42
10149	yujin noh	225	1 27.6.2	176	22	E	Y	176.22 27.6.2	"HE NDP Announcement frame" and "NDP Announcement frame" are mixed in use. In order to keep consisteny, "NDP Announcement frame" should be replaced with "HE NDP Announcement frame" in this sub-clause.	As in the comment.	2017/1/9 9:42
10150	yujin noh	225	1 27.6.2	176	46	E	Y	176.46 27.6.2	Nc Index "field" should be replaced with Nc Index "subfield" as described in Table 9-76a	As in the comment.	2017/1/9 9:42
10151	yujin noh	225	1 27.6.2	176	46	T	Y	176.46 27.6.2	no "Feedback Type subfield" defined in the STA Info subfield of the HE NDP Announcement frame. It should be replaced with "Feedback Type And Ng subfield" which indicates the feedback type and Ng jointly.	As in the comment.	2017/1/9 9:42
10152	yujin noh	225	1 27.6.2	176	62	T	Y	176.62 27.6.2	no "Beamformee STS Capability field" defined in Table 9-262aa HE PHY Capabilities Information field. Refer to "Beamformee STS For <= 80 MHz", "NSTS Total For <= 80 MHz", "Beamformee STS For > 80 MHz" and "NSTS Total For > 80 MHz" in Table 9-262aa	As in the comment.	2017/1/9 9:42
10153	yujin noh	225	1 27.6.2	177	1	T	Y	177.01 27.6.2	no "Feedback Type subfield" and "Ng field" defined in the STA Info subfield of the HE NDP Announcement frame. It should be replaced with "Feedback Type And Ng subfield" which indicates the feedback type and Ng jointly.	As in the comment.	2017/1/9 9:42
10154	yujin noh	225	1 27.6.2	177	5	E	Y	177.05 27.6.2	"RU Start Index" and "RU End Index" are replaced with "RU Start Index subfield" and "RU End Indexsubfield" in this paragraph (L4-L19) as described in Figure 9-51c.	As in the comment.	2017/1/9 9:42
10155	yujin noh	225	1 27.6.2	177	19	E	Y	177.19 27.6.2	Table YY-1 should be replaced with Table 9-76c	As in the comment.	2017/1/9 9:42
10156	yujin noh	225	1 27.6.2	177	36	T	Y	177.36 27.6.2	"Nc Index field" should be replaced with "Nc subfield" as described in Figure 9-51b. clarify the text "set the Nc Index field to 0 and the Ng field to 0." There is no Ng field in the NDP Announcement frame.	As in the comment.	2017/1/9 9:42
10157	yujin noh	225	1 27.6.2	177	52	E	Y	177.52 27.6.2	Resolution of the Figure 27-3 is not good for readers. Change the Figure 27-3 to have the letter clearly.	As in the comment.	2017/1/9 9:42
10158	yujin noh	225	1 27.6.2	177	55	E	Y	177.55 27.6.2	no AID subfield defined. "AID subfield" should be replaced with "AID11 subfield" as described in Figure 9-51b	As in the comment.	2017/1/9 9:42
10159	yujin noh	225	1 27.6.2	178	18	E	Y	178.18 27.6.2	Resolution of the Figure 27-4 is not good for readers. Change the Figure 27-4 to have the letter clearly.	As in the comment.	2017/1/9 9:42

10160	yujin noh	225	1 27.6.2	178	25	T	Y	178.25 27.6.2	"Beamforming Report Poll variant Trigger frame" and "Beamforming Report Poll Trigger frame" are mixed in use. In order to be consistent, choose one and mofigy the rest.	As in the comment.		2017/1/9 9:42
10161	yujin noh	225	1 27.6.2	178	41	E	Y	178.41 27.6.2	"RU start index" and "RU end index" should be modified with "RU Start Index" and "RU End Index" as described in Figure 9-51c.	As in the comment.		2017/1/9 9:42
10162	yujin noh	225	1 9.3.1.23	43	1	T	Y	43.01 9.3.1.23	The CS Required subfield is set to 1, ED-based CCA follows the same procedure as defined in VHT receiver specification. The rules describes the STA behaviors such that the STA shall start sensing the primary 20MHz channel first and then if present, additional secondary 20MHz channel, secondary 40MHz and secondary 80MHz channel(s) are measured to compare with the pre-determined CCA-ED threshold(s) depending on the operating channel. However when receiving the Trigger frame in 11ax, there might be a STA which is assigned to use the RU whose 20MHz channel(s) does not contain the primary 20MHz channel. ED-based CCA needs to be modified to sense either a single 20 MHz channel or multiple of 20 MHz channels which does not contain the	As in the comment.		2017/1/9 9:42
10163	yujin noh	225	1 28.3.10.10	314	1	T	Y	314.01 28.3.10.10	clarify the setence below how to recommended. "When a 1x, 2x or 4x HE-LTF is transmitted, it is recommended that the spatial mapping matrix applied to HE-STF and beyond is chosen such that it preserves the smoothness of the physical channel, achieved by limiting the variation of each element's real and imaginary values in the spatial mapping matrix across successive tones within one RU." If it is implement dependent, add the following sentence: The method used by the beamformer to recomment the spatial mapping matrix is implementation specific.	As in the comment.		2017/1/9 9:42
10164	yujin noh	225	1 27.6.2	178	60	E	Y	178.60 27.6.2	"RU start index" and "RU end index" should be modified with "RU Start Index" and "RU End Index" as described in Figure 9-51c.	As in the comment.		2017/1/9 9:42
10165	Yunbo Li	225	1 27.5.2.2.1	164	46	E	Y	164.46 27.5.2.2.1	The are two dots at the end of this sentence.	remove one dot.		2017/1/9 9:42
10166	Yunbo Li	225	1 27.5.2.2.1	164	63	E	Y	164.63 27.5.2.2.1	"more than one Trigger frame is ..." should changed to " more than one Trigger frames are..."	As in comment.		2017/1/9 9:42
10167	Yunbo Li	225	1 27.5.2.2.1	165	26	T	Y	165.26 27.5.2.2.1	In sentence,"The AP shall apply the Trigger Frame MAC Padding field with duration corresponding to the longest value among all STAs that have requested extra MinTrigProcTime through Trigger Frame MAC Padding Duration capability", only need to consider all triggered STAs.	change "among all STAs" to "among all triggered STAs"		2017/1/9 9:42
10168	Yunbo Li	225	1 27.5.2.3	167	55	T	Y	167.55 27.5.2.3	the condition for OFDMA random access (AID12 set to 0) is not included	change to "The received PPDU contains either a Trigger frame (that is not an MU-RTS variant) with a User Info field addressed to the STA or AID12 set to 0, or an MPDU,...".		2017/1/9 9:42
10169	Yunbo Li	225	1 27.5.2.3	167	59	T	Y	167.59 27.5.2.3	there is a TBD for unassociated STA	resolve the TBD		2017/1/9 9:42
10170	Yunbo Li	225	1 27.5.2.3	167	65	E	Y	167.65 27.5.2.3	"Otherwise, a STA shall not send an HE trigger-based PPDU" should be a separate paragraph.	As in comment.		2017/1/9 9:42

10171	Yunbo Li	225	1 27.2.1	150	13	T	Y	150.13 27.2.1	"An HE AP receives either a VHT MU PPDU or an HE MU PPDU" is one of the conditions to determine an inter-BSS frame in Draft 1.0. But HE MU PPDU is allowed to be used in UL transmission (DL/UL indication in HE MU PPDU). When HE MU PPDU is transmitted by intra-BSS STA for UL transmission, it can not be determined as an inter-BSS frame.	Remove the condition of HE MU PPDU, or disallow HE MU PPDU for UL transmission.		2017/1/9 9:42
10172	Yunbo Li	225	1 27.5.2.4	170	23	T	Y	170.23 27.5.2.4	"ED-based CCA is described in 21.3.18.5.2 (CCA sensitivity for operating classes requiring CCA-ED)". There is a subclause for CCA-ED in 28.3.17.6.2, the ED-based CCA for UL MU CS is better to refer to this subclause. Same comment for other CCA reference of HE operation.	As in comment.		2017/1/9 9:42
10173	Yunbo Li	225	1 27.5.2.6.1	172	45	T	Y	172.45 27.5.2.6.1	"An HE STA shall use the OCWmin and OCWmax values indicated in the RAPS element within the most recently received Beacon or Probe Response regardless of the access category of traffic the HE STA intends to transmit." What's the reason that a STA using OFDMA random access will neglect the AC of the traffic?	Give the technical reasons. Otherwise, the OFDMA random access should also consider the AC of traffic.		2017/1/9 9:42
10174	Yunbo Li	225	1 27.5.2.6.2	173	46	E	Y	173.46 27.5.2.6.2	A dot is missed after AID value 0.	As in comment.		2017/1/9 9:42
10175	Yunbo Li	225	1 27.5.2.6.2	173	51	T	Y	173.51 27.5.2.6.2	It is not reasonable to let a STA randomly select a RU in the subsequent Trigger frame. Because it will cause severe collision in the subsequent Trigger frame without a backoff.	The STA should perform a backoff before randomly select a RU in the subsequent Trigger frame to avoid the severe collision.		2017/1/9 9:42
10176	Yunbo Li	225	1 27.5.2.6.2	173	36	T	Y	173.36 27.5.2.6.2	There is a confliction in the descriptions for STA1 to decrease its OBO counter when following below the two sentences. "if the OBO counter is smaller than the number of RUS assigned to AID value 0 in a Trigger frame, then the HE STA shall decrement its OBO counter to zero " and "HE STA1 and STA2 decrement their nonzero OBO counters by 1 in every RU assigned to AID value 0 for random access within the Trigger frame".	modify the sentences to make the descritions coincide with each other.		2017/1/9 9:42
10177	Yunbo Li	225	1 27.5.2.6.2	173	36	E	Y	173.36 27.5.2.6.2	"decrement" is a noun┤+εa verb should be used here╥╟Θ	change "decrement" to "decrease".		2017/1/9 9:42
10178	Yunbo Li	225	1 28.3.17.6	348	58	T	Y	348.58 28.3.17.6	The CCA for preamble puncturing is missed in this subclause.	Add a subclause to decripte the CCA for preamble puncturing.		2017/1/9 9:42
10179	Yunbo Li	225	1 10.22.2.7	132	22	T	Y	132.22 10.22.2.7	The bandwidth select rule in current spec only allows the TXOP holder to set CH_BANDWIDTH same or narrower than preceding PPDU. After OFDMA is introduced, AP may communicate with multiple STAs that each STA occupies a narrow band than AP. In this case, when a STA initiate a TXOP with a narrow bandwidth, while AP could sensed a wider bandwidth at idle status, if the AP is allowed to use a wider bandwidth than the initiated STA, AP could communicate with the initial STA at a narrow bandwith wihch include primary 20MHz, and communicate with other STAs at secondary sub-channel which are busy for the initiated STA. It could be used to improve the system efficiency.	Discuss the fesiblity of the bandwidth extension during TXOP.		2017/1/9 9:42
10180	Yusuke Asai	225	1 3.2	4	9	T	N	4.09 3.2	Some conditions for an HE PHY to transmit 20 MHz non-HT/HT/VHT PPDUs applying 20 MHz spectral mask defined in Clause 28 may be needed as well as 40/80/160/80+80 MHz mask PDUs. Because the 20 MHz spectral mask for HE PHY is different from that for non-HT/HT/VHT╥╟PHY.	If needed, add some conditions.		2017/1/9 9:42

10181	Yusuke Asai	225	1 3.2	4	39	E	N	4.39 3.2	Redundant word of "(HE)" should be deleted.	As in comment.	2017/1/9 9:42
10182	Yusuke Asai	225	1 3.2	6	48	T	Y	6.48 3.2	To distinguish from "frequency segment", the definition of "frequency subbock" is needed.	Add the definition of it in Subclause 3.2.	2017/1/9 9:42
10183	Yusuke Asai	225	1 4.3.14a	9	29	T	Y	9.29 4.3.14a	The Mandatory/optional feature for UL MU-MIMO function should be clarified in the normative text.	As in comment.	2017/1/9 9:42
10184	Yusuke Asai	225	1 4.3.14a	9	38	T	Y	9.38 4.3.14a	The condition should also be applied to an 80+80 MHz channel.	"a 160 MHz channel" -> "a 160 MHz or 80+80 MHz channel"	2017/1/9 9:42
10185	Yusuke Asai	225	1 4.3.14.a	9	43	T	Y	9.43 4.3.14.a	According to the condition "Optional support for 1024-QAM on 242-, 484- and 996-tones RUs", the HE PHY spec does not allow to use 1024-QAM on a 2x996-tone RU. On the other hands, in P317L42, the text "LDPC is the only FEC coding scheme in the HE PPDU Data field for MCS10 and MCS11 in a 242-, 484-, 996- and 2x996-tone RU." suggests that 1024QAM may be used on a 2x996-tone RU. These two sentences contradicts with each other.	Fix it.	2017/1/9 9:42
10186	Yusuke Asai	225	1 4.3.14a	9	51	E	N	9.51 4.3.14a	As well as the other clauses, "basic trigger frame" should be captalized.	As in comment.	2017/1/9 9:42
10187	Yusuke Asai	225	1 4.3.14a	9	60	T	N	9.60 4.3.14a	"MU OFDMA" should be "OFDMA" because OFDMA is an MU transmission inherently.	As in comment.	2017/1/9 9:42
10188	Yusuke Asai	225	1 4.3.14a	9	62	T	N	9.62 4.3.14a	"transmission resource" should be "RUs".	As in comment.	2017/1/9 9:42
10189	Yusuke Asai	225	1 6.3.3.3.2	11	22	E	N	11.22 6.3.3.3.2	"BSSDescription" -> "BSSDescriptionSet"	As in comment.	2017/1/9 9:42
10190	Yusuke Asai	225	1 6.3.3.3.2	11	21	T	Y	11.21 6.3.3.3.2	This change for the primitive parameters should be also added to "HE Capabilities" and "HE Operation".	As in comment.	2017/1/9 9:42
10191	Yusuke Asai	225	1 9.3.1.9.1	34	10	T	Y	34.10 9.3.1.9.1	The first bit of "Reserved" field is not B6 but B5.	Revise it.	2017/1/9 9:42
10192	Yusuke Asai	225	1 17.2.2.1	145	22	T	Y	145.22 17.2.2.1	In Clause 17, a TXVECTOR parameter "TRIGGER_RESPONDING" and the corresponding requirement of pre-correction accuracy are defined. It is seemed that this TXVECTOR parameter is true when an STA respond to a trigger frame; however, there is no definition about it.	Clarify it and add some normative text.	2017/1/9 9:42
10193	Yusuke Asai	225	1 27.2.1	150	19	E	N	150.19 27.2.1	"cannot be" should be "is not".	As in comment.	2017/1/9 9:42
10194	Yusuke Asai	225	1 27.9.1	190	11	T	Y	190.11 27.9.1	There is no definition of "SR PPDU."	Define it on Subclause 3.2 or delete it.	2017/1/9 9:42
10195	Yusuke Asai	225	1 27.9.2.2	191	10	E	N	191.10 27.9.2.2	"OBSSPD" should be "OBSS_PD"	As in comment.	2017/1/9 9:42
10196	Yusuke Asai	225	1 28.1.1	209	59	T	Y	209.59 28.1.1	QPSK DCM is defined in some HE-MCSs tables but not stated here.	Add "QPSK DCM" after "(QPSK)".	2017/1/9 9:42
10197	Yusuke Asai	225	1 28.1.1	210	39	E	N	210.39 28.1.1	"1x" -> "1x LTF"	As in comment.	2017/1/9 9:42
10198	Yusuke Asai	225	1 28.2.2	216	47	E	Y	216.47 28.2.2	The conditions of CHAN_MAT_TYPE for HE_MU, HE_EXT_SU, or HE_TRIG appear twice.	Fix it.	2017/1/9 9:42
10199	Yusuke Asai	225	1 28.2.2	219	25	T	Y	219.25 28.2.2	The condition when RSSI_LEGACY exists is not clear. In addition, "PHY legacy preamble" is not clear whether non-HE portion preamble in an HT/VHT/HE PPDU or PLCP preamble in a Non-HT PPDU.	Clarify it.	2017/1/9 9:42
10200	Yusuke Asai	225	1 28.3.3.10.4	240	19	T	Y	240.19 28.3.3.10.4	The title of this subclause should be changed to "Maximum number of spatial streams in UL MU-MIMO". An HE trigger-based PPDU carries an uplink OFDMA transmission; however, the context of this subclause only expialns about UL MU-MIMO transmissions.	As in comment.	2017/1/9 9:42
10201	Yusuke Asai	225	1 28.3.4	241	53	E	N	241.53 28.3.4	"Figure 28-8" -> "Table 28-8".	As in comment.	2017/1/9 9:42
10202	Yusuke Asai	225	1 28.3.5	244	21	T	N	244.21 28.3.5	For clarification, the note of "N_STS is 2 only for HE extend rage SU PPDU." should be added.	As in comment.	2017/1/9 9:42
10203	Yusuke Asai	225	1 28.3.5	247	18	T	Y	247.18 28.3.5	The first and last user indices should be 0 and N_{u-1}, respectiely. Because the user index range is defined as "u takes values 0 to NUM_USERS-1." in Clause 28 (ex. Table 28-12). In addition, N_u should be N_user.	As in comment.	2017/1/9 9:42

10204	Yusuke Asai	225	1 28.3.5	249	8	T	Y	249.08 28.3.5	The input of the first IDFT on the first transmit chain of the first frequency segment shoud be connected to the output of the Spatial Mapping of the second frequency segment.	Fix it.	2017/1/9 9:42
10205	Yusuke Asai	225	1 28.3.6.4	250	43	T	N	250.43 28.3.6.4	The subclause 28.3.10.5 (L-SIG) should be referred. Ditto in P251L11.	Add a reference of the subclause "28.3.10.5 (L-SIG)" in the bullet item f) .	2017/1/9 9:42
10206	Yusuke Asai	225	1 28.3.6.6	251	50	E	N	251.50 28.3.6.6	"inverse Fourier transform" -> "inverse discrete Fourier transform"	As in comment.	2017/1/9 9:42
10207	Yusuke Asai	225	1 28.3.6.8	253	23	E	N	253.23 28.3.6.8	Subclause number error (21.3.10->28.3.10). Ditto in P253L48.	As in comment.	2017/1/9 9:42
10208	Yusuke Asai	225	1 28.3.6.11.4	255	52	E	N	255.52 28.3.6.11.4	"Q" in "Q matrix" should be italic.	As in comment.	2017/1/9 9:42
10209	Yusuke Asai	225	1 28.3.8	260	6	T	Y	260.06 28.3.8	The TXVECTOR parameter NUM_USERS_TOTAL does not exist on Table 28-1 (TXVECTOR and RXVECTOR parameters)	Define the TXVECTOR parameter or revise the explanation of N_{user,r}.	2017/1/9 9:42
10210	Yusuke Asai	225	1 28.3.10.7.2	275	33	T	Y	275.33 28.3.10.7.2	"Doppler mode" is defined in an HE-SIG-A; however, there is no specific text for the definition of it and how a transmitter and a receiver should utilize this information. In addition, when this parameter should be enabled is not clear.	Clarify them add some normative text.	2017/1/9 9:42
10211	Yusuke Asai	225	1 28.3.10.7.2	275	36	T	Y	275.36 28.3.10.7.2	"bits 0 to 41 of the HE-SIG-A field" should be "bits 0-25 of HE-SIG-A1 and bits 0-15 of HE-SIG-A2" Ditto in P278L18, P281L15 and P282L48.	As in comment.	2017/1/9 9:42
10212	Yusuke Asai	225	1 28.3.10.7.2	277	16	T	Y	277.16 28.3.10.7.2	As well as other values, the case for value of 7 should be defined as which channel is punctured. Current definition is not clear whether secondary 40 MHz in the primary 80 MHz exists or not.	Change "the primary 40 MHz is present." to "only the secondary 40 MHz is punctured."	2017/1/9 9:42
10213	Yusuke Asai	225	1 28.3.10.7.2	282	39	E	N	282.39 28.3.10.7.2	"set Spatial Reuse to x" should be "Spatial Reuse shall be set to x".	As in comment.	2017/1/9 9:42
10214	Yusuke Asai	225	1 28.3.10.7.4	284	32	T	Y	284.32 28.3.10.7.4	The definitions of HE-SIG-Ax (x=1,2,3,4) for an HE extended range SU PPDU is inconsistent with Table 28-18.	Revise it. For example, replace HE-SIG-A1, HE-SIG-A2, HE-SIG-A3 and HE-SIG-A4 with HE-SIG-A11, HE-SIG-A12 HE-SIG-A21 HE-SIG-A22, respectively. In addition, some text changes are needed accordingly.	2017/1/9 9:42
10215	Yusuke Asai	225	1 28.3.10.7.4	285	5	T	Y	285.05 28.3.10.7.4	The numbering for HE-SIG-* are missed.	Fix them.	2017/1/9 9:42
10216	Yusuke Asai	225	1 28.3.10.8.2	286	33	T	Y	286.33 28.3.10.8.2	HE-SIG-B for 80+80 MHz PPDU is not defined.	Define it.	2017/1/9 9:42
10217	Yusuke Asai	225	1 28.3.10.8.4	292	4	T	Y	292.04 28.3.10.8.4	According to the definition of y2y1y0, z2z1z0, y1y0 and z1z0, some of 8 bits indicates in Table 28-21 are incorrect. For example, the cases of RUs of 242, 484 and 996 cannot be defined by y2y1y0 because the y2y1y0 is for 106-tone RUs.	Correct erros in Table 28-21 and/or revise the definitions of y2y1y0, z2z1z0, y1y0 and z1z0.	2017/1/9 9:42
10218	Yusuke Asai	225	1 28.3.10.8.5	293	61	E	N	293.61 28.3.10.8.5	"802.11ax" should be changed to "HE PHY" or something else.	As in comment.	2017/1/9 9:42
10219	Yusuke Asai	225	1 28.3.10.8.5	297	28	T	N	297.28 28.3.10.8.5	According to P213L54, the minimum number of users per HE MU PPDU is defined as one; howvever, in Table 28-24, N_user starts from two. As well as a VHT MU PPDU, it may be needed that an HE MU PPDU support "one user" transmission.	If necessary, add the case for N_user of one.	2017/1/9 9:42
10220	Yusuke Asai	225	1 28.3.11.5	317	46	E	N	317.46 28.3.11.5	"(#838)" should be deleted.	As in comment.	2017/1/9 9:42
10221	Yusuke Asai	225	1 28.3.11.9	327	40	E	N	327.40 28.3.11.9	Reference error.	Revise "18.3.5.8" to "17.3.5.8 (Subcarrier modulation mapping)".	2017/1/9 9:42
10222	Yusuke Asai	225	1 28.3.11.10	327	58	E	N	327.58 28.3.11.10	Refernce number error.	Replace "22.3.10.9.4" with "21.3.10.9.4".	2017/1/9 9:42
10223	Yusuke Asai	225	1 28.3.11.11	329	46	E	N	329.46 28.3.11.11	Reference souce error.	Fix it.	2017/1/9 9:42
10224	Yusuke Asai	225	1 28.3.11.11	329	49	T	N	329.49 28.3.11.11	"BCC-coded streams" should be "BCC-coded spatial streams".	As in comment.	2017/1/9 9:42
10225	Yusuke Asai	225	1 28.3.11.12	330	39	E	N	330.39 28.3.11.12	iSeg should be italic and "Seg" should be subscript.	As in comment.	2017/1/9 9:42
10226	Yusuke Asai	225	1 28.3.17.3	345	64	E	N	345.64 28.3.17.3	"Table xx-a" -> "Table 28-41".	As in comment.	2017/1/9 9:42
10227	Yusuke Asai	225	1 28.3.17.4	347	11	E	N	347.11 28.3.17.4	"W" should be italic.	As in comment.	2017/1/9 9:42
10228	Yusuke Asai	225	1 28.3.19	362	44	T	N	362.44 28.3.19	Reference error.	Add a correct reference.	2017/1/9 9:42
10229	Yusuke Asai	225	1 28.3.19	362	57	E	N	362.57 28.3.19	Subclause number error. 22.3.18.5 -> 21.3.18.5.	As in comment.	2017/1/9 9:42
10230	Yusuke Asai	225	1 28.3.19	362	57	E	N	362.57 28.3.19	Subclause number error. 7.3.5.12 -> 8.3.5.12.	As in comment.	2017/1/9 9:42
10231	Yusuke Asai	225	1 28.3.19	360	40	T	Y	360.40 28.3.19	Signal extension appears on this subclause; however, no definition is found in the draft.	Add the normative text or delete signal extension throughout the draft if it is not needed.	2017/1/9 9:42

10232	Yusuke Asai	225	1 28.3.19	364	37	T	N	364.37 28.3.19	The rectangle blocks of "Packet Extension?" and "Signal Extension?" should be rhombuses because they are conditional branches.	As in comment.	2017/1/9 9:42
10233	Yusuke Asai	225	1 28.3.19	368	62	E	N	368.62 28.3.19	Reference number. 22.3.18.5 -> 21.3.18.5.	As in comment.	2017/1/9 9:42
10234	Yusuke Asai	225	1 28.5	373	23	T	Y	373.23 28.5	It makes no sense to state "mandatory" or "optional" in the title of each MCS table. Mandatory/optional features are defined in normative text and summalized in PICS (Annex B). There are many tables that includ both mandatory and optional MCS indices. For example, in table 28-48 (HE-MCSs for mandatory 26-tone RU, NSS = 2), all of MCS indices are defined as optional for non-AP STAs.	Delete "mandatory" and "optional" in the caption of the table 28-47 to 28-102.	2017/1/9 9:42
10235	Yusuke Asai	225	1 B.4.3	407	42	T	Y	407.42 B.4.3	"CFHEW" is not defined but referred many times. The term of HEW is not used in other Clauses. Instead of "HEW", "HE" should be used.	Replace all of CFHEW* with CFHE* in Annex B. (* is a wildcard including null.)	2017/1/9 9:42
10236	Yusuke Asai	225	1 B.4.27	410	34	T	Y	410.34 B.4.27	"High Efficiency WLAN (HEW)" should be replaced with "High Efficiency (HE)". Also, HEW should replaced with HE in P410L36, P413L21	As in comment.	2017/1/9 9:42
10237	Yusuke Tanaka	225	1 3.2	4	31	E	N	4.31 3.2	"a HE" should be "an HE". Same comments on whole of this document.	As commented.	2017/1/9 9:42
10238	Yusuke Tanaka	225	1 9.3.1.23.6	51	30	T	Y	51.30 9.3.1.23.6	The operation and the frame for GCR with MU-BAR is defined in this spec, but a hole in a receiver's Block Ack bitmap problem (previously known since11aa) remains. It can be solved by GCR MU-BAR variant with a bitmap of sequence numbers corresponding to the GCR stream.	Add GCR sequence number bitmap in Trigger Dependent Common Info field for the GCR MU-BAR variant.	2017/1/9 9:42
10239	Yusuke Tanaka	225	1 10.3.2.8a.1	116	37	E	N	116.37 10.3.2.8a.1	"HE TB PPDU" is not defined.	Use "HE trigger-based PPDU" in this figure.	2017/1/9 9:42
10240	Yusuke Tanaka	225	1 10.22.2.2	130	2	E	N	130.02 10.22.2.2	"trigger based" should be "trigger-based" Same comments on P130L7, P130L12, P145L65, P225L4, P359L16, P369L6.	As commented.	2017/1/9 9:42
10241	Yusuke Tanaka	225	1 27.2.1	149	20	T	Y	149.20 27.2.1	It is described that inter-BSS or intra-BSS frame can be identified by its MAC address. From the aspect of early identification for SR, it is beneficial to clarify that the identification of inter-BSS frame is realized per MPDU in the A-MPDU.	Add the following condition for inter-BSS frame identification. "The MAC address of a MPDU with valid FCS in the received A-MPDU is not the MAC address of members of the BSS with which the STA is associated."	2017/1/9 9:42
10242	Yusuke Tanaka	225	1 27.2.1	150	13	T	Y	150.13 27.2.1	It is obvious that if the received signal is not IEEE Std 802.11 transmission it is an inter-BSS frame.	Add the following condition for inter-BSS frame identification. "An HE STA receives signal which is not NON_HT, HT_MF, HT_GF, VHT or HE PPDU."	2017/1/9 9:42
10243	Yusuke Tanaka	225	1 27.2.1	150	15	T	Y	150.15 27.2.1	A precedence rule of PARTIAL_AID should be defined.	Add "or PARTIAL_AID" at the end of the sentence.	2017/1/9 9:42
10244	Yusuke Tanaka	225	1 27.2.1	150	19	T	Y	150.19 27.2.1	If the received frame does not satisfy any of the intra-BSS and inter-BSS conditions, the frame can be defined as inter-BSS frame to improve benefit of OBSS_PD based SR. Even in case if the intra-BSS frame is identified as inter-BSS frame by erroneous detection, received power level of intra-BSS frame is usually high so that OBSS_PD based SR mechanism does not allow to transmit overlapping the frame and prevent interfering.	Replace "then the frame cannot be determined as intra-BSS or inter-BSS frame." with "then the frame can be determined as inter-BSS frame."	2017/1/9 9:42
10245	Yusuke Tanaka	225	1 27.2.1	150	19	E	Y	150.19 27.2.1	This sentence does not provide any information about specification and what it mentions here is beyond the spec.	Delete this sentence.	2017/1/9 9:42

10246	Yusuke Tanaka	225	1 27.2.2	150	48	T	Y	150.48 27.2.2	Static NAV can provide MAC level power save without suffering with unpredictable NAV updating.	Add the following rule at L48. "An HE AP may indicate that the NAV set by the Duration field in the PPDU will not be updated." Add the following rule at L59 and P151L5 "If an HE non-AP STA receives a PPDU with indication that the NAV set by the Duration field in the PPDU will not be updated, the HE non-AP STA may enter the doze state until the end of the NAV."	2017/1/9 9:42
10247	Yusuke Tanaka	225	1 27.2.2	151	51	T	Y	151.51 27.2.2	The condition does not cover the case two NAVs are reset at the same time.	Add "or two NAVs are reset at the same time" after "other NAV timer is 0,"	2017/1/9 9:42
10248	Yusuke Tanaka	225	1 27.2.3	152	29	T	Y	152.29 27.2.3	The operation when the HEMUEDCATimer[AC] reaches zero should consider the retry counters (SSRC/SLRC). The retry counters should be reset to 0 at updating of EDCA parameters, otherwise the STA would give up retransmission after only one transmission with CWmin.	Add the following texts at the end. "When the STA update the CWmin[AC], CWmax[AC] and AIFSN[AC] either, The SSRC and the SLRC shall be reset to 0.	2017/1/9 9:42
10249	Yusuke Tanaka	225	1 27.2.3	152	29	T	Y	152.29 27.2.3	To ensure that the STA receives EDCA Parameter Set element, the trigger frame may contain EDCA Parameter Set element.	Add "in the Trigger frame" after "EDCA Parameter Set element". Define EDCA Parameter Set element in Common Infor field of Trigger frame format in P42L6	2017/1/9 9:42
10250	Yusuke Tanaka	225	1 27.2.3	152	56	T	Y	152.56 27.2.3	Two NAVs is defined in this spec but the current RA field of CF-END is broadcast and an HE STA can not decide which NAV should be reset when it receives CF-END.	Define a new CF-END frame whose RA is the address of the intended STA.	2017/1/9 9:42
10251	Yusuke Tanaka	225	1 27.4.1	157	21	E	N	157.21 27.4.1	The first sentence does not provide any information about specification and would mislead the readers to misunderstand that these two blockack frames are only permitted.	Delete the first sentence in this paragraph.	2017/1/9 9:42
10252	Yusuke Tanaka	225	1 27.4.1	157	61	E	N	157.61 27.4.1	"MU-BAR variant Trigger frame" is lengthy expression so just simplify "MU-BAR frame" as 10.24.10.3. Same expressions can be found in whole of the section 27.4.	As commented.	2017/1/9 9:42
10253	Yusuke Tanaka	225	1 27.4.4.2	160	53	E	N	160.53 27.4.4.2	The brackets of (or Implicit BAR) are not necessary.	As commented.	2017/1/9 9:42
10254	Yusuke Tanaka	225	1 27.4.4.3	161	12	E	N	161.12 27.4.4.3	('01') is not necessary.	As commented.	2017/1/9 9:42
10255	Yusuke Tanaka	225	1 27.4.4.4	161	42	E	N	161.42 27.4.4.4	"Single MPDU" should be "S-MPDU". Same expressions can be found in whole of the section 27.4.4.4.	As commented.	2017/1/9 9:42
10256	Yusuke Tanaka	225	1 27.4.4.5	162	15	E	N	162.15 27.4.4.5	"Single MPDU" should be "S-MPDU".	As commented.	2017/1/9 9:42
10257	Yusuke Tanaka	225	1 27.4.4.5	162	26	E	N	162.26 27.4.4.5	An extra period at the end of the sentence.	As commented.	2017/1/9 9:42
10258	Yusuke Tanaka	225	1 27.5.2.1	164	26	E	N	164.26 27.5.2.1	This rule should cover non class A or class B STAs.	Replace "A STA that is a class B device" with "A STA that is not a class A device"	2017/1/9 9:42
10259	Yusuke Tanaka	225	1 27.5.2.2.1	164	46	E	N	164.46 27.5.2.2.1	An extra period after "access allocation).".	As commented.	2017/1/9 9:42
10260	Yusuke Tanaka	225	1 27.5.2.2.2	166	10	T	Y	166.10 27.5.2.2.2	This rule conflict with the rule described in P164L63. Here it says "An AP shall set all the subfields, except the Trigger Type subfield, of the Common Info field of a Trigger frame to the same value (omitted) carried in the same PPDU" but P164L63 says "If more than one Trigger frame is aggregated in an A-MPDU, all of them shall have the same content."	Resolve the conflict.	2017/1/9 9:42
10261	Yusuke Tanaka	225	1 27.5.2.2.2	166	64	E	N	166.64 27.5.2.2.2	Need space between the period and "A value 0 ...".	As commented.	2017/1/9 9:42
10262	Yusuke Tanaka	225	1 27.5.2.2.2	167	1	E	N	167.01 27.5.2.2.2	Need space between the period and "A value greater ...".	As commented.	2017/1/9 9:42
10263	Yusuke Tanaka	225	1 27.5.2.2.3	167	26	E	N	167.26 27.5.2.2.3	The correct subclause number is 10.22.2.7.	As commented.	2017/1/9 9:42
10264	Yusuke Tanaka	225	1 27.5.2.2.3	167	30	E	N	167.30 27.5.2.2.3	The correct subclause number is 10.22.2.2.	As commented.	2017/1/9 9:42
10265	Yusuke Tanaka	225	1 27.5.2.2.3	167	30	E	N	167.30 27.5.2.2.3	"i.e., transmission failure" is not necessary.	As commented.	2017/1/9 9:42
10266	Yusuke Tanaka	225	1 27.5.2.2.2	167	40	T	Y	167.40 27.5.2.2.2	The spec should define the acknowledgement rule when the AP received a MPDU which contains lower priority traffic than the Preferred AC subfield in the Trigger frame transmitted prior to the response. The AP should acknowledge for even the violating responders for the medium efficiency.	Add texts as follows. "The AP shall respond to MPDUs which contain lower priority traffic than the Preferred AC subfield in the Trigger frame with AC Preference Level subfield set to 1 transmitted prior to the MPDUs."	2017/1/9 9:42

10267	Yusuke Tanaka	225	1 27.5.2.3	168	15	E	N	168.15 27.5.2.3	"that BSS" should be one the STA is associated.	Replace "that BSS" with "the BSS with which the STA is associated"	2017/1/9 9:42
10268	Yusuke Tanaka	225	1 27.5.2.3	169	50	E	N	169.50 27.5.2.3	The title of the referred subclause is missing.	Add the title of the subclause.	2017/1/9 9:42
10269	Yusuke Tanaka	225	1 27.5.2.3	170	15	E	N	170.15 27.5.2.3	An extra period at the end of sentence.	As commented.	2017/1/9 9:42
10270	Yusuke Tanaka	225	1 27.5.2.4	170	20	T	Y	170.20 27.5.2.4	These spec texts in this subclause misuse the terminology "CCA-ED". This terminology problem was discussed in 15/0338r1. CCA-ED is the threshold that is used for specific operation bands to improve spectral sharing. Because of this misuse, the spec texts about CCA-ED in this subclause do not make sense.	Delete texts which mention CCA-ED in this subclause.	2017/1/9 9:42
10271	Yusuke Tanaka	225	1 27.5.2.4	170	26	T	Y	170.26 27.5.2.4	Two-NAVs is mandatory for HE non-AP STA.	Replace "A NAV is" with "An intra-BSS NAV and a basic NAV are".	2017/1/9 9:42
10272	Yusuke Tanaka	225	1 27.5.2.4	170	32	T	Y	170.32 27.5.2.4	This sentence can be simple using "a intra-BSS NAV".	Replace this sentence with as follows. "The intra-BSS NAV was set."	2017/1/9 9:42
10273	Yusuke Tanaka	225	1 27.5.2.5	171	39	E	N	171.39 27.5.2.5	Editorial notes of D0.x are left at the end of the sentence.	As commented.	2017/1/9 9:42
10274	Yusuke Tanaka	225	1 27.5.2.6.2	173	46	E	N	173.46 27.5.2.6.2	Space and period is missing between "AID value0" and "If the selected...".	As commented.	2017/1/9 9:42
10275	Yusuke Tanaka	225	1 27.5.2.7	174	21	T	Y	174.21 27.5.2.7	This subclause defines short feedback, but the texts are insufficient.	Define more specification of short feedback to realize efficient and reliable mechanism without data payload transmission.	2017/1/9 9:42
10276	Yusuke Tanaka	225	1 27.5.2.8	175	22	T	Y	175.22 27.5.2.8	The short feedbacks mechanism is suitable for collecting information from the STAs like PS-Poll information or BSS color information the STAs detect in PPDUs from OBSS.	Define specification of short feedback to collect PS-Poll information and BSS color information the STAs detect in OBSS PPDUs. By allocating keys (indexes) on each RU and the AP announces the allocations to STAs, the collecting mechanism can be realized.	2017/1/9 9:42
10277	Yusuke Tanaka	225	1 27.7.1	180	15	T	Y	180.15 27.7.1	"An AP" and "A STA" should be "An HE AP" and "An HE STA".	As commented.	2017/1/9 9:42
10278	Yusuke Tanaka	225	1 27.7.2	180	39	E	N	180.39 27.7.2	No period at the end. L41, L44 and L46, neither.	Add period.	2017/1/9 9:42
10279	Yusuke Tanaka	225	1 27.7.2	181	19	E	N	181.19 27.7.2	"of" may be needed between "transmission" and "a Trigger". L28, neither.	Add "of".	2017/1/9 9:42
10280	Yusuke Tanaka	225	1 27.7.3.2	184	17	E	N	184.17 27.7.3.2	"of" may be needed between "transmission" and "a Trigger". L25, neither.	Add "of".	2017/1/9 9:42
10281	Yusuke Tanaka	225	1 27.7.4	187	23	E	N	187.23 27.7.4	No period at the end, and most of the sentences in this list, neither.	As commented.	2017/1/9 9:42
10282	Yusuke Tanaka	225	1 27.9.2.1	190	50	T	Y	190.50 27.9.2.1	The rule to determine the length of PPDU transmitted under the OBSS_PD based SR mechanism should be defined. If the length of the PPDU is over the end of the inter-BSS PPDU, it could be unintentional interference on other STAs.	Add "If the PHYCCARESET.request primitive is issued and the STA intends to transmit a PPDU with transmit power adjustment under the rule described in 27.9.2.2(Adjustment of OBSS_PD and transmit power), the STA shall generate a PPDU of which the duration does not exceed the end of the Inter-BSS PPDU.	2017/1/9 9:42
10283	Yusuke Tanaka	225	1 27.9.2.1	190	50	E	N	190.50 27.9.2.1	This sentence is incomplete.	Delete this sentence.	2017/1/9 9:42
10284	Yusuke Tanaka	225	1 27.9.2.2	191	62	E	N	191.62 27.9.2.2	"OBSS_Pdmin_default" and "OBSS_Pdmax_default" are not used in any equations. These definition should not be as variables.	Define as follows. "The default value of OBSS_PDmin is -82 dBm and the default value of OBSS_PDmax is -62 dBm."	2017/1/9 9:42
10285	Yusuke Tanaka	225	1 27.9.2.2	191	64	E	N	191.64 27.9.2.2	The expression of "the antenna connector" should be aligned with P192L17.	Replace it with "the output of the antenna connector."	2017/1/9 9:42
10286	Yusuke Tanaka	225	1 27.9.2.2	192	17	E	N	192.17 27.9.2.2	Unnecessary comma before "shall be equal ...".	As commented.	2017/1/9 9:42
10287	Yusuke Tanaka	225	1 27.9.2.2	192	20	E	N	192.20 27.9.2.2	"TB PPDU" is not defined.	Replace it with "HE trigger-based PPDU"	2017/1/9 9:42
10288	Yusuke Tanaka	225	1 27.10.2	192	41	E	N	192.41 27.10.2	Need space between the period and "An HE ...".	As commented.	2017/1/9 9:42
10289	Yusuke Tanaka	225	1 27.10.4	193	32	E	N	193.32 27.10.4	The structure of texts can be better.	Divide this sub clause into some chapters.	2017/1/9 9:42
10290	Yusuke Tanaka	225	1 27.11.2	196	19	T	Y	196.19 27.11.2	What parameter should be used for Public Action frame sent from an AP to an AP?	Define what parameter should be used for Public Action frame.	2017/1/9 9:42
10291	Yusuke Tanaka	225	1 27.11.4	197	26	T	Y	197.26 27.11.4	This rule contradict the rule described in P196L49.	Delete this sentence.	2017/1/9 9:42
10292	Yusuke Tanaka	225	1 27.11.5	198	5	T	Y	198.05 27.11.5	The condition which this rule is based on is prohibited by the rule described in P197L40.	Remove this rule.	2017/1/9 9:42
10293	Yusuke Tanaka	225	1 27.14.2	200	5	E	N	200.05 27.14.2	The resolution of the figure is too low.	Replace it with a higher resolution figure.	2017/1/9 9:42
10294	Yusuke Tanaka	225	1 27.14.2	200	21	E	N	200.21 27.14.2	"and" may be needed between "Broadcast subfield" and "a value of 2".	Add "and".	2017/1/9 9:42

10295	Yusuke Tanaka	225	1 27.14.2	200	27	T	Y	200.27 27.14.2	In case the AP need to terminate the sequence earlier, it is beneficial to define a method to transmit a Trigger frame not to intend to solicit PPDUs.	Add texts as follows. "The last Trigger frame can solicit no HE trigger-based PPDUs for early terminate of the sequence."	2017/1/9 9:42
10296	Yusuke Tanaka	225	1 27.16.1	204	32	E	N	204.32 27.16.1	The first sentence does not provide any information about specification.	Delete the sentence.	2017/1/9 9:42
10297	Yusuke Tanaka	225	1 27.16.1	205	61	E	N	205.61 27.16.1	"A STA" at the beginning of the sentence should be "An HE STA".	As commented.	2017/1/9 9:42
10298	Yusuke Tanaka	225	1 27.16.2	206	25	E	N	206.25 27.16.2	It can be said that the same BSS color is used in OBSS if it detect that there is OBSS STAs using the same BSS color. In addition "OBSS" is always "other" so these are duplicated.	Replace "other OBSS AP" with "OBSS AP or STA"	2017/1/9 9:42
10299	Yusuke Tanaka	225	1 27.16.2	206	28	T	Y	206.28 27.16.2	The algorithm to choose a new BSS Color is beyond the scope of this standard, but it is beneficial to define frames and procedure to gather color information.	Add texts as follows. "An HE non-AP STA may report the information of BSS color in the PPDUs it received before the association via the BSS Color Statistics Report element(TBD) in Probe Request or (Re)Association Request frames."	2017/1/9 9:42
10300	Yusuke Tanaka	225	1 27.16.2	206	32	T	Y	206.32 27.16.2	P92L19 defines the rule to set the BSS Color Disable subfield to 1 at detecting BSS Color overlapping. The whole operation of BSS Color change should be described here including BSS Color Disable subfield setting.	Add texts as follows after "(Re)Association Response frames.". The AP shall set the BSS Color Disable subfield to 1.	2017/1/9 9:42
10301	Yusuke Tanaka	225	1 27.16.2	206	43	T	Y	206.43 27.16.2	The surrounding STAs not associating the BSS under spatial reuse operation with intra/inter-BSS frame identification could lose opportunity of spatial reuse during the time leading up to the BSS color change TBTT.	Add texts as follows. "an HE AP shall set the existing BSS Color in BSS Color field in HE-SIG-A."	2017/1/9 9:42
10302	Yusuke Tanaka	225	1 27.16.3.1	207	7	T	Y	207.07 27.16.3.1	"should" is ambiguous expression.	Use "shall" or remove this sentence.	2017/1/9 9:42
10303	Yusuke Tanaka	225	1 27.16.3.2	207	22	E	N	207.22 27.16.3.2	"Requester AP" in the figure should be "Responder AP".	As commented.	2017/1/9 9:42
10304	Yusuke Tanaka	225	1 28.3.10.7.2	274	33	E	N	274.33 28.3.10.7.2	The description about a 4x HE-LTF and 0.8 us GI should be also added in the DCM and STBC cells.	As commented.	2017/1/9 9:42
10305	Yusuke Tanaka	225	1 28.3.10.7.2	281	49	T	Y	281.49 28.3.10.7.2	Table 28-19 defines the Spatial Reuse subfield encoding but no procedures of SR operation based on SRP is defined in this spec.	Define procedures of SR operation based on SRP, which should include Tx power controlling not only for a Data frame and but Control frames (e.g. RTS/CTS/CF-End).	2017/1/9 9:42
10306	Yusuke Tanaka	225	1 28.3.10.7.2	282	29	T	Y	282.29 28.3.10.7.2	The equation to define SRP is incorrect from the aspect of dBm unit.	Change SRP definition as follows. "SRP is the sum of the value of TX PWRAP and the value of Acceptable Receiver Interference levelAP." Remove "dBm" from Table 28-19.	2017/1/9 9:42
10307	Yusuke Tanaka	225	1 28.3.17.6.2	348	1	T	Y	348.01 28.3.17.6.2	CCA-ED is given in Table D-2 as written in this section. In this Table 2-5, encoding=1 is assigned to CCA-EDBehavior saying that "CCA shall also detect a medium busy condition when CCAEnergyDetect detects a channel busy condition." Also in the following sentence in this section says; "The operating classes requiring the corresponding CCA-ED behavior class are given in E.1 (Country information and operating classes)." Please note that 11ax D1.0 doesn't include amendment to Annex-E in 11mc so I refer tables in 11mc. If you refer Table E-1 for US, only operating class=13, 14 & 15 requires "CCA-EDBehavior" and these operating channels are 3GHz band. In Table E-2 for EU and E-3 for Japan don't include "CCA-	Either Remove section 28.3.17.6.2 entirely, or Add specifications for 3GHz operation to clause 28.	2017/1/9 9:42

10308 Yusuke Tanaka	225	1 28.3.17.6.4	349	21	T	Y	349.21 28.3.17.6.4	OBSS_PD is only available if the PPDU can be identified as an inter-PPDU. On the other hand the secondary 20MHz channel sensing threshold during aCCAMidTime can be applied for any IEEE Std 802.11 transmission. What is the reason to use OBSS_PD level during aCCAMidTime for any PPDUs without identification of inter-BSS frames? Same comments on secondary 40 MHz channel and 80 MHz channel cases.	Add technical description to explain the reason to apply OBSS_PD to the secondary 20MHz channel sensing threshold during aCCAMidTime. If not, remove OBSS_PD.		2017/1/9 9:42
10309 Yusuke Tanaka	225	1 28.3.17.6.4	349	36	T	Y	349.36 28.3.17.6.4	The threshold value -72dBm during aCCAMidTime is applied for 40MHz band but the value of the OBSS_PD is defined for 20MHz band. Compensate the OBSS_PD by -3dB considering the bandwidth.	Replace "max(-72 dBm, OBSS_PD)" with "max(-72 dBm, OBSS_PD - 3dB)"		2017/1/9 9:42
10310 Yusuke Tanaka	225	1 28.3.17.6.4	349	51	T	Y	349.51 28.3.17.6.4	The threshold value -69dBm during aCCAMidTime is applied for 80MHz band but the value of the OBSS_PD is defined for 20MHz band. Compensate the OBSS_PD by -6dB considering the bandwidth.	Replace "max(-69 dBm, OBSS_PD)" with "max(-69 dBm, OBSS_PD - 6dB)"		2017/1/9 9:42
10311 Yusuke Tanaka	225	1 28.4.3	373	45	T	Y	373.45 28.4.3	aCCAMidTime =25usec, and it is the exactly same as 11ac. Due to longer OFDM symbol in 11ax, I don't think we can expect reliable mid packet detect within 25usec. In 11ac, 25usec can contain 6 OFDM symbols and 0.8u*6=4.8usec can be used for auto-correlation. To have a reliable detection similar to 11ac, we need time of max{(0.8u+12.8u)*6, (1.6u+12.8u)*2, (3.2u+12.8u)*1} = 81.6usec.	Replace 25usec with 81.6usec for aCCAMidTime. To make such change, current description for 28.3.17.6.4 would become invalid. Use two separate "aCCAMidTIme"s, i.e., one is for 11ax having longer OFDM symbol such as 81.6usec as mentioned above, And the other is conventional value of 25usec for 11a/g/n/ac.		2017/1/9 9:42
10312 Zhigang Rong	225	1 27.5.2.2.2	166	24	E	Y	166.24 27.5.2.2.2	"CP_LTF_TYPE" is not a valid TXVECTOR or RXVEXTOR parameter according to "Table 28-1–TXVECTOR and RXVECTOR parameters". "CP_LTF_TYPE" should be corrected to "GI_TYPE and HE_LTF_TYPE".	Change the sentence to the following: "GI and LTF Type is set to 3 if the carrying PPDU TXVECTOR parameters GI_TYPE and HE_LTF_TYPE indicate 4x LTF + 3.2 ++s GI or 2x LTF + 1.6 ++s GI; otherwise is set to 2"		2017/1/9 9:42
10313 Zhigang Rong	225	1 27.5.2.3	169	26	E	Y	169.26 27.5.2.3	"CP_LTF_TYPE" is not a valid TXVECTOR or RXVEXTOR parameter according to "Table 28-1–TXVECTOR and RXVECTOR parameters". "CP_LTF_TYPE parameter" should be corrected to "The GI_TYPE and HE_LTF_TYPE parameters".	Change the sentence to the following: "The GI_TYPE and HE_LTF_TYPE parameters shall be set to indicate 4x LTF + 3.2 ++s GI if the RXVECTOR parameters GI_TYPE and HE_LTF_TYPE indicate 4x LTF + 3.2 ++s GI or 2x LTF + 1.6 ++s GI ; otherwise shall be set to indicate 2x LTF + 1.6 ++s GI"		2017/1/9 9:42
10314 Zhiyong Huang	225	1 28.3.14.3	342	20	T	N	342.20 28.3.14.3	Need to specify either number of packet or time duration for device to meet transmit power accuracy requirement. In subclause 28.3.14.2 it discuss how the device should adjust power. However, it does not specify either number of PPDU or time duration for the device to finish adjust transmitting power. In table 28-40, it also does not specify this requirement. 1 PPDU or 100 PPDU to achieve requirement will impact system perfomance/capacity differently.	add specific number of PPDU for the device to reach transmit power accuracy. If it was implied to reach accuracy requirement within 1 PPDU, it is better to explicitly define it in the 28.3.14.3.		2017/1/9 9:42
10315 Zhiyong Huang	225	1 28.3.17.2	345	5	T	N	345.05 28.3.17.2	It will be good to specify sensitivity for the STA with large power boost between two adjacent RU. With power boost mode, the minimum power delta is 6dB and the largest is 12dB. It will be meaningful to specify the sensitivity with large power boost	add STA sensitivity requirement with 6dB or up to 12dB power boost MU DL signal.		2017/1/9 9:42
10316 Zhou Lan	225	1 27.5.1.3	163	16	T	Y	163.16 27.5.1.3	BQR now is in the section of DL MU operation. However it should be useful for the AP to make right decision on UL MU scheduling as well	Extend BQR to UL MU operation		2017/1/9 9:42

10317	Zhou Lan	225	1 28.3.4	240	57	T	Y	240.57 28.3.4	Define a preamble puncuture mode for Non-HT DUP for the protection of the HE DL/UL MU operation	per comment	2017/1/9 9:42
10318	Zhou Lan	225	1 9.7.1	105	52	T	Y	105.52 9.7.1	Define a new MPDU delimeter for power save optimization	per comment	2017/1/9 9:42
10319	Zhou Lan	225	1 27.2.1	149	20	T	Y	149.20 27.2.1	MPDU delimeter can be extended to convey inter or intra BSS info. The extension allows HE AP being able to send A-MPDU in VHT format that has inter or intra BSS information before chekcing the MAC header	per comment	2017/1/9 9:42
10320	Zhou Lan	225	1 27.2.2	150	25	T	Y	150.25 27.2.2	"An HE non-AP STA shall maintain two NAV timers. An HE AP STA may maintain two NAV timers." clarify the different requirement between AP and Non-AP STA	per comment	2017/1/9 9:42
10321	Zhou Lan	225	1 27.2.2	150	31	T	Y	150.31 27.2.2	"if one of the two NAV timers is nonzero, the virtual CS indication is that the medium is busy." clarify if the intra NAV is zero and inter NAV is non zero, in such case, what is the idle status?	per comment	2017/1/9 9:42
10322	Zhou Lan	225	1 27.2.2	150	40	T	Y	150.40 27.2.2	"The duration information is indicated by a frame in a PSDU as follows" clarify the case when the duration field is in the SIG-A (not part of PSDU),how the NAV update is performed	per comment	2017/1/9 9:42
10323	Zhou Lan	225	1 27.2.2	150	52	T	Y	150.52 27.2.2	"A STA shall update the intra-BSS NAV with the duration information indicated by the received frame in a PSDU if and only if all the following conditions are met:". Clarify if the duration filed is in the SIGA (i.e not part of the PSDU), how the intra NAV will be updated.	per comment	2017/1/9 9:42
10324	Zhou Lan	225	1 27.2.2	150		E	Y	150.00 27.2.2	"A STA that maintains two NAVs has the capability to maintain NAV set by intra-BSS PPDU and inter-BSS PPDU separately. Maintaining two NAV is beneficial in dense deployment scenarios where a STA requires protection from frames transmitted by STAs within its BSS, i.e., intra-BSS, and avoid interference from frames transmitted by STAs in neighboring BSS, i.e., inter-BSS. For example, in a TXOP initiated by the associated AP for UL MU transmission, the intra-BSS NAV of the STA can be set by the AP to prevent the STA from contending the channel, and the basic NAV will not be updated by the associated AP so that NAV set by inter-BSS PPDU can be considered in UL MU CS as described in 27.5.2.4 (UL MU CS mechanism)." This paragraph is more like a general description of two NAV setting. It should be moved to	per comment	2017/1/9 9:42
10325	Zhou Lan	225	1 27.2.2	150		T	Y	150.00 27.2.2	"The STA is not solicited an immediate response by the PPDU carrying the frame.". This condition needs fix. If AP wants to schedule different group of STAs to participate UL MU operation in one TXOP, this condition will only allow the STAs that are scheduled in the first round to transmit later in the same TXOP	need a contribution to fix it	2017/1/9 9:42
10326	Zhou Lan	225	1 27.2.2	151		T	Y	151.00 27.2.2	"The STA is not solicited an immediate response by the PPDU carrying the frame.". This condition needs fix. If AP wants to schedule different group of STAs to participate UL MU operation in one TXOP, this condition will only allow the STAs that are scheduled in the first round to transmit later in the same TXOP	need a contribution to fix it	2017/1/9 9:42

10327	Zhou Lan	225	1 27.2.3	152		T	Y	152.00 27.2.3	Section 27.5.2.1 says "A non-AP STA with dot11ULMUMIMOOptionImplemented equal to true is referred to as an UL MU capable STA.", so an UL MU capable STA is a STA that is capable of supporting UL MU MIMO. However, here in this section, it refers to UL MU MIMO, UL OFDMA, UL OFDMA+MU MIMO. UL OFDMA is a mandatory feature which doesnt need capability indication. So the language should be fixed.	fix the language per comment		2017/1/9 9:42
10328	Zhou Lan	225	1 27.4.1	157		T	Y	157.00 27.4.1	"An HE STA can use Compressed BlockAck frame or Multi-STA BlockAck frame after setting up a block ack agreement." Please clarify if Block ACK aggrement is required in the following cases. 1) Multiple STAs send single management frame in a trigger based PPDU and expecting acknoledgement from AP. 2) OFDMA random access for association and authentication	per comment		2017/1/9 9:42
10329	Zhou Lan	225	1 27.4.1	157	24	T	Y	157.24 27.4.1	"Multi-STA BlockAck frame if either UL MU operation (see 27.5.2 (UL MU operation)) or multi-TID AMPDU operation (27.10.4 (A-MPDU with multiple TIDs)) is supported in the role of recipient.", UL OFDMA (one of the UL MU operation) is mandatory. So M-BA is mandatory. This setence can be deleted.	per comment		2017/1/9 9:42
10330	Zhou Lan	225	1 27.4.1	157	33	T	Y	157.33 27.4.1	Shall define a mandated response rule mechanism to simplify the response MCS selection implementation	per comment		2017/1/9 9:42
10331	Zhou Lan	225	1 27.4.1	157	36	T	Y	157.36 27.4.1	change "HE STA" to "HE AP" if this is the case to ack a trigger based PPDU	per comment		2017/1/9 9:42
10332	Zhou Lan	225	1 27.10.4	193	53	T	Y	193.53 27.10.4	"A multi-TID A-MPDU may contain multiple noncontiguous nonzero length MPDU delimiters with EOF subfield equal to 1, one for each TID that solicits Ack and/or multiple noncontiguous nonzero length MPDU delimiters with EOF subfield equal to 0, one for each TID that solicits BlockAck." is conflicting with the baseline that says"An A-MPDU subframe with EOF set to 0 shall not be added after any A-MPDu subframe with EOF set to 1 " clarify the benefit of allowing this flexibility in terms of supporting MPDU with different ACK policy, othwise remove this	per comment		2017/1/9 9:42
10333	Zhou Lan	225	1 27.4.1	157	48	T	Y	157.48 27.4.1	"An HE STA that supports Multi-STA BlockAck shall examine each received Multi-STA sent by an STA with which it has a BA agreement." A HE STA shall support receiption of a M-BA. So delete "that supports Multi-STA BlockAck"	per comment		2017/1/9 9:42

Appendix AV

Documents

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HE-SIG-A

Created (ET) ▼	Year	DCN	Rev	Group	Title	Author (Affiliation)	Uploaded (ET)	Actions
16-Sep-2019 ET	2019	1581	1	TGax	HE-SIG-A fields proposed text changes	Yan Zhang	16-Sep-2019 06:27:21 ET	Download
13-Sep-2019 ET	2019	1581	0	TGax	HE-SIG-A fields proposed text changes	Yan Zhang	16-Sep-2019 04:52:46 ET	Download
15-Jan-2018 ET	2018	38	1	TGax	CR-PHY-HE-SIG-A-Part-1	Lochan Verma (Qualcomm)	15-Jan-2018 23:13:02 ET	Download
03-Jan-2018 ET	2018	38	0	TGax	CR-PHY-HE-SIG-A-Part-1	Lochan Verma (Qualcomm)	11-Jan-2018 23:53:09 ET	Download
10-May-2017 ET	2017	648	3	TGax	CR on HE-SIG-A	Ron Porat	10-May-2017 03:02:38 ET	Download
10-May-2017 ET	2017	648	2	TGax	CR on HE-SIG-A	Ron Porat	10-May-2017 00:43:23 ET	Download
09-May-2017 ET	2017	648	1	TGax	CR on HE-SIG-A	Ron Porat	09-May-2017 19:50:44 ET	Download
01-May-2017 ET	2017	648	0	TGax	CR on HE-SIG-A	Ron Porat	02-May-2017 19:14:58 ET	Download
13-Sep-2016 ET	2016	1148	6	TGax	CR HE-SIG-A part III	Ross Jian Yu (Huawei)	13-Sep-2016 11:05:26 ET	Download
13-Sep-2016 ET	2016	1148	5	TGax	CR HE-SIG-A part III	Ross Jian Yu (Huawei)	13-Sep-2016 10:17:56 ET	Download
13-Sep-2016 ET	2016	1148	4	TGax	CR HE-SIG-A part III	Ross Jian Yu (Huawei)	13-Sep-2016 09:15:41 ET	Download
13-Sep-2016 ET	2016	1148	3	TGax	CR HE-SIG-A part III	Ross Jian Yu (Huawei)	13-Sep-2016 08:58:29 ET	Download
13-Sep-2016 ET	2016	1148	2	TGax	CR HE-SIG-A part III	Ross Jian Yu (Huawei)	13-Sep-2016 02:34:01 ET	Download
12-Sep-2016 ET	2016	1148	1	TGax	CR HE-SIG-A part III	Ross Jian Yu (Huawei)	12-Sep-2016 12:28:30 ET	Download
08-Sep-2016 ET	2016	1148	0	TGax	CR HE-SIG-A part III	Ross Jian Yu (Huawei)	12-Sep-2016 03:26:29 ET	Download
26-Jul-2016 ET	2016	914	1	TGax	Bit field finalization of HE-SIG-A	Lochan Verma (Qualcomm)	26-Jul-2016 18:16:39 ET	Download
26-Jul-2016 ET	2016	915	2	TGax	Text for bit field finalization of HE-SIG-A	Lochan Verma (Qualcomm)	26-Jul-2016 18:12:32 ET	Download
26-Jul-2016 ET	2016	915	1	TGax	Text for bit field finalization of HE-SIG-A	Lochan Verma (Qualcomm)	26-Jul-2016 17:45:09 ET	Download
26-Jul-2016 ET	2016	872	1	TGax	CR HE-SIG-A Part II	Ross Jian Yu (Huawei)	26-Jul-2016 14:47:40 ET	Download
24-Jul-2016 ET	2016	915	0	TGax	Text for bit field finalization of HE-SIG-A	Lochan Verma (Qualcomm)	25-Jul-2016 01:02:53 ET	Download
24-Jul-2016 ET	2016	914	0	TGax	Bit field finalization of HE-SIG-A	Lochan Verma (Qualcomm)	25-Jul-2016 01:02:17 ET	Download
23-Jul-2016 ET	2016	872	0	TGax	CR HE-SIG-A Part II	Ross Jian Yu (Huawei)	25-Jul-2016 02:11:06 ET	Download
17-May-2016 ET	2016	610	4	TGax	CR HE-SIG-A Part I	Ross Jian Yu (Huawei)	17-May-2016 22:50:11 ET	Download
17-May-2016 ET	2016	610	3	TGax	CR HE-SIG-A Part I	Ross Jian Yu (Huawei)	17-May-2016 18:25:14 ET	Download

17-May-2016 ET	2016	610	2	TGax	CR HE-SIG-A Part I	Ross Jian Yu (Huawei)	17-May-2016 03:12:42 ET	Download
17-May-2016 ET	2016	636	2	TGax	TXOP Duration field in HE-SIG-A	Jeongki Kim (LG Electronics)	17-May-2016 02:15:59 ET	Download
16-May-2016 ET	2016	636	1	TGax	TXOP Duration field in HE-SIG-A	Jeongki Kim (LG Electronics)	16-May-2016 23:35:21 ET	Download
16-May-2016 ET	2016	610	1	TGax	CR HE-SIG-A Part I	Ross Jian Yu (Huawei)	16-May-2016 22:28:39 ET	Download
15-May-2016 ET	2016	636	0	TGax	TXOP Duration field in HE-SIG-A	Jeongki Kim (LG Electronics)	16-May-2016 06:26:33 ET	Download
14-May-2016 ET	2016	610	0	TGax	CR HE-SIG-A Part I	Ross Jian Yu (Huawei)	16-May-2016 12:38:48 ET	Download
15-Sep-2015 ET	2015	826	3	TGax	HE-SIG-A transmission for range extension	Jiayin Zhang (Huawei)	15-Sep-2015 01:09:36 ET	Download
13-Sep-2015 ET	2015	1077	0	TGax	HE-SIG-A Content	Jiayin Zhang (Huawei)	13-Sep-2015 22:34:38 ET	Download
13-Sep-2015 ET	2015	826	2	TGax	HE-SIG-A transmission for range extension	Jiayin Zhang (Huawei)	13-Sep-2015 22:35:43 ET	Download
15-Jul-2015 ET	2015	827	2	TGax	Considerations on HE-SIG-A and B	Katsuo Yunoki (KDDI R&D Laboratories)	15-Jul-2015 01:28:37 ET	Download
14-Jul-2015 ET	2015	826	1	TGax	HE-SIG-A transmission for range extension	Jiayin Zhang (Huawei)	14-Jul-2015 16:54:35 ET	Download
13-Jul-2015 ET	2015	827	1	TGax	Considerations on HE-SIG-A and B	Katsuo Yunoki (KDDI R&D Laboratories)	13-Jul-2015 19:24:48 ET	Download
11-Jul-2015 ET	2015	827	0	TGax	Considerations on HE-SIG-A and B	Katsuo Yunoki (KDDI R&D Laboratories)	13-Jul-2015 03:54:22 ET	Download
11-Jul-2015 ET	2015	826	0	TGax	HE-SIG-A transmission for range extension	Jiayin Zhang (Huawei)	13-Jul-2015 04:55:14 ET	Download

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Appendix AW

IEEE P802.11
Wireless LANs

Bit field finalization of HE-SIG-A in HE PPDU formats

Date: 2016-07-25

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Abstract

This submission proposes finalization of bit field ordering of HE-SIG-A in HE SU PPDU, HE extended range SU PPDU, HE MU PPDU, and HE Trigger-based PPDU.
Revisions:
— Rev 0: Initial version of the document.

Interpretation of a Motion to Adopt

A motion to approve this submission means that the editing instructions and any changed or added material are actioned in the TGax Draft. This introduction is not part of the adopted material.

Editing instructions formatted like this are intended to be copied into the TGax Draft (i.e. they are instructions to the 802.11 editor on how to merge the text with the baseline documents).

TGax Editor: Editing instructions preceded by "TGax Editor" are instructions to the TGax editor to modify existing material in the TGax draft. As a result of adopting the changes, the TGax editor will execute the instructions rather than copy them to the TGax Draft.

Changes to D0.2

TGax Editor: Delete Table 26-19 (Fields in the HE-SIG-A for an HE SU PPDU and HE Extended Range SU PPDU)
Replace Table 26-20 (Fields in the HE-SIG-A for an HE SU PPDU and HE Extended Range SU PPDU) with the following table:

Table 26-20 – Fields in the HE-SIG-A for an HE SU PPDU and HE Extended Range SU PPDU

Two parts of HE-SIG-A	Bits	Field	# of bits	Description
HE-SIG-A1	B0	Format	1	Differentiate between an HE SU PPDU and HE trigger-based PPDU. Set to 0 for HE trigger-based PPDU Set to 1 for HE SU PPDU. This field is reserved and set to 1 for an HE Extended range SU PPDU.
	B1	Beam Change	1	Set to 1 to indicate that the pre-HE STF portion of the SU PPDU is spatially mapped differently from HE-LTF1. Set to 0 to indicate that the pre-HE STF portion of SU PPDU is spatially mapped the same way as HE-LTF1 on each tone.
	B2	UL/DL	1	Indicates whether the PPDU is sent UL or DL. Set to 0 for DL Set to 1 for UL. This field indicates DL for TDLS.
	B3:B6	MCS	4	For HE SU PPDU Set to n for MCSn, where n = 0, 1, 2, …., 11. Values 12 - 15 are reserved For HE Extended Range SU PPDU If bandwidth = 0 (242-tone RU) Set to n for MCSn, where n = 0, 1, 2. Values 3 – 15 are reserved. If bandwidth = 1 (right 106-tone RU in P20) Set to 0 for MCS 0. Values 1 – 15 are reserved.
	B7	DCM	1	Set to 1 to indicate that the payload of the SU PPDU is modulated with dual sub-carrier modulation for the MCS. Set to 0 indicates that the payload of the PPDU is not modulated with dual sub-carrier for the MCS. DCM is only applicable to MCS0, MCS1, MCS3, and MCS4. DCM is only applicable to 1 and 2 spatial streams. DCM is not applicable to STBC.
	B8:B13	BSS Color	6	The BSS Color field is an identifier of the BSS
	B14	Reserved	1	Reserved and set to 1
	B15:B18	Spatial Reuse	4	"SR_allowed" signaling indicates whether SR operation is allowed or not. • Set to 0 to indicate SR is disallowed • The conditions to disallow SR are TBD Other details are TBD

				Notes: this part needs further development.
	B19:B20	Bandwidth	2	For HE SU PPDU Set to 0 for 20 MHz Set to 1 for 40 MHz Set to 2 for 80 MHz Set to 3 for 160/80+80 MHz For HE Extended Range SU PPDU Set to 0 for 242-tone RU Set to 1 for right 106-tone RU within the primary 20 MHz
	B21:B22	LTF + CP	2	Indicates LTF size and guard interval duration Set to 0 for 1x HE-LTF + 0.8 us Set to 1 for 2x HE-LTF + 0.8 us Set to 2 for 2x HE-LTF + 1.6 us Set to 3 for 4x HE-LTF + 3.2 us
	B23:B25	Nsts	3	Indicates the number of spatial streams. For HE SU PPDU Set to n for n+1 space time stream, where n = 0, 1, 2,…..,7. For HE Extended Range PPDU Set to 0 for 1 space time stream. Value 1 is TBD Values 2 - 7 are reserved
HE-SIG-A2	B0:B6	TXOP Duration	7	Indicates the remaining time in the current TXOP. Details TBD.
	B7	Coding	1	Indicates whether BCC or LDPC is used. Set to 0 for BCC Set to 1 for LDPC (#11-16/0610-04)
	B8	LDPC Extra Symbol Segment	1	Indicates presence of extra OFDM symbol segment for LDPC Set to 0 for LDPC extra symbol segment is not present Set to 1 for LDPC extra symbol segment is present. NOTE- This field is reserved and set to 1 when Coding field is set to 0
	B9	STBC	1	Set to 1 if STBC is used Set to 0 otherwise
	B10	Tx BF	1	Set to 1 if a Beamforming steering matrix is applied to the waveform in an SU transmission Set to 0 otherwise
	B11:B12	A-factor	2	Indicates the “a-factor” as defined in Table 26-44 (a-facotr subfield encoding)
	B13	PE Disambiguity	1	Indicates PE Disambiguity as defined in 26.3.11 (Packet Extension)
	B14	Reserved	1	Reserved and set to 1
	B15	Doppler	1	Set to 0 if Doppler mode is not used Set to 1 if Doppler mode is used

	B16:B19	CRC	4	CRC of bits 0 - 41 in HE-SIG-A (see 22.3.9.7.3 (CRC computation)). The first bit to be transmitted is bit C7 as explained in 20.3.9.7.3 (CRC computation).
	B20:B25	Tail	6	Used to terminate the trellis of the convolution decoder. Set to 0.

NOTE- Integer fields are transmitted in unsigned binary format, LSB first, where the LSB is in the lowest numbered bit position.

TGax Editor: Delete Table 26-21 (Fields in the HE-SIG-A for an HE MU PPDU)
Replace Table 26-22 (Fields in the HE-SIG-A for an HE MU PPDU) with the following table:

Table 26-22 – Fields in the HE-SIG-A for an HE MU PPDU

Two parts of HE-SIG-A	Bits	Field	# of bits	Description
HE-SIG-A1	B0	UL/DL	1	Indicates whether the PPDU is sent UL or DL. Set to 0 for DL Set to 1 for UL. This field indicates DL for TDLS.
	B1:B3	SIGB MCS	3	Indicates MCS of HE-SIG-B Set to n for MCSn, where n = 0, 1, 2,….,5 Values 6 - 7 are reserved
	B4	SIGB DCM	1	Set to 1 indicates that the HE-SIG-B is modulated with dual sub-carrier modulation for the MCS. Set to 0 indicates that the HE-SIB-B is not modulated with dual sub-carrier modulation for the MCS. DCM is only applicable to MCS0, MCS1, MCS3, and MCS4.
	B5:B10	BSS Color	6	BSS Color field is an identifier of the BSS
	B11:B14	Spatial Reuse	4	"SR_allowed" signaling indicates whether SR operation is allowed or not. • Set to 0 to indicate SR is disallowed • The conditions to disallow SR are TBD Other details are TBD Notes: this part needs further development.
	B15:B17	Bandwidth	3	Set to 0 for 20 MHz Set to 1 for 40 MHz Set to 2 for 80 MHz Set to 3 for 160/80+80 MHz
	B18:B21	SIGB Number of Symbols/Number of MU-MIMO Users	4	When SIGB compression field=0, indicates the number of HE-SIG-B symbols. Set to n for n+1 HE-SIG-B symbol, where n = 0, 1, 2,…..15 When SIGB compression field=1, indicates the number of MU-MIMO users minus 1.
	B22	SIGB Compression	1	Set to 1 for full BW MU-MIMO. Set to 0 otherwise.
	B23:B24	LTF and CP	2	Set to 0 for Reserved Set to 1 for 2x HE-LTF + 0.8 us Set to 2 for 2x HE-LTF + 1.6 us Set to 3 for 4x HE-LTF + 3.2 us

	B25	Doppler	1	Set to 0 if Doppler mode is not used Set to 1 if Doppler mode is used
HE-SIG-A2	B0:B6	Txop Duration	7	Indicates the remaining time in the current TXOP. Details TBD.
	B7	Reserved	1	Reserved and set to 1
	B8:B10	Number of HE-LTF symbols	3	Indicates the number of HE-LTF symbols. Set to 0 for 1 HE-LTF symbol Set to 1 for 2 HE-LTF symbols Set to 2 for 4 HE-LTF symbols Set to 3 for 6 HE-LTF symbols Set to 4 for 8 HE-LTF symbols Values 5 to 7 are reserved
	B11	LDPC Extra Symbol Segment	1	Indicates presence of extra OFDM symbol segment for LDPC Set to 0 for LDPC extra symbol segment is not present Set to 1 for LDPC extra symbol segment is present.
	B12	STBC	1	In an HE MU PPDU where each RU includes no more than 1 user, set to 1 to indicate al RUs are STBC encoded in the payload. Set to 0 to indicate al RUs are not STBC encoded in the payload. STBC is not applied in MU-MIMO RUs. STBC doesn't apply to HE-SIG-B.
	B13:B14	A-factor	2	Indicates the "a-factor" as defined in Table 26-44 (a-facotr subfield encoding)
	B15	PE Disambiguity	1	Indicates PE Disambiguity as defined in 26.3.11 (Packet Extension)
	B16:B19	CRC	4	CRC of bits 0 - 41 in HE-SIG-A. See 22.3.9.7.3 (CRC computation)). The first bit to be transmitted is bit C7 as explained in 20.3.9.7.3 (CRC computation).
	B20:B25	Tail	6	Used to terminate the trellis of the convolution decoder. Set to 0.

NOTE- Integer fields are transmitted in unsigned binary format, LSB first, where the LSB is in the lowest numbered bit position.

TGax Editor: Replace Table 26-23 (Fields in the HE-SIG-A for an HE trigger-based PPDU) with the following table:

Two parts of HE-SIG-A	Bits	Field	# of bits	Description
HE-SIG-A1	B0	Format	1	Differentiate between an HE SU PPDU and an HE trigger-based PPDU. Set to 0 for HE trigger-based PPDU Set to 1 for HE SU PPDU
	B1:B6	BSS Color	6	BSS Color field is an identifier of the BSS
	B7:B22	Spatial Reuse	16	"SR_allowed" signaling indicates whether SR operation is allowed or not. • Set to 0 to indicate SR is disallowed • The conditions to disallow SR are TBD Multiple SR fields (≥2) are signalled, where each SR field corresponds to a different subband of the PPDU. Other details are TBD. Notes: this part needs further development.

	B23	Reserved	1	Reserved and set to value indicated in the Trigger frame
	B24:B25	Bandwidth	2	Set to 0 for 20 MHz Set to 1 for 40 MHz Set to 2 for 80 MHz Set to 3 for 160/80+80 MHz
HE-SIG-A2	B0:B6	Txop Duration	7	Indicates the remaining time in the current TXOP. Details TBD.
	B7:B15	Reserved	9	Reserved and set to value indicated in the Trigger frame
	B16:B19	CRC	4	CRC of bits 0 - 41 in HE-SIG-A. See 22.3.9.7.3 (CRC computation). The first bit to be transmitted is bit C7 as explained in 20.3.9.7.3 (CRC computation).
	B20:B25	Tail	6	Used to terminate the trellis of the convolution decoder. Set to 0.

NOTE- Integer fields are transmitted in unsigned binary format, LSB first, where the LSB is in the lowest numbered bit position.

References:

1. **IEEE P802.11ax™/D0.2, June 2016.**

Appendix AX

TGax PHY Ad Hoc Jul 2016 Meeting Agenda

Date: 2016-07-26

Authors:

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IEEE 802.11 TGax
High Efficiency WLAN
PHY Ad Hoc

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Co-Chairs:
Bo Sun (ZTE)
Jianhan Liu (Mediatek)
Hongyuan Zhang (Marvell)

Agenda Items

- **Call meeting to order**
- **Patent policy, etc. (Call for Potentially Essential Patents)**
- **Review ad hoc rules**
- **Set and approve agenda**
- **Technical Presentations approved by 802.11ax for presentation this week, and related straw polls**
  - CRs will be prioritized.
- **Any other technical presentations**

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Meeting Protocol, Attendance, Voting & Document Status

- **Please announce your affiliation when you first address the group during a meeting slot**
- **Cell Phones to be silent or Off**
- **Register your attendance via https://imat.ieee.org while on meeting SSID (e.g. Verilan-secure)**
- **Make sure your badges are correct**
- **If you plan to make a submission be sure it does not contain company logos or advertising**
- **Questions on Voting status, Ballot pool, Access to Reflector, Documentation, Member's Area**
  - Contact Jon Rosdahl – jrosdahl@ieee.org

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Patent Policy and Other Guidelines

- Following 5 slides

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Instructions for the WG Chair

The IEEE-SA strongly recommends that at each WG meeting the chair or a designee:

- **Show slides #1 through #4 of this presentation**
- **Advise the WG attendees that:**
  - The IEEE's patent policy is consistent with the ANSI patent policy and is described in Clause 6 of the *IEEE-SA Standards Board Bylaws*;
  - Early identification of patent claims which may be essential for the use of standards under development is strongly encouraged;
  - There may be Essential Patent Claims of which the IEEE is not aware. Additionally, neither the IEEE, the WG, nor the WG chair can ensure the accuracy or completeness of any assurance or whether any such assurance is, in fact, of a Patent Claim that is essential for the use of the standard under development.
- **Instruct the WG Secretary to record in the minutes of the relevant WG meeting:**
  - That the foregoing information was provided and that slides 1 through 4 (and this slide 0, if applicable) were shown;
  - That the chair or designee provided an opportunity for participants to identify patent claim(s)/patent application claim(s) and/or the holder of patent claim(s)/patent application claim(s) of which the participant is personally aware and that may be essential for the use of that standard
  - Any responses that were given, specifically the patent claim(s)/patent application claim(s) and/or the holder of the patent claim(s)/patent application claim(s) that were identified (if any) and by whom.
- The WG Chair shall ensure that a request is made to any identified holders of potential essential patent claim(s) to complete and submit a Letter of Assurance.
- It is recommended that the WG chair review the guidance in *IEEE-SA Standards Board Operations Manual* 6.3.5 and in FAQs 12 and 12a on inclusion of potential Essential Patent Claims by incorporation or by reference.

Note: **WG** includes Working Groups, Task Groups, and other standards-developing committees with a PAR approved by the IEEE-SA Standards Board.

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Participants, Patents, and Duty to Inform

All participants in this meeting have certain obligations under the IEEE-SA Patent Policy. Participants:

- **"Shall inform the IEEE (or cause the IEEE to be informed)" of the identity of each "holder of any potential Essential Patent Claims of which they are personally aware" if the claims are owned or controlled by the participant or the entity the participant is from, employed by, or otherwise represents**
  - **"Personal awareness" means that the participant "is personally aware that the holder may have a potential Essential Patent Claim," even if the participant is not personally aware of the specific patents or patent claims**
- **"Should inform the IEEE (or cause the IEEE to be informed)" of the identity of "any other holders of such potential Essential Patent Claims" (that is, third parties that are not affiliated with the participant, with the participant's employer, or with anyone else that the participant is from or otherwise represents)**
- **The above does not apply if the patent claim is already the subject of an Accepted Letter of Assurance that applies to the proposed standard(s) under consideration by this group**

Quoted text excerpted from IEEE-SA Standards Board Bylaws subclause 6.2

- Early identification of holders of potential Essential Patent Claims is strongly encouraged
- No duty to perform a patent search

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Slide #1

Patent Related Links

All participants should be familiar with their obligations under the IEEE-SA Policies & Procedures for standards development.

Patent Policy is stated in these sources:

IEEE-SA Standards Boards Bylaws

http://standards.ieee.org/guides/bylaws/sect6-7.html#6

IEEE-SA Standards Board Operations Manual

http://standards.ieee.org/guides/opman/sect6.html#6.3

Material about the patent policy is available at

http://standards.ieee.org/board/pat/pat-material.html

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If you have questions, contact the IEEE-SA Standards Board Patent Committee Administrator at patcom@ieee.org or visit http://standards.ieee.org/board/pat/index.html

This slide set is available at http://standards.ieee.org/board/pat/pat-slideset.ppt

Slide #2

Call for Potentially Essential Patents

- **If anyone in this meeting is personally aware of the holder of any patent claims that are potentially essential to implementation of the proposed standard(s) under consideration by this group and that are not already the subject of an Accepted Letter of Assurance:**
  - Either speak up now or
  - Provide the chair of this group with the identity of the holder(s) of any and all such claims as soon as possible or
  - Cause an LOA to be submitted

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Slide #3

Other Guidelines for IEEE WG Meetings

- All IEEE-SA standards meetings shall be conducted in compliance with all applicable laws, including antitrust and competition laws.
  - **Don't discuss the interpretation, validity, or essentiality of patents/patent claims.**
  - **Don't discuss specific license rates, terms, or conditions.**
    - Relative costs, including licensing costs of essential patent claims, of different technical approaches may be discussed in standards development meetings.
      - Technical considerations remain primary focus
  - **Don't discuss or engage in the fixing of product prices, allocation of customers, or division of sales markets.**
  - **Don't discuss the status or substance of ongoing or threatened litigation.**
  - **Don't be silent if inappropriate topics are discussed … do formally object.**

See *IEEE-SA Standards Board Operations Manual*, clause 5.3.10 and "Promoting Competition and Innovation: What You Need to Know about the IEEE Standards Association's Antitrust and Competition Policy" for more details.

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Slide #4

Ad Hoc Groups Operation

- **Straw Polls are only allowed during Ad Hoc group meeting // no motions, anyone can vote**
- **A straw poll needs to achieves at least 75% to be converted to a motion at the TG level.**
- **Each Presentation is suggested to have 15 minutes including presenting and Q&A.**

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TGax PHY Adhoc Schedule in a Glance

	Monday	Tuesday		Wednesday		Thursday
AM1	**TGax**			**TGax**		
AM2		**PHY (Seaport DE)**	MAC			**TGax**
PM1				**PHY (Location TBD)**	MAC	**TGax**
PM2	**TGax**	SR	MU	**TGax**		
EVE		**PHY (Seaport DE)**	MAC			

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PHY Submissions (1/3)

Notes:

- **Docs in green color have been presented.**
- **Docs in red color have been withdrawn.**
- **Docs in black color have NOT been presented.**

DCN	Title	Author	ad hoc
11-16/0816	Comment Resolution for CID 2183	Daewon Lee	PHY
11-16/0872	CR HE-SIG-A Part II	Ross Jian Yu	PHY
11-16/0873	CR HE-SIG-B Part I	Ross Jian Yu	PHY
11-16/0893	11ax Extended Range PPDU	Bin Tian	PHY
11-16/0900	PHY Comment Resolution for CID 1052 and 2519	Bin Tian	PHY
11-16/0891	LDPC for 1024QAM	Hongyuan Zhang	PHY
11-16/0892	Spec Text on LDPC for 1024QAM	Hongyuan Zhang	PHY
11-16/0894	HE-LTF Capabilities	Hongyuan Zhang	PHY
11-16/0895	Spec Text for HE-LTF Capabilities	Hongyuan Zhang	PHY
11-16/0896	11ax Beamformee Capabilities	Hongyuan Zhang	PHY
11-16/0897	Spec Text for Beamformee Capabilities	Hongyuan Zhang	PHY

PHY Submissions (1/3)

Notes:

- **Docs in green color have been presented.**
- **Docs in red color have been withdrawn.**
- **Docs in black color have NOT been presented.**

DCN	Title	Author	ad hoc
11-16/0898	BW Field in HE-MU Format	Hongyuan Zhang	PHY
11-16/0899	Spec Text for BW Field in HE-MU Format	Hongyuan Zhang	PHY
11-16/0903	Gamma phase rotation for HE PPDU	Yujin Noh	PHY
11-16/0904	proposed text for gamma phase rotation for HE PPDU	Yujin Noh	PHY
11-16/0937	11ax Comment Resolutions for Clauses 26.3.2-26.3.9.3-26.3.9.4-26.3.9.5-26.3.10.2- 26.3.10.13	Rui Cao	PHY
11-16/0906	RU restriction on 20MHz operating STAs	Joonsuk Kim	PHY
11-16/0908	CR - proposed text on RU restriction of 20MHz STAs	Joonsuk Kim	PHY
11-16/0910	Minimum Occupied Bandwidth	Ron Porat	PHY
11-16/1021r1	further-change-on-the-proposed-change-of-cid-2032-2549-2133-2548-1009	Ross	PHY
11-16/0914	Bit field finalization of HE-SIG-A	Lochan Verma	PHY

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PHY Submissions (1/3)

Notes:

- **Docs in green color have been presented.**
- **Docs in red color have been withdrawn.**
- **Docs in black color have NOT been presented.**

DCN	Title	Author	ad hoc
11-16/0915	Text for bit field finalization of HE-SIG-A	Lochan Verma	PHY
11-16/0920	PHY comment resolution for CID 1659,493,494	Xiaogang Chen	PHY
11-16/0922	PHY CR 1024 QAM	Sriram Venkateswaran	PHY
11-16/0923	PHY CR DCM Constellation Mapping	Sriram Venkateswaran	PHY
11-16/0928	CR on Section 26.3.9.8 - HE-SIG-B	Kaushik Josiam	PHY
11-16/0964	Considerations on MAC-PHY interactions during SR operations	Jing Ma	PHY

- 11-16/0923 will be updated and presented again in TG meeting
- 11-16/0928 presented but not completed due to limited time.

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Straw-poll 1 (#1, 11-16/0816r0)

- **Do you agree the resolution to the comments as below in 11-16/0816r0**
  - CID 2183

1058

- **SP: Passed without objection**

Straw-poll 2 (#1, 11-16/0872r1)

- **Do you agree the resolution to the comments as below in 11-16/0872r1**
  - CID 2007, 2005, 2123, 2747, 2746, 2244, 842, 846, 526, 910

1059

- **SP: Passed without objection**

Straw-poll 3 (#1, 11-16/0873r1)

- **Do you agree the resolution to the comments as below in 11-16/0873r1**
  - CID 302, 2040, 2032, 2549, 2133, 2548, 1009, 2132, 2680, 2039, 2038, 1001,479, 2150

1060

- **SP: Passed without objection**

- **Note, solutions to CID 2032, 2549, 2133, 2548, 1009 are replaced by solutions to same CIDs in 11-16/1021r2 in a following SP.**

Straw-poll 4 (#1, 11-16/0893r0)

Do you agree to make the following changes to the spec D0.2

Replace the following text in Subclause 26.3.5 P82 L65

The HE extended range SU PPDU is 20 MHz and can only be transmitted with the <HE-MCS, NSS> tuples <MCS 0, 1>, <MCS 1, 1> and <MCS 2, 1>

by

The HE extended range SU PPDU only supports single 242-tone and 106-tone RU. The 242-tone RU can only be transmitted with the <HE-MCS, NSS> tuples <MCS 0, 1>, <MCS 1, 1> and <MCS 2, 1>. The 106-tone RU can only be transmitted with the <HE-MCS, NSS> tuples <MCS 0, 1>. The 106-tone RU location within the 20MHz tone plan is fixed as the right one.

1061

- **SP: Passed without objection**

Straw-poll 5 (#2, 11-16/0893r0)

- Do you agree to the spec text changes to D0.2 on Table 26-20 – Fields in the HE-SIG-A for an HE SU PPDU and HE Extended Range SU PPDU as shown in doc 11/16-0915r0?

  .

1062

- **SP: Passed without objection**
- **Conditional motion depending on the latest revision of 11-16/0915**

Straw-poll 6 (#1, 11-16/0900r1)

- **Do you agree the resolution to the comments as below in 11-16/0900r1**
  - CID 1052, 2519

1063

- **SP: Passed without objection**

Straw-poll 7 (#1, 11-16/0891r0)

- **Do you agree to adopt the spec text change as shown in doc 11/16-0892r0?**

  .

- **SP: Passed without objection**

Straw-poll 8 (#1, 11-16/0894r0)

- **Do you agree that for DL-MUMIMO over the full BW, or for a HE-MU PPDU format sent to a single user, the mapping from $N_{STS,total}$ to N_{HE-LTF} is as in Table 21-13 (Number of VHT-LTFs required for different numbers of space-time streams) in clause 21.3.8.3.5 (VHT-LTF definition), i.e. the same as in 11ac?**

1065

- **SP: Passed without objection**
- **No motion**

Straw-poll 9 (#2, 11-16/0894r0)

- **Do you agree that 1x HE-LTF is mandatory to transmit in UL-MUMIMO PPDUs over the full BW, for a STA that supports UL-MUMIMO?**

1066

- **SP: passed without objection**
- **No motion**

Straw-poll 10 (#3, 11-16/0894r0)

- **Do you agree with the followings?**
  - 1x HE-LTF is disallowed in any DL-MUMIMO PPDU over the full BW.

1067

- **SP: passed without objection**
- **No motion**

Straw-poll 11 (#4, 11-16/0894r0)

- **Do you agree to adopt the spec text changes as shown in doc 11/16-0895r0, which reflects Straw Polls 1~3?**

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- **SP: passed without objection**

Straw-poll 12 (#1, 11-16/0896r0)

- **Do you agree to adopt the spec text changes as shown in doc 11/16-0897r1?**

1069

- **SP: passed without objection**

Straw-poll 13 (#2, 11-16/0898r0)

- **Do you agree to adopt the spec text changes as shown in doc 11/16-0899r0?**

- **SP: passed without objection.**

Straw-poll 14 (#1, 11-16/0906r0)

- **Do you support to add following rules for 20MHz operating STAs?**
  - AP shall not assign following RUs to 20 MHz operating STAs
    - For 26-tone RUs, [1]
      - RU_{26} #5, 14 in 40 MHz DL/UL OFDMA PPDU
        - 2 RU_{26}s are restricted
      - RU_{26} # 5, 10, 14, 19, 24, 28, 33 in 80 MHz DL/UL OFDMA PPDU
        - 7 RU_{26}s are restricted
      - RU_{26} # 5, 10, 14, 19, 24, 28, 33 in lower 80 MHz and upper 80 MHz, in 80+80 or 160 MHz DL/UL OFDMA PPDU
        - 14 RU_{26}s are restricted
    - For 52-tone RUs, [1]
      - RU_{52} #5, 12 in 80 MHz DL/UL OFDMA PPDU
        - 2 RU_{52}s are restricted
      - RU_{52} #5, 12 in lower 80 MHz and upper 80 MHz, in 80+80 or 160 MHz DL/UL OFDMA PPDU
        - 4 RU_{52}s are restricted
    - For 106-tone RUs, [1]
      - RU_{106} #3, 6 in 80MHz DL/UL OFDMA PPDU
        - 2 RU_{106}s are restricted
      - RU_{106} #3, 6 in lower 80 MHz and upper 80 MHz, in 80+80 or 160 MHz DL/UL OFDMA PPDU
        - 4 RU_{106}s are restricted
  - Center RU26 in primary 20 channel shall not be assigned to any STAs where 20MHz operating STAs are recipients of 40/80/160/80+80 OFDMA
  - [1] Table 26-9 and 26-10 of 16/0024r1

- **SP: passed without objection**
- **No motion**

1071

Straw-poll 15 (#2, 11-16/0906r0)

- **Do you support to add following rules for 20MHz operating STAs?**
  - It is optional whether all RU_{242}s of 20 MHz operating STAs to be supported in 40/80/160/80+80 MHz DL-OFDMA
    - If supported, there is no restriction on RU_{242}s
  - RU_{242} shall not be allocated to 20MHz operating STAs in 40/80/160/80+80 for UL-OFDMA

Function	Format	Sub-format	20MHz operating Non-AP STA
In 2.4 GHz	40MHz DL-OFDMA	RU242 tone mapping	O
In 5 GHz	40 & 80 MHz DL-OFDMA	RU242 tone mapping	O
In 5 GHz	80+80 or 160 MHz DL-OFDMA	RU242 tone mapping	O

- **SP: passed without objection**
- **No motion**

1072

Straw-poll 16 (#1, 11-16/0908r1)

- **Do you agree the resolution to CID 854 as in doc 11/16-0908r1?**

1073

- **SP: passed without objection**

Straw-poll 17 (11-16/0910r0)

- **Do you support the proposed addition to the end of section 26.3.7.1 in 11ax spec D0.2?**
  - In a HE MU PPDU transmission, at least Nx4x26 tones (contiguous or non-contiguous), where N is the number of 20MHz channels' legacy preambles present, shall be occupied throughout the signaled BW

1074

- **SP: passed without objection**

Straw-poll 18 (#1, 11-16/1021r2)

- **Do you agree the resolution to the following comments in 11-16/1021r2 to replace the resolutions to these CIDs in 11-16/0873r1?**
  - CID 2032, 2549, 2133, 2548, 1009

1075

- **SP: passed without objection**

Straw-poll 19 (#1, 11-16/0914r1)

- **Do you agree to adopt the spec. text changes proposed in "11-16-0915-02-00ax"?**

1076

- **SP: passed without objection**

Straw-poll 20 (#1, 11-16/0920r3)

- **Do you agree to the resolutions to the following CIDs in 11-16/0920r3?**
  - CID 1659
  - CID 493
  - CID 494

- **SP: passed without objection**

1077

Straw-poll 21 (#1, 11-16/0922r2)

- **Do you agree to the resolutions to the following CIDs in 11-16/0922r2?**
  - CID 1782, 2082, 2083

1078

- **SP: passed without objection**

Straw-poll 22 (#1, 11-16/0937r7)

- **Do you agree the resolution to the comments as below in 11-16/0937r7**
  - CID 836 883 884 1930 2247 292 525 904 906 908 1984 1990 1995 1988 1994 1058 1992 1991 1985 1989 1684 523 1857 271 1412 1195 1996 2532 2120 2098 293 1987 1993 2748 2749

- **SP: passed without objection**

Straw-poll xx (#1, 11-16/0923r1)

- **Do you agree to the resolutions to the following CIDs in 11-16/0923r1?**
  - CID 482, 1867, 2084, 2085

1080

- **SP: Not run, go to TG meeting**

Appendix AY

IEEE P802.11
Wireless LANs

Proposed resolutions to comments on clause 26.3.9.8

Date: 2016-05-16

Author(s):

Name	Affiliation	Address	Phone	email
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Abstract

This submission contains proposed comment resolutions to comments on TGax Draft D0.1.

The comments assigned to the author in Clause 26.3.9.8 are:
302, 304, 306, 310, 311, 477, 478, 479, 527, 1001, 1002, 1003, 1009, 1010, 1692, 2020, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2032, 2033, 2035, 2036, 2037, 2038, 2039, 2040, 2130, 2131, 2132, 2133, 2150, 2151, 2157, 2245, 2246, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2679, 2680, 2681, 2748, 2749.

The resolutions proposed in this document are marked with green.
306, 310, 311, 477, 1002, 1003, 1010, 1692, 2020, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2036, 2037, 2130, 2151, 2245, 2246, 2543, 2544, 2545, 2546, 2547, 2679, 2681

The changes marked in this document are based on **TGax Draft 0.2**.

Revision Notes

R0	Initial revision
R1	Changes to the resolution of some comments
R2	Fix comment reference errors and changes to the resolution of some comments.

Comments for Clause 26.3.9.8

CID 2020, 2022, 2543

CID	Page. Line	Clause Number	Comment	Proposed Change	Proposed Resolution
2020	111.31	26.3.9.8.1	The notion of "content channel" should be explained in this section, as it is used later on in the description of HE-SIG-B	See comment	Revised. The original spec text has been augmented, clarifying the definition of content channel by the text below. **Instruction to Editor:** TGax editor to make the changes shown in 11-16/928r1 under all headings that include CID 2020
2022	111.52	26.3.9.8.1	Replace "multiple" with "one or more"	See comment	Accepted. The change has been made as per the comment **Instruction to Editor:** TGax editor to make the changes shown in 11-16/928r1 under all headings that include CID 2022
2543	111.31	26.3.8.9.1	HE-SIG-B may not contain Common Block field.	Add some where in this subclause that there is a mode in which the HE-SIG-B Commone Block field is not included.	Revised. Agree with the commenter. A sentence has been added to describe the absence of HE-SIG-B Common

					Block when compression bit is set – as shown in the text below. Further description of the user field arrangement was also missing. That has been added **Instruction to Editor:** TGax editor to make the changes shown in 11-16/928r1 under all headings that include CID 2543

Proposed Text Changes for CID 2020, 2022 and 2543

Instruction to Editor:
Please make the following changes in TGax D0.2 P114 L 6 under subclause 26.3.9.8. 1
The HE-SIG-B field is separately encoded on each 20 MHz band. The encoding structure in one such 20 MHz band is shown in Figure 26-19 (HE-SIG-B field encoding structure in each 20 MHz). It consists of a Common Block field followed by a User Specific field which together are referred to as the HE-SIG-B content channel.(#2020)

The Common Block field of a HE-SIG-B content channel (#2020) contains information regarding the resource unit allocation such as the RU arrangement in frequency domain, the RUs allocated for MU-MIMO and the number of users in MU-MIMO allocations. The Common Block field is described in detail in 26.3.9.8.4 (HE-SIG-B common content).

The User Specific field of a HE-SIG-B content channel consists of ~~multiple~~ one or more (#2022)User Block fields. Each User Block field ~~contains~~ is made up of two user fields that contain (#2020) information for two STAs to decode their payloads. The last User Block field may contain information for only one STA, if the number of user fields indicated by the RU allocation signaling in the common block is odd. See 26.3.9.8.5 (HE-SIG-B per-user content) for a description of the contents of the User Block field.

When SIGB Compression bit in HE-SIG-A of a HE-MU-PPDU is set to 1 indicating full bandwidth MU-MIMO transmission, the Common Block field is not transmitted and the content channel consists of only the User Specific field. (#2543)

Please add the following sentences to TGax D0.2 P121 L 36 under subclause 26.3.9.8.5

When SIGB Compression bit in HE-SIG-A of a HE-MU PPDU is set to 1 indicating full bandwidth MU-MIMO transmission, the number of STAs in the MU-MIMO group is indicated in the 'SIGB Number of Symbols/Number of MU-MIMO users field' in HE-SIG-A. For bandwidths larger than 20 MHz, the User block fields are split equitably between two HE-SIG-B content channels, i.e., for a k user MU-MIMO PPDU, 1, …., ceil(k/2) User block fields are carried in HE-SIG-B content channel 1 and ceil(k/2)+1,……,k User block fields in HE-SIG-B content channel 2. (#2543)

CID 306, 2026, 2547

CID	Page. Line	Clause Number	Comment	Proposed Change	Proposed Resolution
306	113.38	26.3.9.8.2	If the padding bits are used to round the number of symbols to the	Clarify that the padding bits are added both to have an integer number	Revised

			"nearest" integer, then how would it be possible to align the number of symbols across both content channels?	of symbols as well as to ensure that both content channels have the same number of symbols. Addition descriptions on how this should be done also need to be added - by adding more padding bits to the content channel with the smaller number of users etc..	The revised text for the spec draft has been added that addresses the comments intent. **Instruction to Editor:** TGax editor to make the changes shown in 11-16/928r1 under all headings that include CID 306
2026	113.38	26.3.9.8.3	"bits are added to round up the number of symbols to the nearest integer"	The number of symbols in HE-SIG-B is communicated in HE-SIG-A	DUPLICATE of CID 306 in doc 16-928r0.
2547	113.56	26.3.9.8.3	HE-SIG-B on different 20 MHz bands must end at the same OFDM symbol.	clarify "... round up the number of symbols to the nearest integer." to indicate that HE-SIG-B padding should be done so that HE-SIG-B on different 20 MHz bands end at the OFDM symbol.	DUPLICATE of CID 306 in doc 16-928r0.

Proposed Text Changes for CID 306

Instruction to Editor:
Please make the following changes in TGax D0.2 P115 L 59 under subclause 26.3.9.8.3
In the User Specific field, in any 20 MHz band, the bits corresponding to two STAs (i.e. two User fields) are encoded together. Specifically, the STAs scheduled in the HE-MU-PPDU are split into groups of two. Each group of two User fields shall have CRC and tail bits added and then BCC encoded at rate R = ½ using the encoder described in 18.3.5.6. ~~If the number of users is even, padding bits are added to round up the number of symbols to the nearest integer.~~ If the number of users in a content channel is odd, the User Block field corresponding to the last user, who is not grouped, is encoded after adding tail and CRC bits. After encoding, padding bits are added to each content channel to round up the number of symbols the content channel occupies to the nearest integer value. Further padding is added to each content channel until the number of OFDM symbols in the content channel equals the Number of HE-SIG-B symbols signalled by a 4 bit field in HE-SIG-A for an HE MU PPDU. Thus, padding ensures that the content channels in different 20MHz bands end at the same OFDM symbol. (#306)~~and only then are any padding bits added~~. ~~The padding bits added ensure that both content channels have the same number of symbols.~~ The specific method of generating padding bits is TBD. When the code rate is not equal to ½, the convolutional encoder output bits for each field (including padding bits) are concatenated, then the concatenated bit streams are punctured continuously as described in 18.3.5.6 (Convolutional encoder).

CID 2024, 2544, 2545, 2130, 2023, 1692

CID	Page. Line	Clause Number	Comment	Proposed Change	Proposed Resolution

2024	112.27	26.3.9.8.2	Improve wording	"the 1st and 3rd 20 MHz bands from the top" is not very precise. Find better formulation.	Revised. The commenter is correct. However the proposed change is insufficient. An alternate text for Section 26.3.9.8.2 has been proposed. **Instruction to Editor:** TGax editor to make the changes shown in 11-16/928r1 under all headings that include CID 2024
2544	112.04	26.3.9.8.2	242-tones RU can cross the physical 20 MHz boundary. So, the notion that the HE-SIG-B Common Block field is transmitted on the same 20 MHz band as the STA's data is not strictly correct.	Clarify the HE-SIG-B description to match the actual design of the standard.	Revised. The commenter is correct. However the proposed change is insufficient. An alternate text for Section 26.3.9.8.2 has been proposed **Instruction to Editor:** TGax editor to make the changes shown in 11-16/928r1 under all headings that include CID 2544
2545	112.26	26.3.9.8.2	What is the "1st" 20 MHz band? For example, in an 80 MHz BSS using channels 36/40/44/48 (5GHz) with channel 40 being the Primary20, what is the "1st" 20 MHz band? Is it channel 40? Channel 36? Also, in case of 80+80 MHz BSS where the Primary80 segment has higher carrier frequency than the Secondary80 segment, would the "1st" 20 MHz band start in the Primary80 segment, or the segment lower in frequency?	Clarify what a "1st" 20 MHz band is.	DUPLICATE of CID 2024 in doc 16-928r1.

2130	112.01	26.3.9.8.2	Unclear what subbands A,B,C,D are tied to. (ie, to i_BW in eqn 26-25)	clarify mapping A,B,C,D to subband indices	DUPLICATE of CID 2024 in doc 16-928r1.
2023	112.02	26.3.9.8.2	Is there a specific relationship between content channels and the primary channel when BW>20?	The order of the content channels matter for MU transmissions. Is it correct to assume that the first content channel is always in the primary channel?	Revised. The arrangement of the content channels is in the order of increasing sub-carrier index starting from the lowest – which carries content channel #1. The text to clarify this has been proposed **Instruction to Editor:** TGax editor to make the changes shown in 11-16/928r1 under all headings that include CID 2023
1692	86.09	26.3.9.8.3	It is not clear at which position, and in which SIG-B channel that it carries the per-user content of the center 26-tone RU of 80MHz tone plan	specify the per-user content is located in the last per-user block of channel 1 , if common info is not 11010yyy or 11011yyy	Revised, The comment is correct but the proposed change is not. An alternate text that shows a 1-bit signaling in the content channel corresponding to the center 26 tone RU – to indicate presence of user field is proposed. **Instruction to Editor:** TGax editor to make the changes shown in 11-16/928r1 under all headings that include CID 1692

Proposed Text Changes for CID 2024, 2544, 2023 and 1692

Instruction to Editor:
Replace the contents of sub-clause 26.3.9.8.2 Frequency domain mapping in TGax D0.2 beginning P114 until P 115 line 47 with the following:

26.3.9.8.2 Frequency domain mapping (#2024)

The 20 MHz PPDU contains one content channel in which the Common Block field and User Specific field are carried as shown in Figure 26-20(HE-SIG-B content channel for a 20 MHz PPDU). The Common Block field contains the RU allocation signaling for RUs that occur within the 242-subcarrier RU boundary.

Figure 26-20—HE-SIG-B content channel for a 20 MHz PPDU

The 40MHz PPDU contains two content channels, each occupying a 20MHz segment. Each content channel contains a Common Block field followed by User Specific field as shown in Figure 26-21 (HE-SIG-B content channel arrangement for a 40 MHz PPDU). The content channels are ordered in increasing order of the absolute frequency i.e., the first content channel carries Common Block field and User Specific field corresponding to RUs whose sub-carrier indices fall between [-244:-3] and the second content channel carries Common Block field and User Specific field corresponding to RUs whose sub-carrier indices fall between [3:244] .(#2544) In case a 484-subcarrier RU is signaled, both content channels will carry Common Block field and User Specific field corresponding to the 484-subcarrier RU.

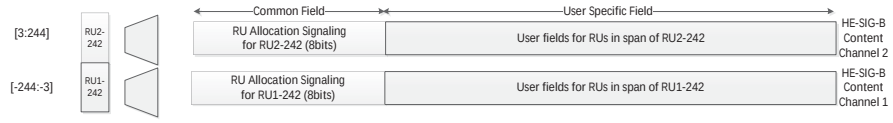

Figure 26-21—HE-SIG-B content channel arrangement for a 40 MHz PPDU

The 80MHz PPDU contains two content channels each of which are duplicated once as shown in Figure 26.22 (Default mapping of the two HE-SIG-B content channels and their duplication in an 80MHz PPDU). The arrangement of the content channels are in increasing order of the absolute frequency – where HE-SIG-B content channel #1 occupies the tones in the 20MHz segment with the lowest subcarrier indices followed by the HE-SIG-B content channel #2 in the adjacent 20MHz segment. This structure of the first content channel occupying the lower subcarrier index followed by the second content channel is repeated with content duplication in the remaining two 20MHz segments respectively. The first content channel appearing in the 20MHz segments carries a Common Block field and User Specific field corresponding to RUs whose subcarriers indices overlap those segments. (#2544) The Common Block field of content channel 1 contains the following: a RU allocation signaling field for RUs whose sub-carrier indices fall in the range [-500:-259], followed by a second RU allocation signaling field for RUs whose sub-carrier indices are between [17:258] and 1 bit to indicate presence of the user field corresponding to the center 26 sub-carrier RU that spans subcarriers [-16:-4, 4:16].(#1692) The second content channel carries a Common Block field and User Specific field corresponding to RUs whose subcarrier indices fall in those segments. The Common Block field of content channel 2 contains the following: a RU allocation signaling field for RUs whose sub-carrier indices fall in the range [-258:-17], followed by a second RU allocation signaling field for RUs whose sub-carrier indices are between [259:500] and 1 bit to indicate presence of the user field corresponding to center 26 sub-carrier RU that spans subcarriers [-16:-4, 4:16]. The same value for the bit signaling presence of center 26 sub-carrier RU is carried in both content channels. (#1692) The user fields in the User Specific field that follow the common field are arranged in the same order as the RU allocation signaling. When assigned, the user field corresponding to center 26 sub-carrier RU that spans subcarriers [-16:-4, 4:16] is carried as the last user field in HE-SIG-B content channel 1.(#1692) (#2023) When RUs greater than 242 subcarriers are signaled in the RU allocation signaling in a portion of the bandwidth, the signaling is carried in both content channels placed in the order of the absolute sub-carrier index.

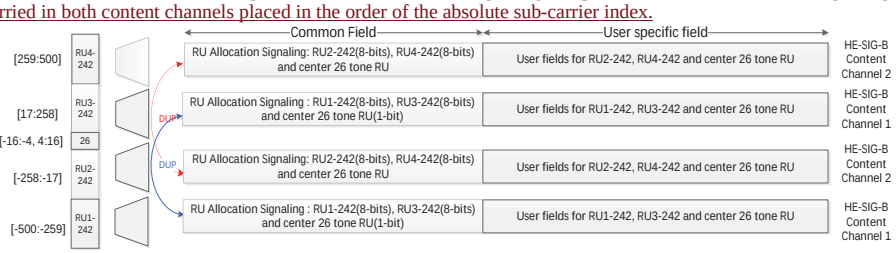

Figure 26-22—Default mapping of the two HE-SIG-B channels and their duplication in an 80 MHz PPDU

Field Code Changed

Field Code Changed

Field Code Changed

The 160MHz PPDU contains two content channels each of which are duplicated four times as shown in Figure 26-27 (Default mapping of the two HE-SIG-B channels and their duplication in a 160MHz PPDU). The arrangement of the content channels are in increasing order of the absolute frequency.(#2023) The first content channel occupies the tones in the 20MHz segment with the lowest subcarrier indices and the second content channel in the adjacent 20MHz segment. This pattern of arranging HE-SIG-B content channel 1 and HE-SIG-B content channel 2 is duplicated over the other segments. The HE-SIG-B content channel 1 and HE-SIG-B content channel 2 carries RU allocation signaling at 242 sub-carrier RU granularity that overlap with the 20MHz segments in which the content channels are carried (including duplication). The signaling for the presence of the user field corresponding to a center 26 tone RU in the 80MHz segment with the lower sub-carrier index is carried in HE-SIG-B content channel 1 as a 1-bit sub-field placed at the end of the Common field. Similarly, signalling for the center 26 tone RU in the 80MHz segment with the higher sub-carrier index is carried in HE-SIG-B content channel 2 as 1-bit sub-field placed at the end of the common field. When assigned, the user field corresponding to the center 26 tone RU in the 80MHz segments is carried as the last user field in their respective content channels. (#1692) When RUs greater than 242 subcarriers are signaled in the RU allocation signaling in a portion of the bandwidth, the signaling is carried in both content channels placed in the order of the absolute sub-carrier index.

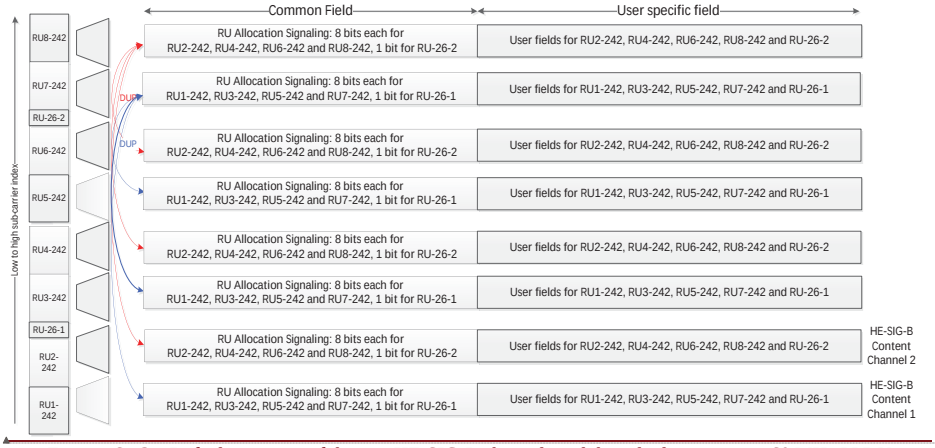

Figure 26-23—Default mapping of the two HE-SIG-B channels and their duplication in a 160 MHz PPDU

Field Code Changed

Instruction to Editor:
Insert the following in TGax D0.2 beginning P117 line 5 in Section 26.3.9.8.4.

Table 26-xx HE-SIG-B Common field in HE MU PPDU (#2024, #1692)

Field	# of bits	Description
RU Allocation	$N \times 8$	Indicates the RU arrangement in frequency domain. It also indicates number of user fields in each RU. For RUs of size greater than or equal to 106-tones that support MU-MIMO, it indicates the number of users multiplexed using MU-MIMO. $N = 1$ for 20 MHz and 40 MHz HE MU PPDU $N = 2$ for 80 MHz HE MU PPDU $N = 4$ for 160/80+80 MHz HE MU PPDU
Center 26-tone RU	1	This field is present only for full bandwidth 80 MHz and 160/80+80 MHz. For full bandwidth 80 MHz Set to 1 to indicate that Center 26-tone RU is allocated in the Common Block fields of both SIGB content channels with same value. Set to 0, otherwise. For full bandwidth 160/80+80 MHz Set to 1 to indicate that Center 26-tone RU is allocated for one individual 80 MHz in Common Block fields of both SIGB content channels. Set to 0, otherwise.

CRC	4	See CRC computation (26.3.9.7.3)
Tail	6	Used to terminate the trellis of the convolutional decoder. Set to 0.

NOTE- Integer fields are transmitted in unsigned binary format, LSB first, where the LSB is in the lowest numbered bit position.

CID 2546

CID	Page. Line	Clause Number	Comment	Proposed Change	Proposed Resolution
2546	113.23	26.3.9.8.2	Using "MHz" for RU size is not very accurate. For example, is a 26-tones RU 2 MHz RU? 2.5 MHz RU? 2.0312 MHz RU? Suggest to use # of tones when referring to RU size.	Change "RU size > 20 MHz" to "RU size greater than 242-tones".	Revised **Instruction to Editor:** TGax editor to make the changes shown in 11-16/928r1 under all headings that include CID 2546

Proposed Text Changes for CID 2546

Instruction to Editor:
Please make the following changes in TGax D0.2 P115 L 48 under subclause 26.3.9.8.3

For MU-MIMO allocation of RU size ~~> 20 MHz~~ greater than 242-sub-carriers (#2546), the User Block ~~sub~~fields are dynamically split between the two HE-SIG-B content channels (1/2) and the split is decided by the AP (on a per case basis).

CID 477 and 2679

CID	Page. Line	Clause Number	Comment	Proposed Change	Proposed Resolution
477	113.56	26.3.9.8.3	Section 25.3.9.2.4 does not exist. The definition of the default mode in HE SIG-A is missing.	Clarify what the default mode in HE SIG-A means. Additionally, rename the "default mode" default is typically specificfied in case some signaling is missing. The name of the mode implies some signaling is not transmitted in some cases and transmitted in other cases.	Revised. The word default mode is confusing. The HE-SIG-A has been clarified as that in a HE-MU PPDU **Instruction to Editor:** TGax editor to make the changes shown

					in 11-16/928r1 under all headings that include CID 477
2679	113.56	26.3.9.8.3	There's no Section 25.3.9.2.4, and there's no definition on "default mode".	Add the definition of the "default mode".	DUPLICATE of CID 477 in doc 16-928r1.

Proposed Text Changes for CID 477

Instruction to Editor:

Please make the following changes in TGax D0.2 P116 L 18 under subclause 26.3.9.8.3

The number of ~~symbols in~~ HE-SIG-B symbols, denoted by $N_{SYM,HE\text{-}SIG\text{-}B}$, shall be ~~signaled~~signalled by a 4 bit field in HE-SIG-A of a HE MU PPDU (#477) ~~in the default mode~~ (see (#1304)26.3.9.7.2 (Content)(#2781)).

CID 2025

CID	Page. Line	Clause Number	Comment	Proposed Change	Proposed Resolution
2025	113.30	26.3.9.8.3	For CRC, add reference to 26.3.9.7.3	See comment	Revised. The comment should have been the proposed change **Instruction to Editor:** TGax editor to make the changes shown in 11-16/928r1 under all headings that include CID 2025

Proposed Text Changes for CID 2025

Instruction to Editor:

Please make the following changes in TGax D0.2 P116 L 18 under subclause 26.3.9.8.3

In each 20 MHz band, the bits in the Common Block field shall have CRC and tail bits added and then be BCC encoded at rate R = ½. The CRC bits are computed as described in 26.3.9.7.3.(#2025)

CID 2027

CID	Page. Line	Clause Number	Comment	Proposed Change	Proposed Resolution
2027	113.43	26.3.9.8.3	TBD	Define	Revised. The comment seeks to resolve the TBD in the sentence "The specific method of generating

					padding bits is TBD". The padding can either be defined as all zeros or left unspecified. Simulations [1] have verified that the PAPR with a long zero padding is within reasonable limits when used with the adopted phase rotation method for PAPR reduction in HE-SIG-B We can leave the padding sequence unspecified. The recommendation is to delete the sentence. **Instruction to Editor:** TGax editor to make the changes shown in 11-16/928r1 under all headings that include CID 2027

Proposed Text Changes for CID 2027

Instruction to Editor:
Please delete the following changes in TGax D0.2 P116 L 2 under subclause 26.3.9.8.3
~~The specific method of generating padding bits is TBD.~~ (#2027)

CID 2028 and 2029

CID	Page. Line	Clause Number	Comment	Proposed Change	Proposed Resolution
2028	113.43	26.3.9.8.3	Clarify puncturing requirement	The concatenation before the puncturing should also include the bits of the common field. Make this explicit and put the puncturing requirement in a separate paragraph, not as part of a paragraph on user-specific field.	Revised. Accepted in principle- an alternate text to clarify the intent of the **Instruction to Editor:** TGax editor to make the changes shown in 11-16/928r1 under all headings that include CID 2028
2029	113.34	26.3.9.8.3	Not clear what "continuously" means	delete "continuously"	Accepted **Instruction to Editor:** TGax editor to make the changes

					shown in 11-16/928r1 under all headings that include CID 2029

Proposed Text Changes for CID 2028, 2029

Instruction to Editor:
Please move the following sentence in TGax D0.2 P116 L 3 under subclause 26.3.9.8.3 to a new paragraph with the following change:

For both common and User Specific fields ,~~When~~ when the code rate is not equal to ½, the convolutional encoder output bits for each field (including padding bits) are concatenated, then the concatenated bit streams are punctured ~~continuously~~ (#2029) as described in 17.3.5.6 (Convolutional encoder)(#307)(#2028).

CID 310

CID	Page. Line	Clause Number	Comment	Proposed Change	Proposed Resolution
310	118.36	26.3.8.9.5	"When MU-MIMO is used in RUs of size 20 MHz or greater" should be " greater than 242 subcarriers". If RU size is 20MHz, still only one HE SIGB content channel is needed. Also RU size shoul be in the unit of subcarriers	as in comment	Revised. The correct change as described in the comment is proposed as text **Instruction to Editor:** TGax editor to make the changes shown in 11-16/928r1 under all headings that include CID 310

Proposed Text Changes for CID 310

Instruction to Editor:
Please make the following changes in TGax D0.2 P118 L 32 under subclause 26.3.9.8.5

When MU-MIMO is used in an RU of size ~~≤ 20 MHz~~ less than or equal to 242 sub-carriers (#310), the number of users (Nuser) in an MU-MIMO allocation is equal to the number of user-fields per RU signaled for the RU in the RU allocation subfield of an HE-SIG-B Common Block field. When MU-MIMO is used in RUs of size ~~20 MHz or greater~~ greater than 242 sub-carriers (#310), the number of users (Nuser) in an MU-MIMO allocation is computed as the sum of the number of user-fields per RU indicated for the RU by the 8-bit RU allocation subfield in each HE-SIG-B content channel. For a given value of Nuser, the four bits of the spatial configuration subfield are used as follows: A STA with a STA-ID that matches the 11-bit ID signaled in the user field for an MU-MIMO allocation derives the number of spatial streams allocated to it using the row corresponding to the signaled 4-bit spatial configuration subfield and the column corresponding to the position of the user-field in the user-specific field. The starting stream index for the STA is computed by summing the Nsts in the columns prior to the column indicated by the STA's user-field position. In the case of load balancing for RUs of size ~~> 20 MHz~~ greater than 242 sub-carrierswhere user fields corresponding to the same MU-MIMO allocations are split into two HE-SIG-B content channels, the user-field positions are logically continuous, with the first user-field corresponding to the same RU ~~,~~ in the second HE-SIG-B content channel updating its position (and therefore, column index) from that of the last user-field in the first HE-SIG-B content channel. (#310)

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CID 311

CID	Page. Line	Clause Number	Comment	Proposed Change	Proposed Resolution
311	118.00	26.3.8.9.5	The computation for the total number of spatial streams is missing from the description of how the spatial streams are indicated to each user	Mention that the total number of spatial streams is indicated by summing all the columns for the indicated row in the corresponding table.	Revised The total number of spatial streams (Total N_{STS}) is indicated in Table 26-21. The signalled *spatial configuration subfield corresponding to a signaled* N_{user} indicates the row and the user field position in the content channel specifies the number of spatial streams allocated to the user. The total number of spatial streams is just a table-look up given *Nuser*. **Instruction to Editor:** TGax editor to make the changes shown in 11-16/928r1 under all headings that include CID 311

Proposed Text Changes for CID 311

Instruction to Editor:
Please insert the following sentence in TGax D0.2 P118 L 45 under subclause 26.3.9.8.5

The total number of spatial streams (Total N_{STS}) is computed by summing all columns for the row signalled by the spatial configuration sub-field and is indicated in Table 26-21 (Spatial Configuration subfield encoding) under the column Total N_{STS} (#311).

CID 1002, 2036

CID	Page. Line	Clause Number	Comment	Proposed Change	Proposed Resolution
1002	117.35	26.3.8.9.5	Clarify the STA-ID field in the Table 26.19. The description reference to a MAC section is unclear and needs to be clarified	Replace the sentence "The STA identifier that addresses a STA - reference to MAC section(?)" with the following sentence: "The STA-ID refers to the AID described in the section 8.4.1.8. The 11 LSBs of the AID field are used to address STAs in this field.	Accepted **Instruction to Editor:** TGax editor to make the changes shown in 11-16/928r1 under all headings that include CID 1002
2036	117.36	26.3.8.9.5	missing reference	Replace "reference to MAC section(?)" with correct reference.	DUPLICATE of CID 1002 in doc 16-928r1.

Proposed Text Changes for CID 1002

Instruction to Editor:
Please make the following changes in TGax D0.2 P120 L 13 under subclause 26.3.9.8.5
~~The STA identifier that addresses a STA - reference to MAC section(?).~~The STA-ID refers to the AID described in the section 8.4.1.8. The 11 LSBs of the AID field are used to address STAs in this field (#1002).

CID 1003

CID	Page. Line	Clause Number	Comment	Proposed Change	Proposed Resolution
1003	118.11	26.3.8.9.5	Clarify the STA-ID field in the Table 26.20. The description reference to a MAC section is unclear and needs to be clarified	Replace the sentence "The STA identifier that addresses a STA - reference to MAC section(?)" with the following sentence: "The STA-ID refers to the AID described in the section 8.4.1.8. The 11 LSBs of the AID field are used to address STAs in this field."	Accepted. **Instruction to Editor:** TGax editor to make the changes shown in 11-16/928r1 under all headings that include CID 1003

Proposed Text Changes for CID 1003

Instruction to Editor:

Please make the following changes in TGax D0.2 P120 L 53 under subclause 26.3.9.8.5

~~The STA identifier that addresses an STA – reference to MAC section(?).~~The STA-ID refers to the AID described in the section 8.4.1.8. The 11 LSBs of the AID field are used to address STAs in this field (#1003).

CID 2681

CID	Page. Line	Clause Number	Comment	Proposed Change	Proposed Resolution
2681	117.49	26.3.8.9.5	In subclause 25.11, it says "For a multiple BSS AP, if the RU is intended for all STAs on all its BSSs, the STA_ID_LIST element is set to 2047". This table should be in line with this text.	Modify the sentence to "For a Multiple BSS AP, the STAID for Broadcast to all BSS of the AP is set to 2047.".	Accepted **Instruction to Editor:** TGax editor to make the changes shown in 11-16/928r1 under all headings that include CID 2681

Proposed Text Changes for CID 2681

Instruction to Editor:

Please make the following changes in TGax D0.2 P120 L 24 under subclause 26.3.9.8.5

~~For Multiple BSS AP, the STAID for Broadcast to all BSS of the AP will have a special STAID value reserved.~~ For a multiple BSS AP, the STAID for Broadcast to all BSS of the AP is set to 2047 (#2681).

CID 1010 and 2151

CID	Page. Line	Clause Number	Comment	Proposed Change	Proposed Resolution
1010	116.00	26.3.8.9.5	The text of the PHY motion 128 states, "Multiple RU allocation for one STA shall not be allowed in 11ax." This has to be incorporated in the spec text	Will bring a detailed text proposal for this comment	Revised. The proposed change is insufficient. To reflect the agreement accurately, text has been added to the spec as shown. **Instruction to Editor:** TGax editor to make the changes shown in 11-16/928r1 under all headings that include CID 1010
2151	116.00	26.3.8.9.5	Please confirm, maximum of one RU will be		DUPLICATE of CID 1010 in doc 16-928r1.

			expected to be decoded by a given STA		The normative behaviour is on the signalling – where the AP cannot allocate more than one RU to an addressed STA. That clarification is provided by the modification ot the text as suggested below.

Proposed Text Changes for CID 1010

Instruction to Editor:
Please make the following changes in TGax D0.2 P119 L 16 under subclause 26.3.9.8.5
Multiple RU allocations addressed to a single STA shall not be allowed in 802.11ax. Therefore, the signalling that enables STAs to decode its data is carried in only one user field (#1010).

CID 2037

CID	Page. Line	Clause Number	Comment	Proposed Change	Proposed Resolution
2037	117.51	26.3.9.8.5	Define values of fields	Also, lines 53, 56, 59, 61	Revised. The comment is correct. The proposed change is unclear. So, an alternate resolution is provided for both Table 26-19 and 26-20. **Instruction to Editor:** TGax editor to make the changes shown in 11-16/928r1 under all headings that include CID 2037

Proposed Text Changes for CID 2037

Instruction to Editor:
Please make the following changes to Table 26-19 and Table 26-20 under subclause 26.3.9.8.5 inTGax D0.2

Table 26-19—Fields of the HE-SIG-B user field for an(#916) non-MU-MIMO(#1101) allocation

Bit	Sub-Field	Number of bits	Description
B0:B10 ~~TBD~~	STA-ID	11	The STA identifier that addresses a STA – reference to MAC section(?). For RUs that carry a broadcast allocation:

			• For single BSS AP, the STAID for Broadcast will be 0; • For Multiple BSS AP, the STAID for Broadcast to a specific BSS will follow the group addressed AID assignment in the TIM according to the existing Multi-BSSID TIM operation; • For Multiple BSS AP, the STAID for Broadcast to all BSS of the AP will have a special STAID value reserved. • STAID value 2046 is used to indicate that the RU carries no data • When a STA transmits on the uplink using the HE_MU_PPDU format, the STA-ID field is populated by the AID of the transmitter assigned by the AP
B11:B13 ~~TBD~~	NSTS	3	Number of spatial streams Set to n for n+1 space time stream, where n = 0, 1, 2, …., 7
B14 ~~TBD~~	Tx Beamforming	1	Use of transmit beamforming Set to 1 if a Beamforming steering matrix is applied to the waveform in an SU transmission Set to 0 otherwise
B15:B18 ~~TBD~~	MCS	4	Modulation and Coding Scheme. Set to n for MCSn, where n = 0, 1 ,2 …., 11 Values 12 to 15 are reserved
B19 ~~TBD~~	DCM	1	Indication for use of dual carrier modulation. Set to 1 to indicate that the payload of the MU PPDU is modulated with dual sub-carrier modulation for the MCS Set to 0 indicates that the payload of the PPDU is not modulated with dual sub-carrier for the MCS.
B20 ~~TBD~~	Coding	1	Indicates whether BCC or LDPC is used. ~~Indication for use of LDPC~~ Set to 0 for BCC Set to 1 for LDPC

NOTE- Integer fields are transmitted in unsigned binary format, LSB first, where the LSB is in the lowest numbered bit position. (#1010)

Table 26-20—Fields of the HE-SIG-B user field for an(#2817) MU-MIMO allocation

Bit	Sub-Field	Number of bits	Description
B0:B10 ~~TBD~~	STA-ID	11	The STA identifier that addresses an STA – reference to MAC section(?)
~~TBD~~ B11:B14	Spatial Configuration	4	Indication for the number of spatial streams for a STA in an(#2817) MU-MIMO allocation. See Table 26-21 (Spatial Configuration subfield encoding).
~~TBD~~ B15:B18	MCS	4	Modulation and Coding Scheme. Set to n for MCSn, where n = 0, 1, 2,…..11 Values 12 to 15 are reserved
~~TBD~~ B19	DCM	1	Use of dual carrier modulation

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			Set to 1 to indicate that the payload of the MU PPDU is modulated with dual sub-carrier modulation for the MCS. Set to 0 indicates that the payload of the PPDU is not modulated with dual sub-carrier for the MCS.
~~TBD~~ B20	Coding	1	~~Use of LDPC~~ Indicates whether BCC or LDPC is used. Set to 0 for BCC Set to 1 for LDPC

NOTE- Integer fields are transmitted in unsigned binary format, LSB first, where the LSB is in the lowest numbered bit position.(#1010)

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CID 2245

CID	Page. Line	Clause Number	Comment	Proposed Change	Proposed Resolution
2245	112.24	26.3.9.8.2	HE-SIG-B definition is inelegant and prone to interoperability issues once systems are deployed.	Change SIG-B to be as efficient as possible: encode different users in each 20MHz segment. Or, change SIG-B to be more elegant and encode all users in each 20MHz segment	Rejected. Reason: The proposed change is insufficient in detail. Requires re-design of the HE-SIG-B content channel mapping – needs detailed proposal from the commenter

CID 2246

CID	Page. Line	Clause Number	Comment	Proposed Change	Proposed Resolution
2246	113.34	26.3.9.8.3	The time-domain encoding of user-specific-fields is inelegant and prone to interoperability issues	Remove the part about splitting users into two groups and remove the painful process of figuring out padding bits as a function of whether the number of users is even or odd. Encode user-specific-fields contained in a 20MHz segment together with one tail/CRC.	Rejected Reason: The proposed change is insufficient in detail. The comment requires us to revisit the current HE-SIG-B time-domain encoding and change it. While the rationale is to simplify, it will require us to make substantial

					changes to the exisiting design.

References:

[1] Bin Tian, et. Al., “PAPR Reduction for HE SIG-B”, IEEE 802.11-16/0619r0

Appendix AZ

IEEE P802.11
Wireless LANs

IEEE 802.11 TGax

July 2016 San Diego Meeting Minutes

Date: 2016-08-17

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Abstract

TGax meeting minutes from the IEEE 802.11 July 2016 San Diego meeting, July 24th – 29th, 2016.

Minutes/motions from the ad hoc groups are contained in the following documents:

- PHY Ad Hoc
  - https://mentor.ieee.org/802.11/dcn/16/11-16-1040-00-00ax-tgax-july-2016-san-diego-phy-ad-hoc-meeting-minutes.docx
- MAC Ad Hoc
  - https://mentor.ieee.org/802.11/dcn/16/11-16-1000-02-00ax-july-2016-san-diego-tgax-mac-ad-hoc-meeting-minutes.docxMU Ad Hoc
- MU Ad Hoc
  - https://mentor.ieee.org/802.11/dcn/16/11-16-1027-00-00ax-mu-ad-hoc-meeting-minutes-july-2016.docx
- SR Ad Hoc
  - https://mentor.ieee.org/802.11/dcn/16/11-16-1022-00-00ax-tgax-spatial-reuse-ad-hoc-group-meeting-minutes.docx

IEEE 802.11 Task Group ax
July 2016 San Diego Meeting
Manchester Grand Hyatt, San Diego, CA
July 24th – 29th, 2016

TGax Chair	**Osama Aboul-Magd (Huawei Technologies)**
Vice Chair	**Simone Merlin (Qualcomm)**
Vice Chair	**Ron Porat (Broadcom)**
TGax Secretary	**Yasuhiko Inoue (NTT)**
TGax Technical Editor	**Robert Stacy (Intel)**

Monday, July 25th, 2016, AM1 TGax Ad Hoc Session (8:00-10:00)

1. The meeting called to order by Osama Aboul-Magd (Huawei Technologies), the chair of the TGax, @8:05
   1.1. This is TGax ad hoc session since this session is placed before the WG opening plenary.

2. Announcement
   2.1. Agenda Doc.11-16/0779r0 on the server. Rev. 1 is the working document.
   2.2. Meeting Protocol: Chair asked to state name and affiliation when speaking for the first time.
   2.3. Attendance reminder.
      2.3.1. The attendance server: https://imat.ieee.org/

3. The chair reviewed the mandatory 5 slides of P&P.
   3.1. Instructions for the WG Chair.
   3.2. Participants, Patents, and Duty to Inform.
   3.3. Patent Related Links.
   3.4. Call for potentially essential patents.
      3.4.1. Chair asked if anyone is aware of potentially essential patents.
      3.4.2. No potentially essential patents reported.
   3.5. Other Guidelines for IEEE WG Meetings.

4. Agenda items for the week
   4.1. Approve TG and Telecons minutes since May meeting.
   4.2. Resolution of comments received on draft D0.1
   4.3. Ad Hoc group meetings
   4.4. Technical Presentations and related straw polls and/or motions
   4.5. Schedule Telecon times.

5. General Flow of the meeting
   5.1. Slides 13 and 14 of the 16/0779r1 contain general flow of the meeting.
   5.2. There are eight meeting slots planed for TGax.

	Monday	Tuesday		Wednesday	Thursday
AM1	TGax (full, ad hoc)			TGax (full)	
AM2		TGax (Ad Hoc)	TGax (Ad Hoc)		TGax (full)

PM1				TGax (Ad Hoc)	TGax (Ad Hoc)	TGax (full)
PM2	TGax (full)	TGax (Ad Hoc)	TGax (Ad Hoc)	TGax (full)		
PM3		TGax (Ad Hoc)	TGax (Ad Hoc)			

6. Agenda for Monday, July 25th, AM1 (8:00 – 10:00 AM).

6.1. Proposed Agenda for Monday AM1:

6.1.1. Call meeting to order
6.1.2. Patent policy, etc.
6.1.3. This is TGax full ad hoc meeting (No motions)
6.1.4. Call for submissions.
6.1.5. Set up agenda for the ad hoc meeting.
6.1.6. Presentations
6.1.7. Adjourn

6.2. Chair asked if there are any other items – No items proposed. Meeting will be conducted based on this order.

7. Call for submissions – we have 90 submissions

7.1. PHY – 26 submissions

7.1.1. 11-16-0816, "Comment Resolution for CID 2183," Daewon Lee (Newracom)
7.1.2. 11-16-0872, "CR HE-SIG-A Part II," Ross Jian Yu (Huawei Technologies)
7.1.3. 11-16-0873, "CR HE-SIG-A Part I," Ross Jian Yu (Huawei Technologies)
7.1.4. 11-16-0891, "LDPC for 1024QAM," Hongyuan Zhang (Marvell)
7.1.5. 11-16-0892, "Spec Text on LDPC for 1024QAM," Hongyuan Zhang (Marvell)
7.1.6. 11-16-0893, "11ax Extended Range PPDU," Bin Tian (Qualcomm)
7.1.7. 11-16-0894, "HE-LTF Capabilities," Hongyuan Zhang (Marvell)
7.1.8. 11-16-0895, "Spec Text for HE-LTF Capabilities," Hongyuan Zhang (Marvell)
7.1.9. 11-16-0896, "11ax Beamformee Capabilities," Hongyuan Zhang (Marvell)
7.1.10. 11-16-0897, "Spec Text for Beamformee Capabilities," Hongyuan Zhang (Marvell)
7.1.11. 11-16-0898, "BW Field in HE-MU Format," Hongyuan Zhang (Marvell)
7.1.12. 11-16-0899, "Spec Text for BW Field in HE-MU Format," Hongyuan Zhang (Marvell)
7.1.13. 11-16-0900, "PHY Comment Resolution for CID 1052 and 2519," Bin Tian (Qualcomm)
7.1.14. 11-16-0903, "Gamma phase rotation for HE PPDU," Yujin Noh (Newracom)
7.1.15. 11-16-0904, "Proposed text for gamma phase rotation for HE PPDU," Yujin Noh (Newracom)
7.1.16. 11-16-0906, "RU restriction on 20MHz operating STAs," Joonsuk Kim (Apple)
7.1.17. 11-16-0908, "CR - proposed text on RU restriction of 20MHz STAs," Joonsuk Kim (Apple)
7.1.18. 11-16-0910, "Minimum Occupied Bandwidth," Ron Porat (Broadcom)
7.1.19. 11-16-0914, "Bit field finalization of HE-SIG-A," Lochan Verma (Qualcomm)
7.1.20. 11-16-0915, "Text for bit field finalization of HE-SIG-A," Lochan Verma (Qualcomm)
7.1.21. 11-16-0920, "PHY comment resolution for CID 1659,493,494," Xiaogang Chen (Intel)
7.1.22. 11-16-0922, "PHY CR 1024 QAM," Sriram Venkateswaran (Broadcom)
7.1.23. 11-16-0923, "PHY CR DCM Constellation Mapping," Sriram Venkateswaran (Broadcom)
7.1.24. 11-16-0928, "CR on Section 26.3.9.8 - HE-SIG-B," Kaushik Josiam
7.1.25. 11-16-0937, "11ax Comment Resolutions for Clauses 26.3.2-26.3.9.3-26.3.9.4-26.3.9.5-26.3.10.2- 26.3.10.13," Rui Cao (Marvell)
7.1.26. 11-16-0964, "Considerations on MAC-PHY interactions during SR operations," Jing Ma (NICT)

7.2. MAC – 34 submissions

7.2.1. 11-16-0828, "HE Fragmentation - part 1," Alfred Asterjadhi (Qualcomm)

7.2.2. 11-16-0829, “Comment Resolution for Section 10.24.10 Block Ack/GCR block ack,” Reza Hedayat (Newracom)
7.2.3. 11-16-0844, “CC0-Intra_PPDU_PS,” Alfred Asterjadhi (Qualcomm)
7.2.4. 11-16-0856, “Issue of Buffer Status reporting,” Stephane Baron (Canon)
7.2.5. 11-16-0860, “comment resolution on A-MPDU format, » Yongho Seok (Newracom)
7.2.6. 11-16-0861, “comment resolution on mu acknowledgment procedure,” Yongho Seok (Newracom)
7.2.7. 11-16-0862, “comment resolution on subclause 25.11,” Yongho Seok (Newracom)
7.2.8. 11-16-0864, “d0.1 comment resolution on clause 6,” Yasuhiko Inoue (NTT)
7.2.9. 11-16-0867, “CIDs for CIDs: Section 9.3.1.9.3 Compressed BA format,” George Cherian (Qualcomm)
7.2.10. 11-16-0868, “CIDs for Section 9.3.1.9.7 Multi STA BAs, ” George Cherian (Qualcomm)
7.2.11. 11-16-0869, “Comment resolution section 9.3 TWT,” Zhou Lan (Broadcom)
7.2.12. 11-16-0871, “Trigger Frame Per User Info Order,” Zhou Lan (Broadcom)
7.2.13. 11-16-0877, “Comment resolution on CID 783 (TXOP Duration field format),” Jeongki Kim (LG Electronics)
7.2.14. 11-16-0878, “Comment resolution on CID 782 (Intra-PPDU PS),” Jeongki Kim (LG Electronics)
7.2.15. 11-16-0881, “Comment resolution on ROMI,” Jayh Park (LG Electronics)
7.2.16. 11-16-0882, “Comment resolution on TOMI,” Jayh Park (LG Electronics)
7.2.17. 11-16-0883, “Comment resolution for CID 152,” Jayh Park (LG Electronics)
7.2.18. 11-16-0884, “Spec. Text for HE Operation element and AID Assign Rule,” Jianhan Liu (MediaTek)
7.2.19. 11-16-0890, “Comment Resolution on NAV Setting of Single and Multiple Protection and Control Response,” Po-Kai Huang (Intel)
7.2.20. 11-16-0913, “SU Multi-TID Rules,” Jarkko Kneckt (Apple)
7.2.21. 11-16-0916, “TID value of ALL ACK signaling,” Woojin Ahn (Wilus Institute)
7.2.22. 11-16-0917, “Text for TID value of ALL ACK signaling,” Woojin Ahn (Wilus Institute)
7.2.23. 11-16-0918, “Discussions on Partial BSS Color,” Geonjung Ko (Wilus Institute)
7.2.24. 11-16-0924, “NAV resetting with RTS/MU-RTS,” Weimin Xing (ZTE)
7.2.25. 11-16-0925, "Spex text on NAV resetting with RTS/MU-RTS,” Weimin Xing (ZTE)
7.2.26. 11-16-0941, “CR HE Fragmentation - part 2,” Ming Gan (Huawei technologies)
7.2.27. 11-16-0942, “CR Service Field,” Ming Gan (Huawei Technologies)
7.2.28. 11-16-0951, “Setting for TXOP Duration Field,” Po-Kai Huang (Intel)
7.2.29. 11-16-0952, “Spec text trigger frame per user info order,” Zhou Lan (Broadcom)
7.2.30. 11-16-0953, “Comment Resolution and Spec Text for Setting for TXOP Duration field,” Po-Kai Huang (Intel)
7.2.31. 11-16-0960, “AP access procedure for UL MU operation,” Jinsoo Ahn (Yonsei Univ.)
7.2.32. 11-16-0961, “Consideration on Multi-STA BlockAck Optimization,” Hanseul Hong (Yonsei Univ.)
7.2.33. 11-16-0962, “EDCA rules follow up 1,” Jing Ma (NICT)
7.2.34. 11-16-0963, “EDCA rules follow up 2,” Jing Ma (NICT)
7.2.35. 11-16-0966, “CID 71 and CID 190 Resolutions,” Jarkko Kneckt (Apple)
7.2.36. 11-16-0998, “2 sets of EDCA parameters,” Laurent Cariou (Intel)

7.3. MU – 12 submissions
7.3.1. 11-16-0866, “Comment Resolution of Section 26.3.13 MU-MIMO,” Kome Oteri (InterDigital)
7.3.2. 11-16-0875, “CR for the section 10.3.2.8a CS Condition to Respond CTS,” Kiseon Ryu (LG Electronics)
7.3.3. 11-16-0876, “CR for the section 25.5.2.4 UL MU CS CCA and CS Required Bit,” Kiseon Ryu (LG Electronics)
7.3.4. 11-16-0880, “UL MU Transmission Rules - EDCA backoff,” Jayh Park (LG Electronics)
7.3.5. 11-16-0885, “Comment Resolution on UL MU CS NAV Consideration,” Po-Kai Huang (Intel)
7.3.6. 11-16-0886, “Comment Resolution for some UL MU CS TBD,” Po-Kai Huang (Intel)
7.3.7. 11-16-0887, “Spec Text for MU-RTS restriction on HE MU PPDU,” Po-Kai Huang (Intel)
7.3.8. 11-16-0926, “Soliciting UL_MU_ACK,” Raja Banerjea (Qualcomm)

7.3.9. 11-16-0929, “CR - UL MU Operation,” Simone Merlin (Qualcomm)
7.3.10. 11-16-0930, “CR - DL MU Operation,” Simone Merlin (Qualcomm)
7.3.11. 11-16-0938, “Comment Resolution for Sub-clause 25.10.4,” Chittabrata Ghosh (Intel)
7.3.12. 11-16-0958, “UL OFDMA for Unassociated STAs,” Leonardo Lanante (Kyushu Institute of Tech.)

7.4. SR – 10 submissions
7.4.1. 11-16-0879, “Comment resolution on SR for VHT PPDUs,” Jeongki Kim (LG Electronics)
7.4.2. 11-16-0889, “Comment Resolution for Spatial Reuse (Intra BSS detection),” Young Hoon Kwon (Newracom)
7.4.3. 11-16-0901, “Clarification of SR Fields in HE Trigger Based PPDU,” Daewon Lee (Newracom)
7.4.4. 11-16-0902, “Proposed Text Changes for SR Fields in HE Trigger-Based PPDU,” Daewon Lee (Newracom)
7.4.5. 11-16-0905, “SR Fields Clarification,” Ron Porat (Broadcom)
7.4.6. 11-16-0919, “Discussions on SR Fields in HE Trigger-based PPDU,” Geonjung Ko (Wilus Institute)
7.4.7. 11-16-0310, “DSC Proposal Text,” Graham Smith (SR Technologies)
7.4.8. 11-16-0945, “Clarifications for OBSS_PD-based SR parameters,” Laurent Cariou (Intel)
7.4.9. 11-16-0946, “Proposed text changes for OBSS_PD-based SR parameters,” Laurent Cariou (Intel)
7.4.10. 11-16-0957, “Comment Resolutions on OBSS_PD Conditions in 25.9.3,” James Wang (MediaTek)

7.5. TG – 8 submissions
7.5.1. 11-16-0835, “EIFS,” Alfred Asterjadhi (Qualcomm)
7.5.2. 11-15-1095, “OFDMA Performance in 11ax,” Suhwook Kim (LG Electronics)
7.5.3. 11-16-0870, “Conclusing MAC Trigger Padding,” Zhou Lan (Broadcom)
7.5.4. 11-16-0907, “20MHz HE devices,” Joonsuk Kim (Apple)
7.5.5. 11-16-0909, “CR – proposed text on 20 MHz devices,” Joonsuk Kim (Apple)
7.5.6. 11-16-0949, “MAC trigger frame padding follow up,” Zhou Lan (Broadcom)
7.5.7. 11-16-0965, “On High Efficiency WLAN (HEW) TG PAR Scope,” Osama Aboul-Magd (Huawei Technologies)

8. Ad Hoc meeting scheduling

8.1. Ad Hoc slot assignment
8.1.1.MAC … as many as possible, PHY … as many as possible, SR … 1, MU … 1.
8.2. Chair asked if there are any objections to approve the TGax schedule as follow.
8.2.1.There are no objections. The TGax schedule is approved.

	Monday	Tuesday		Wednesday		Thursday
AM1	TGax (full, ad hoc)			TGax (full)		
AM2		TGax (MAC)	TGax (PHY)			TGax (full)
PM1				TGax (PHY)	TGax (MAC)	TGax (full)
PM2	TGax (full)	TGax (SR)	TGax (MU)	TGax (full)		
PM3		TGax (MAC)	TGax (PHY)			

9. Presentations

9.1. Bo Sun (ZTE) presented "Proposed Resolutions to comments on 26.2.2" based on the submission 11-16-0813-03 (on behalf of Ke Yao).

9.1.1.Summary

9.1.1.1. Resolutions for the CIDs 1780, 370, 1923, 2517 and 1610 are proposed.

9.1.1.2. TBDs are removed.

9.1.1.3. Three parameters for the TXVECTOR and RXVECTOR are added.

9.1.2. Discussion

9.1.2.1. A member asked for offline discussion on additional parameters.

9.1.2.2. There are two other related submissions.

9.1.3. Next step

9.1.3.1. Bo Sun to work with the authors of related submissions.

9.2. Alfred Asterjadhi (Qualcomm) presented "EIFS," based on the submission 11-16-0835-00.

9.2.1.Summary

9.2.1.1. The title of the document is EIFS, however it is mostly related to

9.2.2. Discussion

9.2.2.1. No discussion.

9.3. Jeongki Kim (LG Electronics) presented "Comment Resolution on CID 783 (TXOP Duration Field)," based on the submission 11-16-0877-00.

9.3.1.Summary

9.3.1.1. Text for TXOP Duration field was proposed.

9.3.2.Discussion

9.3.2.1. No discussion.

9.3.2.2. Jeongki to work with Alfred.

9.4. Po-Kai Huang (Intel) presented "Setting for TXOP Duration Field," based on the submission 11-16-0951-00.

9.4.1.Summary

9.4.1.1. Size of TXOP Duration field in HE-SIG-A has been decided.

9.4.1.2. The setting rule of TXOP Duration field remains TBD and is discussed in this contribution.

9.4.1.3. Spec text contained in 16/953r0 which related to CID 2596 was also presented.

9.4.2.Discussion

9.4.2.1. A member has a suggestion on the proposed text.

9.4.2.2. A member commented that there will be more than one STA responding to a Trigger and all of them should have the same TXOP duration.

9.4.2.3. Another member asked for evaluation results such as channel access or throughput since preamble and MAC header have different length for TXOP.

9.4.2.4. A member pointed out that all 1s could be all 0s.

9.5. Bo Sun (ZTE) presented "Proposed Resolutions to comments on 26.2.2" based on the submission 11-16-0813-04.

9.5.1. Update: TXOP Duration is covered by Jeongki's submission 16/877r1.

10. AoB

10.1. Chair asked if we have any business that can be conducted

11. Adjournment

11.1. TGax ad hoc session adjourned @ 10:00 AM.

Monday, July 25th, 2016, PM2 TGax Full Session (16:00-18:00)

1. The meeting called to order by Osama Aboul-Magd (Huawei Technologies), the chair of the TGax, @16:00
   1.1. About 120 people are in the room.

2. Announcement
   2.1. Agenda Doc.11-16/0779r1 on the server. Rev. 2 is the working document.
   2.2. Meeting Protocol: Chair asked to state name and affiliation when speaking for the first time.
   2.3. Attendance reminder.
      2.3.1. The attendance server: https://imat.ieee.org/

3. The chair reviewed the mandatory 5 slides of P&P.
   3.1. Instructions for the WG Chair.
   3.2. Participants, Patents, and Duty to Inform.
   3.3. Patent Related Links.
   3.4. Call for potentially essential patents.
      3.4.1. Chair asked if anyone is aware of potentially essential patents.
      3.4.2. No potentially essential patents reported.
   3.5. Other Guidelines for IEEE WG Meetings.

4. Agenda Setting
   4.1. Proposed Agenda for this time slot:
      4.1.1. Call meeting to order
      4.1.2. Patent policy, etc.
      4.1.3. Call for submissions
      4.1.4. Set Ad Hoc Groups schedule and approve agenda
      4.1.5. Comment Resolution Tutorial – Adrian Stephens
      4.1.6. Summary from May 2016 meeting
      4.1.7. TG motions
         4.1.7.1. Approve TG meeting and Telecon minutes since May meeting.
         4.1.7.2. Approve resolutions of comments, if needed.
      4.1.8. Comment Resolution Status – Robert Stacey
      4.1.9. Timeline
      4.1.10. Presentations and Comment Resolution
         4.1.10.1. TXOP Duration Issues (Jeongki Kim and Bo Sun)
         4.1.10.2. 11-16/0965; On HEW TG PAR Scope
         4.1.10.3. 11-15/1095; OFDMA Performance in 11ax
         4.1.10.4. …
      4.1.11. Recess
   4.2. Chair asked if there is any addition, modification to the agenda?
      4.2.1. One additional submission reported.
      4.2.2. TGax Schedule
      4.2.3. Nothing reported. The agenda was approved.

5. Comment Resolution Tutorial by Adrian Stephens.
   5.1. Adrian Stephens, WG Chair, presented "**802.11 Comment Resolution – a Tutorial**," based on the document 11-13-0230r3.
      5.1.1. Summary
      5.1.2. Discussion
         5.1.2.1. Numbering of Motions – CR resolution motions should be numbered.
         5.1.2.2. Comment Resolution:

5.1.2.2.1. Structure: Comment/Discussion/Proposed Text/Some Analysis
5.1.2.2.2. For the sake of people to understand the process to come to conclusion, it is recommended.

6. Call for presentations

6.1. Done during the AM1 today.

7. Set Ad Hoc Groups schedule and approve agenda

7.1. Done during AM1.

7.2. TGax Schedule for the week:

	Monday	Tuesday		Wednesday		Thursday
AM1	TGax (full ad hoc)			TGax (full)		
AM2		TGax (PHY)	TGax (MAC)			TGax (full)
PM1				TGax (PHY)	TGax (MAC)	TGax (full)
PM2	TGax	TGax (SR)	TGax (MU)	TGax (full)		
PM3		TGax (PHY)	TGax (MAC)			

8. Summary from May 2016 Meeting

8.1. Received about 70 submissions. Majority of the submission were requesting changes to the TG Specification Framework document. Few submissions were addressing comment resolution mainly for the PHY clause.

8.2. Agreed to terminate the Specification Framework process. The frame of reference is Draft D0.1.

8.2.1. Future submissions shall bring text to continue developing the TG draft

8.3. Approved the resolutions of about 200 comments, most of them addressing the PHY clause

8.4. Revisited the timeline and accepted a new modified timeline – next slide.

8.5. The TG had a series of telecons where resolutions of about 227 comments were discussed.

8.6. Submissions Covered During Teleconferences

8.6.1. https://mentor.ieee.org/802.11/dcn/16/11-16-0725-03-00ax-comment-resolution-on-9-3-1-23.docx (6 CIDs)

8.6.2. https://mentor.ieee.org/802.11/dcn/16/11-16-0773-02-00ax-comment-resolution-section-25-6-he-sounding.docx (15 CIDs)

8.6.3. https://mentor.ieee.org/802.11/dcn/16/11-16-0774-01-00ax-comment-resolution-on-9-3-1-23-ruallocation.docx (14 CIDs)

8.6.4. https://mentor.ieee.org/802.11/dcn/16/11-16-0780-01-00ax-comment-resolution-on-9-3-1-23-phy-tbd.docx (31 CIDs)

8.6.5. https://mentor.ieee.org/802.11/dcn/16/11-16-0775-01-00ax-comment-resolution-on-section-26-3-12-4-phy-mu-mimo-power-pre-correction.docx (7 CIDs)

8.6.6. https://mentor.ieee.org/802.11/dcn/16/11-16-0766-00-00ax-he-variant-ht-control-ul-mu-response.docx (28 CIDs)

8.6.7. https://mentor.ieee.org/802.11/dcn/16/11-16-0798-00-00ax-he-variant-ht-control-general.docx (33 CIDs)

8.6.8. https://mentor.ieee.org/802.11/dcn/16/11-16-0815-02-00ax-comment-resolution-mu-rts-scrambler-seed.docx (5 CIDs)

8.6.9. https://mentor.ieee.org/802.11/dcn/16/11-16-0819-01-00ax-cids-for-section-9-3-1-9-blockack-frame-format.docx (9 CIDs)

8.6.10. https://mentor.ieee.org/802.11/dcn/16/11-16-0806-00-00ax-he-variant-ht-control-buffer-status-report.docx (24 CIDs)
8.6.11. https://mentor.ieee.org/802.11/dcn/16/11-16-0807-00-00ax-comment-resolution-on-mu-rts-cts-procedure.docx (27 CIDs)
8.6.11.1. Note: A new revision is expected to accommodate Mark's comments
8.6.12. https://mentor.ieee.org/802.11/dcn/16/11-16-0808-00-00ax-comment-resolution-on-trigger-frame-format-mu-rts-variant.docx (14 CIDs)
8.6.12.1. Note: A new revision is expected to accommodate Mark's comments
8.6.13. https://mentor.ieee.org/802.11/dcn/16/11-16-0813-00-00ax-cr-on-secition-26-2-2-txrxvector-parameters.doc (4 CIDs)
8.6.13.1. Note: We need to revisit this document again to try to cose a couple of TBDs
8.6.14. https://mentor.ieee.org/802.11/dcn/16/11-16-0836-00-00ax-comment-resolution-on-section-9-4-1-phy-mu-mimo-compressed-beamforming-report.docx (10 CIDs)
8.6.14.1. Note: Adds significant amount of text and introduces new frame.
8.7. Chair asked if there is any comment – No comment.

9. TG Motions

9.1. Motion: Approve TGax minutes of meetings and teleconferences from May 2016 interim meeting to today:

- **https://mentor.ieee.org/802.11/dcn/16/11-16-0686-00-00ax-tgax-may-2016-waikoloa-meeting-minutes.docx**
- **https://mentor.ieee.org/802.11/dcn/16/11-16-0768-05-00ax-tgax-teleconference-minutes-from-june-to-july-2016.docx**
- **https://mentor.ieee.org/802.11/dcn/16/11-16-0755-00-00ax-tgax-may-2016-waikoloa-phy-ad-hoc-meeting-minutes.docx**
- **https://mentor.ieee.org/802.11/dcn/16/11-16-0716-00-00ax-mu-ad-hoc-meeting-minutes-may-2016.docx**

9.1.1.https://mentor.ieee.org/802.11/dcn/16/11-16-0701-00-00ax-combined-spatial-reuse-mac-ad-hoc-group-meeting-minutes.docx

9.1.2. Moved: Bo Sun, Second: Robert Stacy
9.1.3. Discussion: No discussion.
9.1.4. Result: The motion was accepted with no objection.

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10. Comment Resolution Status (Editor Report)

10.1. Robert Stacy presented "TGax Editor's Report," based on the submission 11-16-995r0
10.2. Discussion
10.2.1. C: There was a request to change MU database maintainer.
10.2.2. Q: What about the comments discussed during the teleconference?
10.2.3. A: Those resolutions are not motioned. They will be incorporated after motions.
10.2.4. Chair is wondering if September is the realistic time to produce draft 1.0.

11. From IEEE 802.11 Operation Manual

11.1. **https://mentor.ieee.org/802.11/dcn/14/11-14-0629-14-0000-802-11-operations-manual.docx**
11.2. Motions modifying drafts may be made at appropriate times during meetings. Complex technical changes to a draft shall be in a submission that has been accepted by document control according to document formats specified in section 3.7 of this document and

has been made available electronically for a period of not less than four active 802.11 WG session hours. The TG chair determines if a technical change is sufficiently complex to require a submission.

11.3. When a CRC is following the "Accelerated process" for completion of a WG letter ballot, and is not meeting during an 802.11 WG session, any submission containing changes to the draft shall be on the server and announced to the appropriate TG reflector no less than 72 hours before any motion is made related to that submission.

NOTE – when a CRC is meeting coincident with an 802.11 session, it is subject to the four hour rule described in the previous paragraph.

11.4. Comment:

11.4.1. This rule is applied once the draft gets 75% approval – it is not applied to TGax right now.

11.4.2. It is good to follow this practice even though the rule is not applied to us.

12. Timeline

12.1. Slide 27 of the agenda document

- **May 2014: start of the TG**
- **Nov. 2014: First draft of the TG SFD was approved**
- **Jan. 2016: proposed TG draft**
- **March 2016: Draft D0.1 was approved and CC started**
- **September 2016: Draft 1.0 and WG letter ballot**
- **March 2017: Draft 2.0 and recirculation**
- **July 2017: MDR (Mandatory Document Review)**
- **November 2017: Formation of SB pool**
- **March 2018: Sponsor Ballot**
- **December 2018: RevCom**

13. Presentations

13.1. Jeongki Kim (LG Electronics) presented "," based on the submission 11-16-0877-04.

13.1.1. Summary

13.1.1.1. The presenter had offline discussion with some members after AM1 and the document was revised.

13.1.1.1.1. Text for TXOP_DURATION was updated.

13.1.2. Discussion

13.1.2.1. A member asked for the revision number of the document. → Rev. 4.

13.1.2.2. Chair suggested to upload r5 modifying that part.

13.2. Bo Sun (ZTE) presented "" based on the submission 11-16-0813-04.

13.2.1. Summary

13.2.1.1. The document was updated based on the Jeongki's document 11-16-0877-04.

13.2.2. Discussion

13.2.2.1. Chair asked if there is any objection for the proposed resolution. There is no objection.

13.3. Osama Aboul-Magd (Huawei Technologies) presented "PAR" based on the submission 11-16-0965-00.

13.3.1. Summary

13.3.1.1. This submission attempts to start the discussion on how to verify the TG PAR scope.

13.3.1.2. No straightforward way to see 4 times improvement.

13.3.1.3. Options:

13.3.1.3.1. Do nothing → likely to cause problem.

13.3.1.3.2. To change the PAR → will be the last choice.
13.3.1.3.3. Run simulations based on the scenarios we agreed and show that we have a mode of operation to achieve our goal.
13.3.2. Discussion
13.3.2.1. If we do not have simulation, we can show some analysis result.
13.3.2.2. There are some submissions showing the simulation results.
13.3.2.3. Should we form a team to do this work?
13.3.2.3.1. A member mentioned that his team can do this work.
13.3.2.3.2. Another member mentioned document 15/333 contains some analysis.
13.3.2.4. Q: Will the simulation scenario document be updated? – Yes, if it is needed.

13.4. Suhwook Kim (LG Electronics) presented "OFDMA Performance in 11ax," based on the submission 11-15-1095-09.

13.4.1. Summary
13.4.1.1. TCP traffic is considered in this version.
13.4.1.2. TCP timeout has a significant impact on the system performance.
13.4.1.3.
13.4.2. Discussion
13.4.2.1. Q: Is the OFDMA based on the 802.11ax spec? → Yes.
13.4.2.1.1. Then, we do not have four times improvement.
13.4.2.2. C: Bluray needs 50 M bit/s throughput. → Chair suggested offline discussions.
13.4.3.

14. AoB

14.1. Ad Hoc schedule for tomorrow
14.1.1. AM2
14.1.1.1. PHY
14.1.1.2. MAC
14.1.2. PM2
14.1.2.1. MU.
14.1.2.2. SR.
14.1.3. PM3
14.1.3.1. PHY
14.1.3.2. MAC

15. TGax meeting recessed @ 18:01.

Tuesday, July 26th, 2016, AM2 TGax Ad Hoc Sessions (10:30-12:30)

- PHY Ad hoc – Seaport D & E.
  - Agenda: 11-16-1007
- MAC Ad hoc – Seaport G.
  - Agenda: 11-16-997

Tuesday, July 26th, 2016, PM2 TGax Ad Hoc Sessions (16:00-18:00)

- MU Ad hoc – Seaport D & E.
  - Agenda: 11-16-1012
- SR Ad hoc – Seaport G.
  - Agenda: 11-16-1016

Tuesday, July 26th 2016, PM3 TGax Ad Hoc Session (19:30-21:30)

- PHY Ad hoc – Seaport D & E.
  - Agenda: 11-16-1007
- MAC Ad hoc – Seaport G
  - Agenda: 11-16-997

Wednesday, July 27th 2016, AM1 TGax Full Sessions (8:00-10:00)

1. The meeting called to order by Osama Aboul-Magd (Huawei Technologies), the chair of the TGax, @8:02
   1.1. About 120 people are in the room.

2. Announcements/Reminder
   2.1. Chair asked participants to state name and affiliation when speaking for the first time during the session.
   2.2. Chair reminded that the meeting is conducted under IEEE 802 and 802.11 P&P.
   2.3. Chair reminded attendance.

3. Agenda Setting
   3.1. Proposed agenda for this session
      3.1.1. Call Meeting to order
      3.1.2. IEEE 802 and 802.11 IPR Policy and procedure.
      3.1.3. Progress from Ad Hocs
      3.1.4. Presentations
         3.1.4.1. 11-16/0907: 20 MHz HE Devices – Joonsuk kim
         3.1.4.2. 11-16/0909: Text for 20 MHz - Joonsuk Kim
         3.1.4.3. 11-16/0870 and 11-16/0949 – Zhou Lan
         3.1.4.4. 11-16/0971 – Graham Smith
         3.1.4.5. 11-16/0957 – James Wang
         3.1.4.6. 11-16/0947 – Laurent Cariou
      3.1.5. Recess
   3.2. Chair asked if there is any objection to proceed with this agenda. → No objection.
   3.3. The agenda for Wednesday AM1 was approved.

4. Progress from Ad Hoc groups
   4.1. PHY: 8 submissions remaining.
   4.2. MAC: heard half dozen presentations.
   4.3. MU: 6 submissions left – all of them are comment resolutions.
   4.4. SR: 6 presentations heard.

5. Presentations
   5.1. Joonsuk Kim (Apple) presented "20 MHz-only Device in 11ax," based on the submission 11-16-0907r2.
      5.1.1. Summary
         5.1.1.1. The 20 MHz only device is for low power, low complexity and better connectivity for wearable devices, home network connectivity, etc.
      5.1.2. Discussion
         5.1.2.1. Slide 12, Mandatory/Optional table: A member commented that we have not discussed M/O in TGax. → This table is just an example.
      5.1.3. Straw Polls

         5.1.3.1. Straw Poll #1: Do you support following Mandatory and Optional features on bandwidth?
            - In 2.4GHz,
               - 20MHz is mandatory for AP and non-AP

- 40MHz is optional for AP and non-AP [signaled in capability field]
- In 5GHz,
  - 20/40/80MHz is mandatory for AP
  - Non-AP can be either 20MHz-only, 80MHz, 160MHz or 80+80MHz capable [signaled in capability field]
    - 11ax spec document shall not allow STAs that are 40MHz capable but not 80MHz capable

5.1.3.1.1. Result: Y/N/A = 80/0/14

5.1.3.2. Straw Poll #2: Do you support 20MHz-only non-AP STAs operate in primary 20MHz channel as a mandatory mode?

5.1.3.2.1. Result: Y/N/A = 76/0/8.

5.1.3.3. Straw Poll #3: Do you support 20MHz-only non-AP STAs support tone mapping of tone-26 RU, tone-52 RU, tone-106 RU and tone-242 RU for

- 20, 40* MHz OFDMA in 2.4GHz and 5GHz band
- 80*, 80+80*, 160* MHz OFDMA in 5GHz band
-
- [Note*] Some of RUs are restricted for operation [1]

5.1.3.3.1. Result: 72/0/11.

5.1.4. Joonsuk presented "Spec text for 20 MHz-only devices in 11ax," based on 11-16-0909-01.

5.1.4.1. Discussion

5.1.4.1.1. A member suggested that text should refer to the all of relevant channel width such as 80 MHz, 160 MHz and 80+80 MHz.

5.1.4.1.2. Another member commented for clarification purpose that a 20 MHz only device does not support VHT operation.

5.1.4.2. Next step:

5.1.4.2.1. Joonsuk to upload updated version (r2) of this document incorporating the comments and suggestions. A motion to adopt 16/909r2 will be conducted during PM2 session.

5.2. Zhou Lan (Broadcom) presented "MAC trigger frame padding follow up," based on the submission 11-16-0949-01.

5.2.1. Summary

5.2.1.1. TBDs related to MAC trigger frame padding are resolved.

5.2.1.2. Related CIDs: 2890, 2896 and 1643.

5.2.1.3. Spec text (11-16-0870-00) also proposed.

5.2.2. Discussion

5.2.2.1. A member asked for the purpose of MAC padding. → For a Trigger frame, the receiver needs some time to process and prepare for the next action.

5.2.3. Straw Polls

5.2.3.1. Straw Poll #1: Do you support to direct TGax editor to adopt doc 11-16-0870r0 into TGax Draft per editing instruction in doc.11-16-0870r0 to conclude MAC trigger padding TBDs?

5.2.3.1.1. Result: No objection.

5.2.3.2. Straw Poll #2: Do you support to adopt the resolution text for comment CID 2890, 2896, 1634 as provided in 11-16-0870r0?

5.2.3.2.1. Result: No objection.

5.3. Graham Smith (SR Technologies) presented "Resolution on CID 69 and others," based on the submission 11-16-0971-02.

5.3.1. Summary

5.3.1.1. 16/971r2 contains the proposed text for 11ax Draft with respect to dynamic sensitivity control (DSC) so as to satisfy CID 69.

5.3.1.2. Other CIDs #9, 187, 188, 208, 209, 225, 257, 463, 464, 651, 703, 704, 953, 994, 1016, 2332, 2336, 2912, 2724, and 2742 are also resolved.

5.3.2. Discussion

5.3.2.1. A member commented on the relationship between the information in preamble and DSC.

5.3.2.2. Another member expressed concern that we already have two operations to change the sensitivity and detect the OBSS packet, therefore additional mode could increase the complexity. → The presenter responded that this proposal is much simpler.

5.3.2.3. There is an opinion that spatial reuse technique should only be applied to the OBSS cases, and this proposal is not aligned to that direction.

5.3.2.4. Some members are supportive for this proposal.

5.3.2.5. There was a comment that determination of threshold should clarified.

5.3.3. Straw Polls – Chair suggested to defer the straw poll.

5.4. James Wang (MediaTek) presented "Comment Resolution on OBSS_PD Conditions in 25.9.3," based on the submission 11-16-0957-01.

5.4.1. Summary

5.4.1.1. The resolution for CID #706 on Clause 25.9.3 is provided.

5.4.1.2. Spec text for this sub-clause is proposed.

5.4.2. Discussion

5.4.2.1. A member mentioned that there still are three TBDs in the text. → Those TBDs are resolved by CR for different CIDs.

5.4.2.2. A member has some comments on the text of P50, L1 and would like to work offline with James. The commenter also mentioned that the equation has to be updated.

5.4.2.3. Another member commented that we have not seen that this algorithm actually works and he is not convinced.

6. AOB

6.1. As a general policy, given a motion on an explicitly listed CID X that is resolved in an explicitly specified doc (say with revision R), if the proposed comment resolution within the doc for CID X refers to a revision earlier than R (e.g. R-1, due to an oversight by the comment resolver), the chair indicated he was OK if the database editors modified the comment resolution to refer to revision "R" in accordance with the intent of the motion.

6.2. No concerns were raised by the members.

7. Recess

7.1. TGax full session is in recess until PM2 today.

Wednesday, July 27th 2016, PM1 TGax Ad Hoc Sessions (13:30-15:30)

- PHY ad hoc → Seaport D & E.
  - Agenda: 11-16-1007

- MAC ad hoc → Seaport G
  - Agenda: 11-16-0997

Wednesday, July 27th 2016, PM2 TGax Full Sessions (16:00-18:00)

8. The meeting called to order by Osama Aboul-Magd (Huawei Technologies), the chair of the TGax, @16:00

9. Announcements
   - 9.1. Chair asked participants to state name and affiliation when speaking for the first time during the session.
   - 9.2. Chair reminded that the meeting is conducted under IEEE 802 and 802.11 P&P.
   - 9.3. Chair reminded attendance.

10. Agenda Setting
    - 10.1. Proposed Agenda for this session:
      - 10.1.1. Meeting call to order
      - 10.1.2. Announcement
      - 10.1.3. Agenda setting
      - 10.1.4. Presentations
        - 10.1.4.1. 11-16/947: Laurent Cariou
        - 10.1.4.2. 11-16/957: James Wang (??)
      - 10.1.5. TG Motions
      - 10.1.6. Recess
    - 10.2. Chair asked for comments and/or suggestions for the comments. → Heard none.
    - 10.3. The agenda for Wednesday PM2 was approved.

11. Presentations
    - 11.1. Laurent Cariou (Intel) presented "Clarification for OBSS_PD-based SR parameters," based on the submission 11-16-0945-01.
      - 11.1.1. Summary
        - 11.1.1.1. Proposed to fill the TBDs in the spec by defining default parameters for OBSS_Pdmin/max and PWRref which the AP can adaptively change.
        - 11.1.1.2. Proposed to clarify that SR_disallow in HE-SIGA only disallow SRP-based SR
      - 11.1.2. Discussions
        - 11.1.2.1. C (Slide 15): Background of choosing these parameters are not clear enough. Do not understand why 3 spatial streams is the break point.
        - 11.1.2.2. A member commented that it is not clear how a device sets the power reference. → Default parameters in slide 15 are out-of-box conditions.
        - 11.1.2.3. Another member commented that it is not clear what we can get from SR. Simulation works are needed.
        - 11.1.2.4. There was a comment that what we need to specify is the rules for SR. In the original DSC, the TPC is not effective.

11.1.3. Laurent presented the spec text "Proposed Text Changes for OBSS_PD-based SR parameters," based on the submission 11-16-0947-04.

11.1.3.1. Discussions

11.1.3.1.1. A member commented on the SR disallow mode: There will be certain condition that a STA sets SR disallow flag. It is not clear what will be motivation for a STA to set this parameter.

11.1.3.1.2. Another member commented that the condition(s) to disallow SPR-based SR shall be provided.

11.1.3.1.3. A member pointed out that there are some TBDs.

12. TG Motions

12.1. SR Motion #9: Move to include the text in doc 11-16/0971r2 related to DSC in the next revision of the TG draft

12.1.1. Moved by Graham Smith, Seconded by Sean Coffey.

12.1.2. Discussions

12.1.2.1. A member commented that the document 16/971r2 contains fundamental flaw.

12.1.2.2. Another member mentioned that it is beneficial to include text in the draft.

12.1.2.3. There was an opinion that the proposed text is more appropriate to be considered in TGmc.

12.1.2.4. There was a comment that this proposal violates the PAR.

12.1.3. Result: After long discussions, motion was withdrawn.

12.2. SR Motion #10: Move to accept the proposed text changes in document "11-16/0947r4, for OBSS_PD-based SR parameters" and include the changes in the next revision of the TG draft

12.2.1. Moved by Laurent Cariou, Seconded by Ron Porat.

12.2.2. Discussions

12.2.2.1. Some members expressed objection to conduct this motion since not enough information is provided.

12.2.2.2. Chair determined this motion to be recorded vote.

12.2.3. Result: Y/N/A = 59/21/29, motion fails.

12.2.3.1. The vote record is provided in the Appendix A.

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13. AoB

No time to conduct any other business.

14. Recess

14.1. TGax is in recess until the start of Thurday AM2 (10:30 AM).

Thursday, July 28th, 2016, AM2 TGax full Session (10:30-12:30)

1 The meeting called to order by Osama Aboul-Magd (Huawei Technologies), the chairperson of the TGax, @10:32 AM

1.1 Agenda 16/0779r5 is on the server. Rev. 6 is the working document.

2 Announcement/Reminder

2.1 Chair reminded IEEE 802 and 802.11 IPR P&P.
2.2 Chair asked people to state name and affiliation when addressing for the first time in the session.
2.3 Chair reminded people to do attendance.

3 Agenda for this session

3.1 Thursday AM2 and PM1
- 3.1.1 Call Meeting to order
- 3.1.2 Announcement/Reminder
  - 3.1.2.1 IEEE 802 and 802.11 IPR Policy and procedure.
  - 3.1.2.2 Attendance
- 3.1.3 Agenda Setting
- 3.1.4 Presentations (if any)
- 3.1.5 TG Motions
- 3.1.6 Timeline update
- 3.1.7 Goals for September 2016
- 3.1.8 Conference Calls Schedule
- 3.1.9 AOB
- 3.1.10 Adjourn

3.2 Chair asked if there are any modifications to the agenda.
3.3 Agenda approved without objections.

4 Presentations – No presentation left.

5 Motions

5.1 SR Motion

5.1.1 SR Motion #11: Move to accept the proposed text changes in document 11-16/0902r3 and include the changes in the next revision of the TG draft.

5.1.1.1 Moved by Daewon Lee, Seconded by Ron Porat
5.1.1.2 Discussion – No discussion.
5.1.1.3 Result: Motion passes with no objection.

5.2 PHY Motions

5.2.1 PHY Motion #158: Move to include the spec text change as shown in doc 11/16-0892r0 to the next revision of the TG draft.

5.2.1.1 Moved by Hongyuan Zhang, Seconded by Bo Sun.
5.2.1.2 Discussion – No discussion.
5.2.1.3 Result: Motion passes with no objection

5.2.2 PHY Motion #159: Move to include the spec text changes as shown in doc 11/16-0895r0 in the next revision of the TG draft, which reflects Straw Polls 1~3 in doc 11-16/0894r0.
5.2.2.1 Moved by Hongyuan Zhang, Seconded by Bo Sun.
5.2.2.2 Discussion – No discussion.
5.2.2.3 Result: Motion passes with no objection.

5.2.3 PHY Motion #160: Move to include the spec text changes as shown in doc 11/16-0897r1 in the next revision of the TG draft.
5.2.3.1 Moved by Hongyuan Zhang, Seconded by Bo Sun.
5.2.3.2 Discussion – No discussion.
5.2.3.3 Result: Motion passes with no objection.

5.2.4 PHY Motion #161: Move to include the spec text changes as shown in doc 11/16-0899r0 (reflects the content of SP1 in doc 11-16/0898r0) to the next revision of the TG draft
5.2.4.1 Moved by Hongyuan Zhang, Seconded by Bo Sun.
5.2.4.2 Discussion – No discussion.
5.2.4.3 Result: Motion passes with no objection.

5.2.5 PHY Motion #162: Move to add the spec text changes to D0.2 on Table 26-20 – Fields in the HE-SIG-A for an HE SU PPDU and HE Extended Range SU PPDU as shown in doc 11/16-0915r0
5.2.5.1 Moved by Bin Tian.
5.2.5.2 Result: This motion was not conducted.

5.2.6 PHY Motion #163: Move to include the spec text change as shown in doc 11/16-0909r2 in the next revision of the TG draft.
5.2.6.1 Moved by Joonsuk Kim, Seconded by Bo Sun.
5.2.6.2 Discussion - No discussion.
5.2.6.3 Result: Motion passes with no objection.

5.2.7 PHY Motion #164: Move to include the spec text changes in doc 11-16/0915r2 in the next revision of the TG draft.
5.2.7.1 Moved by Brian Hart, Seconded by Bo Sun.
5.2.7.2 Discussion – No discussion.
5.2.7.3 Result: Motion accepted with no objection.

5.2.8 PHY Motion #165: Move to add to the next revision of the TG draft:
- **Add at the end of section 26.3.7.1 the following sentence:**
- **In a HE MU PPDU transmission, at least Nx4x26 tones (contiguous or non-contiguous), where N is the number of 20MHz channels' legacy preambles present, shall be occupied throughout the signaled BW**

5.2.8.1 Moved by Ron Porat, Seconded by Bo Sun.
5.2.8.2 Discussion – No discussion.
5.2.8.3 Result: Motion passes with no objection.

5.3 MU Motions
5.3.1 MU Motion #57: Move to add the following to the next revision of the TG draft:

- *Insert the following at the end of 10.22.2.2:*
  - When an HE STA successfully receives the corresponding acknowledgement frame in response to the MPDU sent in HE trigger based PPDU, the backoff for the associated EDCAF resumes the backoff counter countdown
- *Insert the following at the end of 10.22.2.2:*
  - When an HE STA does not receive the corresponding acknowledgement frame in response to the MPDU sent in HE trigger based PPDU, the backoff for the associated EDCAF resumes the backoff counter countdown
- *Insert the following at the end of 10.22.2.2:*
  - If an HE STA does not successfully receive the corresponding acknowledgement frame in response to the MPDU sent in an HE trigger based PPDU, the short retry counters and long retry counters for the associated EDCAF are not changed

5.3.1.1 Moved by Kiseon Ryu, Seconded by Simone Merlin.
5.3.1.2 Discussion – No discussion.
5.3.1.3 Result: Motion passes with no objection.

5.4 MAC Motions

5.4.1 MAC Motion #85: Move to add the following text to the TG draft:

- The Queue Size subfield is an 8-bit field that indicates the amount of buffered traffic, for a given TC or TS at the STA sending this frame.
- *An HE non-AP STA uses the Queue Size subfield to indicate the amount of buffered traffic intended for the STA identified by the receiver address of the frame containing the QoS Control field.*

5.4.1.1 Moved by Pascal Vigar, Seconded by Stephane Baron.
5.4.1.2 Discussion - No discussion.
5.4.1.3 Result: Motion passes with no objection.

5.4.2 MAC Motion #86: Move to add the following text to the TG draft:

- Add to clause #9.3.1.23
- "Per User Info fields with AID = 0 shall be allocated only after Per User Info fields with AID not equals to 0, if any, and before the MAC padding field, if present."

5.4.2.1 Moved by Zhou Lan, Seconded by Reza Hedayat.
5.4.2.2 Discussion – No discussion.
5.4.2.3 Result: Motion passes with no objection.

5.5 CR Motions

5.5.1 CR Motion #15: Move to approve resolutions of CIDs, 9, 228, 2219, 2422, 2691, 2900 in doc 11-16/0725r3.

5.5.1.1 Moved by Raja Banerjea, Simone Merlin.
5.5.1.2 Discussion – No discussion.
5.5.1.3 Result: Motion passes with no objection.

5.5.2 CR Motion #16: Move to approve resolutions to CIDs, 55, 1000, 1221, 1915, 2234, 802,1695, 1222, 182, 971,2713, 702, 1916, 2233, 223 in doc 11-16/0773r2.

5.5.2.1 Moved by Raja Banerjea, Robert Stacy.
5.5.2.2 Discussion – No discussion.
5.5.2.3 Result: Motion passes with no objection.

5.5.3 CR Motion #17: Move to accept resolutions to CIDs, 262,1083, 102, 612, 660, 830, 864, 1716, 2215, 2301, 2376, 372, 719, 864 in doc 11-16/0774r1.

5.5.3.1 Moved by Raja Banerjea, Simone Merlin.

5.5.3.2 Discussion – No discussion.

5.5.3.3 Result: Motion passes with no objection.

5.5.4 CR Motion #18: Move to approve resolutions to CIDs, 101,103, 104,374,375, 377, 558, 561, 661, 662, 664, 688, 1296, 1299, 1301, 1717, 1718, 1882, 2113, 2114, 2174, 2217, 2302, 2421, 227, 720, 663,1303,1305,1306 in doc 11-16/0780r1

5.5.4.1 Moved by Raja Banerjea, Simone Merlin.

5.5.4.2 Discussion – No discussion.

5.5.4.3 Result: Motion passes with no objection.

5.5.5 CR Motion #19: Move to approve resolutions to CIDs, 340, 341, 342, 343, 1023, 2734, and 2889 in doc 11-16/0775r2

5.5.5.1 Moved by Lochan Verma, Seconded by Sameer Vermani.

5.5.5.2 Discussion – No discussion.

5.5.5.3 Result: Motion passes with no objection.

5.5.6 CR Motion #20: Move to approve resolutions of CIDs, 855, 1064, 1, 784, 90, 94, 654, 453, 1181, 2249, 2297, 2208, 2406, 2576, 2901, 2902, 2903, 2405, 2904, 1254, 1255, 1256, 1202, 1714, 1761, 1762, 1881, 1418 in doc 11-16/766r1

5.5.6.1 Moved by Alfred Asterjadhi, Seconded by Young Hoon Kwon.

5.5.6.2 Discussion – No discussion.

5.5.6.3 Result: Motion passes with no objection.

5.5.7 CR Motion #21: Move to approve resolutions of CIDs, 1126, 1127, 1179, 58, 89, 361, 2248, 1877, 1878, 792, 686, 687, 793, 1133, 91, 92, 362, 363, 2296, 1712, 1713, 1250, 1253, 1711, 2204, 2205, 2206, 211, 364, 1231, 134, 1750, 1244 in doc 11-16/0798r0

5.5.7.1 Moved by Alfred Asterjadhi, Seconded by Simone Merlin.

5.5.7.2 Discussion – No discussion.

5.5.7.3 Result: Motion passes with no objection.

5.5.8 CR Motion #22: Move to approve resolutions to CIDs, 14, 127, 370, 371, 2602 in doc 11-16/0815r2

5.5.8.1 Moved by Young Hoon Kwon, Seconded by Yongho Seok.

5.5.8.2 Discussion – No discussion.

5.5.8.3 Result: Motion passes with no objection.

5.5.9 CR Motion #23: Move to approve resolutions to CIDs, 961, 1137, 804, 212, 2212, 2412, 2413, 1136, 1493 in doc 11-16/0819r1

5.5.9.1 Moved by Alfred Asterjadhi, Seconded Yasuhiko Inoue.

5.5.9.2 Discussion – No discussion.

5.5.9.3 Result: Motion passes with no objection.

5.5.10 CR Motion #24: Move to approve resolutions to CIDs, 824, 93, 1067, 2388, 45, 178, 254, 438, 680, 769, 770, 771, 817, 818, 1062, 1065, 1066, 1550, 2189, 2190, 2191, 2272, 2711, 147 in doc 11-16/0806r0

5.5.10.1 Moved by Alfred Asterjadhi, Seconded by Matt Fischer.

5.5.10.2 Discussion – No discussion.

5.5.10.3 Result: Motion passes with no objection.

5.5.11 CR Motion #25: Move to approve the resolutions to CIDs, 963, 128, 214, 2171, 2428, 692, 124, 2906, 2840, 2603, 2599, 1209, 2264, 15, 13, 126, 1071, 693, 1768, 401, 1727, 403, 1644, 2281, 2282, 2279, 160 in doc11-16/0807r2

5.5.11.1 Moved by Po-Kai Huang, Seconded by Yongho Seok.

5.5.11.2 Discussion – No discussion.

5.5.11.3 Result: Motion passes with no objection.

5.5.12 CR Motion #26: Move to accept the resolutions of CIDs, 1311, 2223, 110, 2587, 8, 2222, 1068, 1310, 1312, 2588, 2601, 2894, 1204, 2907 in doc 11-16/0808r2.

5.5.12.1 Moved by Po-Kai Huang, Seconded by Kiseon Ryu.

5.5.12.2 Discussion – No discussion.

5.5.12.3 Result: Motion passes with no objection.

5.5.13 CR Motion #27: Move to approve resolutions to CIDs, 2517, 1780, 1923, and 1610 in doc 11-16/0813r5.

5.5.13.1 Moved by Bo Sun, Seconded by Hongyuan Zhang.

5.5.13.2 Discussion – No discussion.

5.5.13.3 Result: Motion passes with no objection.

5.5.14 CR Motion #28: Move to approve resolutions to CIDs, 112, 380, 381, 456, 539, 689, 690, 1154, 1316, 1862 in doc 11-16/0836r1.

5.5.14.1 Moved by Lochan Verma, Seconded by Sriram Venkateswaran.

5.5.14.2 Discussion – No discussion.

5.5.14.3 Result: Motion passes with no objection.

5.5.15 CR Motion #29: Move to approve resolution to CID 2183 in document 11-16/0816r1.

5.5.15.1 Moved by Daewon Lee, Seconded by Young Hoon Kwon.

5.5.15.2 Discussion – No discussion.

5.5.15.3 Result: Motion passes with no objection.

5.5.16 CR Motion #30: Move to approve the resolutions to CIDs, 2007, 2005, 2123, 2747, 2746, 2244, 842, 846, 526, 910 in doc 11-16/0872r2.

5.5.16.1 Moved by Ross Jian Yu, Seconded by Bo Sun.

5.5.16.2 Discussion – No discussion.

5.5.16.3 Result: Motion passes with no objection.

5.5.17 CR Motion #31: Move to approve resolutions to CIDs, 302, 2040, 2132, 2680, 2039, 2038, 1001,479, 2150 in doc 11-16/0873r1.

5.5.17.1 Moved by Ross Jian Yu, Seconded by Bo Sun.

5.5.17.2 Discussion – No discussion.

5.5.17.3 Result: Motion passes with no objection.

5.5.18 CR Motion #32: Move to approve resolutions to CIDs, 2032, 2549, 2133, 2548, and 1009 in doc 11-16/1021r2
- 5.5.18.1 Moved by Ross Jian Yu, Seconded by Bo Sun.
- 5.5.18.2 Discussion – No discussion.
- 5.5.18.3 Result: Motion passes with no objection.

5.5.19 CR Motion #33: Move to approve the resolutions to CIDs, 1052, 2519 in doc 11-16/0900r1
- 5.5.19.1 Moved by Robert Stacy, Seconded by Sriram Venkateswaran.
- 5.5.19.2 Discussion – No discussion.
- 5.5.19.3 Result: Motion passes with no objection.

5.5.20 CR Motion #34: Move to approve the resolution to CID 854 in doc 11-16/0908r1.
- 5.5.20.1 Moved by Joonsuk Kim, Seconded by Yongho Seok.
- 5.5.20.2 Discussion – No discussion.
- 5.5.20.3 Result: Motion passes with no objection.

5.5.21 CR Motion #35: Move to approve the resolutions to CIDs, 1659, 493, 494 in doc 11-16/0920r3
- 5.5.21.1 Moved by Xiaogang Chen, Seconded by Bo Sun.
- 5.5.21.2 Discussion – No discussion.
- 5.5.21.3 Result: Motion passes with no objection.

5.5.22 CR Motion #36: Move to approve the resolutions to the CIDs, 1782, 2082, 2083 in doc 11-16/0922r2
- 5.5.22.1 Moved by Sriram Venkateswaran, Seconded by Bo Sun.
- 5.5.22.2 Discussion – No discussion.
- 5.5.22.3 Result: Motion passes with no objection.

5.5.23 CR Motion #37: Move to approve the resolutions to CIDs, 836 883 884 1930 2247 292 525 904 906 908 1984 1990 1995 1988 1994 1058 1992 1991 1985 1989 1684 523 1857 271 1412 1195 1996 2532 2120 2098 293 1987 1993 2748 2749 in doc 11-16/0937r7.
- 5.5.23.1 Moved by Rui Cao, Seconded by Bo Sun.
- 5.5.23.2 Discussion – No discussion.
- 5.5.23.3 Result: Motion passes with no objection.

5.5.24 CR Motion #38: Move to approve resolutions to CIDs, 482, 1867, 2084, 2085 in doc 11-16/0923r1.
- 5.5.24.1 Moved by Sriram Venkateswaran, Seconded by none.
- 5.5.24.2 Discussion - This motion needs presentation.
- 5.5.24.3 Result: This motion was skipped (not conducted).

5.5.25 CR Motion #39: Move to approve resolutions to CIDs, 22, 23, 24, 136, 414, 415, 587, 694, 21, 1213, 2615, 1442, 1443, 1756, 1769, 2231 in doc 11-16/0829r3.

5.5.25.1 Moved by Reza Hedayat, Seconded by Brian Hart.
5.5.25.2 Discussion – No discussion.
5.5.25.3 Result: Motion passes with no objection.

5.5.26 CR Motion #40: Move to approve resolutions to CIDs, 1275, 1270, 1269, 1139, 97, 2213, 1809, 1808, 1807, 1806 in doc 11-16/0867r2.
5.5.26.1 Moved by George Cherian, Seconded by Brian Hart.
5.5.26.2 Discussion – No discussion.
5.5.26.3 Result: Motion passes with no objection.

5.5.27 CR Motion #41: Move to approve resolutions to CIDs, 76, 194, 258, 259, 1598, 1773, 2849 in doc 11-16/0844r2.
5.5.27.1 Moved by Alfred Asterjadhi, Seconded by Brian Hart.
5.5.27.2 Discussion – No discussion.
5.5.27.3 Result: Motion passes with no objection.

5.5.28 CR Motion #42: Move to approve resolutions to CIDs, 1482, 1481, 1480, 1479, 1478, 1476, 1475, 1474, 1473, 30, 1225, 1486, 967, 750, 697, 696, 1793, 424, 167, 2629, 2628, 2627, 2626, 2269, 1484, 1485, 1794, 1662, 1487, 2197, 2464, 2465, 1470, 165, 1217 in doc 11-16/0828r0.
5.5.28.1 Moved by Alfred Asterjadhi, Seconded by Brian Hart.
5.5.28.2 Discussion – No discussion.
5.5.28.3 Result: Motion passes with no objection.

5.5.29 CR Motion #43: Move to approve resolutions to CIDs, 2484, 2483, 2482, 2481, 2430, 2429, 2489 in doc 11-16/0860r1.
5.5.29.1 Moved by Yongho Seok, Seconded by Brian Hart.
5.5.29.2 Discussion – No discussion.
5.5.29.3 Result: Motion passes with no objection.

5.5.30 CR Motion #44: Move to approve the resolutions to CIDs, 73, 210, 192, 642, 1593, 1919, 643, 1595, 2259, 2260 in doc 11-16/0862r3.
5.5.30.1 Moved by Yongho Seok, Seconded by Young Hoon Kwon.
5.5.30.2 Discussion – No discussion.
5.5.30.3 Result: Motion passes with no objection.

5.5.31 CR Motion #45: Move to approve resolutions to CIDs, 2608, 2607, 2606, 2488, 2487, 1399, 2841 in doc 11-16/0861r2.
5.5.31.1 Moved by Yongho Seok, Seconded by Brian Hart.
5.5.31.2 Discussion – No discussion.
5.5.31.3 Result: Motion passes with no objection.

5.5.32 CR Motion #46: Move to approve the resolution to CID 2596 in doc 11-16/0953r2 and includes the text changes in the TG draft.
5.5.32.1 Moved by Po-Kai Huang, Seconded by Young Hoon Kwon.
5.5.32.2 Discussion – No discussion.
5.5.32.3 Result: Motion passes with no objection.

5.5.33 CR Motion #47: Move to approve resolutions to CIDs, 705, 2437, 2436, 2439, 2440 in doc 11-16/0879r2.

5.5.33.1 Moved by Jeongki Kim, Seconded by Young Hoon Kwon.

5.5.33.2 Discussion – No discussion.

5.5.33.3 Result: Motion passes with no objection.

5.5.34 CR Motion #48: Move to approve resolutions to CIDs, 62, 640, 2434, 2438, 703, 2435, 66, 257, 447, 186, 2661, 2662, 776, 2660, 1577, 2332, 2718 in doc 11-16/0889r1.

5.5.34.1 Moved by Young Hoon Kwon, Seconded by Yongho Seok.

5.5.34.2 Discussion – No discussion.

5.5.34.3 Result: Motion passes with no objection.

5.5.35 CR Motion #49: Move to approve resolutions of CIDs, 1070, 2226, 693, 125, 2650, 2651 in doc 11-16/0875r2.

5.5.35.1 Moved by Kiseon Ryu, Seconded by Po-Kai Huang.

5.5.35.2 Discussion – No discussion.

5.5.35.3 Result: Motion passes with no objection.

5.5.36 CR Motion #50: Move to approve the resolutions of CIDs, 768, 829, 978, 1546, 1295, 2710, 2709, 2187, 2647, 2266 in doc 11-16/0876r2.

5.5.36.1 Moved by Kiseon Ryu, Seconded by Po-Kai Huang.

5.5.36.2 Discussion – No discussion.

5.5.36.3 Result: Motion passes with no objection.

5.5.37 CR Motion #51: Move to approve the resolutions of CIDs, 2890, 2896, 1634 in doc 11-16/0870r0.

5.5.37.1 Moved by Zhou Lan, Seconded by Young Hoon Kwon.

5.5.37.2 Discussion – No discussion.

5.5.37.3 Result: Motion passes with no objection.

5.5.38 CR Motion #52: Move to approve resolution to CID 783 in doc 11-16/0877r5.

5.5.38.1 Moved by Jeongki Kim, Seconded by Kiseon Ryu.

5.5.38.2 Discussion – No discussion.

5.5.38.3 Result: Motion passes with no objection.

5.5.39 CR Motion #53: Move to approve resolutions of CIDs, 162, 2444, 2443, 2623 in doc 11-16/0835r1.

5.5.39.1 Moved by Alfred Asterjadhi, Seconded by Po-Kai Huang..

5.5.39.2 Discussion – No discussion.

5.5.39.3 Result: Motion passes with no objection.

5.5.40 CR Motion #54: Move to approve resolutions to CIDs 507, 949, 1005, 1785, 1862 in doc 11-16/0866r4.

5.5.40.1 Moved by Kome Oteri, Seconded by Xiaofei Wang.

5.5.40.2 Discussion – No discussion.

5.5.40.3 Result: Motion passes with no objection.

5.5.41 CR Motion #55: Move to approve resolutions to CIDs, 482, 1867, 2084, 2085 in doc 11-16/0923r1.
5.5.41.1 Moved by Sriram Venkateswaran, Seconded by Ron Porat.
5.5.41.2 Discussion – No discussion.
5.5.41.3 Result: Motion passes with no objection.

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6 AOB

6.1 A member informed the group that some of the motions was moved by an individual who had lost the voting right. Those motions will be taken care of during PM1 session.

7 Recess

7.1 TGax is in recess @ 12:28 PM until PM1 (13:30) today.

Thursday, July 28th, 2016, PM1 TGax full Session (13:30-15:30)

8 The meeting called to order by Osama Aboul-Magd (Huawei Technologies)

8.1 The agenda file: 11-16-0977-05.

9 Announcement

9.1 Chair reminded IEEE 802 and 802.11 IPR P&P.
9.2 Chair asked people to state name and affiliation when addressing for the first time in the session.
9.3 Chair reminded people to do attendance.

10 TG Motions (continued)

10.1 CR Motions (continued)

10.1.1 CR Motion #56: Move to approve resolutions of CIDs, 9, 228, 2219, 2422, 2691, 2900 in doc 11-16/0725r3.
10.1.1.1 Moved by Alfred Asterjadhi, Seconded by Simone Merlin.
10.1.1.2 Note - This motion originally was the CR Motion #15 which was moved be a member who had lost the voting right.
10.1.1.3 Discussion – No discussion.
10.1.1.4 Result: Motion passes with no objection.

10.1.2 CR Motion #57: Move to approve resolutions to CIDs, 55, 1000, 1221, 1915, 2234, 802,1695, 1222, 182, 971,2713, 702, 1916, 2233, 223 in doc 11-16/0773r2.
10.1.2.1 Moved by Alfred Asterjadhi, Seconded by Simone Merlin.
10.1.2.2 Note – This motion originally was the CR Motion #16 moved by an individual who had lost the voting right.
10.1.2.3 Discussion – No discussion.
10.1.2.4 Result: Motion passes with no objection.

10.1.3 CR Motion #58: Move to accept resolutions to CIDs, 262,1083, 102, 612, 660, 830, 864, 1716, 2215, 2301, 2376, 372, 719, 864 in doc 11-16/0774r1.

10.1.3.1 Moved by Alfred Asterjadhi, Seconded by Simone Merlin.
10.1.3.2 Note – This motion originally was the CR Motion #16 moved by an individual who had lost the voting right.
10.1.3.3 Discussion – No discussion.
10.1.3.4 Result: Motion passes with no objection.

10.1.4 CR Motion #59: Move to approve resolutions to CIDs, 101,103, 104,374,375, 377, 558, 561, 661, 662, 664, 688, 1296, 1299, 1301, 1717, 1718, 1882, 2113, 2114, 2174, 2217, 2302, 2421, 227, 720, 663,1303,1305,1306 in doc 11-16/0780r1.
10.1.4.1 Moved by Alfred Asterjadhi, Seconded by Simone Merlin.
10.1.4.2 Note – This motion originally was the CR Motion #16 moved by an individual who had lost the voting right.
10.1.4.3 Discussion – No discussion.
10.1.4.4 Result: Motion passes with no objection.

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11 Presentations

11.1 George Cherian (Qualcomm) presented "CIDs for: Section 9.3.1.9.7 Multi STA BAs," based on the submission 11-16-0868-00.

11.1.1 Summary
11.1.1.1 This submission proposes resolutions for multiple comments related to TGax D0.1 with the following CIDs (31 CIDs)
11.1.1.1.1 80, 1284, 1182, 1143, 1286, 962, 1287, 831, 508, 367, 100, 99, 98, 999, 1812, 2580, 2458, 2414, 2389, 2232, 2185, 2170, 1285, 1813, 2582, 1811, 1810, 1715, 1291, 1288, 1814.
11.1.2 Discussion
11.1.2.1 CID #2389 will be resolved in another submission.
11.1.3 Motion

11.1.3.1 CR Motion #60: Move to accept resolutions to CIDs, 80, 1284, 1182, 1143, 1286, 962, 1287, 831, 508, 367, 100, 99, 98, 999, 1812, 2580, 2458, 2414, 2232, 2185, 2170, 1285, 1813, 2582, 1811, 1810, 1715, 1291, 1288, 1814 in doc 11-16/0868r1
11.1.3.1.1 Moved by George Cherian, Seconded by Simone Merlin.
11.1.3.1.2 Discussion – No discussion.
11.1.3.1.3 Result: Motion accepted with no objection.

11.2 Woojin Ahn (Wilus Institute) presented "TID value of ALL ACK signaling," based on the submission 11-16-0916-01.

11.2.1 Summary
11.2.1.1 The TID value for BA information in case of all ACK was discussed.
11.2.1.2 Without proper TID value setting rule, originator may not distinguish single MPDU ACK and all ACK upon reception of M-BA.
11.2.1.3 Proposed to Set TID value of All ACK to one of values between 1000-1110.
11.2.2 Discussion – No discussion.
11.2.3 Motion

11.2.3.1 MAC Motion #87: Move to include the spec text change as shown in doc 11/16-0917r1 in the TG draft

11.2.3.1.1 Moved by Woojin Ahn, Seconded by John Son.
11.2.3.1.2 Discussion
11.2.3.1.2.1 This motion will be confirmed if correct clause number is captured.
11.2.3.1.3 Result: Motion passes with no objection.

11.3 Kaushik Josiam (Samsung) presented "Proposed resolutions to comments on clause 26.3.9.8," based on the submission 11-16-0928-01.

11.3.1 Summary
11.3.1.1 The resolutions for the following CIDs are contained in this document.
11.3.1.1.1 CIDs #: 306, 310, 311, 477, 1002, 1003, 1010, 1692, 2020, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2036, 2037, 2130, 2151, 2245, 2246, 2543, 2544, 2545, 2546, 2547, 2679, 2681.
11.3.2 Discussion
11.3.2.1 There were comments on the resolutions for CIDs 1010 and 2151 whether these comments are relevant for DL MU only. The presenter will clarify those points.
11.3.3 Motion

11.3.3.1 CR Motion #61: Move to approve resolutions to CIDs, 306, 310, 311, 477, 1002, 1003, 1010, 1692, 2020, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2036, 2037, 2130, 2151, 2245, 2246, 2543, 2544, 2545, 2546, 2547, 2679, 2681 in doc 11-16/0928r2.
11.3.3.1.1 Moved by Kaushik Josiam, Seconded by Bo Sun
11.3.3.1.2 Discussion – No discussion.
11.3.3.1.3 Result: Motion was accepted with no objection.

11.4 Chittabrata Ghosh (Intel) presented "Resolution for CID 1589, 1590, 2668, and 2669 on Multi-TID Aggregation in Sub-clause 25.10.4," based on the submission 11-16-0938-00.

11.4.1 Summary
11.4.1.1 The resolutions for the following CIDs and relevant text are proposed.
11.4.1.1.1 CIDs #1589, 1590, 2668, and 2669.
11.4.2 Discussion
11.4.2.1 C: Relevant MIB (dot11AMPDUwithMultipleTIDOptionImplemented) needs to be specified in Annex C. → One of the next action items.
11.4.3 Motion

11.4.3.1 CR Motion #62: Move to approve resolutions to CIDs, 1589, 1590, 2668, and 2669 in doc 11-16/0938r0.
11.4.3.1.1 Moved by Chittabrata Ghosh, Seconded Yasuhiko Inoue.
11.4.3.1.2 Discussion – No discussion.
11.4.3.1.3 Result: Motion accepted with no objection.

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12 Teleconference planning

12.1 Chair suggested weekly conference calls.
12.1.1 Thursday, August 4th, 2016, 20:00 - 22:00 (ET) – already approved.

12.1.2 Thursday, August 11th, 25th & September 8th, 2016, 10:00 - 12:00 (ET)
12.1.3 Thursday, August 18th & September 1st, 2016, 20:00 - 22:00 (ET)
12.2 Chair asked if there is any objection to this plan. → No objection.

13 Presentations

13.1 Jarkko Kneckt (Apple) presented "SU Multi-TID rules," based on the submission 11-16-0913-00.

13.1.1 Summary
13.1.1.1 This submission discusses how to use the multi-TID aggregation in SU TXOPs.
13.1.1.2 Also, the resolutions for CIDs #71 and 190 are provided.
13.1.2 Discussion
13.1.2.1 There was a discussion on TXOP Limit – Which AC should be assumed? → The answer was the primary AC.
13.1.3 Motion

13.1.3.1 CR Motion #63: Move to approve resolutions to CIDs, 71 and 190 in doc 11-16/966r0
13.1.3.1.1 Moved by Jarkko Kneckt, Seconded by Alfred Asterjadhi.
13.1.3.1.2 Discussion – No discussion.
13.1.3.1.3 Result: Motion accepted with no objection.

13.2 Jeongki Kim (LG Electronics) presented "Comment resolution on CID 782 (Intra-PPDU PS)," based on the submission 11-16-0878-01.

13.2.1 Summary
13.2.1.1 The resolution for the CID #782 and related text are proposed.
13.2.1.2 Conditions for identification of Intra-BSS PPDU for the VHT case and other cases were added.
13.2.2 Discussion
13.2.2.1 There was a request to double check the definition of Partial AID. The presenter agreed to do so.
13.2.3 Motion

13.2.3.1 CR Motion #64: Move to approve resolution to CID 782 in doc 11-16/0878r1.
13.2.3.1.1 Moved by Jeongki Kim, Seconded by Kiseon Ryu.
13.2.3.1.2 Discussion – No discussion.
13.2.3.1.3 Result: Motion was accepted with no objection.

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14 AOB

14.1 No other business that fit with 2 or 3 minutes.

15 Adjournment

15.1 TGax adjourned for the week @ 15:28.

Appendix A. Vote Record for SR Motion #10

Yes	59
No	21
Abstain	49
Abstain %	38.0%
Approve %	73.8%
Membership valid as of	2016-07-14
# voting members	428
# votes	129
# return	30

LastName	FirstName	MI	Affiliation	Vote
Aboulmagd	Osama	S	Huawei Technologies Co. Ltd	
Abraham	Santosh	P	Qualcomm Technologies Incorporated	
Abu Surra	Shadi	A	SAMSUNG	
Adachi	Tomoko		TOSHIBA Corporation	
Agardh	Kare		Sony Mobile Communications	
Ahn	Jinsoo		Yonsei University	A
Ahn	Seung Hyeok		Newracom Inc.	
Ahn	Woojin		WILUS	A
Akhmetov	Dmitry		Intel Corporation	
Aldana	Carlos	H	Intel Corporation	
Alpert	Yaron		Intel Corporation	Y
An	Song-Haur		INDEPENDENT	
Ansley	Carol		ARRIS Group	A
Aoki	Tsuguhide		TOSHIBA Corporation	A
Armstrong	Lee	R	US Department of Transportation	
Arndt	Manfred		Hewlett Packard Enterprise	
Arnold	James		US Department of Transportation	
Asai	Yusuke		NTT	A
Asterjadhi	Alfred		Qualcomm Incorporated	Y
Au	Kwok Shum	S	Huawei Technologies Co. Ltd	
Auluck	Vijay		Intel Corporation	
Awater	Geert	A	Qualcomm Incorporated	
Azizi	Shahrnaz		Intel Corporation	A
Bagby	David		Calypso Ventures, Inc.	A
Baik	Eugene		Qualcomm Incorporated	
bang	saehee		LG ELECTRONICS	
baron	stephane		Canon Research Centre France	A
Barr	David		Intel Corporation	
Barriac	gwendolyn		Qualcomm Incorporated	
Berens	Friedbert		FBConsulting Sarl	
Berger	Christian		Marvell Semiconductor, Inc.	A
Bhandaru	Nehru		Broadcom Corporation	

Bharadwaj	Arjun		Qualcomm Incorporated	
Bims	Harry		Bims Laboratories, Inc.	A
Bocus	Mohammud		Toshiba of Europe Ltd.	
Bourdoux	Andre		IMEC	
Brandt	David		Rockwell Automation	
Buffington	John		Itron Inc.	N
Calcev	George		Huawei R&D USA	A
Calvert	Chris		Landis Gyr Group Worldwide	
cao	fengming		Toshiba of Europe Ltd.	
Cao	Rui		Marvell Semiconductor, Inc.	Y
Capar	Cagatay		Ericsson	
Cariou	Laurent		Intel Corporation	Y
Carney	William		Sony Corporation	
CHANG	SANGHYUN		SAMSUNG ELECTRONICS	
Chang	Soo-Young		California State University, Sacramento (CSUS)	
Chen	Jiamin		HUAWEI	
CHEN	KWANG-CHENG		National Taiwan University	
Chen	Lidong		National Institute of Standards and Technology (NIST)	
Chen	Teyan		Huawei Technologies Co. Ltd	
Chen	Xiaogang		Intel Corporation	Y
Cheng	Paul		MediaTek Inc.	
Cheong	Minho		Newracom Inc.	Y
CHERIAN	GEORGE		Qualcomm Incorporated	Y
Cherniavsky	Dmitry		SiBEAM, Inc.	
Chin	Woon Hau		Toshiba of Europe Ltd.	
Chitrakar	Rojan		Panasonic Asia Pacific Pte Ltd.	N
Cho	Hangyu		lg electronics	Y
Cho	Joongwon		Newracom Inc.	
Choi	Hyeyoung		LG ELECTRONICS	
Choi	In-Kyeong		Newracom Inc.	N
Choi	Jinsoo		LG ELECTRONICS	Y
Choi	Sangsung		Electronics and Telecommunications Research Institute (ETRI)	
Choudhury	Sayantan		Nokia	
Chu	Liwen		Marvell Semiconductor, Inc.	Y
Ciochina	Dana		Sony Corporation	
Coffey	John		Realtek Semiconductor Corp.	N
Cordeiro	Carlos		Intel Corporation	
De Ruijter	Hendricus		Silicon Laboratories	
de Vegt	Rolf	J	Qualcomm Incorporated	
Debergh	Pierre		Orange	Y
Ding	Gang		Qualcomm Incorporated	
DOAN	DUNG		Qualcomm Incorporated	
Dua	Praveen		Qualcomm Incorporated	

Eastlake 3rd	Donald	E	Huawei Technologies Co. Ltd	
Ecclesine	Peter		Cisco Systems, Inc.	
Edgar	Richard		Imagination Technologies Ltd.	A
Eitan	Alecsander		Qualcomm Incorporated	
Emmelmann	Marc		Self Employed	
Erceg	Vinko		Broadcom Corporation	
Fan	Zhong		TOSHIBA Corporation	
Fang	Ping		Huawei Technologies Co. Ltd	
Fang	Yonggang		ZTE TX Inc	
Ferdowsi	Vida		Newracom Inc.	
Filo	Marcin		University of Surrey	
Finn	Norman		Cisco Systems, Inc.	
Fischer	Matthew	J	Broadcom Corporation	
Fischer	Michael		NXP Semiconductors	
Fuller	Richard		OmniTrail Technologies	
Furuichi	Sho		Sony Corporation	
Gan	Ming		Huawei Technologies Co. Ltd	Y
Garcia Villegas	Eduard		Universitat Politecnica de Catalyuna (UPC)	
Ghanbarinejad	Majid		Huawei R&D USA	A
Ghosh	Chittabrata		Intel Corporation	Y
Ghosh	Monisha		InterDigital, Inc.	
Godfrey	Tim		Electric Power Research Institute, Inc. (EPRI)	
Grandhe	Niranjan		Marvell Semiconductor, Inc.	A
Grigat	Michael		Deutsche Telekom AG	
Guo	Yuchen		Huawei Technologies Co., Ltd	
Hadad	Zion		Runcom Technologies LTD.	
Hall	Robert		Johnson Controls Inc	
Halls	David		Toshiba of Europe Ltd.	A
Hamilton	Mark		Ruckus Wireless	
HAN	Xiao		Huawei Technologies Co. Ltd	
Han	Yunbo		HUAWEI	
Handte	Thomas		Sony Corporation	
Hansen	Christopher	J	Peraso Technologies Incorporated	
Hao	Peng		jiangsu university of science and technology	
Harkins	Daniel	N	Aruba Networks, Inc.	
Hart	Brian	D	Cisco Systems, Inc.	Y
Hartman	Chris		Apple, Inc.	
Hayes	Victor		CONSULTANT	
He	Linhai		Qualcomm Incorporated	
he	shiwen		Southeast University, China	
Hedayat	Ahmadreza		Newracom Inc.	Y
Henry	Jerome		Cisco Systems, Inc.	
Hiertz	Guido	R	Ericsson AB	
Ho	Duncan		Qualcomm Incorporated	
Horisaki	Koji		TOSHIBA Corporation	

Hou	Victor		Broadcom Corporation	
Hsieh	Jing-Rong		HTC Corporation	
Hsu	Chien-Fang		MediaTek Inc.	
Hu	Chunyu		Broadcom Corporation	Y
Huang	He		ZTE Corporation	
Huang	Lei		Huawei Technologies Co. Ltd	
Huang	Lei		Panasonic Asia Pacific Pte Ltd.	N
Huang	Po-Kai		Intel Corporation	Y
Huang	Rongsheng		MediaTek Inc.	
Huang	Zhiyong		LitePoint Corporation/Teradyne	
Hunter	David		WireFi Networks Inc.	
Hurtarte	Jeorge		Teradyne, Inc.	
Hwang	Sung Hyun	H	ETRI	
Ibrahim	Brima		Broadcom Corporation	
Inoue	Yasuhiko		Nippon Telegraph and Telephone Corporation (NTT)	Y
Ishihara	Koichi		Nippon Telegraph and Telephone Corporation (NTT)	
Ishizu	Kentaro		National Institute of Information and Communications Technology (NICT)	
Iwatani	Junichi		Nippon Telegraph and Telephone Corporation (NTT)	Y
Jauh	Alan		MediaTek Inc.	
Jeffries	Timothy		Huawei R&D USA	
Ji	Mingyue		Broadcom Corporation	
Jiang	Jinjing		Marvell Semiconductor, Inc.	
Jin	Liang		Spirent Communications	
Jo	Kyungtae		LG ELECTRONICS	
Johnsson	Kerstin		Intel Corporation	
Jokela	Jari	E		
Jones	Allan		Activision	Y
Jones	Vincent Knowles IV		Qualcomm Incorporated	
Josiam	Kaushik		SAMSUNG	Y
Kain	Carl	W	Noblis, Inc.	
Kakani	Naveen	K	Qualcomm Incorporated	
Kang	Hyunduk		Electronics and Telecommunications Research Institute (ETRI)	
Karnam	Mohan		Imagination Technologies Ltd.	
Kasher	Assaf	Y	Qualcomm	
Kennedy	Richard	H	Hewlett Packard Enterprise	
Kerry	Stuart	J	OK-Brit	
Khorov	EVGENY		IITP RAS	A
Khoury	Peter		Ruckus Wireless	N
KI	SANGWON		Newracom Inc.	A
Kim	Jeehoon		NEWRACOM	
Kim	Jeongki		LG ELECTRONICS	Y
Kim	Jin Min		LG ELECTRONICS	

Kim	Joonsuk		Apple, Inc.	A
Kim	Kyeongpyo		Newracom Inc.	N
Kim	Sang Gook		LG ELECTRONICS	A
Kim	Suhwook		LG ELECTRONICS	A
Kim	Yongho		KNUT	A
Kim	Youhan		Qualcomm Incorporated	Y
Kim	Youn-Kwan		The Catholic University of Korea	
Kirimis	Dimitri		Newracom Inc.	A
Kiryanov	Anton		IITP RAS	N
Kitazawa	Shoichi		ATR Wave Engineering Laboratories	
Kloper	David		Cisco Systems, Inc.	
KNECKT	JARKKO		Apple, Inc.	Y
Ko	Geonjung		WILUS Institute	A
Kojima	Fumihide		National Institute of Information and Communications Technology (NICT)	
Kolze	Tom		Broadcom Corporation	
Kotzer	Igal		General Motors Company	
Kountz	Dennis		Chemours	
Kraemer	Bruce	P	Marvell Semiconductor, Inc.	
Kumar	Rajesh		Qualcomm Incorporated	
Kumari	Warren		Google	
Kwak	Byung-Jae		Electronics and Telecommunications Research Institute (ETRI)	
Kwak	Jin-Sam		WILUS Institute	A
Kwon	Yong-Jin		Newracom Inc.	A
Kwon	Young Hoon	H	Newracom Inc.	Y
Lalam	Massinissa		SAGEMCOM SAS	
Lambert	Paul		Marvell Semiconductor, Inc.	
Lan	Zhou		National Institute of Information and Communications Technology (NICT)	Y
Lanante	Leonardo		Kyushu Institute of Technology	Y
Lansford	James		Qualcomm Incorporated	
Lee	Daewon		Newracom Inc.	Y
Lee	Jae Seung	S	ETRI	Y
Lee	Jehun		Newracom Inc.	A
LEE	JOONSOO		Newracom Inc.	A
Lee	Young Ha		Newracom Inc.	N
Lei	Zhongding		Institute for Infocomm Research (I2R)	
Lepp	James		BlackBerry	
Levy	Joseph		InterDigital, Inc.	
Li	Bo		northwestern polytechnical university	
Li	Dejian		Huawei Technologies; HiSilicon	
Li	Guoqing		Apple, Inc.	
Li	Huan-Bang		National Institute of Information and Communications Technology (NICT)	

Li	Jing		Huawei Technologies Co. Ltd	
Li	Qinghua		Intel Corporation	
Li	Yanchun		Huawei Technologies Co. Ltd	
Li	Yunbo		Huawei Technologies Co. Ltd	Y
Lim	Dong Guk		LG ELECTRONICS	A
Lin	Meilu		HUAWEI	
Lin	Wei		Huawei Technologies Co. Ltd	
Lin	Yingpei		Huawei Technologies Co. Ltd	
LIU	CHENCHEN		Huawei Technologies Co. Ltd	
Liu	Der-Zheng		Realtek Semiconductor Corp.	
Liu	Fulei		ZTE Corporation	
Liu	Jianhan		MediaTek Inc.	Y
Liu	Jinnan		HUAWEI	
Liu	Le		Huawei Technologies Co. Ltd	
Liu	Pei		HiSilicon Technologies Co., LTD.	
Liu	Yong		Apple, Inc.	Y
Liu	Yun		Huawei Technologies Co., Ltd	
Liu	Zhiheng		China Mobile Communications Corporation (CMCC)	
Loc	Peter		Huawei Technologies Co. Ltd	Y
Lomayev	Artyom		Intel Corporation	
Lou	Hui-Ling		Marvell Semiconductor, Inc.	
Lukaszewski	Chuck		Aruba Networks, Inc.	
Luo	Jun		Huawei Technologies Co. Ltd	
Luo	Yi		Huawei Technologies Co. Ltd	
Lv	Kaiying		ZTE Corporation	
Ma	Jing		National Institute of Information and Communications Technology (NICT)	
Maamari	Diana		Huawei R&D USA	
MADHAVAN	NARENDAR		TOSHIBA Corporation	A
Maeda	Shigeru		TOSHIBA Corporation	
Malik	Rahul		Qualcomm Incorporated	
Malinen	Jouni	K	Qualcomm Incorporated	
Maltsev	Alexander		Intel Corporation	
Mangold	Stefan		Itron Inc.	
Mano	Hiroshi		Koden Techno Info K.K.	
Marin	James		Self Employed	
Matsuo	Ryoko		TOSHIBA Corporation	
Mccann	Stephen		BlackBerry	
Merlin	Simone		Qualcomm Incorporated	Y
Mestanov	Filip		Ericsson AB	
Miller	James		InterDigital, Inc.	
Mobasher	Amin		SAMSUNG	
Mohanty	Bibhu		Qualcomm Incorporated	
Monajemi	Pooya		Cisco Systems, Inc.	Y
Montemurro	Michael		Research In Motion Limited	

Montreuil	Leo		Broadcom Corporation	
Moon	Sungho		Newracom Inc.	
Mori	Hiroki		TOSHIBA Corporation	
Mori	Kenichi		Space-Time Engineering	N
Mori	Masahito		Sony Corporation	
Morioka	Hitoshi		SRC Software	
Morioka	Yuichi		Sony Corporation	Y
Motozuka	Hiroyuki		Panasonic Corporation	N
Mueller	Robert		Ilmenau University of Technology - TU Ilmenau	
Murakami	Yutaka		Panasonic Corporation	
Murthy	Vinay		Qualcomm Incorporated	
Myles	Andrew		Cisco Systems, Inc.	
Nabetani	Toshihisa		TOSHIBA Corporation	
Nagai	Yukimasa		Mitsubishi Electric Corporation	
Nagao	Yuhei		Radrix Co., Ltd	
Nakano	Hiroki		Kyoto University	
Nandagopalan	SAI SHANKAR	S	Ubilite Inc	A
Nezou	Patrice		Canon Research Centre France	
Ngo	Chiu		SAMSUNG	
Noh	Yujin		Newracom Inc.	Y
Notor	John		Notor Research; ARM, Inc.	
Odman	Knut		Broadcom Corporation	
Oh	Minseok		Kyonggi University	
OH	MIN-SEOK		LG Electronics	
Olesen	Robert		InterDigital, Inc.	N
Oteri	Oghenekome		InterDigital, Inc.	N
Ozaki	Kazuyuki		FUJITSU LABORATORIES LIMITED	A
Palm	Stephen		Broadcom Corporation	
Pandey	Santosh Ghanshyam	G	Cisco Systems, Inc.	
Pang	Jiyong		Huawei Technologies Co. Ltd	
Pare	Thomas		MediaTek Inc.	Y
Park	Eunsung		LG Electronics	A
Park	Hyungu		Newracom Inc.	A
Park	Hyunhee		LG ELECTRONICS	A
Park	Jeonghwan		Newracom Inc.	Y
Park	Minyoung		Intel Corporation	
Park	Sung-jin		LG ELECTRONICS	
Patil	Abhishek		Qualcomm Incorporated	A
Peng	Xiaoming		Institute for Infocomm Research	
Persson	Hakan		Ericsson AB	
Petranovich	James	E	ViaSat, Inc.	
petrick	Albert		Jones-Petrick and Associates, LLC.	N

Pienciak	Walter		IEEE	
Pope	Steve		Self Employed	
porat	ron		Broadcom Corporation	Y
Pulikkoonattu	Rethnakaran		Broadcom Corporation	
Pyo	Chang-Woo	C	National Institute of Information and Communications Technology (NICT)	
Qi	Emily	H	Intel Corporation	
Qiao	Dengyu		Huawei Technologies Co. Ltd	Y
Qu	Shouxing		BlackBerry	
Rabarijaona	Verotiana		National Institute of Information and Communications Technology (NICT)	
Rajakarunanayake	Yasantha		MediaTek Inc.	
Rakanovic	Demir		u-blox	
Rantala	Enrico-Henrik		Nokia	A
Rayment	Stephen G	G	Ericsson AB	
Ren	Yazhen		Huawei Technologies Co. Ltd	
Riegel	Maximilian		Nokia Networks	
Rison	Mark		Samsung Cambridge Solution Centre	
Rong	Zhigang		Huawei Technologies Co. Ltd	Y
Rosdahl	Jon	W	Qualcomm Technologies, Inc.	
Roy	Arnab		InterDigital, Inc.	
Ryu	Kiseon		LG ELECTRONICS	Y
Sadeghi	Bahareh		Intel Corporation	Y
Sakamoto	Takenori		Panasonic Corporation	N
Sakoda	Kazuyuki		Sony Corporation	
Sambasivan	Sam		AT&T	
Sampath	Hemanth		Qualcomm Incorporated	
Sarris	Ioannis		u-blox	
Sasaki	Shigenobu		Niigata University	
Sato	Naotaka		Sony Corporation	
Schelstraete	Sigurd		Quantenna Communications, Inc.	N
Schneider	Daniel		Sony	
Scott	Andy		NCTA	
Segev	Jonathan		Intel Corporation	A
Seok	Yongho		Newracom Inc.	
Shah	Kunal		Silver Spring Networks Inc.	
SHAO	PENG		NEC Communication Systems, Ltd.	
Shen	Bazhong		Broadcom Corporation	
Sherlock	Ian		Texas Instruments Incorporated	Y
Shilo	Shimi		HUAWEI	A
Shimada	Shusaku		Schubiquist Technologies	
SHIN	JUNG-CHUL		NEWRACOM	
Slater	Robert		Motorola Mobility	

Smith	Graham	K	SR Technologies	N
Son	Ju-Hyung		WILUS Institute	A
Song	Hayeong		Newracom Inc.	A
Song	Nah-Oak		Korea Advanced Institute of Science and Technology (KAIST)	
Srinivasa	Sudhir		Marvell Semiconductor, Inc.	
Stacey	Robert		Intel Corporation	Y
Stanley	Dorothy		Hewlett Packard Enterprise	
Stephens	Adrian	P	Intel Corporation	
Stott	Noel		Ixia	A
SU	HONGJIA		Huawei Technologies Co. Ltd	
Suh	JUNG HOON	H	Huawei Technologies Co. Ltd	A
Sun	Bo		ZTE Corporation	A
Sun	Chen		Sony Corporation	
Sun	Li-Hsiang		InterDigital, Inc.	N
sun	sheng		Huawei Technologies Co. Ltd	
Sun	Yakun		Marvell Semiconductor, Inc.	
Sun	Yanjun		Qualcomm Incorporated	
Takahashi	Kazuaki		Panasonic Corporation	
Takai	Mineo		Space-Time Engineering	
Takatori	Yasushi		Nippon Telegraph and Telephone Corporation (NTT)	
Tamhane	Sagar		Marvell Semiconductor, Inc.	
Tanaka	Yusuke		Sony Corporation	Y
Taniguchi	Kentaro		TOSHIBA Corporation	
Tao	Wu		Huawei Technologies Co. Ltd	
Taori	Rakesh		Phazr	
Tian	Bin		Qualcomm Incorporated	Y
Tian	Qingjiang		Qualcomm Incorporated	
Tian	Tao		Qualcomm Incorporated	
Tinnakornsrisuphap	Peerapol		Qualcomm Incorporated	
Tong	Fei		Samsung Cambridge Solution Center	
TorabJahromi	Payam		Broadcom Corporation	
Tosato	Filippo		Toshiba of Europe Ltd.	
Trainin	Solomon	B	Intel Corporation	
Tsai	Chia-Hung		MediaTek Inc.	Y
tsubaki	toshimitsu		Nippon Telegraph and Telephone Corporation (NTT)	
Tuomaala	Esa		Nokia	
Urabe	Yoshio		Panasonic Corporation	Y
Van Nee	Richard	D	Qualcomm Incorporated	
Van Zelst	Allert		Qualcomm Incorporated	
Vangelista	Lorenzo		Patavina Technologies	
Varshney	Prabodh		Nokia	
Venkatachalam Jayara	Venkata Ramanan		Qualcomm Incorporated	

Venkatesan	Ganesh		Intel Corporation	
Venkateswaran	Sriram		Broadcom Corporation	Y
Vermani	Sameer		Qualcomm Incorporated	A
VIGER	Pascal		Canon Research Centre France	A
Villardi	Gabriel		National Institute of Information and Communications Technology (NICT)	
Vlantis	George	A	STMicroelectronics	N
Wang	Chao Chun		MediaTek Inc.	
Wang	Haiming		Southeast University, China	
Wang	Huizhao		Quantenna Communications, Inc.	Y
Wang	James June	J	MediaTek Inc.	Y
Wang	Lei		Marvell Semiconductor, Inc.	Y
Wang	Qi		Broadcom Corporation	
Wang	Xiaofei		InterDigital, Inc.	N
Wang	Xuehuan		Huawei Technologies Co. Ltd	
Ward	Lisa		Rohde & Schwarz	
Watanabe	Fujio		NTT DoCoMo, Inc.	
Wee	Gaius		Panasonic Asia Pacific Pte Ltd.	
Wentink	Menzo	M	Qualcomm Incorporated	
Wilhelmsson	Leif		Ericsson AB	
Wong	Eric		Apple, Inc.	A
Wu	Tianyu		MediaTek Inc.	Y
Xin	Yan		Huawei Technologies Co. Ltd	
Xing	Weimin		ZTE Corporation	Y
Xue	Qi		Qualcomm Incorporated	
Yamada	Akira		NTT DoCoMo, Inc.	
Yang	Ou		Intel Corporation	
Yang	Rongzhen		Intel Corporation	
YANG	RUI		InterDigital, Inc.	A
Yang	Xun		Huawei Technologies Co. Ltd	Y
Yang	Yunsong		Huawei Technologies Co. Ltd	
YAO	KE		ZTE Corporation	
Yee	James		MediaTek Inc.	Y
Yee	Peter		NSA/IAD	
Yokota	Hidetoshi		Landis Gyr Group Worldwide	
Yong	Su Khiong	K	Apple, Inc.	
Young	Christopher		Broadcom Corporation	
Yu	Bo		Marvell Semiconductor, Inc.	
Yu	Chinghwa		Spreadtrum Comm.	
Yu	Heejung		Yeungnam University	
Yu	Jian		Huawei Technologies Co. Ltd	A
Yu	Mao		Marvell Semiconductor, Inc.	
Yunoki	Katsuo	D	KDDI R&D Laboratories	
Zeleznikar	Alan		ARRIS Group	N
Zeng	Kun		Huawei Technologies Co., Ltd	

Zhang	Hongyuan		Marvell Semiconductor, Inc.	Y
ZHANG	JIAYIN		Huawei Technologies Co. Ltd	
Zhang	Xingxin		Huawei Technologies Co. Ltd	
Zhang	Yan		Marvell Semiconductor, Inc.	
ZHAO	XIAOWU		ZTE Corporation	
Zheng	Jun		Broadcom Corporation	
Zheng	Xiayu		Marvell Semiconductor, Inc.	
Zhou	Yan		Qualcomm Incorporated	
Zhu	Chunhui		Huawei Technologies Co. Ltd	
Zhu	Jun		Huawei Technologies Co. Ltd	A
Zhuo	Lan		CESI Group	
Zuniga	Juan Carlos		InterDigital, Inc.	

Appendix B

2023-01-18 TGay Awards Photographs

The TGay awards ceremony was held during the electronic July 2021 session and the accompanying presentation is here. The awards themselves were kept in storage and presented at the January 2023 session at the Hilton Balitmore Inner Harbor, Baltimore, MD, USA, the photos for which are below. Not all recipients were able to attend.

WG and TGay Officer Awards

Dorothy Stanley

WG Chair

Jon Rosdahl

WG Vice Chair

Robert Stacey

WG Vice Chair

Stephen McCann

WG Secretary

Edward Au

TGay Chair

Sang Kim

TGay Vice Chair

Jeorge Hurtarte

TGay Secretary

Robert Stacey accepting on behalf of Carlos Coredeiro

TGay Editor

SangHyun Chang

Former TGay Vice Chair

Yan Xin

Former TGay Vice Chair, major contributor to EDMG PHY and comment resolution

TGay Significant Contributor Awards

Claudio da Silva

For significant contribution to EDMG PHY, coexistance assurance document, and comment resolution

Alecsander Eitan

For signficant contribution to EDMG PHY and comment resolution

Lei Huang

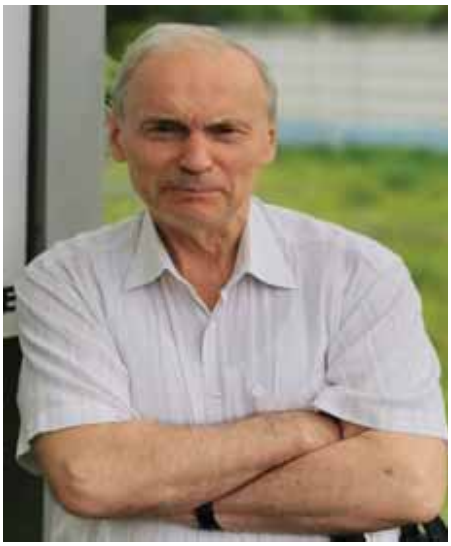
For signficant contribution to EDMG PHY and comment resolution

Assaf Kasher

For signficant contribution to EDMG MAC and comment resolution

Artyom Lomayev

For significant contribution to the EDMG channel modelling, EDMG PHY, and comment resolution



Alexander Maltsev

For significant contribution to the EDMG channel modelling and EDMG PHY

Payam Torab

For significant contribution to TDD millimeter wave distribution networks

Solomon Trainin

For significant contribution to the EDMG MAC and comment resolution

Hiroyuki Motozuka

For major contribution to EDMG PHY comment resolution

Kome Oteri

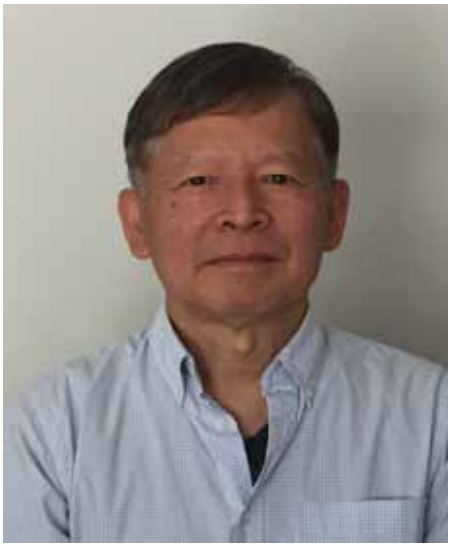
For major contribution to EDMG PHY and comment resolution

Ilya Bolotin

For major contribution to EDMG MAC and comment resolution

Cheng Chen

For major contribution to EDMG MAC, TDD millimeter wave distribution networks, and comment resolution



James Wang

For major contribution to EDMG MAC and comment resolution

Al Petrick

For major contribution to comment resolution. Award given at March 2023 session.

Rui Yang

For major contribution to comment resolution

Rob Sun

For major contribution to comment resolution

TGay PHY Contributor Awards

Nelson Costa

For contribution to comment resolution

Thomas Handte

For contribution to EDMG PHY and comment resoliution

Takenori Sakamoto

For contribution to EDMG PHY and comment resoliution

Sunwoong Yun

For contribution to EDMG PHY

TGay MAC Contributor Awards

Djordje Tujkovic

For contribution to TDD millimeter wave distribution networks

Mohamed AbouelSeoud

For contribution to EDMG MAC comment resoliution

Sauhee Bang

For contribution to EDMG MAC and comment resoliution

George Calcev

For contribution to EDMG MAC comment resoliution

Tony Xiao Han

For contribution to EDMG MAC

Chris Hansen

For contribution to EDMG MAC comment resoliution. Award given at March 2023 session.

Kyungtae Jo

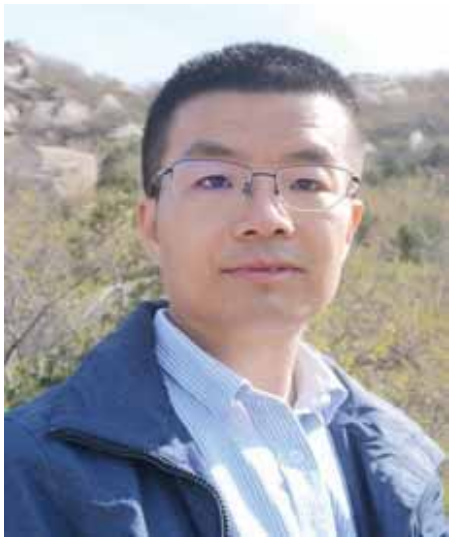
For contribution to EDMG MAC

Oren Kedem

For contribution to EDMG MAC and comment resoliution

Jinmin Kim

For contribution to EDMG MAC and comment resoliution



Dejian Li

For contribution to EDMG MAC comment resoliution

Sungjin Park

For contribution to EDMG MAC and comment resoliution

Kazuyuki Sakoda

For contribution to EDMG MAC comment resoliution

Li-Hsiang Sun

contribution to EDMG MAC comment resoliution

Acknowledgment

Working Group IEEE 802.11 gratefully acknowledges Matthew Fischer and Mark Hamilton for taking these photographs.

This page is maintained by Robert Stacey. Comments are welcome.

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Appendix BA

Documents

Everything | All Years | TGax (inactive)

spec

Created (ET) ▼	Year	DCN	Rev	Group	Title	Author (Affiliation)	Uploaded (ET)	Actions
17-Sep-2020 ET	2020	1280	2	TGax	spec-text-proposal-for-Pre-FEC-Padding-Factor-parameter	Bo Sun (ZTE)	17-Sep-2020 19:08:38 ET	Download
03-Sep-2020 ET	2020	1280	1	TGax	spec-text-proposal-for-Pre-FEC-Padding-Factor-parameter	Bo Sun (ZTE)	03-Sep-2020 13:18:48 ET	Download
24-Aug-2020 ET	2020	1280	0	TGax	spec-text-proposal-for-Pre-FEC-Padding-Factor-parameter	Bo Sun (ZTE)	24-Aug-2020 13:22:53 ET	Download
14-Nov-2019 ET	2019	1922	3	TGax	TSPEC and OM comment resolutions	Jarkko Kneckt (Apple)	14-Nov-2019 16:59:04 ET	Download
14-Nov-2019 ET	2019	1922	2	TGax	TSPEC and OM comment resolutions	Jarkko Kneckt (Apple)	14-Nov-2019 16:00:01 ET	Download
13-Nov-2019 ET	2019	1922	1	TGax	TSPEC and OM comment resolutions	Jarkko Kneckt (Apple)	13-Nov-2019 16:57:13 ET	Download
12-Nov-2019 ET	2019	2035	0	TGax	Transmit Spectral Mask for Preamble Punctured Channels	Dorin Viorel (CableLabs)	12-Nov-2019 14:31:24 ET	Download
06-Nov-2019 ET	2019	1922	0	TGax	TSPEC and OM comment resolutions	Jarkko Kneckt (Apple)	12-Nov-2019 00:08:03 ET	Download
17-Jun-2019 ET	2019	1013	0	TGax	Spec text changes on MCS table	Ross Jian Yu (Huawei Technologies)	10-Jul-2019 04:25:46 ET	Download
08-Nov-2018 ET	2018	1830	1	TGax	CR for TSPEC	Jarkko Kneckt (Apple)	08-Nov-2018 16:28:48 ET	Download
02-Nov-2018 ET	2018	1830	0	TGax	CR for TSPEC	Jarkko Kneckt (Apple)	02-Nov-2018 17:18:24 ET	Download
07-Sep-2018 ET	2018	1442	1	TGax	spec-text-changes-regarding-single-stream-pilot	Ross Jian Yu (Huawei Technologies Co., Ltd.)	07-Sep-2018 16:14:44 ET	Download
27-Aug-2018 ET	2018	1442	0	TGax	spec-text-changes-regarding-single-stream-pilot	Ross Jian Yu (Huawei Technologies Co., Ltd.)	03-Sep-2018 22:25:01 ET	Download
05-Jul-2018 ET	2018	1183	0	TGax	spec. text change for error correction on STBC	Jianhan Liu (Mediatek)	05-Jul-2018 20:54:32 ET	Download
08-May-2018 ET	2018	803	1	TGax	Spec text change on PHY padding	Tianyu Wu (Samsung)	08-May-2018 05:02:54 ET	Download
04-May-2018 ET	2018	868	0	TGax	Spec. change on Receiver minimum input sensitivity on 1024-QAM for 20MHz bandwidth	Jianhan Liu (Mediatek)	06-May-2018 15:45:54 ET	Download
01-May-2018 ET	2018	803	0	TGax	Spec text change on PHY padding	Tianyu Wu (Samsung)	02-May-2018 20:45:38 ET	Download
18-Jan-2018 ET	2018	182	5	TGax	CID related to the use of TSPEC for HE STAs	Guoqing Li (Apple)	18-Jan-2018 12:24:15 ET	Download

16-Jan-2018 ET	2018	182	4	TGax	CID related to the use of TSPEC for HE STAs	Guoqing Li (Apple)	16-Jan-2018 19:40:52 ET	Download
16-Jan-2018 ET	2018	182	3	TGax	CID related to the use of TSPEC for HE STAs	Guoqing Li (Apple)	16-Jan-2018 14:08:55 ET	Download
16-Jan-2018 ET	2018	182	2	TGax	CID related to the use of TSPEC for HE STAs	Guoqing Li (Apple)	16-Jan-2018 13:40:21 ET	Download
16-Jan-2018 ET	2018	216	0	TGax	CID related to the use of TSPEC for HE STAs--pptx	Guoqing Li (Apple)	16-Jan-2018 13:33:40 ET	Download
15-Jan-2018 ET	2018	182	1	TGax	CID related to the use of TSPEC for HE STAs	Guoqing Li (Apple)	15-Jan-2018 13:54:25 ET	Download
14-Jan-2018 ET	2018	182	0	TGax	CID related to the use of TSPEC for HE STAs	Guoqing Li (Apple)	15-Jan-2018 03:49:15 ET	Download
12-Sep-2017 ET	2017	1131	2	TGax	spec text CID 8426	Zhou Lan (Broadcom Ltd.)	12-Sep-2017 17:03:19 ET	Download
12-Sep-2017 ET	2017	1131	1	TGax	spec text CID 8426	Zhou Lan (Broadcom Ltd.)	12-Sep-2017 15:41:55 ET	Download
11-Jul-2017 ET	2017	1131	0	TGax	spec text CID 8426	Zhou Lan (Broadcom Ltd.)	12-Jul-2017 17:01:51 ET	Download
10-Jul-2017 ET	2017	1080	1	TGax	Providing Reference Waveform Generator For 11ax PHY Specification	Fei Tong (Samsung)	10-Jul-2017 08:31:09 ET	Download
10-Jul-2017 ET	2017	1080	0	TGax	Providing Reference Waveform Generator For 11ax PHY Specification	Fei Tong (Samsung)	10-Jul-2017 04:25:20 ET	Download
10-May-2017 ET	2017	766	2	TGax	spec text unify queue size report	Zhou Lan (Broadcom)	10-May-2017 03:20:20 ET	Download
10-May-2017 ET	2017	766	1	TGax	spec text unify queue size report	Zhou Lan (Broadcom)	10-May-2017 00:53:46 ET	Download
07-May-2017 ET	2017	290	5	TGax	CRs on TX specification	Yujin Noh (Newracom)	07-May-2017 19:24:21 ET	Download
07-May-2017 ET	2017	766	0	TGax	spec text unify queue size report	Zhou Lan (Broadcom)	09-May-2017 04:55:34 ET	Download
03-May-2017 ET	2017	290	4	TGax	CRs on TX specification	Yujin Noh (Newracom)	03-May-2017 01:55:49 ET	Download
26-Apr-2017 ET	2017	290	3	TGax	CRs on TX specification	Yujin Noh (Newracom)	26-Apr-2017 14:24:04 ET	Download
15-Mar-2017 ET	2017	290	2	TGax	CRs on TX specification	Yujin Noh (Newracom)	15-Mar-2017 19:45:59 ET	Download
13-Mar-2017 ET	2017	455	0	TGax	Some clarifications on current SR spec text	laurent cariou (Intel)	13-Mar-2017 14:03:10 ET	Download
10-Mar-2017 ET	2017	290	1	TGax	CRs on TX specification	Yujin Noh (Newracom)	10-Mar-2017 14:04:09 ET	Download
10-Mar-2017 ET	2017	317	1	TGax	CRs on Rx Specification	Bin Tian (Qualcomm)	10-Mar-2017 13:37:34 ET	Download
03-Mar-2017 ET	2017	317	0	TGax	CRs on Rx Specification	Bin Tian (Qualcomm)	08-Mar-2017 11:55:02 ET	Download
23-Feb-2017 ET	2017	290	0	TGax	CRs on TX specification	Yujin Noh (Newracom)	07-Mar-2017 19:21:47 ET	Download
08-Nov-2016 ET	2016	1383	2	TGax	spec text: MAC support of preamble puncture	Zhou Lan (Broadcom)	08-Nov-2016 16:19:33 ET	Download
08-Nov-2016 ET	2016	1427	2	TGax	Remove TBDs in PHY Transmit Spec.	Yujin Noh (Newracom)	08-Nov-2016 11:23:15 ET	Download
07-Nov-2016 ET	2016	1427	1	TGax	Remove TBDs in PHY Transmit Spec.	Yujin Noh (Newracom)	07-Nov-2016 19:07:52 ET	Download
07-Nov-2016 ET	2016	1402	1	TGax	11ax Receiver Specification	Bin Tian (Qualcomm)	07-Nov-2016 18:34:58 ET	Download
07-Nov-2016 ET	2016	1406	1	TGax	Spec Text for 11ax Receiver Requirements	Bin Tian (Qualcomm)	07-Nov-2016 18:34:09 ET	Download

07-Nov-2016 ET	2016	1383	1	TGax	spec text: MAC support of preamble puncture	Zhou Lan (Broadcom)	07-Nov-2016 17:46:19 ET	Download
06-Nov-2016 ET	2016	1443	0	TGax	spec text: Smoothness Recommendation for HE-LTF	Feng Jiang (intel corporation)	07-Nov-2016 02:41:25 ET	Download
06-Nov-2016 ET	2016	1442	0	TGax	Spec texts for section 25.4 BA	Jeongki Kim (LG Electronics)	06-Nov-2016 22:46:00 ET	Download
06-Nov-2016 ET	2016	1427	0	TGax	Remove TBDs in PHY Transmit Spec.	Yujin Noh (Newracom)	06-Nov-2016 23:10:52 ET	Download
05-Nov-2016 ET	2016	1406	0	TGax	Spec Text for 11ax Receiver Requirements	Bin Tian (Qualcomm)	07-Nov-2016 00:10:54 ET	Download
05-Nov-2016 ET	2016	1402	0	TGax	11ax Receiver Specification	Bin Tian (Qualcomm)	07-Nov-2016 00:09:51 ET	Download
05-Nov-2016 ET	2016	1390	0	TGax	Spec Text: Revision for NAV Setting Rule under Immediate Response	Po-Kai Huang (Intel)	07-Nov-2016 01:16:10 ET	Download
05-Nov-2016 ET	2016	1121	2	TGax	Spec Texts: Spatial Reuse Indication for Trigger	Po-Kai Huang (Intel)	07-Nov-2016 01:16:35 ET	Download
05-Nov-2016 ET	2016	1383	0	TGax	spec text: MAC support of preamble puncture	Zhou Lan (Broadcom)	07-Nov-2016 11:47:25 ET	Download
31-Oct-2016 ET	2016	1356	0	TGax	Spec text for HE NDP	Yongho Seok (NEWRACOM)	05-Nov-2016 15:38:46 ET	Download
31-Oct-2016 ET	2016	1355	0	TGax	Spec text for 10.22.2.5 and 3.2	Yongho Seok (NEWRACOM)	05-Nov-2016 15:38:25 ET	Download
15-Sep-2016 ET	2016	1242	1	TGax	spec text for packet extension factor calculation fix	Yan Zhang (Marvell)	15-Sep-2016 05:55:51 ET	Download
14-Sep-2016 ET	2016	884	5	TGax	Spec. Text for HE Operation element and AID Assign Rule	Jianhan Liu (Mediatek Inc.)	14-Sep-2016 10:19:39 ET	Download
14-Sep-2016 ET	2016	1191	2	TGax	Comment Resolution for CIDs on PHY Transmit Spec	Daewon Lee (Newracom)	14-Sep-2016 07:58:17 ET	Download
14-Sep-2016 ET	2016	884	4	TGax	Spec. Text for HE Operation element and AID Assign Rule	Jianhan Liu (Mediatek Inc.)	14-Sep-2016 03:35:42 ET	Download
14-Sep-2016 ET	2016	1191	1	TGax	Comment Resolution for CIDs on PHY Transmit Spec	Daewon Lee (Newracom)	14-Sep-2016 02:20:21 ET	Download
13-Sep-2016 ET	2016	1134	1	TGax	11ax spec text on sounding modes reduction	Yan Zhang (Marvell)	13-Sep-2016 04:52:32 ET	Download
12-Sep-2016 ET	2016	884	3	TGax	Spec. Text for HE Operation element and AID Assign Rule	Jianhan Liu (Mediatek Inc.)	12-Sep-2016 09:56:20 ET	Download
12-Sep-2016 ET	2016	1242	0	TGax	spec text for packet extension factor calculation fix	Yan Zhang (Marvell)	12-Sep-2016 04:57:05 ET	Download
12-Sep-2016 ET	2016	1234	0	TGax	Spec Text for TWT Protectioin field	Hanseul Hong(Yonsei Univ.)	12-Sep-2016 03:52:02 ET	Download
12-Sep-2016 ET	2016	884	2	TGax	Spec. Text for HE Operation element and AID Assign Rule	Jianhan Liu (Mediatek Inc.)	12-Sep-2016 03:07:32 ET	Download
11-Sep-2016 ET	2016	1191	0	TGax	Comment Resolution for CIDs on PHY Transmit Spec	Daewon Lee (Newracom)	12-Sep-2016 03:15:23 ET	Download
03-Sep-2016 ET	2016	1134	0	TGax	11ax spec text on sounding modes reduction	Yan Zhang (Marvell)	12-Sep-2016 04:36:46 ET	Download
02-Sep-2016 ET	2016	1121	1	TGax	Spec Texts: Spatial Reuse Indication for Trigger	Po-Kai Huang (Intel)	02-Sep-2016 18:19:00 ET	Download

29-Aug-2016 ET	2016	1121	0	TGax	Spec Texts: Spatial Reuse Indication for Trigger	Po-Kai Huang (Intel)	29-Aug-2016 22:12:32 ET	Download
11-Aug-2016 ET	2016	887	1	TGax	Spec Text for MU-RTS restriction on HE MU PPDU	Po-Kai Huang (Intel)	11-Aug-2016 11:11:00 ET	Download
27-Jul-2016 ET	2016	952	1	TGax	Spec text trigger frame per user info order	Zhou Lan (Broadcom)	27-Jul-2016 02:04:31 ET	Download
26-Jul-2016 ET	2016	884	1	TGax	Spec. Text for HE Operation element and AID Assign Rule	Jianhan Liu (Mediatek Inc.)	26-Jul-2016 15:13:12 ET	Download
25-Jul-2016 ET	2016	953	2	TGax	Comment Resoluaton and Spec Text for Setting for TXOP Duration field	Po-Kai Huang (Intel), Liwen Chu (Marvell), Jun Luo (Huawei)	25-Jul-2016 20:35:24 ET	Download
25-Jul-2016 ET	2016	897	1	TGax	Spec Text for Beamformee Capabilities	Hongyuan Zhang (Marvell)	25-Jul-2016 14:02:13 ET	Download
25-Jul-2016 ET	2016	953	1	TGax	Comment Resoluaton and Spec Text for Setting for TXOP Duration field	Po-Kai Huang (Intel), Liwen Chu (Marvell), Jun Luo (Huawei)	25-Jul-2016 18:07:45 ET	Download
25-Jul-2016 ET	2016	953	0	TGax	Comment Resoluaton and Spec Text for Setting for TXOP Duration field	Po-Kai Huang (Intel), Liwen Chu (Marvell), Jun Luo (Huawei)	25-Jul-2016 03:13:41 ET	Download
25-Jul-2016 ET	2016	952	0	TGax	Spec text trigger frame per user info order	Zhou Lan (Broadcom)	25-Jul-2016 09:44:04 ET	Download
23-Jul-2016 ET	2016	899	0	TGax	Spec Text for BW Field in HE-MU Format	Hongyuan Zhang (Marvell)	25-Jul-2016 03:07:35 ET	Download
23-Jul-2016 ET	2016	897	0	TGax	Spec Text for Beamformee Capabilities	Hongyuan Zhang (Marvell)	25-Jul-2016 03:06:25 ET	Download
23-Jul-2016 ET	2016	895	0	TGax	Spec Text for HE-LTF Capabilities	Hongyuan Zhang (Marvell)	25-Jul-2016 03:03:38 ET	Download
23-Jul-2016 ET	2016	892	0	TGax	Spec Text on LDPC for 1024QAM	Hongyuan Zhang (Marvell)	25-Jul-2016 03:02:23 ET	Download
23-Jul-2016 ET	2016	887	0	TGax	Spec Text for MU-RTS restriction on HE MU PPDU	Po-Kai Huang (Intel)	25-Jul-2016 02:03:51 ET	Download
23-Jul-2016 ET	2016	884	0	TGax	Spec. Text for HE Operation element and AID Assign Rule	Jianhan Liu (Mediatek Inc.)	23-Jul-2016 13:24:25 ET	Download
25-May-2016 ET	2015	132	17	TGax	Spec Framework	Robert Stacey (Intel)	25-May-2016 23:08:05 ET	Download
15-May-2016 ET	2016	639	0	TGax	Follow-up on HE-SIG-B user-specific field	Jinsoo Choi (LG Electronics)	16-May-2016 04:43:30 ET	Download
18-Mar-2016 ET	2015	132	16	TGax	Spec Framework	Robert Stacey (Intel)	18-Mar-2016 14:58:19 ET	Download
14-Mar-2016 ET	2016	343	1	TGax	Spectral mask discussions	Hongyuan Zhang (Marvell)	14-Mar-2016 01:37:08 ET	Download
12-Mar-2016 ET	2016	343	0	TGax	Spectral mask discussions	Hongyuan Zhang (Marvell)	13-Mar-2016 23:27:28 ET	Download
02-Mar-2016 ET	2016	24	1	TGax	Proposed draft specification	Robert Stacey (Intel)	02-Mar-2016 23:56:10 ET	Download
28-Jan-2016 ET	2015	132	15	TGax	Spec Framework	Robert Stacey (Intel)	28-Jan-2016 17:19:15 ET	Download
21-Jan-2016 ET	2015	132	14	TGax	Spec Framework	Robert Stacey (Intel)	21-Jan-2016 23:03:08 ET	Download
15-Jan-2016 ET	2016	24	0	TGax	Proposed draft specification	Robert Stacey (Intel)	17-Jan-2016 18:32:48 ET	Download
07-Dec-2015 ET	2015	132	13	TGax	Spec Framework	Robert Stacey (Intel)	07-Dec-2015 18:20:06 ET	Download
01-Dec-2015 ET	2015	132	12	TGax	Spec Framework	Robert Stacey (Intel)	01-Dec-2015 19:09:11 ET	Download
28-Nov-2015 ET	2015	132	11	TGax	Spec Framework	Robert Stacey (Intel)	28-Nov-2015 17:18:35 ET	Download

25-Nov-2015 ET	2015	132	10	TGax	Spec Framework	Robert Stacey (Intel)	25-Nov-2015 17:19:22 ET	Download
08-Nov-2015 ET	2015	1345	1	TGax	Trigger type specific information	Kiseon Ryu (LG Electronics)	08-Nov-2015 21:39:39 ET	Download
08-Nov-2015 ET	2015	1345	0	TGax	Trigger type specific information	Kiseon Ryu (LG Electronics)	08-Nov-2015 21:34:22 ET	Download

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Appendix BB

IEEE P802.11
Wireless LANs

Specification Framework for TGax

Date: 2016-01-28

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Abstract

This document provides the framework from which the draft TGax amendment will be developed. The document provides an outline of each the functional blocks that will be a part of the final amendment. The document is intended to reflect the working consensus of the group on the broad outline for the draft specification. As such it is expected to begin with minimal detail reflecting agreement on specific techniques and highlighting areas on which agreement is still required. It may also begin with an incomplete feature list with additional features added as they are justified. The document will evolve over time until it includes sufficient detail on all the functional blocks and their inter-dependencies so that work can begin on the draft amendment itself.

Revision history

Revision	Date	Changes
0	January 13, 2015	As approved by TG motion at the November 2014 meeting [1]
1	January 13, 2015	Added motioned text from PM1 session January 13, 2015
2	January 15, 2015	Added motioned text from January 14, 2014
3	March 27, 2015	Added motioned text from PM1 session March 12, 2015
4	March 27, 2015	Some corrections to the March PHY motion numbers and missing statement added.
5	May 14, 2015	Removed duplicate statement on OFDMA operation in bandwidths less than 20 MHz. Added text for motions passed during the May 2015 session.
6	July 9, 2015	Fixed typo in reference #14. Tomo Adachi notified the editor by email that MU Motion 5 was added in error since the motion failed. Text removed.
7	July 16, 2015	Added text for motions passed July 16, 2015
8	September 18, 2015	Nrow → Nrot (per email from Youhan Kim). Grouped statements in appropriate subsections. Added missing MAC Motion 23 from July (thanks again Tomo Adachi). Added text that passed motion on September 17, 2015 as found in 15/0987r6.
9	September 22, 2015	Updated based on comments from Hongyuan: missing 40 MHz for mandatory LDPC; RL-SIG in HE NDP PPDU format
10	November 24, 2015	Added PHY motions passed November 12, 2015. Automated heading numbering.
11	November 28, 2015	Added remaining motions from November meeting
12	December 1, 2015	Previous revision appears to be an incomplete, perhaps a interim saved version of the document rather than the completed version. Corrected with this release.
13	December 7, 2015	Added missing MAC Motion 29 from Spetember 2015 session. Fixed type on PHY Motion 80.
14	January 21, 2016	Added motioned text from January session.
15	January 28, 2016	Missed motion on slide 27 of 15/1516r3. Document referenced in motion is 16/0043r0.

1 Definitions

2 Abbreviations and acronyms

HE High Efficiency
UL Uplink
DL Dowlink
OFDMA Orthogonal Frequency-Division Multiple Access

3 High Efficiency (HE) Physical Layer

3.1 General

Section 3 describes the functional blocks in the physical layer.

The HE extended Range SU PPDU is transmitted only on the primary 20 MHz.

[PHY Motion 116, January 2016, see [2]]

The HE Extended Range SU PPDU can only be transmitted with MCS0, MCS1, MCS2 and only with 1 spatial stream.
[PHY Motion 117, January 2016, see [2]]

There are two STA classes that support HE trigger-based PPDU with information exchanged as part of the device capability

- Class A: STAs that are high capability devices and
- Class B: STAs that are low capability devices

[PHY Motion 118, January 2016, see [3]]

STAs that participate in HE trigger-based PPDU shall support per chain max(P-32,-10dBm) as the min Tx power, with P the max power the STA can transmit at the antenna connector of that chain using MCS0 while meeting the TX EVM and spectral mask requirements. A STA transmitting at and above the min power shall support the EVM requirements for TBD MCS (but at least MCS7).
[PHY Motion 119, January 2016, see [3]]

STAs that participate in HE trigger-based PPDU shall support the following absolute Tx power requirements and the RSSI measurement accuracy requirements for the two device classes

Parameter	11ax Minimum Requirements		Comments
	Class A devices	Class B devices	
Absolute Transmit Power accuracy	+/-3dB	+/-9dB	Accuracy of achieving a specified transmit power level
RSSI Measurement Accuracy	+/- 2 dB	+/- 5 dB	Difference between the actual RSSI and the measured RSSI Requirements are valid from minimum RX to maximum RX input power

[PHY Motion 120, January 2016, see [3]]

STAs that participate in HE trigger-based PPDU shall pre-compensate for carrier frequency offset (CFO) error and timing drift. After compensation, the absolute value of residual CFO error with respect to the corresponding Trigger frame shall not exceed 350 Hz for data subcarriers when measured as the 10% point of CCDF of CFO errors in AWGN at a received power of -60 dBm in the primary 20MHz. The residual CFO error measurement shall be made on the HE trigger-based PPDU packet after HE-SIGA.
[PHY Motion 121, January 2016, see [3]]

STA that participate in HE Trigger based PPDU transmission shall have timing accuracy of +/-0.4μs relative to the Trigger frame. This requirement does not include round trip delay.
[PHY Motion 122, January 2016, see [3]]

The following TX LO leakage requirements are supported for all transmission modes in 11ax:

- The power measured at the location of the RF LO using resolution BW 78.125 kHz shall not exceed the maximum of –32 dB relative to the total transmit power and -20 dBm, or equivalently max(P-32,-20), where *P* is the transmit power per antenna in dBm. The transmit center frequency leakage is specified per antenna.

[PHY Motion 123, January 2016, see [3]]

Transmit center frequency and the symbol clock frequency for all transmit antennas and frequency segments shall be derived from the same reference oscillator.
[PHY Motion 124, January 2016, see [3]]

The non-contiguous channel bonding will be supported in 802.11ax by:

- Transmitting using OFDMA PPDU format by nulling the tones of one or more secondary channels in 80 MHz and 160 (80+80) MHz;
- Modes for non-contiguous channel bonding are TBD;
- Non-contiguous channels within primary or secondary 80 MHz only exists at AP side.

[PHY Motion 125, January 2016, see [4]]

3.2 HE preamble

3.2.1 General

An HE PPDU shall include the legacy preamble (L-STF, L-LTF and L-SIG), duplicated on each 20 MHz, for backward compatibility with legacy devices. [PHY Motion #3, January 2015, see [5]]

In an HE PPDU, both the first and second OFDM symbols immediately following the L-SIG shall use BPSK modulation.

NOTE–This is to spoof all legacy (11a/n/ac) devices to treat an HE PPDU as a non-HT PPDU.

[PHY Motion 15, July 16, 2015, see [6]]

MU-MIMO shall only be supported on allocations sizes ≥ 106 tones.

[PHY Motion 35, July 16, 2015, see [7]]

The number of spatially multiplexed users in a DL or UL MU-MIMO transmission is up to 8 (in a given RU).

[PHY Motion 92, November 2015, see [8]]

There are only three pre-HE-STF preamble formats defined:

- SU format (mandatory) / Trigger based UL
- MU format (mandatory)
- Extended range SU format (mandatory)

[PHY Motion 68, November 2015, see [9], modified with PHY Motion 115, Janaury 2016, see [2]]

Editorial note: Let's refer to the associated PPDU formats as the HE SU PPDU, HE Trigger-based UL PPDU, HE MU PPDU and HE Extended Range SU PPDU. When discussing features associated with all formats, we use the term HE PPDU.

The signaling of the three preamble formats is illustrated in Figure 1.

- LSIG length set as mod3=1 means SU format. Set as mod3=2 means either MU format or extended range SU format
- QBPSK on HE-SIGA2 means extended range SU format

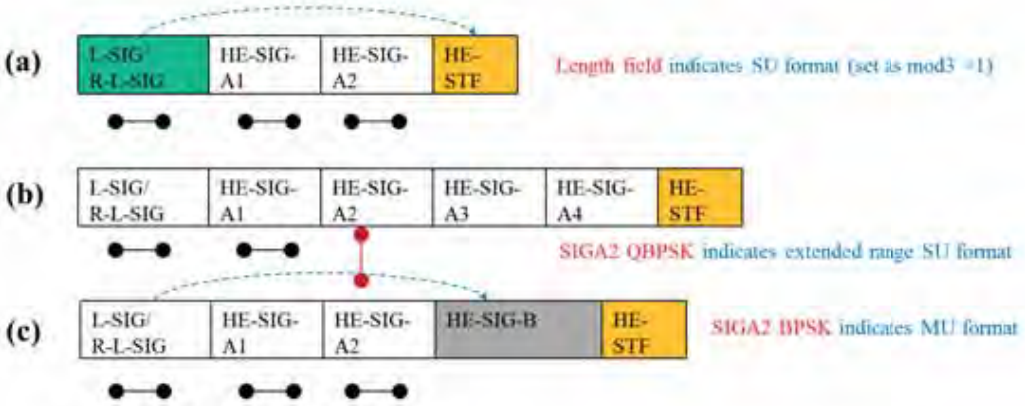

Figure 1 – Preamble format signaling

[PHY Motion 69, November 2015, see [9]]

The spec shall define an HE NDP PPDU for DL Sounding. The HE NDP PPDU format is based on the HE SU PPDU format and is shown in Figure 2. The presence and duration of packet extension at the end of HE NDP PPDU is TBD.

L-STF	L-LTF	L-SIG	RL-SIG	HE-SIG-A	HE-STF	HE-LTFs	Packet Extension

Figure 2 – HE NDP PPDU format

[PHY Motion 37, September 17, 2015, see [10], editorially changed TBD field to RL-SIG based on Motion 51]

If the Beam Change field in HE-SIG-A is 0 then the pre-HE-STF portion of the preamble shall be spatially mapped in the same way as HE-LTF1 on each tone.
[PHY Motion 84, November 2015, see [11]]

An HE PPDU has 4 extra subcarriers, two at each edge of each 20 MHz sub-channel for the L-SIG, RL-SIG, HE-SIG-A and HE-SIG-B fields:

- The 4 subcarriers added to the L-SIG and RL-SIG fields are transmitted with known TBD BPSK constellations (±1).
- The number of data subcarriers in HE-SIG-A and HE-SIG-B fields is increased by 4 in each 20 MHz sub-channel.
- The L-SIG, RL-SIG, HE-SIG-A and HE-SIG-B fields are always transmitted with same total power as L-LTF field (in cases when L-LTF is not being boosted).

[PHY Motion 72, November 2015, see [12]]

STBC is an optional feature in 11ax and it is ONLY defined for single spatial stream (Nss=1 and Nsts=2) In an HE MU PPDU, all RUs are either STBC or not STBC.
[PHY Motion 75, November 2015, see [13]]

3.2.2 L-STF and L-LTF

L-STF power is boosted by 3 dB in the extended range preamble.
[PHY Motion 66, November 2015, see [14]]

L-LTF power is boosted by 3 dB in the extended range preamble.
[PHY Motion 67, November 2015, see [14]]

3.2.3 L-SIG and repeated L-SIG

In L-SIG, the L_LENGTH field is set to a value not divisible by 3.
[PHY Motion 52, September 17, 2015, see [15], modified with first motion January 2016, see [16]]

The 11ax preamble shall have a 4 μs symbol repeating the L-SIG content right after the legacy section. This symbol shall be modulated by BPSK and rate ½ BCC.

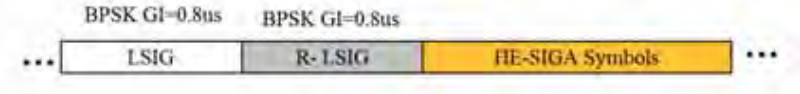

Figure 3 -- Repeated L-SIG

[PHY Motion 51, September 17, 2015, see [15]]

The content of 4 extra tones [-28,-27,27,28] of L-SIG and RL-SIG in 20 MHz HE PPDU is [-1,-1,-1,1].
[PHY Motion 114, January 2016, see [17]]

3.2.4 HE-SIG-A

HE-SIG-A (using a DFT period of 3.2 μs and subcarrier spacing of 312.5 kHz) is duplicated on each 20 MHz after the legacy preamble to indicate common control information.
[Motion #4, January 2015, see [5]]

HE-SIG-A is present in all 11ax packets and is two OFDM symbols long when it uses MCS0

- Information bits in HE-SIG-A are jointly encoded as in VHT-SIG-A (using 52 tones).
- SU packets and UL Trigger based packets do not contain HE-SIG-B symbols.

[PHY Motion 16, July 16, 2015, see [18], modified with first motion January 2016, see [16]]

~~HE-SIG-A shall include the following fields in an SU PPDU (the size of each field is TBD and other fields are TBD):~~

- ~~Format indication~~
- ~~TXOP duration~~
- ~~BW~~
- ~~Payload GI~~
- ~~PE~~
- ~~MCS~~
- ~~Coding~~
- ~~LTF Compression~~
- ~~NSTS~~
- ~~STBC~~
- ~~BF~~
- ~~CRC~~
- ~~Tail~~

[PHY Motion 43, September 17, 2015, see [19], removed with PHY Motion 96, November 2015]

~~HE-SIG-A shall include the following fields in an MU DL PPDU the size of each field is TBD and other fields are TBD):~~

- ~~Format indication~~
- ~~TXOP duration~~
- ~~Number of HE-SIG-B symbols~~
- ~~MCS of HE-SIG-B~~
- ~~CRC~~
- ~~Tail~~

[PHY Motion 44, September 17, 2015, see [19], removed with PHY Motion 97, November 2015]

The MCS of HE-SIG-B field indicates the following MCS values for HE-SIG-B:

- MCS0, MCS 1, MCS 2, MCS 3, MCS4, MCS5
- Other MCS is TBD

The MCS of HE-SIG-B field is 3 bits in length. If two MCS values for BW >= 40 MHz are to be signaled, additional TBD bits used.
[PHY Motion 88, November 2015, see [20]]

~~HE-SIG-A shall include the following fields in an MU-UL PPDU the size of each field is TBD and other fields are TBD):~~

- ~~Format indication~~
- ~~TXOP duration~~
- ~~CRC~~
- ~~Tail~~

[PHY Motion 45, September 17, 2015, see [19], removed with PHY Motion 98, November 2015]

~~The spec shall support adding a BSS Color field in the HE-SIG-A field. The BSS Color field is an identifier of the BSS (size TBD).~~
[PHY Motion 46, September 17, 2015, see [21], removed with PHY Motion 96, November 2015]

~~An UL/DL Flag field is present in the HE-SIG-A field of an HE SU PPDU. The UL/DL Flag field indicates whether the frame is UL or DL. The value of this field for TDLS is TBD.~~
[PHY Motion 48, September 17, 2015, see [21], removed with PHY Motion 96, November 2015]

~~HE-SIG-A includes a 1-bit DCM indication.~~
[PHY Motion 54, September 17, 2015, see [22], removed with PHY Motion 96, November 2015]

The format of the HE-SIG-A field for an HE SU PPDU is defined in Table 1.

Table 1 - HE-SIG-A field for an HE SU PPDU

Field	Length (bits)	Description	Encoding
DL/UL	1	Indicates whether the frame is UL or DL. The field is set to DL for TDLS. *NOTE: The TDLS peer can identify the TDLS frame by To DS and From DS fields in the MAC header of the MPDU.* [MAC Motion 57, November 2015, see [23]]	
Format	1	Differentiate between an SU PPDU and a Trigger-based UL PPDU. See [19].	
BSS Color	6	Base station identifier.	
Spatial Reuse	TBD	Exact bits TBD, e.g., indication of CCA Level, Interference Level accepted, TX Power	
TXOP Duration	TBD	Indicates the remaining time in the current TXOP. See [19].	

Bandwidth	2		
MCS	4		
CP+LTF Size	3		1x LTF + 0.8 μS 2x LTF + 0.8 μS 2x LTF + 1.6 μS 4x LTF + 3.2 μS
Coding	2		
Nsts	3		
STBC	1		
TxBF	1		
DCM	1	Dual carrier modulation indication	
Packet Extension	3	"a"-factor field of 2 bits and 1 disambiguation bit	
Beam Change	1	Indicate precoder change/no change between L-LTF and HE-LTF. See [11].	
CRC	4		
Tail	6		

[PHY Motion 96, November 2015, see [24]]

The format of the HE-SIG-A field for an HE MU PPDU is defined in Table 2.

Table 2 - HE-SIG-A field for an HE MU PPDU

Field	**Length (bits)**	**Description**	**Encoding**
DL/UL	1		
BSS Color	6	Base station identifier.	
Spatial Reuse	TBD		
TXOP Duration	TBD	Indicates the remaining time in the current TXOP. See [19].	
Bandwidth	≥ 2	May accommodate more than in SU case to take advantage of OFDMA	
SIGB MCS	3	See [20].	MCS0, MCS1, MCS2, MCS3, MCS4, MCS5 Other MCS TBD
SIGB DCM	1		
SIGB Number Of Symbols	4	Support about 16 users using MCS0 per BCC	
SIGB Compression Mode	≥ 1	Differentiates full bandwidth MU-MIMO from OFDMA MU PPDU. More compression modes TBD. See [25].	
Number of HE-LTF Symbols	3	Up to 8 LTF symbols possible	
CP+LTF Size	3		2x LTF + 0.8 μS 2x LTF + 1.6 μS 4x LTF + 3.2 μS
LPDC Extra Symbol	1		
Packet Extension	3		
CRC	4		
Tail	6		

[PHY Motion 97, November 2015, see [24]]

In an HE MU PPDU the HE-SIG-A field shall indicate the number of STAs when full bandwidth MU-MIMO compressed SIG-B mode is indicated. Details are TBD.
[PHY Motion 111, Janaury 2016, see [26]]

The format of the HE-SIG-A field for an HE Trigger-based UL PPDU is defined in Table 3.

Table 3 - HE-SIG-A fields for the HE Trigger-based UL PPDU

Field	Length (bits)	Description	Encoding
Format	1	Differentiate between an SU PPDU and a Trigger-based UL PPDU	
BSS Color	6	Base station identifier.	
Spatial Reuse	TBD		
TXOP Duration	TBD	Indicates the remaining time in the current TXOP. See [19].	
Bandwidth	TBD		
CRC	4		
Tail	6		

[PHY Motion 98, November 2015, see [24]]

HE-SIG-A includes a 1-bit Beam Change field. A value 1 indicates that spatial mapping is changed and a value 0 indictes that spatial mapping is unchanged.
[PHY Motion 83, November 2015, see [11]]

A compression bit is carried in the HE-SIG-A MU format to differentiate full BW MU-MIMO from OFDMA MU PPDU. In case of full BW MU-MIMO, the following conditions hold:

- Only applicable for RU sizes 242, 484, 996, 2*996
- The RU information in HE-SIG-B common is not signaled
- For bandwidths > 20 MHz, the user specific sub-fields are split equitably between the two HE-SIG-B Channels

[PHY Motion 87, November 2015, see [25]]

The HE-SIG-A field shall have a repetition mode for range extension. In the repetition mode, HE-SIG-A symbols are repeated once in time. The bit interleaver is bypassed in the repeated HE-SIG-A symbols.
[PHY Motion 55, September 17, 2015, see [27], modified with first motion January 2016, see [16]]

The CRC bits of HE-SIG-A and each coding group of HE-SIG-B are generated as 4 LSB of HT CRC generator output.
[PHY Motion 105, January 2016, see [28]]

3.2.5 HE-SIG-B

HE-SIG-B only has one CP size equal to 0.8 μS.
[PHY Motion 71, November 2015, see [9]]

Downlink HE MU PPDU shall include HE-SIG-B field, and the number of OFDM symbols of HE-SIG-B field is variable.
NOTE—The HE-SIG-B field includes information required to interpret HE MU PPDU, and detail is TBD.
[PHY Motion #8, March 2015, see [29]]

HE-SIG-B shall use a DFT period of 3.2 μs and subcarrier spacing of 312.5 kHz. [Motion #14, May 2015]

HE-SIG-B does not have any OFDM symbol duplicated in each 20 MHz of the PPDU bandwidth. [PHY Motion 18, July 16, 2015, see [18]]

HE-SIG-B is encoded on a per 20 MHz basis using BCC with common and user blocks separated in the bit domain. [PHY Motion 22, July 16, 2015, see [30]]

SIGB bits for each SIGB content channel are continuously encoded with 1 BCC encoder.
[PHY Motion 106, January 2016, see [31]]

For bandwidths ≥ 40 MHz, the number of 20 MHz subbands carrying different content is two and with structure as shown in Figure 4. Each square in the figure represents 20 MHz subband and 1/2 represents different signalling information. [PHY Motion 23, July 16, 2015, see [30]]

Figure 4 - 20 MHz subchannel content for HE-SIG-B for bandwidths ≥ 40 MHz

HE-SIG-B has a common field followed by a user specific field, where

- The common field includes the information for all of designated STAs to receive the PPDU in corresponding bandwidth
- The user specific field consists of multiple sub-fields that do not belong to the common field, where one or multiple of those sub-fields are for each designated receiving STA
- The boundary between the common and the user specific field is at the bit level and not the OFDM symbol level

[PHY Motion 19, July 16, 2015, see [32]]

The common field in HE-SIG-B contains Resource Unit (RU) allocation.
[PHY Motion 20, July 16, 2015, see [32]]

HE-SIG-B includes resource unit assignment and MCS per station for DL-OFDMA PPDU.
PHY Motion 21, July 16, 2015, see [33]]

The encoding structure of each BCC in HE-SIG-B is shown in Figure 5 and described below:

- Two users are grouped together and jointly encoded in each BCC block in the user specific section of HE-SIG-B
- The common block has a CRC separate from the CRC of the user specific blocks
- The last user information is immediately followed by a CRC and tail bits (regardless of whether the number of users is odd or even) and padding bits are only added after those tail bits

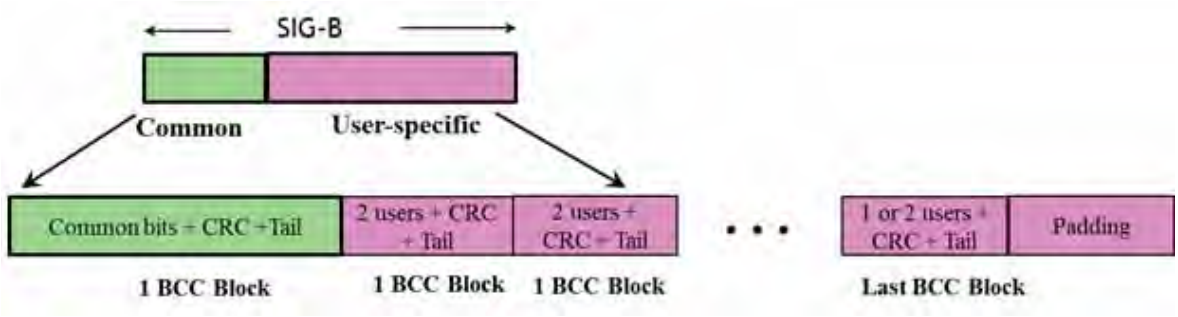

Figure 5 -- Encoding structure in HE-SIG-B

[PHY Motion 39, September 17, 2015, see [34], modified with PHY Motion 95, November 2015, see [35], modified with first motion January 2016, see [16]]

The user specific subfields of HE-SIG-B containing the per user dedicated information include the following fields:

- STAID
- For single-user allocations in an RU: NSTS (Number of Spatial Streams), TxBF (transmit beamforming), MCS (Modulation and Coding Scheme), DCM (Dual Sub-Carrier Modulation) and Coding (Use of LDPC)
- For each user in a multi-user allocation in an RU: Spatial Configuraiton Fields, MCS, DCM and Coding.
- Other fields are TBD.

[PHY Motion 40, September 17, 2015, see [36], modified with PHY Motion 91, see [37]]

The STAID field in the user specific subfields of HE-SIGB is 11 bits in length.
[PHY Motion 90, November 2015, see [37]]

For MU-MIMO allocation of RU size > 20 MHz, the user-specific subfields is dynamically split between two HE-SIG-B content channels (1/2) and the split is decided by the AP (on a per case basis).
[PHY Motion 41, September 17, 2015, see [36]]

The RU allocation signaling in the common field of HE-SIG-B signals an 8 bit, per 20 MHz PPDU BW for signaling

- The RU arrangement in frequency domain
- Number of MU-MIMO allocations: The RUs allocated for MU-MIMO and the number of users in the MU-MIMO allocations.

The mapping of the 8 bits to the arrangement and the number of MU-MIMO allocations is defined in Table 4. Signaling for the center 26 unit in 80 MHz is TBD.

Table 4 - Arrangement and number of MU-MIMO allocations

8 bits indices	#1	#2	#3	#4	#5	#6	#7	#8	#9	Num of entries
000 0 0000	26	26	26	26	26	26	26	26	26	1
000 0 0001	26	26	26	26	26	26	26	52		1
000 0 0010	26	26	26	26	26	52		26	26	1
000 0 0011	26	26	26	26	26	52		52		1
000 0 0100	26	26	52		26	26	26	26	26	1
000 0 0101	26	26	52		26	26	26	52		1
000 0 0110	26	26	52		26	52		26	26	1
000 0 0111	26	26	52		26	52		52		1
000 0 1000	52		26	26	26	26	26	26	26	1

000 0 1001	52		26	26	26	26	26	52						1
000 0 1010	52		26	26	26	52		26	26					1
000 0 1011	52		26	26	26	52		52						1
000 0 1100	52		52		26	26	26	26	26					1
000 0 1101	52		52		26	26	26	52						1
000 0 1110	52		52		26	52		26	26					1
000 0 1111	52		52		26	52		52						1
000 1 xxxx	Definition TBD													16
00100 yyy	26	26	26	26	26	106								8
00101 yyy	26	26	52		26	106								8
00110 yyy	52		26	26	26	106								8
00111 yyy	52		52		26	106								8
01000 yyy	106				26	26	26	26	26					8
01001 yyy	106				26	26	26	52						8
01010 yyy	106				26	52		26	26					8
01011 yyy	106				26	52		52						8
011 xxxxx	Definition TBD													32
10 yyy yyy	106				26	106								64
11 0 00yyy	242													8
11 0 01yyy	484													8
11 0 10yyy	996													8
11 0 11yyy	2*996													8
11 1 xxxxx	Definition TBD													32

‘yyy’ = 000~111 indicates number of MU-MIMO STAs.
Definition for entries with ‘x’ bits is TBD.
[PHY Motion 64, September 17, 2015, see [36], modified with PHY Motion 89, November 2015, see [37]]

At least 1 state is reserved in the 8 bit RU allocation subfield of the HE-SIG-B common field for “no STA-specific information field assigned by the RU allocation subfield’. Details are TBD.
[PHY Motion 110, January 2016, see [38]]

The resource allocation signaling in the common control field and user specific subfields for an STA carried in the HE-SIG-B are transmitted in the same 20 MHz sub-channel as the data for 20 MHz and 40 MHz PPDU. For an 80 MHz PPDU, the default mapping per 20 MHz is as shown in Figure 6.

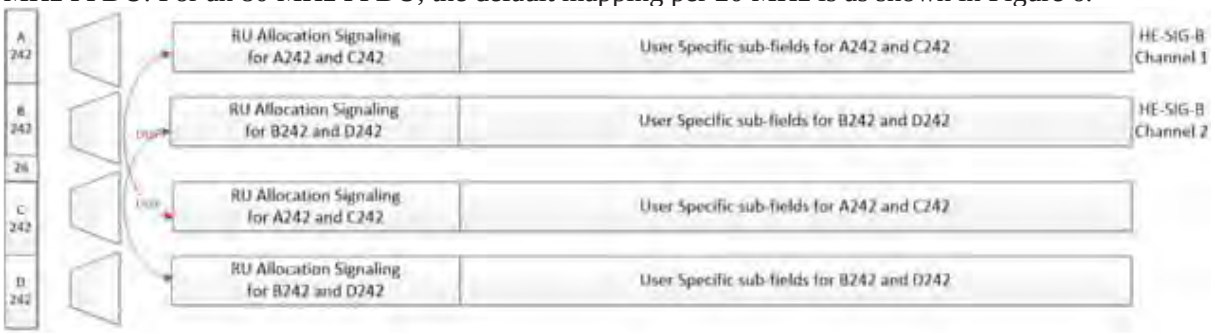

Figure 6 - Default mapping of the two HE-SIG-B channels for an 80 MHz HE PPDU

For a 160MHz PPDU, the default mapping per 20MHz is as shown in Figure 7.

Figure 7 - Default mapping of the two HE-SIG-B channels for a 160 MHz HE PPDU

[PHY Motion 86, November 2015, see [25]]

The length of the user specific subfield in HE-SIG-B for a single-user allocation is equal to the length of the user specific subfield of each user in a multi-user allocation.
[PHY Motion 65, September 17, 2015, see [36]]

The Nsts value for each user in a MU-MIMO RU is less than or equal to 4.
[PHY Motion 93, November 2015, see [8]]

A MU-MIMO user block includes a Spatial Config subfield of 4 bits indicating the number of spatial streams for each multiplexed STA. The subfield is constructed by using the entries corresponding to the value of Nuser of this RU in Table 5.

Table 5 - Spatial Config subfield encoding

Nuser	B0…B3	Nsts [1]	Nsts [2]	Nsts [3]	Nsts [4]	Nsts [5]	Nsts [6]	Nsts [7]	Nsts [8]	Number of Entries
2	0000~0011	1~4	1							10
	0100~0110	2~4	2							
	0111~1000	3~4	3							
	1001	4	4							
3	0000~0011	1~4	1	1						13
	0100~0110	2~4	2	1						
	0111~1000	3~4	3	1						
	1001~1011	2~4	2	2						
	1100	3	3	2						

4	0000~0011	1~4	1	1	1					11
	0100~0110	2~4	2	1	1					
	0111	3	3	1	1					
	1000~1001	2~3	2	2	1					
	1010	2	2	2	2					
5	0000~0011	1~4	1	1	1	1				6
	0100~0101	2~3	2	1	1	1				
6	0000~0010	1~3	1	1	1	1	1			4
	0011	2	2	1	1	1	1			
7	0000~0001	1~2	1	1	1	1	1	1		2
8	0000	1	1	1	1	1	1	1	1	1

[PHY Motion 94, November 2015, see [8]]

The STAID field that identifies the RU allocation in HE-SIG-B for broadcast traffic in DL OFDMA PPDU shall be defined as following:

- For single BSS AP, the STAID for Broadcast will be 0;
- For Multiple BSS AP, the STAID for Broadcast to a specific BSS will follow the group addressed AID assignment in the TIM according to the existing Multi-BSSID TIM operation;
- For Multiple BSS AP, the STAID for Broadcast to all BSSs of the AP will have a special STAID value reserved.

[MAC Motion 56, November 2015, see [39]]

3.2.6 HE preamble following the HE signalling fields

3.2.6.1 General

Gamma (tone rotation as defined in Clause 22.3.7.5 of 11ac amendment) is not applied on HE-STF and beyond.

- TBD in case of a duplicated HE PPDU (if ever defined)

[PHY Motion 82, November 2015, see [40]]

In all transmission modes, HE-STF and HE-LTF only populate RUs that are populated in the data field.
[PHY Motion 81, November 2015, see [40]]

HE-LTF/HE-STF power is boosted 3dB for BPSK and QPSK including DCM in the HE Extended Range SU PPDU preamble.
[PHY Motion 131, January 2016, see [2]]

3.2.6.2 HE-STF

HE-STF of a non-trigger-based PPDU has a periodicity of 0.8 μs with 5 periods.

- A non-trigger-based PPDU is not sent in response to a trigger frame

[PHY Motion #11, May 2015, see [41]]

The HE-STF of a trigger-based PPDU has a periodicity of 1.6 μs with 5 periods.

- A trigger-based PPDU is an UL PPDU sent in response to a trigger frame

[PHY Motion #12, May 2015, see [41]]

The HE-STF tone positions are defined in Equation 1 where N_{STF_sample} = 16 for a non-trigger-based PPDU and N_{STF_sample} = 8 for a trigger-based PPDU

$$i_{STF} \bmod N_{STF_sample} = 0, \quad \lfloor N_{DC} / 2 \rfloor < |i_{STF}| \le N_{SR} \qquad (1)$$

i_{STF} : HE-STF tone index

N_{DC} : number of DC tones

N_{SR} : highest data subcarrier index

[PHY Motion #13, May 2015, see [41]]

The HE-STF sequences for 0.8 μs and 1.6 μs periodicity are as follows:

$$M = \{-1,-1,-1,+1,+1,+1,-1,+1,+1,+1,-1,+1,+1,-1,+1\}$$

20 MHz 1x HE-STF sequence:

$$HES_{-112,112}(-112{:}16{:}112) = M \cdot (1+j) \cdot sqrt\left(\frac{1}{2}\right)$$

$$HES_{-112,112}(0) = 0$$

40 MHz 1x HE-STF sequence:

$$HES_{-240,240}(-240{:}16{:}240) = \{M, 0, -M\} \cdot (1+j) \cdot sqrt(\frac{1}{2})$$

80 MHz 1x HE-STF sequence:

$$HES_{-496,496}(-496{:}16{:}496) = \{M, 1, -M, 0, -M, 1, -M\} \cdot (1+j) \cdot sqrt(\frac{1}{2})$$

20 MHz 2x HE-STF sequence:

$$HES_{-120,120}(-120{:}8{:}120) = \{M, 0, -M\} \cdot (1+j) \cdot sqrt(\frac{1}{2})$$

40 MHz 2x HE-STF sequence:

$$HES_{-248,248}(-248{:}8{:}248) = \{M, -1, -M, 0, M, -1, M\} \cdot (1+j) \cdot sqrt\left(\frac{1}{2}\right)$$

$$HES_{-248,248}(\pm 248) = 0$$

80 MHz 2x HE-STF sequence:

$$HES_{-504,504}(-504{:}8{:}504) = \{M, -1, M, -1, -M, -1, M, 0, -M, 1, M, 1, -M, 1, -M\} \cdot (1+j) \cdot sqrt(\frac{1}{2})$$

$$HES_{-504,504}(\pm 504) = 0$$

[PHY Motion 79, November 2015, see [42]]

3.2.6.3 HE-LTF

The HE-LTF shall adopt a structure of using P matrix in the data tones as in 11ac. In the data tones, every space-time stream is spread over all HE-LTF symbols by one row of the P matrix as defined in 11ac. Different space-time streams use different rows in P matrix. [PHY Motion #5, March 2015, see [43]]

The HE PPDU shall support the following LTF modes:

- HE-LTF symbol duration of 6.4 μs excluding GI
  - Equivalent to modulating every other tone in an OFDM symbol of 12.8 μs excluding GI, and then removing the second half of the OFDM symbol in time domain
- HE-LTF symbol duration of 12.8 μs excluding GI

[PHY Motion #6, March 2015, see [43]]

In an HE PPDU, the HE-LTF section shall start at the same point of time and end at the same point of time across all users. [PHY Motion #7, March 2015, see [43]]

In an OFDMA PPDU using N HE-LTF symbols, an RU with $N_{sts,total}$ shall use the first $N_{sts,total}$ rows of the $N \times N$ P matrix. [PHY Motion 29, July 16, 2015, see [44]]

Single stream pilot (like 11ac) in HE-LTF shall be used for SU, DL and UL OFDMA as well as in DL MU-MIMO transmissions. [PHY Motion 26, July 16, 2015, see [45]]

The HE-LTF sequences for UL MU-MIMO shall be generated as follows. For each stream, a common sequence shall be masked repeatedly in a piece-wise manner by a distinct row of an 8x8 orthogonal matrix. When the length of the LTF sequence is not divisible by 8, the last *M* elements of the LTF sequence (*M* being the remainder after the division of LTF length by 8) shall be masked by the first *M* elements of the orthogonal matrix row.
[PHY Motion 56, September 17, 2015, see [46]]

The orthogonal matrix used to mask the HE-LTF sequence for UL MU-MIMO is the 8x8 P-matrix used in 11ac.
[PHY Motion 57, September 17, 2015, see [46], modified with first motion January 2016, see [16]]

For UL MU MIMO transmissions, support of single stream pilots and masking the LTF sequence of each spatial stream by a distinct orthogonal code is mandatory at the transmitter side (non AP STA). When single stream pilot is used, no masking is applied to the HE LTF. The Trigger frame shall use 1 bit to indicate whether the UL MU MIMO transmission following it uses single stream pilots or a mask on each spatial stream of the LTF sequence by a distinct orthogonal code.
[PHY Motion 126, January 2016, see [47]]

The 4x HE−LTF sequence for 80 MHz is defined by the equation below:

$HE{-}LTF_{996}(-500{:}500) =$

{+1, +1, −1, +1, −1, +1, −1, −1, −1, +1, −1, −1, −1, +1, +1, −1, +1, +1, +1, +1, +1, −1,
−1, +1, +1, +1, +1, −1, +1, −1, +1, −1, −1, +1, +1, −1, +1, +1, +1, −1, −1, +1, −1, −1, −1,
−1, +1, +1, +1, −1, −1, −1, −1, −1, −1, +1, +1, +1, +1, +1, +1, −1, +1, +1, +1, −1, +1, +1,
−1, −1, −1, +1, −1, +1, −1, −1, +1, +1, −1, +1, −1, +1, +1, +1, +1, +1, −1, −1, +1, +1, +1,
−1, +1, +1, −1, −1, −1, +1, −1, +1, +1, −1, +1, +1, −1, +1, −1, −1, +1, +1, +1, +1, −1, −1,
+1, +1, +1, +1, +1, −1, +1, +1, −1, −1, −1, +1, −1, −1, −1, +1, −1, +1, −1, +1, +1, −1, +1,
−1, +1, −1, +1, +1, +1, −1, +1, +1, +1, −1, −1, +1, −1, −1, −1, −1, −1, +1, +1, −1, −1, −1,
−1, +1, −1, +1, −1, +1, +1, −1, −1, +1, −1, −1, −1, +1, +1, −1, +1, +1, +1, +1, −1, −1, −1,
+1, +1, +1, +1, −1, +1, +1, +1, +1, +1, +1, +1, −1, +1, +1, +1, −1, +1, +1, −1, −1, −1, +1,
−1, +1, −1, −1, +1, +1, −1, +1, −1, +1, +1, +1, +1, +1, −1, −1, +1, +1, +1, −1, +1, +1, −1,
−1, −1, +1, −1, +1, +1, −1, +1, +1, −1, +1, −1, −1, +1, −1, +1, −1, +1, −1, +1, +1, +1, −1,
+1, +1, +1, −1, −1, +1, −1, −1, −1, −1, −1, +1, +1, −1, −1, −1, −1, +1, −1, +1, −1, +1, +1,
−1, −1, +1, −1, −1, −1, +1, +1, −1, +1, +1, +1, +1, −1, −1, −1, +1, +1, +1, +1, −1, +1, −1,
−1, −1, −1, −1, −1, +1, −1, −1, −1, +1, −1, −1, +1, +1, +1, −1, +1, −1, +1, +1, −1, −1, +1,
−1, +1, −1, −1, −1, −1, −1, +1, +1, −1, −1, −1, +1, −1, −1, +1, +1, +1, −1, +1, −1, −1, +1,
−1, −1, +1, −1, +1, +1, +1, +1, +1, +1, −1, −1, +1, +1, +1, +1, +1, −1, +1, +1, −1, −1, −1,
+1, −1, −1, −1, +1, −1, +1, −1, +1, +1, −1, +1, −1, +1, −1, +1, +1, +1, −1, +1, +1, +1,
−1, −1, +1, −1, −1, −1, −1, −1, +1, +1, −1, −1, −1, −1, +1, −1, +1, −1, +1, +1, −1, −1, +1,
−1, −1, −1, +1, +1, −1, +1, +1, +1, +1, −1, −1, −1, +1, +1, +1, +1, −1, −1, +1, +1, +1, +1,
+1, +1, −1, +1, +1, +1, −1, +1, +1, −1, −1, −1, +1, −1, +1, −1, −1, +1, +1, −1, +1, −1, +1,
+1, +1, +1, +1, −1, −1, +1, +1, +1, −1, +1, +1, −1, −1, −1, +1, −1, +1, +1, −1, +1, +1, −1,
+1, −1, −1, −1, +1, −1, +1, −1, −1, −1, −1, +1, +1, +1, −1, −1, +1, 0, 0, 0, 0, 0, +1, −1,
−1, −1, −1, −1, −1, +1, −1, +1, +1, −1, −1, +1, +1, −1, +1, −1, +1, +1, −1, −1, +1, −1, +1,
−1, −1, −1, +1, +1, −1, +1, +1, +1, −1, +1, +1, +1, +1, +1, +1, +1, −1, +1, −1, −1, +1, −1,
−1, +1, −1, +1, +1, +1, −1, −1, +1, −1, −1, −1, +1, +1, −1, −1, −1, −1, −1, +1, −1, −1, −1,
−1, −1, +1, +1, −1, −1, −1, −1, −1, +1, −1, −1, +1, +1, +1, −1, +1, +1, +1, −1, +1, −1, +1,
−1, −1, −1, −1, −1, +1, +1, +1, −1, −1, −1, −1, +1, −1, −1, +1, +1, +1, −1, +1, +1, −1, −1,
+1, −1, +1, −1, −1, −1, −1, −1, −1, −1, +1, +1, −1, −1, −1, +1, −1, −1, +1, +1, +1, −1, +1,
−1, −1, +1, −1, −1, +1, −1, +1, +1, +1, −1, +1, −1, −1, +1, +1, −1, +1, −1, +1, +1, +1, −1,
−1, +1, −1, −1, −1, +1, −1, −1, −1, −1, −1, −1, −1, +1, −1, +1, +1, −1, +1, +1, −1, +1, −1,
−1, −1, +1, +1, −1, +1, +1, +1, −1, −1, +1, +1, +1, +1, +1, −1, +1, −1, −1, −1, −1, +1, +1,

−1, −1, −1, −1, −1, +1, −1, −1, +1, +1, +1, −1, +1, +1, +1, −1, +1, −1, +1, −1, −1, −1, −1,
−1, +1, +1, +1, −1, −1, −1, −1, +1, −1, −1, +1, +1, +1, −1, +1, +1, −1, −1, +1, −1, +1, −1,
+1, +1, +1, −1, +1, −1, −1, +1, +1, −1, +1, −1, +1, +1, +1, −1, −1, +1, −1, −1, −1, +1, −1,
−1, −1, −1, −1, −1, −1, +1, −1, +1, +1, −1, +1, +1, −1, +1, −1, −1, −1, +1, +1, −1, +1, +1,
+1, −1, −1, +1, +1, +1, +1, +1, −1, +1, +1, +1, +1, +1, −1, −1, +1, +1, +1, +1, +1, −1, +1,
+1, −1, −1, −1, +1, −1, −1, −1, +1, −1, +1, −1, +1, +1, +1, +1, +1, −1, −1, −1, +1, +1, +1,
+1, −1, +1, +1, −1, −1, −1, +1, −1, −1, +1, +1, −1, +1, −1, +1, −1, −1, −1, −1, −1, −1, +1,
+1, −1, −1, −1, +1, −1, −1, +1, +1, +1, −1, +1, −1, −1, +1, −1, −1, +1, −1, +1, −1, +1, −1,
+1, −1, −1, +1, +1, −1, +1, −1, +1, +1, +1, −1, −1, +1, −1, −1, −1, +1, −1, −1, −1, −1, −1,
−1, −1, +1, −1, +1, +1, −1, +1, +1, −1, +1, −1, −1, −1, +1, +1, −1, +1, +1, +1, −1, −1, +1,
+1, +1, +1, +1, −1, +1, −1, −1, −1, −1, +1, +1, −1, −1, −1, −1, −1, +1, −1, −1, +1, +1, +1,
−1, +1, +1, +1, −1, +1, −1, +1, −1, −1, −1, −1, −1, +1, +1, +1, −1, −1, −1, −1, +1, −1, −1,
+1, +1, +1, −1, +1, +1, −1, −1, +1, −1, +1, −1, +1, −1, +1, +1, −1, +1, −1, −1, −1, +1, −1}

The 2x HE−LTF sequence for 80 MHz is defined by the equation below:

$HE{-}LTF_{996}(-500{:}2{:}500)$ =

{+1, +1, −1, +1, +1, +1, −1, +1, +1, +1, +1, −1, −1, −1, +1, −1, −1, +1, +1, −1, +1, +1,
+1, −1, −1, −1, −1, +1, +1, +1, +1, −1, +1, +1, +1, −1, +1, −1, −1, +1, −1, −1, −1, +1, +1,
−1, −1, −1, +1, −1, −1, +1, −1, +1, +1, −1, +1, +1, −1, +1, −1, −1, −1, +1, −1, −1, −1, −1,
+1, −1, −1, +1, +1, −1, +1, +1, +1, −1, −1, −1, −1, +1, −1, +1, +1, +1, −1, +1, +1, +1, +1,
−1, −1, −1, +1, +1, +1, −1, −1, +1, +1, +1, −1, +1, +1, −1, +1, −1, −1, −1, −1, +1, −1, −1,
−1, +1, −1, +1, +1, −1, +1, +1, −1, −1, −1, +1, −1, −1, −1, +1, −1, +1, +1, −1, +1, +1, +1,
−1, −1, +1, +1, +1, −1, +1, +1, −1, +1, −1, −1, +1, −1, +1, +1, +1, −1, +1, +1, +1, +1, −1,
−1, −1, +1, −1, −1, +1, +1, −1, +1, +1, +1, −1, −1, −1, −1, +1, +1, +1, −1, −1, −1, −1, +1,
−1, −1, −1, +1, −1, +1, +1, +1, −1, −1, +1, +1, +1, −1, +1, +1, −1, +1, −1, −1, −1, −1, +1,
−1, −1, −1, +1, −1, +1, +1, −1, +1, +1, −1, +1, +1, −1, −1, +1, −1, −1, −1, +1, +1, +1, +1,
−1, +1, −1, −1, −1, +1, −1, −1, −1, −1, +1, +1, +1, +1, −1, −1, −1, +1, +1, +1, 0, 0, 0, +1,
−1, −1, +1, +1, −1, +1, −1, −1, −1, +1, +1, +1, +1, −1, +1, +1, +1, −1, +1, −1, −1, −1, −1,
+1, +1, +1, −1, +1, +1, −1, −1, +1, −1, −1, +1, −1, −1, +1, −1, +1, +1, +1, −1, +1, +1, +1,
+1, −1, +1, −1, −1, +1, −1, −1, −1, +1, +1, −1, −1, −1, +1, −1, +1, +1, +1, −1, +1, +1, +1,
+1, −1, −1, −1, +1, +1, +1, +1, −1, −1, −1, +1, −1, −1, +1, +1, −1, +1, +1, +1, −1, −1, −1,
−1, +1, −1, −1, −1, +1, −1, +1, +1, −1, +1, −1, −1, +1, −1, −1, −1, +1, +1, −1, −1, −1, +1,
−1, −1, +1, −1, +1, +1, +1, −1, +1, +1, +1, −1, +1, −1, +1, +1, −1, +1, −1, −1, −1, +1, −1,
−1, −1, −1, +1, −1, +1, +1, −1, +1, +1, +1, −1, −1, +1, +1, +1, −1, +1, +1, +1, −1, −1, +1, +1,
−1, +1, +1, +1, −1, +1, −1, −1, −1, −1, +1, +1, +1, −1, +1, +1, −1, −1, +1, −1, −1, −1, −1,
+1, −1, −1, −1, +1, −1, +1, +1, −1, +1, +1, −1, +1, −1, −1, +1, −1, −1, −1, +1, +1, −1, −1,
−1, +1, −1, −1, +1, −1, +1, +1, +1, −1, +1, +1, +1, +1, −1, −1, −1, −1, +1, +1, +1, −1, +1,
+1, −1, −1, +1, −1, −1, −1, +1, +1, +1, +1, −1, +1, +1, +1, −1, +1, +1}

The 4x HE−LTF sequence for 40 MHz is defined by the equation below:

$HE{-}LTF_{484}(-244{:}244)$ =

{ +1, −1, −1, −1, −1, +1, −1, −1, +1, +1, −1, +1, −1, +1, −1, +1, +1, −1, +1, −1, −1, −1,
+1, +1, −1, −1, −1, −1, −1, −1, −1, +1, −1, −1, +1, +1, −1, +1, −1, −1, −1, −1, −1, +1, −1,
+1, +1, +1, −1, −1, +1, +1, +1, −1, −1, +1, +1, +1, +1, −1, +1, +1, −1, −1, +1, −1, +1, −1,
+1, −1, −1, +1, −1, +1, +1, +1, −1, −1, +1, +1, +1, −1, −1, −1, −1, +1, −1, −1, +1, +1, −1,
+1, −1, −1, −1, −1, −1, +1, −1, +1, +1, +1, −1, −1, +1, +1, +1, +1, +1, +1, +1, +1, −1, +1,
+1, −1, −1, +1, −1, +1, +1, +1, +1, +1, −1, +1, −1, −1, −1, +1, +1, −1, −1, −1, −1, −1, −1,
−1, −1, +1, −1, −1, +1, +1, −1, +1, −1, +1, −1, +1, +1, −1, +1, −1, −1, −1, +1, +1, −1, −1,
−1, −1, −1, −1, −1, +1, −1, −1, +1, +1, −1, +1, −1, −1, −1, −1, −1, +1, −1, +1, +1, +1, −1,
−1, +1, +1, +1, −1, −1, −1, −1, −1, −1, +1, −1, −1, +1, +1, −1, +1, −1, +1, −1, +1, +1, −1,
+1, −1, −1, −1, +1, +1, −1, −1, −1, +1, +1, +1, +1, −1, +1, +1, −1, −1, +1, −1, +1, +1, +1,
+1, +1, −1, +1, −1, −1, −1, +1, +1, −1, −1, −1, +1, 0, 0, 0, 0, 0, −1, +1, +1, +1, +1, −1,
+1, +1, −1, −1, +1, −1, +1, −1, +1, −1, −1, +1, −1, +1, +1, +1, −1, −1, +1, +1, +1, +1, +1,
+1, +1, −1, +1, +1, −1, −1, +1, −1, +1, +1, +1, +1, +1, −1, +1, −1, −1, −1, +1, +1, −1, −1,

−1, +1, +1, −1, −1, −1, −1, +1, −1, −1, +1, +1, −1, +1, −1, +1, −1, +1, +1, −1, +1, −1, −1,
−1, +1, +1, −1, −1, −1, +1, +1, +1, +1, −1, +1, +1, −1, −1, +1, −1, +1, +1, +1, +1, +1, −1,
+1, −1, −1, −1, +1, +1, −1, −1, −1, +1, −1, −1, −1, −1, +1, −1, −1, +1, +1, −1, +1, −1, +1,
−1, +1, +1, −1, +1, −1, −1, −1, +1, +1, −1, −1, −1, +1, −1, −1, −1, −1, +1, −1, −1, +1, +1,
−1, +1, −1, +1, −1, +1, +1, −1, +1, −1, −1, −1, +1, +1, −1, −1, −1, −1, −1, −1, −1, +1, −1,
−1, +1, +1, −1, +1, −1, −1, −1, −1, −1, +1, −1, +1, +1, +1, −1, −1, +1, +1, +1, −1, +1, −1,
−1, −1, −1, +1, −1, −1, +1, +1, −1, +1, −1, +1, −1, +1, +1, −1, +1, −1, −1, −1, +1, +1, −1,
−1, −1, +1, +1, +1, +1, −1, +1, +1, −1, −1, +1, −1, +1, +1, +1, +1, +1, −1, +1, −1, −1, −1,
+1, +1, −1, −1, −1, −1}

The 2x HE−LTF sequence for 40 MHz is defined by the equation below:

HE−LTF$_{484}$(−244:2:244) =

{+1, −1, −1, −1, −1, −1, +1, +1, −1, −1, +1, −1, +1, −1, −1, −1, −1, −1, −1, +1, +1, +1,
+1, −1, +1, −1, +1, +1, −1, −1, −1, −1, −1, +1, +1, −1, −1, +1, −1, +1, −1, +1, +1, +1, +1,
+1, −1, −1, −1, −1, +1, −1, +1, −1, +1, +1, +1, +1, +1, −1, +1, −1, −1, +1, −1, +1, −1, −1,
+1, +1, +1, +1, +1, −1, −1, +1, +1, −1, +1, −1, +1, +1, +1, +1, +1, +1, +1, −1, −1, −1, −1, +1,
−1, +1, −1, −1, −1, −1, −1, −1, −1, +1, +1, −1, −1, +1, −1, +1, −1, +1, +1, +1, +1, +1, −1,
−1, −1, −1, +1, −1, +1, −1, 0, 0, 0, −1, −1, −1, −1, −1, +1, +1, −1, −1, +1, −1, +1, −1, −1,
−1, −1, −1, −1, +1, −1, +1, +1, −1, +1, −1, +1, +1, +1, +1, +1, +1, +1, −1, −1, +1, +1, −1,
+1, −1, +1, −1, −1, −1, −1, −1, +1, −1, +1, +1, −1, +1, −1, +1, +1, +1, +1, +1, +1, +1, −1,
−1, +1, +1, −1, +1, −1, +1, −1, −1, −1, −1, −1, +1, +1, −1, −1, +1, −1, +1, −1, −1, −1, −1,
−1, −1, +1, −1, +1, +1, −1, +1, −1, +1, +1, −1, −1, −1, −1, −1, +1, +1, −1, −1, +1, −1, +1,
−1, +1, +1, +1, +1, +1, −1, +1, −1, −1, +1, −1, +1, −1, +1}

The 4x HE−LTF sequence for 20 MHz is defined by the equation below:

HE−LTF$_{242}$(−122:122) =

{−1, −1, +1, −1, +1, −1, +1, +1, +1, −1, +1, +1, +1, −1, −1, +1, −1, −1, −1, −1, −1, +1,
+1, −1, −1, −1, −1, +1, +1, −1, +1, −1, +1, +1, +1, +1, −1, +1, −1, −1, +1, +1, −1, +1, +1,
+1, +1, −1, −1, +1, −1, −1, −1, +1, +1, +1, +1, −1, +1, +1, −1, −1, −1, −1, +1, −1, −1, +1,
+1, −1, +1, −1, −1, −1, −1, +1, −1, +1, −1, −1, −1, −1, −1, −1, +1, +1, −1, −1, −1, −1, −1,
+1, −1, −1, +1, +1, +1, −1, +1, +1, +1, −1, +1, −1, +1, −1, −1, −1, −1, −1, +1, +1, +1, −1,
−1, −1, +1, −1, +1, +1, +1, 0, 0, 0, −1, +1, −1, +1, −1, +1, +1, −1, +1, +1, +1, −1, −1, +1,
−1, −1, +1, −1, +1, −1, +1, +1, +1, −1, +1, +1, +1, −1, −1, +1, −1, −1, −1, −1, −1, +1, +1,
−1, −1, −1, −1, −1, −1, +1, −1, +1, −1, −1, −1, −1, +1, −1, +1, +1, −1, −1, +1, −1, −1, −1,
−1, +1, +1, −1, +1, +1, +1, +1, +1, +1, +1, −1, +1, +1, −1, −1, −1, −1, +1, −1, −1, +1, +1,
−1, +1, −1, −1, −1, −1, +1, −1, +1, −1, −1, +1, +1, +1, +1, −1, −1, +1, +1, +1, +1, +1, −1,
+1, +1, −1, −1, −1, +1, −1, −1, −1, +1, −1, +1, −1, +1, +1}

The 2x HE−LTF sequence for 20 MHz is defined by the equation below:

HE−LTF$_{242}$(−122:2:122) =

{−1, − 1, −1, +1, +1, −1, +1, −1, −1, −1, −1, +1, −1, +1, −1, −1, +1, +1, −1, +1, +1, +1,
+1, +1, −1, +1, −1, +1, −1, −1, +1, +1, −1, +1, −1, −1, −1, −1, +1, −1, +1, +1, +1, −1, −1,
+1, −1, −1, −1, −1, −1, +1, −1, −1, −1, +1, +1, +1, −1, −1, +1, 0, +1, −1, +1, +1, −1, +1,
+1, −1, +1, +1, −1, −1, +1, −1, +1, +1, +1, +1, −1, +1, −1, +1, +1, −1, −1, +1, −1, −1, −1,
−1, −1, +1, −1, +1, +1, −1, −1, +1, +1, −1, +1, −1, −1, −1, −1, +1, −1, +1, +1, +1, −1, −1,
+1, −1, −1, −1, −1, −1, +1, −1, +1, −1, −1, −1, −1, +1, −1, +1, +1, −1, −1, +1, −1, −1, −1}

[PHY Motion 80, November 2015, see [40]]

4x HE-LTF$_{160MHz}$(-1012:1:1012) =[4x LTF$_{80MHz_primary}$, zeros(1,23), 4x LTF$_{80MHz_secondary}$]

4x LTF$_{80MHz_primary}$ = [L-LTF$_{80M}$, 0, R-LTF$_{80M}$] as agreed for 80MHz 4x HE-LTF;

4x LTF$_{80MHz_secondary}$ = [L-LTF$_{80M}$, 0, (-1)* R-LTF$_{80M}$]

4x HE-LTF$_{80+80MHz}$ = [4x LTF$_{80MHz_primary}$, 4x LTF$_{80MHz_secondary}$]

[PHY Motion 107, January 2016, see [48]]

2x HE-LTF$_{160MHz}$(-1012:2:1012) = [2x LTF$_{80MHz_primary}$, zeros(1,11), 2x LTF$_{80MHz_secondary}$]

2x LTF$_{80MHz_primary}$ as agreed for 80MHz 2x HE-LTF = [{1st 242-RU}, {2nd 242-RU}, {central 26-RU}, {3rd 242-RU}, {4th 242-RU}];

2x LTF$_{80MHz_secondary}$ = [{1st 242-RU}, (-1)*{2nd 242-RU}, {central 26-RU}, {3rd 242-RU}, (-1)*{4th 242-RU}];

2x HE-LTF$_{80+80MHz}$= [2x LTF$_{80MHz_primary}$, 2x LTF$_{80MHz_secondary}$]

[PHY Motion 108, Janaury 2016, see [48]]

1x HE-LTF20MHz(-120:4:120) =

[-1, +1, +1, -1, +1, -1, +1, +1, +1, +1, -1, -1, +1, +1, +1, -1, -1, -1, +1, -1, -1, +1, +1, -1, -1, +1, -1, -1, +1, -1, +1, -1, 0, -1, +1, +1, +1, +1, +1, +1, -1, -1, -1, -1, -1, +1, -1, -1, -1, +1, -1, -1, +1, -1, -1, +1, -1, +1, -1, -1, -1, -1, -1] ;

1x HE-LTF40MHz(-244:4:244) =

[+1, +1, +1, +1, -1, +1, +1, -1, -1, +1, -1, +1, -1, +1, -1, -1, +1, -1, +1, +1, +1, -1, -1, +1, +1, +1, +1, +1, +1, +1, -1, +1, +1, -1, -1, +1, -1, +1, -1, +1, -1, -1, +1, -1, +1, +1, +1, -1, -1, +1, +1, +1, +1, -1, +1, -1, +1, -1, +1, -1, -1, -1, 0, +1, +1, -1, -1, +1, -1, +1, +1, +1, +1, +1, +1, -1, +1, +1, -1, -1, +1, -1, +1, +1, +1, +1, +1, -1, +1, -1, -1, -1, +1, +1, -1, -1, -1, +1, -1, -1, -1, -1, +1, -1, -1, +1, +1, -1, +1, -1, -1, -1, -1, -1, +1, -1, +1, +1, +1, +1, +1, -1, -1, +1, +1, +1]

1x HE-LTF80MHz(-500:4:500) =

[-1, -1, +1, +1, +1, +1, +1, -1, -1, -1, +1, +1, -1, -1, +1, -1, +1, -1, -1, -1, -1, -1, -1, +1, +1, -1, -1, +1, -1, +1, -1, -1, -1, -1, -1, +1, +1, -1, -1, +1, -1, +1, -1, +1, +1, +1, +1, +1, -1, -1, +1, +1, -1, +1, -1, -1, -1, -1, +1, -1, -1, -1, -1, -1, -1, +1, +1, +1, -1, -1, +1, -1, +1, -1, +1, +1, +1, +1, -1, +1, +1, -1, +1, -1, +1, -1, +1, +1, +1, +1, +1, -1, -1, +1, -1, -1, +1, +1, -1, +1, -1, -1, -1, -1, +1, -1, +1, -1, +1, +1, +1, +1, -1, +1, -1, +1, -1, -1, -1, -1, -1, +1, +1, -1, -1, +1, -1, +1, -1, +1, +1, +1, +1, -1, +1, -1, -1, +1, -1, -1, -1, +1, -1, +1, -1, +1, +1, +1, +1, +1, +1, +1, -1, -1, +1, +1, -1, +1, -1, +1, -1, -1, -1, +1, +1, -1, +1, -1, +1, -1, -1, -1, +1, +1]

[PHY Motion 109, January 2016, see [48]]

The only mandatory combinations of LTF size and CP size are:

- 2x LTF + 0.8 μS
- 2x LTF + 1.6 μS
- 4x LTF + 3.2 μS

with HE-LTF and payload using the same CP size. The LTF size and CP size are jointly signaled using 3 bits.

[PHY Motion 70, November 2015, see [9]]

A 1x LTF as an optional mode in 11ax for SU PPDUs (TBD for MU-MIMO). The 1x LTF + 0.8 μs GI is one optional combination as indicated by the "GI and LTF size" sub-field in HE-SIG-A.

[PHY Motion 85, November 2015, see [11]]

11ax allows 1xLTF as an optional mode in the following cases:

- SU, with GI = 0.8 μs only
- Full-BW UL-MUMIMO, with GI=1.6 μs only
- Full BW DL-MUMIMO with GI=0.8 μs is TBD

[PHY Motion 103, January 2016, see [49]]

When 1x/2x HE-LTF is transmitted, it is recommended that the spatial mapping matrix applied to HE-STF and beyond is chosen such that it preserves the smoothness of the physical channel, achieved by limiting the variation of each element's real and imaginary values in the spatial mapping matrix across successive tones.

[PHY Motion 104, January 2016, see [50]]

3.3 HE Data field

3.3.1 General

The Data field in UL MU transmissions shall immediately follow the HE-LTF section.
[PHY Motion 17, July 16, 2015, see [18]]

Data symbols in an HE PPDU shall use a DFT period of 12.8 μs and subcarrier spacing of 78.125 kHz.
[PHY Motion #1, January 2015, see [51]]

Data symbols in an HE PPDU shall support guard interval durations of 0.8 μs, 1.6 μs and 3.2 μs. [PHY Motion #2, January 2015, see [51]]

HE PPDUs shall have single stream pilots in the data section

- All streams use the same pilot sequence even in UL MU-MIMO

[PHY Motion 24, July 16, 2015, see [52]]

3.3.2 Tone plan

3.3.2.1 Resource unit, edge and DC tones

HE-PPDU for UL-OFDMA shall support UL data transmission below 20 MHz for an HE STA. [MU Motion #3, March 2015]

Define 20 MHz OFDMA building blocks as follows:

- 26-tone with 2 pilots, 52-tone with 4 pilot and 106-tone with 4 pilots and with 7 DC Nulls and (6,5) guard tones, and at locations shown in Figure 8
- An OFDMA PPDU can carry a mix of different tone unit sizes within each 242 tone unit boundary
- ~~The following is TBD: Exact location of extra leftover tones~~ *[Ed: deleted, see 3.3.2.2]*

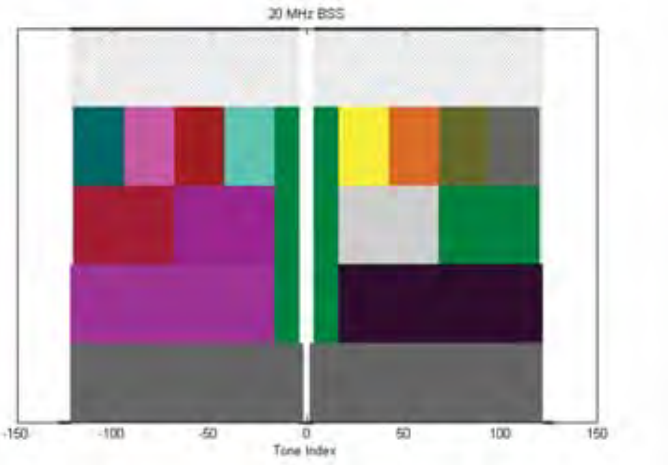

Figure 8 – 20 MHz tone plan

Define 40 MHz OFDMA building blocks as follows

- 26-tone with 2 pilots, 52-tone with 4 pilots, 106-tone with 4 pilots and 242-tone with 8 pilots and with 5 DC Nulls and (12,11) guard tones, and at locations shown in Figure 9
- ~~The following is TBD: exact location of extra leftover tones~~ *[Ed: deleted, see 3.3.2.2]*

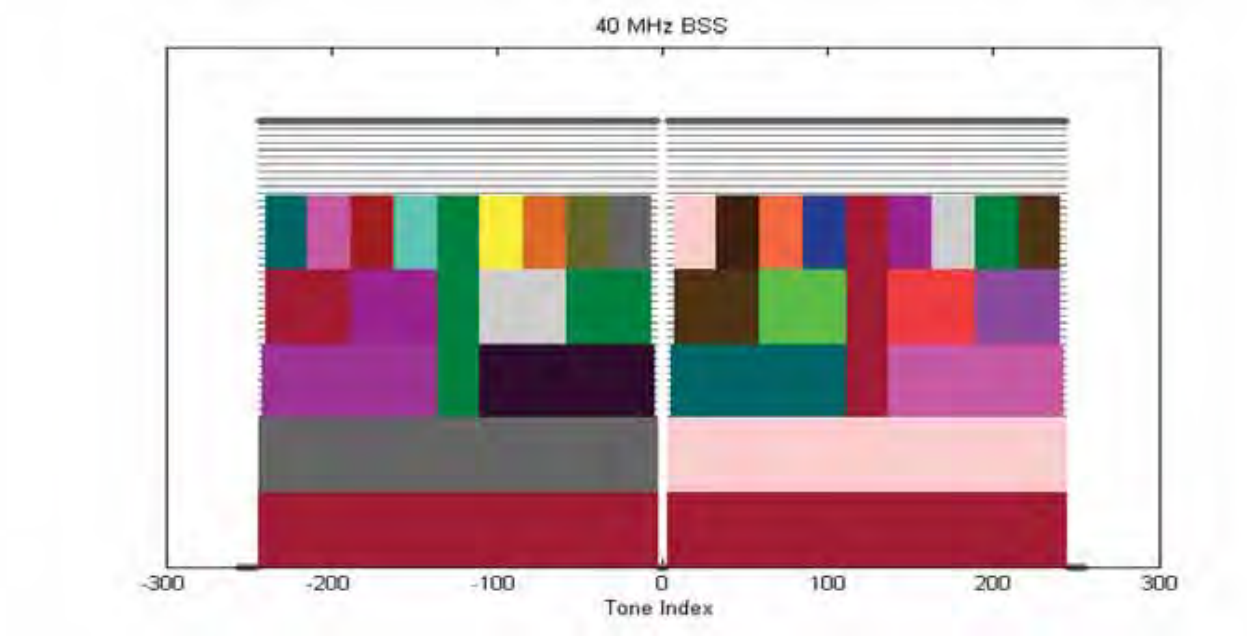

Figure 9 – 40 MHz tone plan

Define 80 MHz OFDMA building blocks as follows:

- 26-tone with 2 pilots, 52-tone with 4 pilots, 106-tone with 4 pilots, 242-tone with 8 pilots and 484-tone with 16 pilots and with 7 DC Nulls and (12,11) guard tones, and at locations shown in Figure 10
- ~~The following is TBD: exact location of extra leftover tones~~ *[Ed: deleted, see 3.3.2.2]*

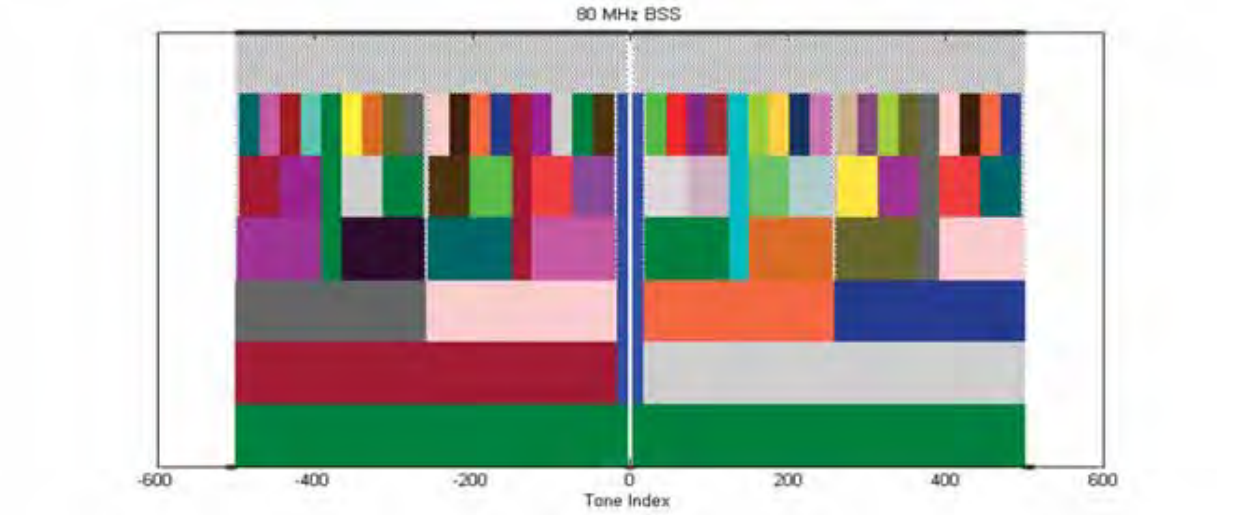

Figure 10 - 80 MHz tone plan

Define 160 MHz/80 MHz+80 MHz OFDMA building blocks as follows:

- 26-tone with 2 pilots
- 52-tone with 4 pilots
- 106-tone with 4 pilots
- 242-tone with 8 pilots
- 484-tone with 16 pilots
- 996-tone with 16 pilots (note that 996-tone is defined for 80 MHz HE-SA-PPDU or 80 MHz HE-SA-MU-PPDU)
- The following is TBD: exact location of extra leftover tones

[PHY Motion #10, May 2015, see [53]]

The 2x996-tone RU employs a segment parser (as in 11ac) between the two 996-tone frequency segments and the LDPC tone mapper in each 996-tone segment uses $D_{TM} = 20$.
[PHY Motion 74, November 2015, see [54]]

Multiple RU allocation for one STA shall not be allowed in 11ax.
[PHY Motion 128, January 2016, see [55]]

3.3.2.2 Left over tones

The left over tone locations for the 20 MHz, 40 MHz and 80 MHz tone plans are shown in Figure 11, Figure 12 and Figure 13 respectively.
NOTE—Left over tones have zero energy
[PHY Motion 25, July 16, 2015, see [45]]

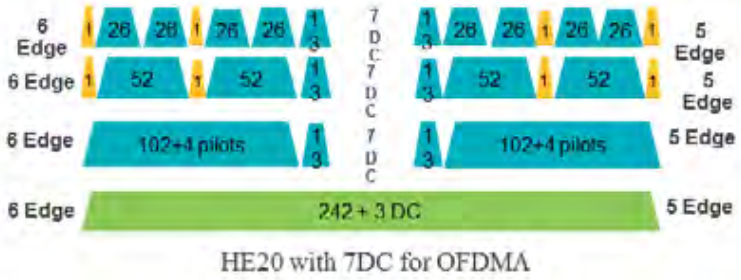

Figure 11 – Left over tone locations for 20 MHz

Figure 12 – Left over tone locations for 40 MHz

Figure 13 – Left over tone locations for 80 MHz

3.3.2.3 Pilot tones

All pilot tones in 4x data OFDMA symbol are at even indices. If pilots present in 4x HE-LTF, their tone indices shall be the same as those pilots in 4x data symbol. If pilots present in 2x HE-LTF, their tone indices shall be the same as the indices of those pilots in 4x data symbol divided by 2. [PHY Motion 27, July 16, 2015, see [45]]

The pilot tone locations for 20 MHz, 40 MHz and 80 MHz bandwidth are as shown in Figure 14, Figure 15 and Figure 16 respectively.
Note—80 MHz pilot positions are enumerated below for reference:

RU-26 pilots: ±10, ±24, ±38, ±50, ±64, ±78, ±92, ±104, ±118, ±130, ±144, ±158, ±172, ±184, ±198, ±212, ±226, ±238, ±252, ±266, ±280, ±292, ±306, ±320, ± 334, ±346, ±360, ±372, ±386, ±400, ±414, ±426, ±440, ±454, ±468, ±480, ± 494

RU-106/242/484 pilots: ±24, ±50, ±92, ±118, ±158, ±184, ±226, ±252, ±266, ±292, ±334, ±360, ±400, ±426, ±468, ±494

RU-996 pilots: ±24, ±92, ±158, ±226, ±266, ±334, ±400, ±468

The pilot locations for 160 MHz or 80+80 MHz use the same structure as 80 MHz for each half of the BW.

[PHY Motion 28, July 16, 2015, see [45]]

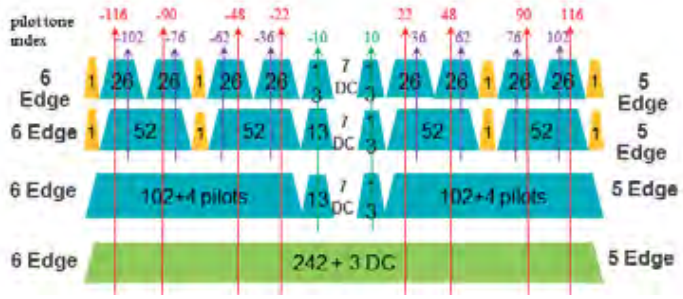

Figure 14 – Pilot tone locations for 20 MHz

Figure 15 – Pilot tone locations for 40 MHz

Figure 16 – Pilot tone locations for 80 MHz

3.3.3 Coding

LDPC is the only coding scheme in the HE PPDU Data field for allocation sizes of 484 tones, 996 tones and 996*2 tones.

[PHY Motion 30, July 16, 2015, see [56], modified with PHY Motion 36, September 17, 2015, see [57]]

Support of BCC code is limited to less than or equal to four spatial streams (per user in case of MU-MIMO), and is mandatory (for both TX and RX) for RU sizes less than or equal to 242 tones (20MHz).

Support of LDPC code for both TX and RX is mandatory for HE STAs declaring support for at least one of HE 40/80/160/80+80 SU PPDU bandwidths, or for HE STAs declaring support for more than 4 spatial streams. Otherwise, support of LDPC code for either TX or RX is optional.

[PHY Motion 31, July 16, 2015, see [56]]

The 11ax MCS table shall not have any MCS exclusion and, when LDPC is applied, N_{DBPS} is computed as follows

$N_{DBPS} = \lfloor N_{CBPS} R \rfloor$, where R is the coding rate

[PHY Motion 32, July 16, 2015, see [56]]

The BCC interleaver and LDPC tone mapper parameters are defined in Table 6.

Table 6 - BCC interleaver and LDPC tone mapper parameters

RU size (tones)	BCC		LDPC	LDPC (with DCM)
	N_{col}	N_{rot}	D_{TM}	D_{TM}
26	8	2	1	1
52	16	11	3	1
106	17	29	6	3
242	26	58	9	9
484	-	-	12	9
996	-	-	20	14

[PHY Motion 33, July 16, 2015, see [56], DCM column added with PHY Motion 130, January 2016, see [58]]

3.3.4 Modulation

1024-QAM is an optional feature for SU and MU using resource units equal to or larger than 242 tones in 11ax.

[PHY Motion 42, September 17, 2015 see [59]]

Move to add the following new MCS levels as an optional feature to the 11ax SFD:

- MCS10: 1024 QAM with 3/4 code rate
- MCS11: 1024 QAM with 5/6 code rate

[PHY Motion 112, Janaury 2016, see [60]]

TX EVM requirement of -35dB is used for MCS 10 and MCS 11.

[PHY Motion 113, January 2016, see [60]]

Dual sub-carrier modulation (DCM) is an optional modulation scheme for the HE-SIG-B and Data fields. DCM is only applied to BPSK, QPSK and 16-QAM modulations.

[PHY Motion 53, September 17, 2015, see [22]]

Move to add the following QPSK DCM modulation scheme to the IEEE802.11ax SFD

- The coded/interleaved bits are modulated as QPSK and mapped to the lower half frequency segment: $[d_1, d_2, \ldots d_{N_SD/2}]$;
- The modulated symbols of the lower half frequency segment are repeated and conjugated and then mapped to the upper half frequency segment: $[d_{N_SD/2+1}, d_{N_SD/2+2}, \ldots d_{N_SD}] = \text{conj}([d_1, d_2, \ldots d_{N_SD/2}])$

[PHY Motion 129, January 2016, see [58]]

3.3.5 Padding and packet extension

An 11ax SU PPDU should apply the MAC/PHY pre-FEC padding scheme as in 11ac, to pad toward the nearest of the four possible boundaries (*a-factor*) in the last Data OFDM symbol(s), and then use post-FEC padding bits to fill up the last OFDM symbol(s).

- Packet Extension (PE) field is defined at the end of HE PPDU
- PE should have the same average power as data field

[PHY Motion 58, September 17, 2015, see [61]]

11ax shall define the max packet extension modes of 8 μs and 16 μs, correspond to the short symbol segment padding boundaries (*a-factor*) according to the following PE duration (TPE) values:

- Max packet extension mode 8 μs: T_{PE} = [0 0 4 8] μs for a = 1~4 respectively;
- Max packet extension mode 16 μs: T_{PE} = [4 8 12 16] μs for a = 1~4 respectively.

HE Capability field shall define two constellation level thresholds (*threshold16* and *threshold8*) for a given {NSS, BW} combination, to determine if and when max packet extension modes 8 μs and 16 μs are applied, i.e.

- 3 bits are used to specify each threshold as the table below.
- If constellation ≥ *threshold16* apply max PE 16 μs mode, else if constellation ≥ *threshold8* apply max PE 8 μs mode, else no packet extension.
- If no PE is required for all constellations both *threshold8* and *threshold16* are set to 111
- If only max PE 8 μs mode is required, set *threshold16* to be 111, and *threshold8* to be the constellation at which max PE 8 μs mode starts
- If only max PE 16 μs mode is required, set *threshold16* to be the constellation at which max PE 16 μs mode starts, and *threshold8* to be 111
- Packet extension device capability thresholds are defined for all RU sizes greater than or equal to 242 tones. No thresholds defined for an RU size less than 242 tones

Table 7 - Threshold encoding in HE capability

Constellation	Threshold Encoding in HE Capability
BPSK	000
QPSK	001
16QAM	010
64QAM	011
256QAM	100
1024QAM (TBD)	101
None	111

[PHY Motion 59, September 17, 2015, see [61], modified with PHY Motion 127, January 2016, see [62]]

The number of uncoded bits for each of the first 3 short symbol segments (a=1~3) equals to the number of uncoded bits corresponding to $N_{SD.short}$ subcarriers as specified by the following table, and the number of uncoded bits for the last short symbol segment (a=4) equals to the number of bits of the whole OFDM symbol subtracting the total number of uncoded bits of the first three short symbol segments.

Table 8 - N_{SD}.short

RU Size	$N_{SD.short}$
26	6
52	12
106	24
242	60
484	120
996	240
996x2	492

[PHY Motion 60, September 17, 2015, see [61]]

HE-SIG-A field contains an a-factor field of 2 bits and a PE Disambiguity field of 1 bit that are set as described below.

In L-SIG, the L-LENGTH field is set by:

$$L_{LENGTH} = \left\lceil \frac{TXTIME - 20}{4} \right\rceil \times 3 - 3 - m, m = 1 \text{ or } 2$$

where

$TXTIME = T_{L_PREAMBLE} + T_{HE_PREAMBLE} + T_{HE_DATA} + T_{PE}$

$T_{HE_DATA} = T_{HE_SYM} \times N_{SYM} = (12.8 + T_{GI}) \times N_{SYM}$

T_{PE} is the PE duration

The ecoding of the a-factor field in HE-SIG-A is defined in Table 9.

Table 9 - A Factor field encoding

a-factor value	a-factor field encoding
1	01
2	10
3	11
4	00

The PE Disambiguity field in HE-SIG-A is set as follows:

- If $T_{PE} + 4 \times \left(\left\lceil\frac{TXTIME-20}{4}\right\rceil - \left(\frac{TXTIME-20}{4}\right)\right) \geq T_{SYM}$, where $T_{SYM} = 12.8 + T_{GI}$, then this field is set to 1; otherwise this field is set to 0.
- At the receiver, the following equations are used to compute N_{SYM} and T_{PE} respectively:

$$N_{SYM} = \left\lfloor \frac{\left(\frac{L_LENGTH + m + 3}{3} \times 4 - T_{HE_PREAMBLE}\right)}{T_{SYM}} \right\rfloor - b_{PE_Disambiguity}$$

$$T_{PE} = \left\lfloor \frac{\left(\frac{L_LENGTH + m + 3}{3} \times 4 - T_{HE_PREAMBLE}\right) - N_{SYM} \times T_{SYM}}{4} \right\rfloor \times 4$$

[PHY Motion 61, September 17, 2015, see [61], modified with PHY Motion 73, November 2015]

When the AP transmits a DL MU PPDU:

- All users use the same N_{SYM} and *a-factor* values according to the user with the longest span
- Based on the *a-factor* value and each user's PE capabilities, compute the PE duration for each user, $T_{PE,u}$, and the PE duration of the DL MU PPDU, $T_{PE} = \max_u(T_{PE,u})$
- In HE-SIG-A field, the a-factor field, the PE Disambiguity field and the LDPC Extra Symbol field are common to all users

[PHY Motion 62, September 17, 2015, see [61]]

For an UL MU PPDU transmission:

- The AP indicates its desired N_{SYM}, *a-factor*, LDPC extra symbol indication and PE duration values in the Trigger frame
- Possible PE values for UL MU are TBD
- Each user transmitting an UL MU PPDU shall encode and conduct PHY padding using the following parameters:
  - N_{SYM} as indicated in the Trigger frame
  - *a-factor* as indicated in the Trigger frame
  - LDPC Extra Symbol as indicated in the Trigger frame
  - Append PE specified in the Trigger frame

[PHY Motion 63, September 17, 2015, see [61]]

3.4 Transmit spectral mask

The spectral masks for non-OFDMA 20 MHz, 40 MHz, 80 MHz, 160 MHz and 80+80 MHz PPDUs are are defined below.

- The bandwidth of the applied spectrum mask for a (non-OFDMA) PPDU shall be determined by the bandwidth occupied by the pre HE-STF portion of the preamble in this PPDU, regardless of the BSS bandwidth
- The spectral mask requirements do not apply to LO leakage

The HE 20 MHz spectral mask is the 11ac 80 MHz mask downclocked by 4 (6/5 guard tones) as shown in Figure 17.

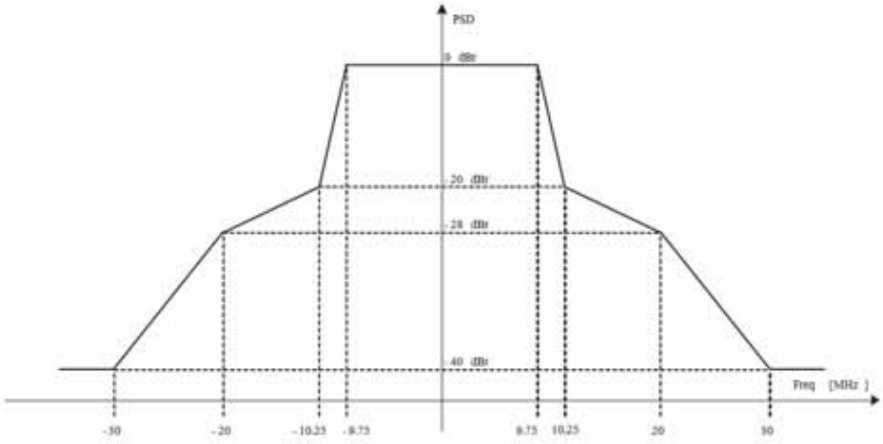

Figure 17 - Transmit spectral mask for an HE 20 MHz PPDU

The HE 40 MHz and 80 MHz spectral masks are the 11ac 80 MHz and 160 MHz masks downclocked by 2 (12/11 guard tones) as shown in Figure 18 and Figure 19.

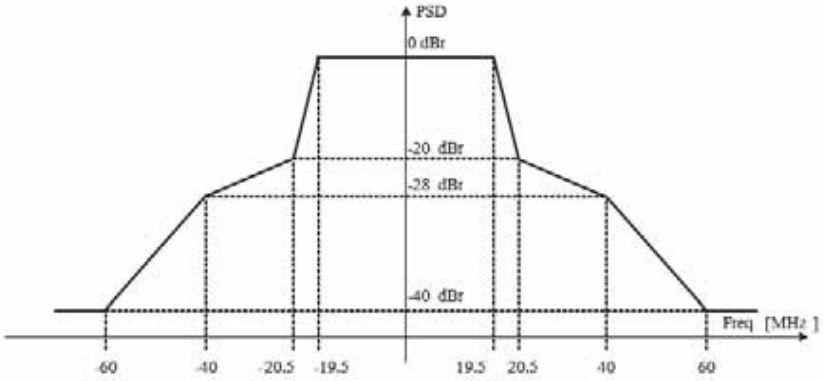

Figure 18 - Transmit spectral mask for HE 40 MHz PPDU

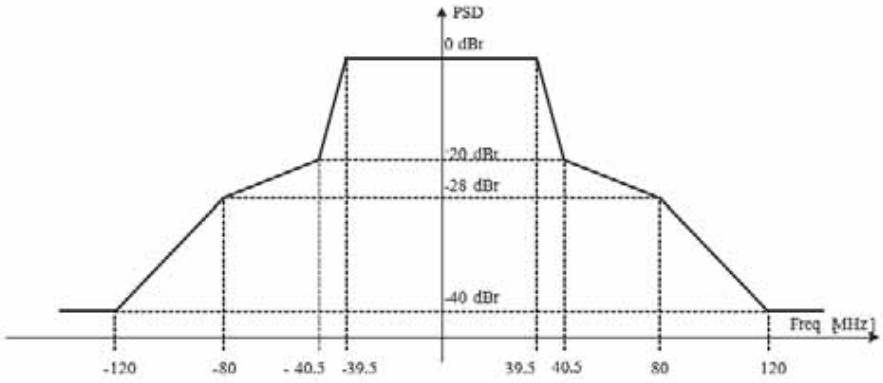

Figure 19 - Transmit spectral mask for HE 80 MHz PPDU

The HE 80+80 MHz and 160 MHz are similar to 11ac. The HE 160 MHz mask as shown in Figure 20 has the same skirt as that of 11ac 160 MHz and the 1st rolloff identical to HE 40/80 MHz. The 160 MHz tone

plan has the same number of guard tones (12/11) as HE 40/80 MHz. The HE 80+80 MHz mask is a combination of two 80 MHz interim spectral masks as shown in Figure 21.

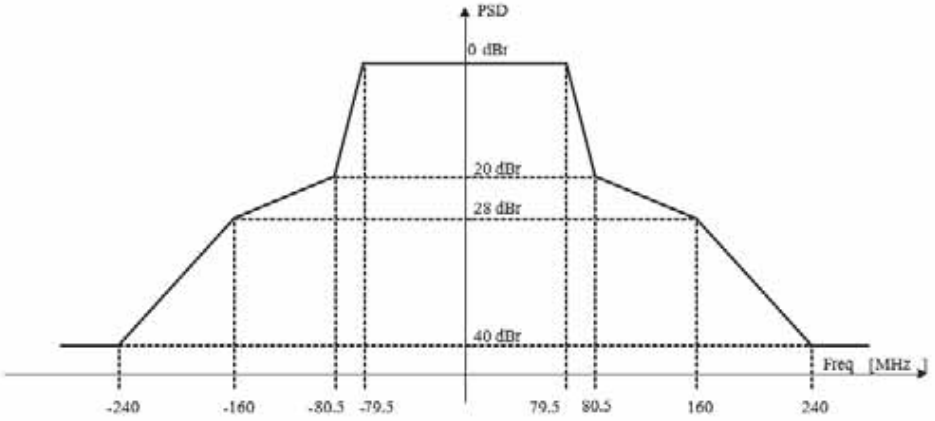

Figure 20 - Transmit spectral mask for HE 160 MHz PPDU

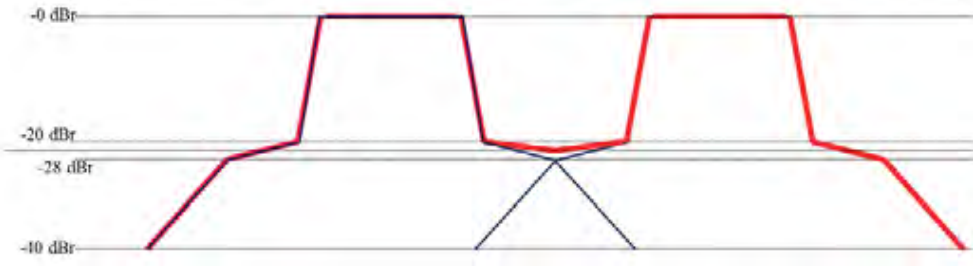

Figure 21 - Transmit spectral mask for HE 80+80 MHz PPDU

[PHY Motion 76, November 2015, see [63]]

4 Multi-user (MU) features

4.1 General

This section describes MU related features. MU features include UL and DL OFDMA and UL and DL MU-MIMO.

A TXOP can include both DL MU and UL MU transmissions.
[MAC Motion 14, July 16, 2015, see [64]]

The spec shall include the definition of a cascading TXOP structure, allowing alternating DL and UL MU PPDUs starting with a DL MU PPDU in the same TXOP

- The TXOP sequence has only one DL transmitter
- The TXOP sequence may have different UL transmitters within each UL MU PPDU
- The TXOP sequence may have a different set of transmitters in an UL MU PPDU as compared to the DL MU PPDU that follows the UL MU PPDU within the same TXOP

[MAC Motion 15, July 16, 2015, see [64]]

DL/UL OFDMA can multiplex different types of unicast frames in frequency domain. Types of frames can be data frame/control frame/management frame.
[MAC Motion 16, July 16, 2015, see [64]]

DL/UL MU-MIMO can multiplex different types of unicast frames in spatial domain. Types of frames can be data frame/control frame/management frame. Different types of frames are to/from different users.
[MAC Motion 17, July 16, 2015, see [64]]

The transmission for all the STAs in a DL MU (MIMO, OFDMA) PPDU shall end at the same time. The A-MPDU padding per each STA follows the 11ac procedure.
[MAC Motion 22, July 16, 2015, see [65]]

The transmission from all the STAs in an UL MU PPDU shall end at the time indicated in Trigger frame. The A-MPDU padding per each STA follows the 11ac procedure.
[MAC Motion 23, July 16, 2015, see [65]]

DL-OFDMA may reuse the same sharing mechanism of an EDCA TXOP as DL MU-MIMO.
[MAC Motion 36, September 17, 2015, see [66]]

The spec shall allow multiple TIDs in a single PSDU between AP and a STA for DL/UL OFDMA/MU-MIMO. Multiple TIDs aggregation rules are TBD if necessary.
[MU Motion 16, September 17, 2015, see [67]]

MPDUs with multiple TIDs that ask for Ack and/or BA acknowledgement and a management frame that asks for Ack acknowledgement may be aggregated in one A-MPDU of MU transmission.
[MAC Motion 66, January 2016, see [68]]

4.2 DL MU operation

The amendment shall include a mechanism to multiplex BA/ACK responses to DL MU transmission.
[MU Motion #4, March 2015, see [69]]

In each payload within a DL MU PPDU a Trigger frame may be present that carries the information that enables the recipient of the STA to send its ACK/BA response frame a TBD IFS after the DL MU PPDU.
[MU Motion 11, July 16, 2015, see [70]]

A unicast Trigger frame for a single user may be included in an A-MPDU for that user in the DL MU PPDU that precedes the UL MU transmission by TBD IFS. [MAC Motion 20, July 16, 2015, see [71]]

Broadcast trigger transmitted in a subchannel of DL OFDMA shall not include the resource allocation information of the STAs which are recipients of frames in the other subchannels of the DL OFDMA. The subchannel of the broadcast trigger frame is identified by TBD signaling. [MAC Motion 21, July 16, 2015, see [71]]

The spec shall allow that the schedule information for OFDMA acknowledgement from STAs is contained in the MAC header of DL MPDU.
[MU Motion 23, September 17, 2015, see [72]]

The contents of the scheduling information for an UL OFDMA ACK/BA includes UL PPDU Length (9 bits) and RU Allocation (TBD).
[MU Motion 24, September 24, 2015, see [72]]

In a HE MU PPDU, at most one A-MPDU is allowed to contain one or more MPDUs that solicit an immediate response, except when an immediate response is carried in HE TB UL PPDU. In such case, one or more A-MPDUs are allowed to contain one or more MPDUs that solicit an immediate response carried in an HE TB UL PPDU.
[MAC Motion 29, September 2015, see [73]]

Scheduling information for UL MU Acknowledgement from STA may be contained within the HE variant of the HT Control Field.

[MU Motion 29, November 2015, see [74]]

Within an A-MPDU the trigger information for a STA, if present, shall be signaled either in Trigger frame(s) or in the MAC header of MPDU(s) contained in the A-MPDU but not both.
[MU Motion 38, November 2015, see [75]]

Ack Policy field set to 01 (Trigger based UL MU Ack) has the following normative behavior for an HE STA:

- The addressed recipient that receives the trigger information, within a DL MU PPDU returns an immediate Ack/BlockAck response, either individually or as part of an A-MPDU after the PPDU carrying the frame, according to the trigger information carried in the same DL MU PPDU
- The addressed recipient that does receive no valid trigger information takes no action upon the receipt of the frame, except for recording the state (if necessary)

[MAC Motion 42, November 2015, see [76]]

Ack Policy field in a frame soliciting an immediate response is set to 00 (Normal Ack or Implicit Block Ack Request) if the immediate response is carried in SU PPDU, or it is set to 01 (Trigger based UL MU Ack) if the immediate response is carried in MU PPDU.
[MAC Motion 43, November 2015, see [77]]

When an AP initiates a DL MU transmission soliciting more than one immediate response frames, the DL MU transmission is successful if the AP receives the response frame correctly from at least one STA indicated by any trigger information in the DL MU transmission.
[MAC Motion 46, November 2015, see [78]]

The spec shall allow UL MU transmission of Multi-STA Block ACK frame in response to multi-TID A-MPDU of DL MU transmission. The value of the AID field in M-BA is TBD.
[MAC Motion 65, January 2016, see [68]]

4.3 UL MU operation

An UL MU PPDU (MU-MIMO or OFDMA) is sent as an immediate response (IFS TBD) to a Trigger frame (format TBD) sent by the AP. [MAC Motion #3, March 2015]

The inter frame space between a PPDU that contains a Trigger frame and its triggered HE trigger-based PPDU is SIFS.
[MU Motion 44, Janaury 2016, see [79]]

The spec shall define a MAC padding scheme (TBD) for trigger frame sent in Non-HT PPDUs
[MU Motion 45, Janaury 2016, see [79]]

The CP length for UL OFDMA/MU-MIMO transmissions shall be explicitly indicated by AP in the Trigger frame that allocates resources for the UL OFDMA/MU-MIMO transmission. The value of CP length for all users addressed by the Trigger frame shall be the same. [PHY Motion 34, July 16, 2015, see [80]]

A Trigger frame that addresses STAs in multiple BSSs corresponding to a multiple BSS set shall use a common address TBD in the A2 field.
[MAC Motion 55, November 2015, see [81]]

An UL OFDMA MPDU/A-MPDU is the acknowledgement of the trigger frame. When the AP receives MPDU correctly from at least one STA indicated by trigger frame, the frame exchange initiated by the trigger frame is successful. [MAC Motion 13, July 16, 2015, see [82]]

The amendment shall define a mechanism for multiplexing DL acknowledgments sent in response to UL MU transmissions. [MU Motion #1, January 2015, see [83]]

An AP shall not allocate UL subchannel in any 20 MHz channel that is not occupied by the immediately preceding DL PPDU that contains trigger information. In each 20 MHz channel occupied by the immediately preceding DL PPDU that contains trigger information, there is at least one allocated subchannel. [MAC Motion #10, May 2015, see [84], modified with MAC Motion 40, September 17, 2015, see [85]]

Non-AP STAs support using the QoS Control field in QoS Data and QoS Null frames to report per-TID Buffer Status information.
[MAC Motion 37, September 17, 2015, see [86]]

An AP can poll STAs for buffer status reports using the frame carrying the trigger info. The poll can request for specific buffer status information with TBD granularity.
[MAC Motion 38, September 17, 2015, see [86]]

A STA that is polled from a Trigger frame for UL MU transmission considers the NAV in determining whether to respond unless one of the following conditions is met

- The NAV was set by a frame originating from the AP sending the trigger frame
- The response contains ACK/BA and the duration of the UL MU transmission is below a TBD threshold
- The NAV was set by a frame originating from intra-BSS STAs
- Other condition TBD

[MU Motion 15, September 17, 2015, see [87], modified with MU Motion 28, November 2015, see [88]]

~~A STA shall consider CCA status to respond to a Trigger frame under a non-null TBD set of conditions.~~
[MU Motion 14, September 17, 2015, see [89], replaced with MU Motion 43, Janaury 2016]

Trigger frame carries an indication of whether or not the carrier sensing is required for the STA to transmit a UL MU PPDU in response to a Trigger frame. If a Trigger frame indicates that the carrier sensing is required, the STA shall consider the channel status of the physical channel sensing (meaning ED) and virtual carrier sense (NAV) before UL MU transmission in response to the Trigger Frame. Otherwise, the STA may transmit a UL MU PPDU without the carrier sensing. The AP shall require the carrier sensing except under TBD conditions.
[MU Motion 43, January 2016, see [90]]

When a STA is required to sense the medium before its UL MU transmission in response to a trigger frame, it senses the medium using ED after receiving the PPDU that contains the trigger frame (i.e. during the TBD IFS time).
[MU Motion 40, January 2016, see [91]]

When a STA needs to perform the energy-detect (ED) before its UL MU transmission in response to a trigger frame, it shall perform the energy-detect (ED) at least in the subchannel that contains the STA's UL allocation, where the sensed subchannel consists of either a single 20 MHz channel or multiple of 20 MHz channels.
[MU Motion 41, January 2016, see [91]]

When required to sense the medium before its UL MU transmission in response to a trigger frame, if a STA detects the 20MHz channels containing the allocated UL RU are not all idle, then the STA shall not transmit anything in the allocated UL RU.
[MU Motion 42, January 2016, see [92]]

The spec shall allow DL OFDMA transmission of Multi-STA Block ACK frame in response to UL MU PPDUs.
[MAC Motion 44, November 2015, see [93]]

When an AP selects rate, MCS, NSS of M-BA or OFDMA BA that acknowledges the UL OFDMA, the AP may ignore the MCS, NSS of UL OFDMA PPDU that elicits the DL acknowledgement.
The AP shall transmit the M-BA using one of rate, MCS, NSS that all of the acknowledgement receivers support.
[MAC Motion 45, November 2015, see [94]]

The recipient of a MU-BAR frame can transmit other data or management frame in addition to BA/ACK frame if it does not exceed the indicated UL MU duration.
[MAC Motion 58, January 2016, see [95]]

If the Trigger frame requests a specific frame type as response, the response to this Trigger frame shall contain at least the frame with the required type if the required type is available at the STA side; if the STA has no frame with the required type, the STA should transmit QoS Null frame to AP.
[MAC Motion 59, January 2016, see [96]]

4.4 MU RTS/CTS procedure

The spec shall define a frame that solicits simultaneous CTS responses from multiple STAs to protect DL MU transmission. [MU Motion 6, July 16, 2015, see [97]]

The scrambler seed of a simultaneous CTS is same as the scrambler seed of the frame that triggers the simultaneous CTS. The transmission rate of a simultaneous CTS shall use the primary rate based on the rate or MCS of the frame that triggers the simultaneous CTS. [MU Motion 7, July 16, 2015, see [97]]

MU-RTS/CTS frame exchange may be used for protection of MU transmissions during that TXOP.
[MU Motion 31, November 2015, see [98]]

The CTS sent in response to a frame that solicits simultaneous CTS shall be transmitted on one or more 20 MHz channels.
[MU Motion 33, November 2015, see [98]]

MU-RTS may request STAs to send non-HT CTS immediate response.
[MU Motion 34, November 2015, see [98]]

MU-RTS will carry signaling for each STA to indicate the 20 MHz channel(s) for transmitting CTS responses when CTS is sent in (duplicate) non-HT PPDU

- When a STA sends CTS in response to MU-RTS, the CTS response shall be transmitted in the 20 MHz channel(s) indicated in MU-RTS
    - provided other transmission conditions TBD are met (e.g. channel idleness)
- The indicated 20 MHz channel(s) can be either Primary20, Primary40, Primary80 or 160/80+80 MHz. Other indications are TBD.
- Exact Signaling TBD

[MU Motion 35, November 2015, see [98]]

4.5 UL OFDMA-based random access

The spec shall define a Trigger frame that allocates resources for random access. [MU Motion 8, July 16, 2015, see [99]]

An HE AP is allowed to broadcast a TBD parameter in the trigger frame to the STAs so that STAs can initiate the random access process after the trigger frames.
[MAC Motion 41, September 17, 2015, see [100]]

When an STA has a frame to send, it initializes its OBO (OFDMA Back-off) to a random value in the range 0 to CWO (OFDMA Contention window). For an STA with non-zero OBO value, it decrements its OBO by 1 in every RU assigned to AID value TBD within the TF-R. For a STA, its OBO decrements by a value, unless OBO=0, equal to the number of RUs assigned to AID value TBD in a TF-R. OBO for any STA can only be 0 once every TF-R. A STA with OBO decremented to 0 randomly selects any one of the assigned RUs for random access and transmits its frame.
[MU Motion 27, September 17, 2015, see [101]]

The spec shall indicate cascaded sequence of Trigger frames by using a bit in the Trigger frame.
[MU Motion 21, September 17, 2015, see [102], modified with MAC Motion 50, November 2015, see [103]]

The spec shall include a mechanism that allows the Beacon frame to indicate the target transmission time(s) of one or more Trigger frame(s) that allocate resources for random access.
[MU Motion 22, September 17, 2015, see [102]]

The AP may send trigger frame to elicit buffer status report (BSR) using random access.
[MU Motion 39, November 2015, see [104]]

4.6 Sounding protocol

The amendment shall include a CSI feedback mechanism which allows for a minimum feedback granularity of less than 20 MHz.
[MU Motion 9, July 16, 2015, see [105]]

The amendment shall define a mechanism to enable multiplexing of the Compressed Beamforming Action frame (CSI feedback) from multiple stations using UL MU (MIMO or OFDMA) mode.
[MU Motion 17, September 17, 2015, see [106]]

The amendment shall define a channel sounding sequence (Figure 22) initiated by an HE AP that includes a Trigger frame that is sent SIFS after the NDP frame in order to solicit UL MU mode of Compressed Beamforming Action frame from multiple HE STAs.
[MU Motion 18, Spetember 17, 2015, see [106], modified with MU Motion 37, November 2015, see [106]]

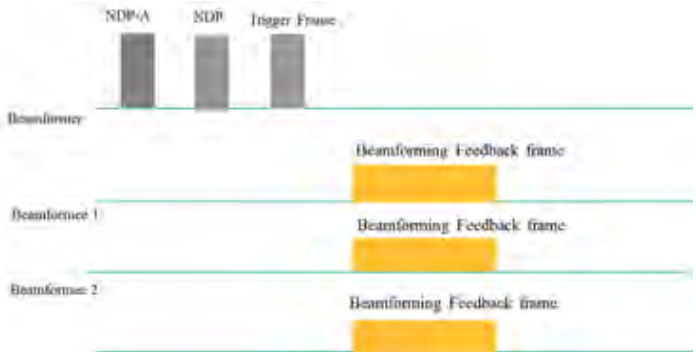

Figure 22 -- Illustration of DL Sounding Sequence

[MU Motion 20, September 17, 2015, see [107]]

The amendment shall define a mechanism to reduce the MIMO compressed beamforming feedback overhead.
[MU Motion 25, September 17, 2015, see [108]]

That mechanism shall use the compressed beamforming feedback as defined in section 8.4.1.48 in 802.11ac as a baseline.
[PHY Motion 100, November 2015]

4.7 GCR BA operation

The amendment shall include a mechanism to multiplex acknowledgment frames in response to Multicast receptions under GCR BA operation.
[MU Motion 12, September 17, 2015, see [109]]

5 Coexistence

This section describes the functional blocks that support coexistence.

5.1 Features for operation in dense environments

This section describes features that improve overlapping BSS (OBSS) operation in dense environments. This includes features such as deferral rules and CCA levels.

The STA determines whether the detected frame is an inter-BSS or an intra-BSS frame by using BSS color or MAC address in the MAC header. If the detected frame is an inter-BSS frame, under TBD condition, uses TBD OBSS PD level that is greater than the minimum receive sensitivity level
NOTE–Maybe extra rules need to be added to ensure that all 11ax STAs can make the decision in a consistent manner.
[MAC Motion 34, September 17, 2015, see [110]]

A STA should regard an Inter-BSS PPDU with a valid PHY header and that has a receive power/RSSI below the OBSS PD level used by the receiving STA and that meets additional TBD conditions, as not having been received at all (e.g., should not update its NAV), except that the medium condition shall indicate BUSY during the period of time that is taken by the receiving STA to validate that the PPDU is from an Inter-BSS, but not longer than the time indicated as the length of the PPDU payload. The OBSS PD level is greater than the minimum receive sensitivity level.
[SR Motion 1, September 17, 2015, see [111]]

The amendment shall include one or more mechanisms to improve spatial reuse by allowing adjustments to one or more of the CCA-ED, 802.11 Signal Detect CCA, OBSS_PD or TXPWR threshold values. The constraints on selecting threshold values are TBD.
[SR Motion 2, September 17, 2015, see [112]]

The specification to consider a procedure that may revise the NAV depending on TBD conditions at the recipient of the ongoing OBSS frame.
[SR Motion 3, September 17, 2015, see [113]]

An 11ax STA regards a valid OBSS PPDU as not having been received at all (e.g., should not update its NAV), except that the medium condition shall indicate BUSY during the period of time that is taken by the receiving STA to validate that the PPDU is from an Inter-BSS, but not longer than the time indicated as the length of the PPDU payload if the RXPWR of the received PPDU is below the OBSS_PD threshold and TBD conditions are met, noting that the OBSS_PD threshold is accompanied by a TXPWR

value and a reduction in the TXPWR may be accompanied by an TBD increase in the OBSS_PD threshold value.
[SR Motion 4, September 17, 2015, see [114]]

An HE STA should have a mechanism to remember and distinguish NAVs set by intra-BSS frame and OBSS frame. A CF-end frame that comes from intra-BSS should not reset NAV that was set by a frame from OBSS. To determine which BSS is the origin of a frame, the HE STA may use BSS color.
[SR Motion 5, November 2015, see [115]]

6 MAC

6.1 General

This section describes general MAC functional blocks.

The amendment shall define a mechanism to allow the AP to configure the use of RTS/CTS initiated by non-AP STA.
[MAC Motion #1, January 2015, see [116]]

In 2.4 GHz HE STAs should send beacon and probe (request & response) frames at rates ≥ 5.5 Mb/s.
[MAC Motion 24, 2015, see [117]]

HE STAs shall support the Multiple BSSID Set.
[MAC Motion 28, September 17, 2015, see [118]]

When a STA receives a CF-End from an OBSS STA, if the last NAV update was caused by an Intra-BSS frame, the STA should not reset its NAV.
[MAC Motion 33, September 17, 2015, see [119]]

A STA maintains two NAVs

- One is the NAV for Intra-BSS frame, and second one is the NAV for Inter-BSS frame or frame that cannot be determined to be Intra-BSS or Inter-BSS
- Note that maintaining two NAVs does not imply maintaining two NAV timers
- The detailed method of maintaining two NAVs (e.g., two NAV timers or one NAV timer with difference of two NAV values, etc.) is TBD
- Mandatory or Optional TBD

[MU Motion 36, November 2015, see [120]]

AP and STAs in one BSS of a Multiple BSSID set shall consider a frame from another BSS of the same Multiple BSSID set as an intra-BSS frame (Signaling for a Multiple BSSID set is TBD).
[MAC Motion 60, January 2016, see [121]]

A same BSS Color shall be used for the virtual APs which are defined by TBD Multiple BSSID element.
[MAC Motion 61, January 2016, see [122]]

6.2 Target Wake Time (TWT)

The spec shall include a mechanism that allows a target transmission time for a Trigger frame to be indicated. The mechanism is based on implicit TWT operation and additionally enables:

- Broadcast triggered TWT by including a TWT element in the Beacon
- Solicited triggered TWT by using implicit TWT negotiation procedure

[MAC Motion 25, July 16, 2015, see [123]]

When the broadcast triggered TWT is enabled, STA and AP may exchange TWT request/response to indicate the target Beacon frame to be monitored by the PS STA.
[MAC Motion 26, July 16, 2015, see [123]]

The TWT Flow Identifier field in the TWT IE included in the Beacon frame specifies the different types of flows allowed during the TWT SP.
[MAC Motion 48, November 2015, see [103]]

Multiple TWTs can be indicated in the TWT IE in the Beacon frame by allowing multiple TWT parameter sets in the same TWT IE.
[MAC Motion 49, November 2015, see [103]]

6.3 Power Save

An HE non-AP STA may enter the Doze state until the end of an HE DL MU PPDU if both the following conditions are true:

- The value of the PPDU's BSS Color field is equal to the BSS color of its BSS
- The value derived from any of the STA identifiers in the HE-SIG-B field does not match its own identifier or that of a broadcast/multicast identifier

An HE non-AP STA may enter the Doze state until the end of an HE UL MU PPDU if:

- The value of the PPDU's BSS Color field is equal to the BSS color of its BSS

[PHY Motion 47, September 17, 2015, see [21]]

An HE STA may enter the Doze state until the end of an HE SU PPDU if both the following conditions are true:

- The value of the PPDU's BSS Color field is equal to the BSS color of its BSS
- The value of the UL/DL Flag field indicates that the frame is UL

[PHY Motion 49, September 17, 2015, see [21]]

HE STA may use a notification of its operating mode changes for 802.11ax power saving mechanism.
[MAC Motion 30, September 17, 2015, see [124]]

The spec shall define a mechanism for a transmitting STA to indicate its RX operating mode, i.e. RX NSS, RX channel width, in a transmitted DATA type MAC header, so that the responding STA shall not transmit a subsequent PPDU using an NSS or channel width value not indicated as supported in the RX operating mode of the transmitting STA. The responding STA shall not adopt the new NSS and BW until a time TBD.
[MAC Motion 32, September 17, 2015, see [125]]

6.4 Fragmentation

The spec shall support fragmentation negotiation in A-MPDUs for HE STAs.
[MU Motion 19, September 17, 2015, see [126]]

The 11ax fragmentation negotiation shall allow the following fragmentation types (levels) to be indicated:

- Level 0: No support for fragments
- Level 1: Support for a fragment in a VHT single MPDU only
- Level 2: Support for up to one fragment per MSDU in an A-MPDU
- Level 3: Support for multiple fragments of an MSDU per A-MPDU

[MAC Motion 47, November 2015, see [127]]

Under 11ax fragmentation, the following acknowledgement rules apply:

– Fragmentation – Level I

- Recipient shall respond with an Ack to a fragment carried in a "VHT" single MPDU soliciting immediate response
- Fragmentation – Level II
  - Recipient shall respond with:
    - Ack frame to a fragment carried in a "VHT" single MPDU soliciting immediate response
    - C-BA frame to an A-MPDU soliciting immediate response
    - Each bit in BlockAck Bitmap indicates successful reception of the carried fragment or of the full MSDU
- Fragmentation – Level III
  - Recipient shall respond with:
    - Ack frame to a fragment carried in a "VHT" single MPDU soliciting immediate response
    - C-BA frame to an A-MPDU that does not carry fragments and soliciting immediate response
    - "Dedicated" C-BA frame to an A-MPDU carrying fragments and soliciting immediate response
      - Each bit in BlockAck Bitmap indicates successful reception of each of the carried fragments
      - The max number of fragments for which the BA frame signals the receive status is contained in a nonzero value of the FN subfield of the BA frame
  - Maximum number of fragments per MSDU in the eliciting A-MPDU transmitted by the originator shall be 4

[MAC Motion 63 and 64, January 2016, see [128]]

7 Frame formats

7.1 Fields

7.1.1 HT Control field

The spec shall define an HE variant (of the VHT variant) of the HT Control field that carries one or more control fields for HE control information

- B0 and B1 of the HT Control field in this case are set to 1
- The control fields can be called HE Control field

[MAC Motion 39, September 17, 2015, see [129]]

HE link adaptation shall define reference payload size for the reported MCS in MFB.
Reference payload size may be dependent on the frames involved in link adaptation or fixed in specification. Details are TBD.
[PHY Motion 77, November 2015, see [130]]

The HE link adaptation field, which is part of HE variant of HT control field, consists of MFB and TBD subfields. The MFB subfield includes NSS and MCS subfield.
[PHY Motion 78, November 2015, see [130]]

7.1.2 QoS Control field

Bits in QoS Control field		**Meaning**
Bit 5	**Bit 6**	

0	1	No explicit acknowledgment or PSMP Ack or Trigger based UL MU Ack. When bit 6 of the Frame Control field (see 8.2.4.1.3 (Type and Subtype fields)) is set to 1: … When bit 6 of the Frame Control field (see 8.2.4.1.3 (Type and Subtype fields)) is set to 0: The acknowledgment for a frame indicating PSMP Ack when it appears in a PSMP downlink transmission time (PSMP-DTT) is to be received in a later PSMP uplink transmission time (PSMP-UTT). … If the DL PPDU is HE MU PPDU, the addressed recipient returns an Ack/BA in MU format as an immediate response to a DL MU PPDU.

[MAC Motion 43, November 2015]

7.2 Frames

7.2.1 Trigger frame

The spec shall define a new control frame format that carries sufficient information to identify the STAs transmitting the UL MU PPDUs and allocating resources for the UL MU PPDUs. The format of the new frame is given in Figure 23. The presence of A1 is TBD. [MAC Motion 19, July 16, 2015, see [131]]

FC	Duration	(A1)	A2	Common Info	Per User Info 1		Per User Info N	FCS
2	2	TBD	6	TBD	TBD		TBD	4

Figure 23 - Trigger frame

Trigger frame is a new subtype of the control type as indicated in the FC B4 to B7 with the subtype not equal to 6.
[MAC Motion 53, November 2015, see [131]]

The Common Info field includes the following subfields:

- Length [12 bits]
  - Value of the L-SIG Length of the UL MU PPDU
  - A responding STA will copy this value in its L-SIG length field, hence the encoding shall be same as defined for the L-SIG Length of the UL MU PPDU
- Info bits content of the SIG-A of the response UL MU PPDU [# of bits TBD]
  - May Exclude the bits that may be implicitly already known by all responding STAs, if any TBD
- CP + HE LTF type [TBD # of bits]
- Allowed response type / trigger type [# of bits TBD]
  - Types TBD

[MAC Motion 51, November 2015, see [131]]

The Per User Info field includes the following subfields:

- MCS [4 bits]
- Coding type [# bits TBD]
- RU allocation information [# bits TBD]
- SS allocation [# bits TBD]
- DCM [1 bit]
- User identifier field [12 bits]

- AID for STAs associated with AP; TBD for unassociated STAs

[MAC Motion 52, November 2015, see [132]]

The spec shall define optional type-specific Common Info and optional type-specific Per User Info of Trigger frame. The locations of type-specific Common Info and type-specific Per User Info are TBD.
[MAC Motion 54, November 2015, see [133]]

The MU BAR frame is a variant of Trigger frame whose Trigger Type subfield is MU BAR that carries additional BAR Control subfield (TBD) and an additional BAR Information subfield (TBD) in Common Info and/or each Per-User info.
[MU Motion 30, November 2015, see [134]]

The MAC format of MU-RTS is a variant of trigger frame format.
[MU Motion 32, November 2015, see [98]]

7.2.2 Multi-STA BA frame

The spec shall define a multi-STA BA frame by using the Multi-TID BlockAck frame format with the following changes:

- Add an indication that the frame is a multi-STA BA (TBD)
- Each BA Information field can be addressed to different STAs
- B0-B10 of the Per TID Info field carry a (Partial) AID identifying the intended receiver of the BA Information field

[MAC Motion #1, March 2015, see [135]]

The spec shall define a signaling in the Multi-STA BA frame that can indicate an ACK, as follows:

- If B11 in the per-TID info field is set, then the BlockAck bitmap and the SC subfields in the BA Info field are not present and this BA Info field indicates an ACK of either single MPDU or all MPDUs carried in the eliciting PPDU that was transmitted by the STA whose AID is indicated in the per-TID info field. [Modifed with MAC Motion #8, May 2015, see [136]]

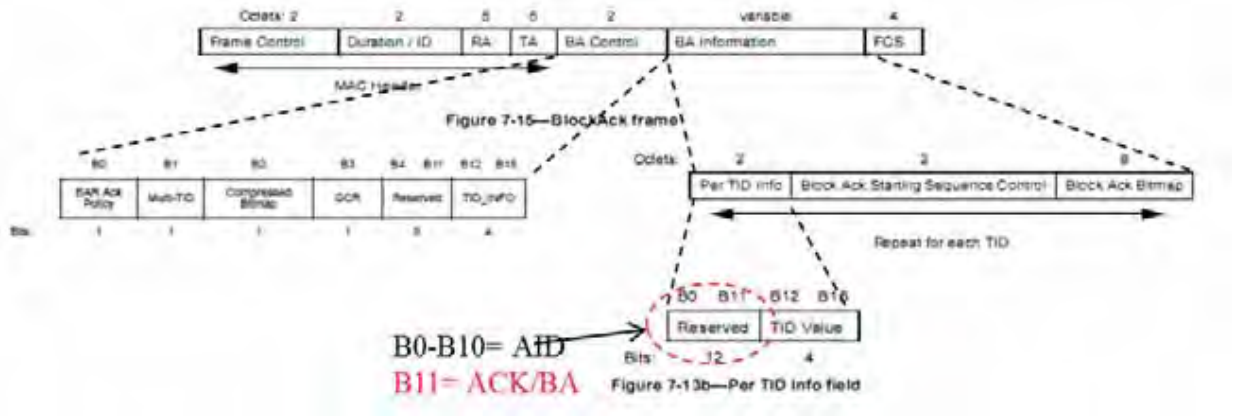

Figure 24 - Multi-STA BA frame

[MAC Motion #2, March 2015, see [135]]

7.2.3 MU-BAR frame

The spec shall define a MU-BAR frame to solicit BA/ACKs from multiple STAs in UL MU transmissions.
[MU Motion 13, September 17, 2015, see [137]]

7.3 Sounding feedback

802.11ax spec shall not support *Ng = 1* for sounding feedback.
NOTE—The tone grouping factor, Ng is defined with respect to data tones of the HE PPDU.
[PHY Motion 38, September 17, 2015, see [138]]

802.11ax spec shall support *Ng* = 4 and 16 for sounding feedback with SU/MU-MIMO-OFDM(A).
NOTE—The tone grouping factor, Ng is defined with respect to data tones of the HE PPDU.
[PHY Motion 101, January 2016, see [139]]

In the MU Exclusive Beamforming Report for the delta SNR, the locations of the feedback tones shall be identical to the tone locations of the compressed V matrices fed back.
[PHY Motion 102, January 2016, see [140]]

An HE AP indicates the necessary TBD parameters so that multiple HE STAs can construct the compressed beamforming feedback matrix immediately after receiving the HE NDP frame.
[MU Motion 46, Janaury 2016, see [106]]

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[139] Kome Oteri (InterDigital), “16/0030r1 Maximum Tone Grouping Size for 802.11ax Feedback with MU-MIMO”.

[140] Sriram Venkateswaran (Broadcom), “16/0088r0 Ng for Compressed Beamforming feedback”.

[141] Narendar Madhavan (Toshiba), “15/1340r2 NDP Announcement for HE Sequence”.

[142] Narendar Madhavan (Toshiba), “16/0091r2 Regarding HE NDPA frame for DL Sounding Sequence”.

1
2

Appendix BC

The Wayback Machine - https://web.archive.org/web/20160307130519/http://www.ieee802.or…

Status of Project IEEE 802.11ax

High Efficiency WLAN (HEW)

Osama Aboul-Magd (Huawei Technologies), Chair
Simone Merlin (Qualcomm), Vice Chair
Ron Porat (Broadcom), Vice Chair
Yasuhiko Inoue (NTT), Secretary
Robert Stacy (Intel), Technical Editor

Background

In May 2013, the High Efficiency WLAN Study Group (HEW SG), a study group within IEEE 802.11 working group had started its activity to consider the improvement of spectrum efficiency to enhance the system throughput/area in high density scenarios of APs and/or STAs.

The study group was created based on the following straw poll and motion:
<Straw Poll>
Do you support starting a new study group called “high efficiency WLAN” to enhance 802.11 PHY and MAC in 2.4 and 5GHz with a focus on:

- Improving spectrum efficiency and area throughput
- Improving real world performance in indoor and outdoor deployments
  - in the presence of interfering sources, dense heterogeneous networks
  - in moderate to heavy user loaded APs

<Motion>
Request an approval by IEEE 802 LMSC to form an 802.11 Study Group to consider High-efficiency WLAN [as described in doc 11-13-0339r2] with the intent of creating a PAR and five criteria.

The HEW SG has successfully developed PAR and CSD documents and the project 802.11ax has started in May 2014.

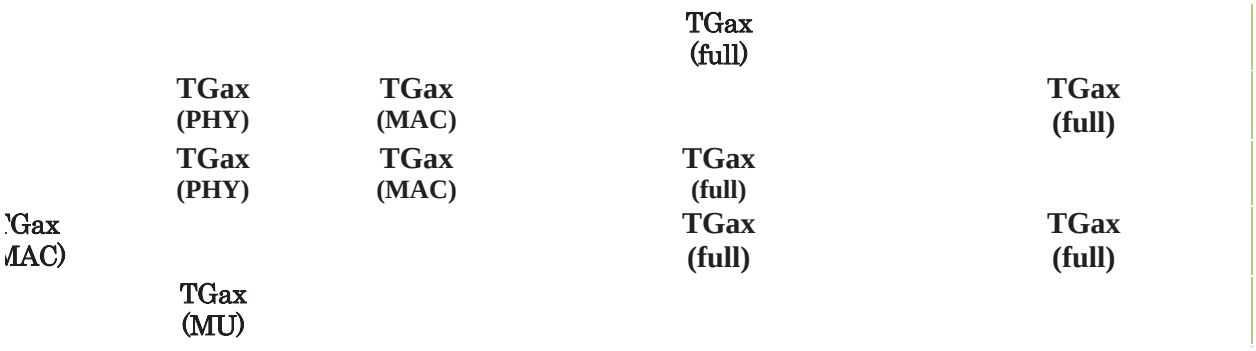
Task Group Documents – the latest revisions (as of November 25th, 2015)

- 11-14-0165-01 PAR and 11-14-0169-01 CSD
- 11-14-0938-04 TGax Selection Procedure
- 11-14-0980-16 TGax Simulation Scenarios
- 11-14-0571-12 TGax Evaluation Methodology
- 11-14-0882-04 TGax Channel Models
- 11-14-1009-02 TGax Functional Requirements
- 11-15-0132-15 TGax Specification Framework

January 2016 – Atlanta, GA

The TGax planned to have 10 sessions during the week.
Four out of eleven sessions were assigned to the ad hoc group sessions.

Tuesday	Wednesday	Thursday



Main documents

- TGax Agenda: 11-15-1516-03, TGax January 2016 Meeting Agenda
  - TGax PHY ad hoc agenda: 11-16-0108-02, TGax PHY Ad Hoc Jan 2016 Meeting Agenda
  - TGax MAC ad hoc agenda: 11-16-0109-02, TGax MAC Ad Hoc January 2016 Meeting Agenda
  - TGax Multi-User ad hoc agenda: 11-16-0147-01, TGax MU Ad-hoc January 2016 Agenda
- Closing report: 11-16-0187-00, TGax January 2016 Closing Report
- Draft TGax minutes: 11-16-0096-00, TGax January 2016 Atlanta Meeting Minutes
  - TGax PHY ad hoc meeting minutes: 11-16-0119-00, January 2016 Atlanta PHY Ad Hoc Meeting Minutes
  - TGax MAC ad hoc meeting minutes: 11-16-0110-00, Jan 2016 Atlanta TGax MAC Ad hoc Meeting Minutes
  - TGax Multi-User ad hoc meeting minutes: 11-16-0150-00, January 2016 Atlanta TGax MU Ad hoc Meeting minutes

Achievements

1. TG Documents

- **Passed a number of affecting all aspects of the TG Specification Framework:**
  - PHY – 30 motions passed.
  - MAC – 9 motions passed.
  - MU – 7 motions passed.
- **Latest revision of the Specification Framework is available at;**
  - https://mentor.ieee.org/802.11/dcn/15/11-15-0132-15-00ax-spec-framework.docx
- **Other TG documents**
  - Simulation Scenario https://mentor.ieee.org/802.11/dcn/14/11-14-0980-16-00ax-simulation-scenarios.docx
  - Evaluation Methodology https://mentor.ieee.org/802.11/dcn/14/11-14-0571-12-00ax-evaluation-methodology.docx
  - Channel Model https://mentor.ieee.org/802.11/dcn/14/11-14-0882-04-00ax-tgax-channel-model-document.docx
  - Functional Requirements https://mentor.ieee.org/802.11/dcn/14/11-14-1009-02-00ax-proposed-802-11ax-functional-requirements.doc

2. Technical Presentations

48 technical submissions have been covered during the week.
A list of the submissions is available in the agenda document.

- Submissions – PHY (22 submissions)
  - 11-16/0030, "Maximum Tone Grouping Size for 802.11ax Feedback with MU-MIMO," Kome Oteri (InterDigital)
  - 11-16/0033, "1x HE-LTF for ULMUMIMO," Hongyuan Zhang (Marvell)
  - 11-16/0034, "Beamforming with HE-LTF Compression," Hongyuan Zhang (Marvell)
  - 11-16/0036, "CRC Generation for HE-SIG," Yakun Sun (Marvell)

- 11-16/0037, "Continuous Puncturing for HE-SIGB Encoding," Yakun Sun (Marvell)
- 11-16/0038, "Sequence for 1x LTF," Daewon Lee (Newracom)
- 11-16/0039, "RU Allocation in SIG-B," Daewon Lee (Newracom)
- 11-16/0040, "Issues with Compressed SIG-B Mode," Yujin Noh (Newracom)
- 11-16/0041, "Link Adaptation for HE WLAN," Yujin Noh (Newracom)
- 11-16/0044, "MCS Levels and TX EVM Requirement for 1024 QAM," Eunsung Park (LG Electronics)
- 11-16/0045, "Flexible Wider Bandwidth Transmission," John Son (WILUS)
- 11-16/0046, "Content for the extra tones in LSIG and RLSIG," Jiayin Zhang (Huawei)
- 11-16/0047, "Discussion on the HE Extended Range SU PPDU," Jiayin Zhang (Huawei)
- 11-16/0052, "Remaining HE-LTF Sequence Design," Le Liu (Huawei)
- 11-16/0053, "Requirements for UL MU Transmissions," Arjun Bharadwaj (Qualcomm)
- 11-16/0056, "On QPSK DCM Modulation and LDPC Tone Mapper for DCM," Jianhan Liu (MediaTek)
- 11-16/0071, "Packet Extension Follow Up," Ron Porat (Broadcom)
- 11-16/0079, "Allocation sizes for BCC in OFDMA," Ken Taniguchi (Toshiba)
- 11-16/0080, "1x/2x/4x OFDM Symbol in HE SU PPDU with BCC," Heejung Yu (Yeungnam Univ./NEWRACOM)
- 11-16/0088, "Ng for Compressed Beamforming feedback," Sriram Venkateswaran (Broadcom)
- 11-16/0089, "Single Stream Pilots in UL MU MIMO," Sriram Venkateswaran (Broadcom)
- 11-16/0104, "Rate Matching for HE-SIG-B," Daewon Lee (Newracom)

- Submissions – MAC (12 submissions)
  - 11-16/0015, "Explicit Block Ack Request in DL MU PPDU," Yongho Seok (Newracom)
  - 11-16/0017, "Beacon Collision Avoidance," Evgeny Khorov (IITP)
  - 11-16/0018, "TDMA for Eliminating Hidden Station Effect in Dense Networks," Evgeny Khorov (IITP)
  - 11-16/0028, "Follow Up for Multi-STA BA for SU Transmissions," Xiaofei Wang (InterDigital)
  - 11-16/0029, "TXOP Truncation Enhancement," Xiaofei Wang (InterDigital)
  - 11-16/0042, "BSS Color Settings for a Multiple BSSID Set," Geonjung Ko (WILUS)
  - 11-16/0050, "Fragmentation for MU frames-Follow up on acks," Alfred Asterjadhi (Qualcomm)
  - 11-16/0051, "Response Give Trigger Type," David Xun Yang (Huawei)
  - 11-16/0068, "BSS Color and Multiple BSSID," Liwen Chu (Marvell)
  - 11-16/0069, "Multi-TID A-MPDU in MU Transmission," Liwen Chu (Marvell)
  - 11-16/0087, "NAV cancellation issues on MU protection," Jinsoo Ahn (Yonsei Univ.)
  - 11-16/0102, "High Efficiency Medium Access via Rosters," Sean Coffey (RealTek)

- Submissions – Multi-User (9 submissions)
  - 11-16/0031, "Proposed UL MU CS Rules," Lei Wang (Marvell)
  - 11-16/0048, "Protection using MU RTS/CTS," Young Hoon Kwon (Newracom)
  - 11-16/0054, "UL MU CCA Response," Kaiying Lv (ZTE)
  - 11-16/0057, "Indication for UL MU Carrier Sensing," Kiseon Ryu (LG Electronics)
  - 11-16/0065, "Duration/ID field in UL-MU," Tomo Adachi (Toshiba)
  - 11-16/0066, "Views on UL-MU Features," Joonsuk Kim (Apple)
  - 11-16/0067, "MAC Padding in Trigger Frame," Liwen Chu (Marvell)
  - 11-16/0085, "Congestion control for UL MU random access," Woojin Ahn (Yonsei Univ.)
  - 11-16/0091, "Regarding HE NDPA frame for DL Sounding Sequence," Narendar Madhavan (Toshiba)

- Submissions – Spatial Reuse (1 submission)
  - 11-16/0060, "Recipient-aware Spatial Reuse," Reza Hedayat (Newracom)

- Submissions – TG (4 submissions)
  - ✧ 11-15/1095, "OFDMA Performance in 11ax," Suhwook Kim (LG Electronics)
  - ✧ 11-16/0024, "Proposed draft specification," Robert Stacy (Intel)
  - ✧ 11-16/0043, "Clarification of SFD Texts," John Son (WILUS)
  - ✧ 11-16/0059, "Non-contiguous Channel Bonding in 11ax," Yunbo Li (Huawei)

3. Draft Specification

- Document 11-16/0024r0 was submitted by the TG Editor and it includes a "draft" draft specification.
- The submission was reviewed by the TG Editor and is available on mentor to be reviewed by TG members.
- The submission is available at: https://mentor.ieee.org/802.11/dcn/16/11-16-0024-00-00ax-proposed-draft-specification.docx

4. Plan for Progressing TG Draft

- Approve the TG draft specification during the March 2016 meeting.
  - Draft 0.1
- Start a comment collection (CC) for 30 days on draft 0.1 – Ends some time in April.
- Comment resolution (May and July)
- Draft 1.0 in July 2016 and start WG LB.

Goals for March 2016

- Discuss Proposals affecting the TG Specification Framework document
- Approve D0.1 of the TG Draft
- Approve a 30-day Comment Collection Process.

Teleconferences

- Three teleconferences are planned before the March 2016 session.
  - ✧ Thursday, February 4th, 10:00 – 12:00 (ET)
  - ✧ Thursday, February 18th, 20:00 – 22:00 (ET)
  - ✧ Thursday, March 3rd, 10:00 – 12:00 (ET)

November 2015 – Dallas, TX

The TGax planed to have 10 sessions during the week.
One more session was added during the WG opening week plenary session due to the large number of submissions.
Five out of eleven sessions were assigned to the ad hoc group sessions.

Tuesday		Wednesday		Thursday
		TGax		TGax
TGax (PHY)	TGax (MAC)			TGax
TGax (MU)	TGax (SR)	TGax (PHY)	TGax (SR)	TGax
		TGax	TGax	

(PHY) (MU)

TGax (PHY) TGax (MAC)

Main documents

- TGax Agenda: 11-15-1232-04, TGax November 2015 Meeting Agenda
  - TGax PHY ad hoc agenda: 11-15-1385-03, TGax PHY Ad Hoc Nov 2015 Meeting Agenda
  - TGax MAC ad hoc agenda: 11-15-1382-03, TGax MAC ad hoc Nov 2015 Meeting Agenda
  - TGax Multi-User ad hoc agenda: 11-15-1418-02, TGax MU Ad-hoc November 2015 Agenda
  - TGax Spatial Reuse ad hoc agenda: 11-15-1403-06, 802.11ax Spatial Reuse Ad Hoc Group Agenda
- Closing report: 11-15-1457-00, TGax November 2015 Closing Report
- Draft TGax minutes: 11-15-1368-01, TGax November 2015 Dallas Meeting Minutes
  - TGax PHY ad hoc meeting minutes: 11-15-1442-00, November 2015 Dallas PHY Ad Hoc Meeting Minutes
  - TGax MAC ad hoc meeting minutes: 11-15-1414-00, Nov 2015 Dallas TGax MAC Ad hoc Meeting Minutes
  - TGax Multi-User ad hoc meeting minutes: 11-15-1423-01, November 2015 Dallas TGax MU Ad hoc Meeting minutes
  - TGax Spatial Reuse ad hoc meeting minutes: 11-15-1421-01, Minutes of the IEEE 802.11ax Spatial Reuse ad hoc group meeting – Dallas, November 2015

Achievements

5. TG Documents

- **Passed a number of affecting all aspects of the TG Specification Framework:**
  - PHY – 33 motions passed.
  - MAC – 16 motions passed.
  - MU – 12 motions passed.
  - SR – 1 motion passed.
- **Latest revision of the Specification Framework is available at;**
  - https://mentor.ieee.org/802.11/dcn/15/11-15-0132-10-00ax-spec-framework.docx
- **Approved new revisions of the TGax Simulation Scenario and Evaluation Methodology documents.**
  - Simulation Scenario https://mentor.ieee.org/802.11/dcn/14/11-14-0980-16-00ax-simulation-scenarios.docx
  - Evaluation Methodology https://mentor.ieee.org/802.11/dcn/14/11-14-0571-11-00ax-evaluation-methodology.docx
- Other documents
  - https://mentor.ieee.org/802.11/dcn/14/11-14-0882-04-00ax-tgax-channel-model-document.docx
  - https://mentor.ieee.org/802.11/dcn/14/11-14-1009-02-00ax-proposed-802-11ax-functional-requirements.doc

6. Technical Presentations

83 technical submissions have been covered during the week.
A list of the submissions is available in the agenda document.

- Submissions – PHY
  - 11-15-1059, "SIG-B Encoding Structure Part II," Ron Porat (Broadcom)
  - 11-15-1289, "Non-Uniform Constellations for 1024-QAM," Thomas Handte (Sony)
  - 11-15-1303, "LTF Sequence Designs," Sungho Moon (Newracom)
  - 11-15-1304, "Supported Resource Allocations in SIG-B," Sungho Moon (Newracom)
  - 11-15-1305, "STBC and Padding Discussions" Hongyuan Zhang (Marvell)
  - 11-15-1309, "Extended Range Support for 11ax," Sameer Vermani (Qualcomm)
  - 11-15-1310, "11ax LDPC Tone Mapper for 160MHz," Bin Tian (Qualcomm)

- 11-15-1311, “11ax Spectral Mask,” Bin Tian (Qualcomm)
- 11-15-1315, “HE-SIG-B Mapping and Compression,” Kaushik Josiam (Samsung)
- 11-15-1320, “Maximum Tone Grouping Size for 802.11ax Feedback,” Kome Oteri (InterDigital)
- 11-15-1321, “Reducing Explicit MIMO Compressed Beamforming Feedback Overhead for 802.11a,” Kome Oteri (InterDigital)
- 11-15-1322, “Channel Estimation Enhancement and Transmission Efficiency Improvement Using Beam-Change Indication and 1x HE-LTF,” Jianhan Liu (MediaTek)
- 11-15-1323, “HE-STF Sequence,” Ensung Park (LG Electronics)
- 11-15-1324, “MCS for HE-SIG-B,” Dongguk Lim (LG Electronics)
- 11-15-1327, “Diversity Mode in OFDMA,” Yujin Noh (Newracom)
- 11-15-1329, “Link Adaptation for HE WLAN,” Yujin Noh (Newracom)
- 11-15-1331, “PHY Padding Capability Signaling,” Daewon Lee (Newracom)
- 11-15-1332, “Implicit Sounding for HE WLAN,” Daewon Lee (Newracom)
- 11-15-1334, “HE-LTF Sequence Design,” Le Liu (Huawei)
- 11-15-1335, “HE-SIG-B Contents,” Le Liu (Huawei)
- 11-15-1347, “Strategies to reduce MIMO feedback overhead,” Filippo Tosato (Toshiba)
- 11-15-1349, “Sounding for Uplink Transmission,” Sungho Moon (Newracom)
- 11-15-1350, “Spatial Configuration And Signaling for MU-MIMO,” Yakun Sun (Marvell)
- 11-15-1353, “Preamble Formats,” Ron Porat (Broadcom)
- 11-15-1354, “SIGA fields and Bitwidths,” Ron Porat (Broadcom)
- 11-15-1357, “Extra tones in the preamble,” Xiaogang Chen (Intel)
- 11-15-1372, “L-LENGTH Equation Updates,” Hongyuan Zhang (Marvell)

- Submissions – MAC
  - 11-15-1265, “RTSCTS for UL DL OFDMA Control,” Cheeha Kim (POSTECH)
  - 11-15-1278, “HE MU Acknowledgment Procedure,” Yongho Seok (Newracom)
  - 11-15-1300, “DL MU transmission sequence,” Yong Hoon Kwon (Newracom)
  - 11-15-1318, “Fragmentation for MU frames-Follow up,” Alfred Asterjadhi (Qualcomm)
  - 11-15-1319, “Scheduled Trigger frames-Follow up,” Alfred Asterjadhi (Qualcomm)
  - 11-15-1330, “A method of transmitting Multi-STA Block frame,” Jeongki Kim (LG Electronics)
  - 11-15-1341, “Reception Status of Frames Transmitted in Random Access RUs,” Tomoko Adachi (Toshiba)
  - 11-15-1344, “Trigger Frame Format,” Simone Merlin (Qualcomm)
  - 11-15-1345, “Trigger type specific information,” Kiseon Ryu (LG Electronics)
  - 11-15-1346, “Ack Policy for UL MU Ack transmission,” Kiseon Ryu (LG Electronics)
  - 11-15-1351, “Rate MCS Selection Rules for M-BA and DL OFDMA BA,” Liwen Chu (Marvell)
  - 11-15-1352, “broadcast STAID in HE SIG B,” Liwen Chu (Marvell)
  - 11-15-1355, “Considerations for TDLS transmission in 11ax,” Yingpei Lin (Huawei)
  - 11-15-1359, “System Performance Evaluation of 802.11ae,” Yu Wang (Ericsson)

- Submissions – Multi-User
  - 11-15-1280, “Traffic priority for random Multi User Uplink OFDMA,” Stephane Baron (Canon)
  - 11-15-1301, “NAV Rule for UL MU Response,” Yingpei Lin (Huawei)
  - 11-15-1312, “MU BAR Frame Format,” Reza Hedayat (Newracom)
  - 11-15-1314, “I/Q Imbalance Impact to TGax OFDMA Uplink Reception,” Rui Yang (InterDigital)
  - 11-15-1325, “MU-RTS/CTS Follow Up,” Po-Kai Huang (Intel)
  - 11-15-1326, “NAV Consideration for UL MU Response Follow Up,” Po-Kai Huang (Intel)
  - 11-15-1328, “Scheduling information for UL OFDMA Acknowledgement,”Yujin Noh (Newracom)

- 11-15-1340, "NDP Announcement for HE Sequence," Narendar Madhavan (Toshiba)
- 11-15-1364, "Signaling Trigger Information for STAs in 11ax," Chittabrata Ghosh (Intel)
- 11-15-1369, "Random access based buffer status report," Woojin Ahn (Yunsei Univ.)
- 11-15-1370, "UL OFDMA Random Access Control," Jinsoo Ahn (Yonsei Univ.)
- 11-15-1374, "Consideration for protecting cascading MU DL/UL transmission with MU RTS/CTS," Jing Ma (NICT)

- Submissions – Spatial Reuse
  - 11-15-1259, "Use of TG ax Scenarios for Spatial Reuse," Graham Smith (SR Tecnologies)
  - 11-15-1284, "Simulation results for spatial reuse in 11ax," Jinmin Kim (LG Electronics)
  - 11-15-1313, "Considerations for Spatial Reuse," Reza Hedayat (Newracom)
  - 11-15-1316, "DSC calibration results with NS-3," M. Shahwaiz Afaqui (T.U. Catalonia)
  - 11-15-1336, "BSS Color Field Size Measurements," Chuck Lukaszewski (Aruba-HP)
  - 11-15-1337, "Secondary Channel CCA of HE STA," John Son (Willus Institute)
  - 11-15-1338, "Improving Spatial Reuse During OBSS UL MU Procedure," Geonjung Ko (Willus Institute)
  - 11-15-1348, "Multiple NAVs for Spatial Reuse," Sigurd Schelstraete (Quantenna)
  - 11-15-1427, "Drivers of the dynamic CCA adaptation," Eduard Garcia-Villegas (Technical Univ. of Catalonia)

- Submissions – TG
  - 11-15-1288, "An issue of wider bandwidth operation at real denser environment," Katsuo Yunoki (KDDI R&D Labs)
  - 11-15-1302, "System Level Simulator Evaluation with/without Capture Effect," Vida Ferdowsi (Newracom)
  - 11-15-1360, "Implications of wrap-around for TGax Scenario 3 and Scenario 4 – follow-up," Marcin Filo (Univ. of Surrey)
  - 11-15-1361, "Energy consumption with Scheduled PSP," Dmitry Akhmetov (Intel)
  - 11-15-1362, "On TGax Scenario 4 channel model – follow-up," Marcin Filo (Univ. of Surrey)
  - 11-15-1363, "Regulatory Landscape for Narrowband Transmissions in 11ax," Ilan Sutskover (Intel)
  - 11-15-1373, "Updated Box5 Calibration Results," Narendar Madhavan (Toshiba)
  - 11-15-1375, "11ax Support for IoT - Requirements and Technological Implications," Shimo Shilo (Huawei)

Goals for January 2016

- Continue to advance TG documents based on submissions.
  - Priority to the TG Specification Framework document.
- TG timeline indicates draft D0.1 will be available in January 2016.
- Technical Presentations.

Teleconferences

- One teleconference is planned before the January 2016 session.
  - Thursday, December 10th, 10:00 – 12:00 (ET)

September 2015 – Bangkok, Thailand

Originally, TGax planned to have ten sessions during the week.
Two more sessions were added during the WG opening week plenary session due to the large number of submissions.
Six out of twelve sessions were assigned to the ad hoc sessions.

Tuesday			Wednesday		Thursday
			TGax		TGax
	TGax (PHY)	TGax (MAC)			
Gax [AC)	TGax (MU)	TGax (SR)	TGax (PHY)	TGax (SR)	TGax
	TGax		TGax		
Gax [AC)	TGax (MU)	TGax (SR)			

Main documents

- TGax Agenda: 11-15-0987-06, TGax September 2015 Meeting Agenda
  - TGax PHY ad hoc agenda: 11-15-1125-04, TGax PHY Ad Hoc September 2015 Meeting Agenda
  - TGax MAC ad hoc agenda: 11-15-1126-03, TGax MAC ad hoc September 2015 Meeting Agenda
  - TGax Multi-User ad hoc agenda: 11-15-1141-02, TGax MU ad-hoc September 2015 Agenda
  - TGax Spatial Reuse ad hoc agenda: 11-15-1143-03, TGax Spatial Reuse Ad Hoc September 2015 Meeting Agenda
- Closing report: 11-15-1190-00, TGax September 2015 Closing Report
- Draft TGax minutes: 11-15-1093-00, TGax September 2015 Bangkok Meeting Minutes
  - TGax PHY ad hoc meeting minutes: 11-15-1205-00, September 2015 Bangkok PHY Ad Hoc Meeting Minutes
  - TGax MAC ad hoc meeting minutes: 11-15-1130-02, September 2015 TGax MAC Ad hoc Meeting Minutes
  - TGax Multi-User ad hoc meeting minutes: 11-15-1160-00, September 2015 TGax MU Ad hoc Meeting minutes
  - TGax Spatial Reuse ad hoc meeting minutes: 11-15-1206-00, Minutes of the IEEE 802.11ax Spatial Reuse ad hoc group meeting – Bangkok, September 2015

Achievements

7. TG Documents

- **Passed a number of affecting all aspects of the TG Specification Framework:**
  - PHY – 29 motions passed.
  - MAC – 12 motions passed.
  - MU – 15 motions passed.
  - SR – 4 motions passed.
- **Latest revision of the Specification Framework is available at;**
  - https://mentor.ieee.org/802.11/dcn/15/11-15-0132-09-00ax-spec-framework.docx
- **Approved new revisions of the TGax Simulation Scenario and Evaluation Methodology documents.**
  - Simulation Scenario https://mentor.ieee.org/802.11/dcn/14/11-14-0980-14-00ax-simulation-scenarios.docx
  - Evaluation Methodology https://mentor.ieee.org/802.11/dcn/14/11-14-0571-10-00ax-evaluation-methodology.docx
- Other documents
  - https://mentor.ieee.org/802.11/dcn/14/11-14-0882-04-00ax-tgax-channel-model-document.docx
  - https://mentor.ieee.org/802.11/dcn/14/11-14-1009-02-00ax-proposed-802-11ax-functional-requirements.doc

8. Technical Presentations

83 technical submissions have been covered during the week.

A list of the submissions is available in the agenda document.

- PHY
  - 11-15-0579, “Preamble Design and Auto-detection,” Hongyuan Zhang (Marvell)
  - 11-15-0580, “11ax Coding Discussion,” Hongyuan Zhang (Marvell)
  - 11-15-0602, “HE-LTF squence for UL MU-MIMO,” Xiaogang Chen (Intel)
  - 11-15-0810, “HE PHY Padding and Packet Extension,” Hongyuan Zhang (Marvell)
  - 11-15-0823, “Preamble Design and Auto-Detection for 11ax,” Sungho Moon (Newracom)
  - 11-15-0826, ”HE-SIG-A Transmission for Range Extension,” Jiayin Zhang (Huawei)
  - 11-15-0853, “Extensible Preamble Format Design,” Leonardo Lanante (Kyutech)
  - 11-15-1031, “DL MU Signaling,” Katsuo Yunoki (KDDI)
  - 11-15-1051, “HE NDP frame for sounding,” Young Hoon Kwon (Newracom)
  - 11-15-1059, “SIG-B Encoding Structure Part II,” Ron Porat (Broadcom)
  - 11-15-1066, “HE-SIG-B Contents,” Kaushik Josiam (Samsung)
  - 11-15-1068, “Reliable Transmission Scheme for HE-SIG-B and Data,” Jianhan Liu (MediaTek)
  - 11-15-1070, “1024 QAM Proposal,” Eunsung Park (LG Electronics)
  - 11-15-1071, “Tone Grouping Factors and NDP format for 11ax,” Sameer Vermani (Qualcomm)
  - 11-15-1075, “Number of BSS Color bits,” Junichi Iwatani (NTT)
  - 11-15-1077, “HE-SIG-A Content,” Jiayin Zhang (Huawei)
  - 11-15-1088, “LTF Design for Uplink MU-MIMO,” Daewon Lee (Newracom)
  - 11-15-1089, “Considerations on PHY Padding and Packet Extension in 11ax,” Yujin Noh (Newracom)
  - 11-15-1091, “Considerations on Range Extension with SIG-A Repetition,” Yujin Noh (Newracom)
  - 11-15-1092, “Support of 1x/2x/4x OFDM Symbol in HE SU PPDU,” Heejung Yu (Yeungnam Univ.)
  - 11-15-1106, “SIG-B Structure,” Reza Hedayat (Newracom)
  - 11-15-1111, “SIG-B Resource Unit Allocation Coding,” Amin Jafarian (Newracom)
  - 11-15-1119, “Discussions on HE SIG-A Structure,” John Son (Wilus Institute)
  - 11-15-1122, “Identifiers in HE PPDUs for power saving,” Alfed Asterjadhi (Qualcomm)

- MAC
  - 11-15-1013, “802.11ae & 802.11ax,” Guido R. Hiertz (Ericsson)
  - 11-15-1014, “Multiple BSSID Element,” Guido R. Hiertz (Ericsson)
  - 11-15-1015, “Proxy ARB in 802.11ax,” Guido R. Hiertz (Ericsson)
  - 11-15-1033, “Data field in HE PPDU,” Yongho Seok (Newracom)
  - 11-15-1034, “Notification of Operating Mode Changes,” Yongho Seok (Newracom)
  - 11-15-1044, “Further Study of 11ax Multicast,” Kazuyuki Sakoda (Sony)
  - 11-15-1052, “Bandwidth for UL MU transmission,“ Young Hoon Kwon (Newracom)
  - 11-15-1060, “Receive Operating Mode Indication for Power Save,” Eric Wong (Apple)
  - 11-15-1063, “11ax Channel access procedure,” Chao-Chun Wang (MediaTek)
  - 11-15-1067, “MU TXOP truncation,” Jeongki Kim (LG Electronics)
  - 11-15-1096, “Recovery Procedures in Cascading Sequences,” John Son (Wilus Institute)
  - 11-15-1098, “ACK/BA frame for UL MU under cascading structure,” Narendar Madhavan (Toshiba)
  - 11-15-1114, “Airtime Analysis of EDCA,” Sean Coffey (RealTek)
  - 11-15-1115, “High Efficiency in Accessing the Medium,” Sean Coffey (RealTek)
  - 11-15-1116, “Trigger Frame Channel Access,” Jinsoo Ahn (Yonsei Univ.)
  - 11-15-1120, “Buffer Status Report,” Alfred Asterjadhi (Qualcomm)
  - 11-15-1121, “HE A-Control field,” Alfred Asterjadhi (Qualcomm)
  - 11-15-1137, “Triggered OFDMA Random Access Observations,” Russell Huang (MediaTek)

- Multi-User

- ✧ 11-15-1043, “Overall Protocol of UL MU BA for Multicast Transmission,” Kazuyuki Sakoda (Sony)
- ✧ 11-15-1047, “RU selection process upon TF-R reception,” Stephane Baron (Canon)
- ✧ 11-15-1053, “Multiuser Block ACK Request (MU-BAR),” Guoqing Li (Apple)
- ✧ 11-15-1057, “Multiple Resource Unit Allocation for TGax OFDMA,” Kome Oteri (InterDigital)
- ✧ 11-15-1062, “NAV Consideration for UL MU Response to Trigger frame,” Po-Kai Huang (Intel)
- ✧ 11-15-1065, “11ax uplink Multi-TID aggregation,” Chao-Chun Wang (MediaTek)
- ✧ 11-15-1086, “Consideration on multi-STA BA frame indication,” Jing Ma (NICT)
- ✧ 11-15-1097, “Reducing Channel Sounding Protocol Overhead for 11ax,” Narendar Madhavan (Toshiba)
- ✧ 11-15-1102, “Fragmentation with MU Operation,” Chittabrata Ghosh (Intel)
- ✧ 11-15-1103, “DL Sounding Sequence with UL MU Feedback,” Chittabrata Ghosh (Intel)
- ✧ 11-15-1105, “UL OFDMA-based Random Access Procedure,” Chittabrata Ghosh (Intel)
- ✧ 11-15-1107, “Power Save with Random Access,” Chittarata Ghosh (Intel)
- ✧ 11-15-1117, “Regarding UL MU protection,” Woojin Ahn (Yonei Univ.)
- ✧ 11-15-1123, “Acknowledgement to DL MU,” Liwen Chu (Marvell)
- ✧ 11-15-1129, “Feedback overhead in DL-MU-MIMO,” Filippo Tosato (Toshiba)

- Spatial Reuse
  - ✧ 11-15-1045, “Dynamic CCA control and TPC Simulation Results with SS1-SS3,” Takeshi Itagaki (Sony)
  - ✧ 11-15-1058, “CCA consideration for UL MU transmission,” Kiseon Ryu (LG Electronics)
  - ✧ 11-15-1069, “Adaptive CCA and TPC,” James Wang (MediaTek)
  - ✧ 11-15-1081, “Further consideration on receive behaviour based on the cascading structure and the BSS color scheme,” Jing Ma (NICT)
  - ✧ 11-15-1082, “Analysis of BSS and ESS Structure During Concurrent SR Transmissions,” Chuck Lukaszewski (Aruba/HP)
  - ✧ 11-15-1083, “Cost/Benefit Analysis of SR Techniques,” Chuck Lukaszewski (Aruba/HP)
  - ✧ 11-15-1101, “DSC/DCCA Calibration with TGax Agreed Scenarios,” Masahito Mori (Sony)
  - ✧ 11-15-1104, “TXOP Considerations for Spatial Reuse,” Reza Hedayat (Newracom)
  - ✧ 11-15-1109, “OBSS NAV and PD Threshold Rule for Spatial Reuse,” Rossi Jun Luo (Huawei)
  - ✧ 11-15-1110, “BSS TXOP,” Amin Jafarian (Newracom)
  - ✧ 11-15-1118, “Discussions on Spatial Reuse Enhancement,” Geonjung Ko (WILUS)
  - ✧ 11-15-1138, “To DSC or not to DSC,” Filip Mestanov (Ericsson)

- Simulation and Calibration and others
  - ✧ 11-15/1039, “Spatial Reuse Measurements,” Chuck Lukaszewski (Aruba Networks, a HP company)
  - ✧ 11-15-1046, “MAC calibration results,” Stephane Baron (Canon)
  - ✧ 11-15-1048, “On TGax Scenario 4 channel model,” Marcin Filo (Univ. of Surrey)
  - ✧ 11-15-1049, “Implications of wrap-around for TGax Scenario 3 and Scenario 4,” Marcin Filo (Univ. of Surrey)
  - ✧ 11-15-1056, “Clarifying Link Level Simulator Assumptions,” Kome Oteri (InterDigital)
  - ✧ 11-15-1087, “MU BFee Interference channel feedback,” Sigurd Schelstraete (Quantenna)
  - ✧ 11-15-1095, “OFDMA performance in 11ax,” Suhwook Kim (LG Electronics)
  - ✧ 11-15-1099, “Power Save Simulation Results,” Hyeyoung Choi (LG Electronics)
  - ✧ 11-15-1100, “Discussion on Deep and Shallow Sleep States,” Chittabrata Ghosh (Intel)
  - ✧ 11-15-1113, “Box5 Calibration results,” Vida Ferdowsi (Newracom)
  - ✧ 11-15-1134, “11ax Support for IoT,” Shimi Shilo (Huawei)
  - ✧ 11-15-1135, “Results for SS6 calibration case for single BSS and OBSS,” Esa Tuomaala (Nokia)

Goals for November 2015

- Continue to advance TG documents based on submissions.
  - Priority to the TG Specification Framework document.
- Technical Presentations.

Teleconferences

- One teleconference is planned before the November 2015 session.
  - ✧ Thursday, October 15th, 10:00 – 12:00 (ET)

July 2015 – Waikoloa, HI

Originally, TGax planned to have nine sessions during the week.
Two more sessions were added during the mid-week plenary session (marked red).
Four out of eleven sessions were ad hoc sessions.

Tuesday		Wednesday		Thursday
				TGax
TGax (PHY)	**TGax (MAC)**			**TGax**
TGax (Multi-User)	**TGax (Spatial Reuse)**	**TGax (PHY)**	**TGax (MAC)**	**TGax**
		TGax (PHY)	**TGax (Multi-User)**	**TGax**
	TGax			

Main documents

- TGax Agenda: 11-15-0735-05, TGax July 2015 Meeting Agenda
  - TGax PHY ad hoc agenda: 11-15-0898-03, TGax PHY Ad Hoc Jul 2015 Meeting Agenda
  - TGax MAC ad hoc agenda: 11-15-0888-02, TGax MAC ad hoc July 2015 Meeting Agenda
  - TGax Multi-User ad hoc agenda: 11-15-0899-02, TGax MU ad-hoc July 2015 Agenda
  - TGax Spatial Reuse ad hoc agenda: 11-15-0911-01, 802.11ax Spatial Reuse Ad Hoc Group
- Closing report: 11-15-0963-00, TGax July 2015 Closing Report
- Draft TGax minutes: 11-15-0884-00, TGax July 2015 Waikoloa Meeting Minutes
  - TGax PHY ad hoc meeting minutes: 11-15-0913-00, July 2015 Hawaii PHY Ad Hoc Meeting Minutes
  - TGax MAC ad hoc meeting minutes: 11-15-0922-01, July 2015 Hawaii TGax MAC Ad hoc Meeting Minutes
  - TGax Multi-User ad hoc meeting minutes: 11-15-0949-01, July 2015 Hawaii TGax MU Ad hoc Meeting minutes
  - TGax Spatial Reuse ad hoc meeting minutes: 11-15-0971-01, Minutes of the IEEE 802.11ax Spatial Reuse ad hoc group meeting

Achievements

9. TG Documents

- **Passed a number of PHY, MAC and MU motions affecting the TGax Specification Framework:**

- ✧ PHY Motions: SIG-A, SIG-B, Pilots, etc.
- ✧ MAC Motions: Trigger frame, etc.
- ✧ MU Motions: Trigger frame for random access, MU CTS, etc.

- **Latest revision of the Specification Framework is available at;**
  - ✧ https://mentor.ieee.org/802.11/dcn/15/11-15-0132-07-00ax-spec-framework.docx
- **Approved new revisions of the TGax Simulation Scenario and Evaluation Methodology documents.**
  - ✧ Simulation Scenario https://mentor.ieee.org/802.11/dcn/14/11-14-0980-14-00ax-simulation-scenarios.docx
  - ✧ Evaluation Methodology https://mentor.ieee.org/802.11/dcn/14/11-14-0571-10-00ax-evaluation-methodology.docx
- Other documents
  - ✧ https://mentor.ieee.org/802.11/dcn/14/11-14-0882-04-00ax-tgax-channel-model-document.docx
  - ✧ https://mentor.ieee.org/802.11/dcn/14/11-14-1009-02-00ax-proposed-802-11ax-functional-requirements.doc

10. Technical Presentations

More than 70 technical submissions have been covered during the week.
A list of the submissions is available in the agenda document.

- PHY
  - ✧ 11-15-0579, "preamble design and autodetection," Hongyuan Zhang (Marvell)
  - ✧ 11-15-0580, "11ax coding discussion," Hongyuan Zhang (Marvell)
  - ✧ 11-15-0602, "HE-LTF sequence for UL MU-MIMO," Qinghua Li (Intel)
  - ✧ 11-15-0805, "SIG-B field for HEW PPDU," Young Hoon Kwon (Newracom)
  - ✧ 11-15-0810, "HE PHY Padding and Packet Extension," Hongyuan Zhang (Marvell)
  - ✧ 11-15-0812, "Pilot Design for Data Section," Sameer Vermani (Qualcomm)
  - ✧ 11-15-0813, "CP Indication for UL MU Transmission," Zhigang Rong (Huawei)
  - ✧ 11-15-0816, "Interleaver and Tone Mapper for OFDMA," Yakun Sun (Marvell)
  - ✧ 11-15-0817, "P Matrix for HE-LTF," Yakun Sun (Marvell)
  - ✧ 11-15-0819, "11ax OFDMA Tone Plan Leftover Tones and Pilot Structure," Bin Tian (Qualcomm)
  - ✧ 11-15-0821, "HE SIG-B Structure," Joonsuk Kim (Apple)
  - ✧ 11-15-0822, "SIG-A Structure in 11ax Preamble," Jianhan Liu (MediaTek)
  - ✧ 11-15-0823, "Preamble Design and Auto-Detection for 11ax," Sungho Moon (Newracom)
  - ✧ 11-15-0824, "Pilot Design for 11ax Downlink Transmissions," Yujin Noh (Newracom)
  - ✧ 11-15-0826, "HE-SIG-A transmission for range extension," Jiayin Zhang (Huawei)
  - ✧ 11-15-0827, "Considerations on HE-SIG-A and B," Katsuo Yunoki (KDDI Labs)
  - ✧ 11-15-0832, "Performance evaluation of SU/MU MIMO in OFDMA," Jiayin Zhang (Huawei)
  - ✧ 11-15-0845, "LTF Design for Uplink MU-MIMO," Daewon Lee (Newracom)
  - ✧ 11-15-0853, "Extensible Preamble Format Design," Leonardo Lanante (Kyushu Institute of Technology)
  - ✧ 11-15-0865, "Discussion of ACI performance and ACI requirements for IEEE 802.11ax," Leif Wilhelmsson (Ericsson AB)
  - ✧ 11-15-0868, "Impact of Frequency Selective Scheduling Feedback for OFDMA," Hakan Persson (Ericsson)
  - ✧ 11-15-0873, "SIG-B Encoding Structure," Ron Porat (Broadcom)
  - ✧ 11-15-0887, "Efficient padding for last OFDM symbol," Heejung Yu (Newracom)

- MAC
  - ✧ 11-15-0615, "DL OFDMA Bandwidth," Liwen Chu (Marvell)
  - ✧ 11-15-0803, "Frame Collision Information Management," Peng Shao (NEC Communication Systems)
  - ✧ 11-15-0831, "Broadcast and Unicast (Trigger) in DL MU," Liwen Chu (Marvell)

- ✧ 11-15-0841, “Cascading Structure,” David Xun Yang (Huawei Technologies)
- ✧ 11-15-0851, “HE Trigger Frame Format,” John Son (WILUS Institute)
- ✧ 11-15-0856, “Compressed Uplink Trigger Frame,” Vida Ferdowsi (Newracom)
- ✧ 11-15-0871, “Efficiency enhancement for 802.11ax,” Guido R. Hiertz (Ericsson)
- ✧ 11-15-0872, “802.11ai and 802.11ax,” Guido R. Hiertz (Ericsson)
- ✧ 11-15-0874, “Minimal data rates management frame transmissions in 2.4 GHz,” Guido R. Hiertz (Ericsson)
- ✧ 11-15-0876, “Duration and MAC Padding for MU PPDU,” Simone Merlin (Qualcomm)
- ✧ 11-15-0877, “Trigger Frame Format,” Simone Merlin (Qualcomm)
- ✧ 11-15-0878, “Issues on Trigger Frame Retransmission,” Jinsoo Ahn (Yonsei Univ.)
- ✧ 11-15-0880, “Scheduled Trigger frames,” Alfred Asterjadhi (Qualcomm)
- ✧ 11-15-0914, “Enlarged minimal contention window size,” Guido R. Hiertz (Ericsson)

- Multi-User
  - ✧ 11-15-0800, “Multiplexing of Acknowledgements for Multicast Transmission,” Yusuke Tanaka (Sony)
  - ✧ 11-15-0806, “Protection for MU transmission,” Young Hoon Kwon (Newracom)
  - ✧ 11-15-0818, “Further Analysis of Feedback and Frequency Selective Scheduling (FSS) for TGax OFDMA,” Kome Oteri (InterDigital Communication)
  - ✧ 11-15-0829, “Uplink ACK and BA Multiplexing,” Reza Hedayat (Newracom)
  - ✧ 11-15-0843, “UL MU OFDMA analysis,” Yonggang Fang (ZTE)
  - ✧ 11-15-0852, “Transmission Interval of Trigger Frames,” Leonardo Lanante (Kyushu Institute of Technology)
  - ✧ 11-15-0854, “DL OFDMA Signalling,” Tomoko Adachi (Toshiba)
  - ✧ 11-15-0855, “How to collect STAs’ Tx demands for UL MU,” Tomoko Adachi (Toshiba)
  - ✧ 11-15-0858, “MU BFee Interference channel feedback,” Sigurd Schelstraete (Quantenna)
  - ✧ 11-15-0859, “A mechanism for incremental updates to MU precoding,” Sigurd Schelstraete (Quantenna)
  - ✧ 11-15-0867, “MU-RTS/CTS for DL MU,” Po-kai Huang (Intel)
  - ✧ 11-15-0875, “Random Access with Trigger Frames using OFDMA,” Chittabrata Ghosh (Intel)
  - ✧ 11-15-0881, “Regarding buffer status of UL-STAs in UL-OFDMA,” Woojin Ahn (Yonsei Univ.)

- Spatial Reuse
  - ✧ 11-15-0797, “NAV Operation for Spatial Reuse,” Yongho Seok (Newracom)
  - ✧ 11-15-0801, “DCCA/DSC Reference Simulation Results,” Masahito Mori (Sony)
  - ✧ 11-15-0804, “Outdoor Enterprise Scenario and DSC,” Graham Smith (SR Technologies)
  - ✧ 11-15-0807, “DSC Summary,” Graham Smith (SR Technologies)
  - ✧ 11-15-0811, “Topics for Consideration for Spatial Reuse,” Xiaofei Wang (InterDigital)
  - ✧ 11-15-0882, “DSC leveraging uplink RTS/CTS control,” M. Shahwaiz Afaqui (Technical University of Catalonia)
  - ✧ 11-15-0883, “Follow Up Discussion on The Receiver Behavior,” Yasuhiko Inoue (NTT)
  - ✧ 11-15-0886, “DSC Calibration Results,” Chinghwa Yu (MediaTek)

- Simulation and Calibration and others
  - ✧ 11-15-0754, “WLAN Packet traffic and efficiency analysis,” Jim Lansford (CSR)
  - ✧ 11-15-0781, “Summary of Power Save Calibration Results,” Eric Wong (Apple)
  - ✧ 11-15-0787, “Power Save Calibration Results,” Eric Wong (Apple)
  - ✧ 11-15-0788, “Box 1 and Box 2 calibration results,” Takeshi Itagaki (Sony)
  - ✧ 11-15-0789, “Proposed Changes to Evaluation Methodologies,” Allan Jones (Activision)
  - ✧ 11-15-0802, “Box5 Calibration Results of SS6,” Jiyong Pang (Huawei)
  - ✧ 11-15-0814, “Simulation Results for Box5 Calibration,” Ke Yao (ZTE)

- ✧ 11-15-0833, "Calibration results for PSP and UAPSD for 20, 40 and 80MHz bands," Dmitry Akhmetov (Intel)
- ✧ 11-15-0680, "Reference Box5 Calibration Assumptions and Parameters," Jiyong Pang (Huawei)
- ✧ 11-15-0849, "Simulation Results for Box5 Calibration," Rongzhen Yang (Intel)
- ✧ 11-15-0869, "OFDMA and VoIP Capacity," Hakan Persson (Ericsson)
- ✧ 11-15-0870, "802.11ax in 2.4 GHz," Guido R. Hiertz (Ericsson)
- ✧ 11-15-0885, "Box 5 Calibration Results," ChingHwa Yu (MediaTek)

Goals for September 2015

- Continue to advance TG documents based on submissions.
  - ➢ Priority to the TG Specification Framework document.
- Technical Presentations.

Teleconferences

- One teleconference is planned before the September 2015 session.
  - ✧ Thursday, August 20th, 10:00 – 12:00 (ET)

May 2015 – Vancouver, BC, Canada

TGax had eight sessions during the week. Four out of eight sessions were ad hoc sessions.

	Tuesday		Wednesday		Thursday
					TGax
	TGax (Multi-User)	**TGax (Spatial Reuse)**			
TGax (MAC)	**TGax (PHY)**	**TGax (Spatial Reuse)**	**TGax (PHY)**	**TGax (Multi-User)**	**TGax**
			TGax		

Main documents

- TGax Agenda: 11-15-0500-08, TGax May 2015 Meeting Agenda
  - ➢ TGax PHY ad hoc agenda: 11-15-0640-04, TGax PHY Ad Hoc May 2015 Meeting Agenda
  - ➢ TGax MAC ad hoc agenda: 11-15-0599-02, TGax MAC ad hoc May 2015 Meeting Agenda
  - ➢ TGax Multi-User ad hoc agenda: 11-15-0645-01, TGax MU ad-hoc May 2015 Agenda
  - ➢ TGax Spatial Reuse ad hoc agenda: 11-15-0650-02, 802.11ax Spatial Reuse Ad Hoc Group
- Closing report: 11-15-00692-01, TGax May 2015 Closing Report
- Draft TGax minutes: 11-15-0622-00, TGax May 2015 Vancouver Meeting Minutes
  - ➢ TGax PHY ad hoc meeting minutes: 11-15-0651-02, May 2015 Vancouver PHY Ad Hoc Meeting Minutes
  - ➢ TGax MAC ad hoc meeting minutes: 11-15-0637-00, May 2015 Vancouver TGax MAC Ad hoc Meeting Minutes
  - ➢ TGax Multi-User ad hoc meeting minutes: 11-15-0679-00, May 2015 Vancouver Multi-User ad hoc Meeting minutes
  - ➢ TGax Spatial Reuse ad hoc meeting minutes: 11-15-0662-01, May 2015 Vancouver Spatial Reuse ad hoc Meeting Minutes

Achievements

11. TG Documents

- **Passed a number of PHY and MAC motions affecting the TGax Specification Framework:**
  - PHY Motions: Tone Plans, STF design, SIG-B, etc.
  - MAC Motions: Enhancing multi-STA BA and aspects of the trigger frame
- **Latest revision of the Specification Framework is available at;**
  - https://mentor.ieee.org/802.11/dcn/15/11-15-0132-05-00ax-spec-framework.docx
- **Approved new revisions of the TGax Evaluation Methodology documents.**
  - https://mentor.ieee.org/802.11/dcn/14/11-14-0571-09-00ax-evaluation-methodology.docx
- Other documents
  - https://mentor.ieee.org/802.11/dcn/14/11-14-0980-12-00ax-simulation-scenarios.docx
  - https://mentor.ieee.org/802.11/dcn/14/11-14-0882-04-00ax-tgax-channel-model-document.docx
  - https://mentor.ieee.org/802.11/dcn/14/11-14-1009-02-00ax-proposed-802-11ax-functional-requirements.doc

12. Technical Presentations

More than 50 technical submissions have been covered during the week.
A list of the submissions is available in the agenda document.

- PHY
  - 11-15/0550, "L-preamble issues for UL-OFDMA," Katsuo Yunoki (KDDI Labs)
  - 11-15/0553, "Enhancing Performance of Hybrid-ARQ with Linear Constellation Precoding," Muhammad Mehboob Fareed (King Abdullah Univ. of Science and Technology)
  - 11-15/0569, "Performance of 1x, 2x, and 4x HE-LTF," Kome Oteri (InterDigital)
  - 11-15/0572, "Inefficiency of 256-FFT per 20MHz," Heejung Yu (Yeungnam Univ./Newracom)
  - 11-15/0574, "SIG structure for UL PPDU," Young Hoon Kwon (Newracom)
  - 11-15/0575, "Preamble Structure in 802.11ax," Yujin Noh (Newracom)
  - 11-15/0577, "Pilot Design for 11ax," Daewon Lee (Newracom)
  - 11-15/0579, "Preamble design and auto-detection," Hongyuan Zhang (Marvell)
  - 11-15/0580, "11ax coding discussion," Hongyuan Zhang (Marvell)
  - 11-15/0584, "Considerations on LTF Sequence Design," Sungho Moon (Newracom)
  - 11-15/0600, "Non Uniform Constellations for 1024QAM," Daniel Schneider (Sony)
  - 11-15/0602, "HE-LTF sequence for UL MU-MIMO," Qinghua Li (Intel)
  - 11-15/0621, "Design Principles for HE Preamble," John Son (WILUS)
  - 11-15/0381, "HE-STF Proposal," Yakun Sun (Marvell)

- MAC
  - 11-15/0567, "Multi-STA BA for SU Transmissions," Xiaofei Wang (InterDigital)
  - 11-15/0604, "Random Access with Trigger Frames using OFDMA," Chittabrata Ghosh (Intel)
  - 11-15/0611, "Multi-STA Block ACK Protection," Jinsoo Ahn (Yonsei Univ.)
  - 11-15/0615, "UL OFDMA Bandwidth," Liwen Chu (Marvell)
  - 11-15/0617, "Duration and MAC Padding for UL MU PPDUs," Gang Ding (Qualcomm)
  - 11-15/0626, "Further consideration for Multi-STA Block ACK frame," Jeongki Kim (LG)

- Multi-User
  - 11-15/0378, "Channel Sensing in UL OFDMA," Reza Hedayat (Newracom)
  - 11-15/0568, "Frequency Selective Scheduling (FSS) for TGax OFDMA," Kome Oteri (InterDigital)
  - 11-15/0586, "Frequency Diversity Options in OFDMA," Reza Hedayat (Newracom)
  - 11-15/0587, "Uplink ACK and BA Multiplexing," Reza Hedayat (Newracom)
  - 11-15/0597, "Beamformed HE PPDU," Yongho Seok (Newracom)

- ✧ 11-15/0608, “Regarding trigger frame in UL MU,” Tomo Adachi (Toshiba)
- ✧ 11-15/0612, “Multi Channel availability for UL-OFDMA,” Woojin Ahn (Yonsei Univ.)

- Spatial Reuse
  - ✧ 11-15/0543, “Simulation Scenario changes for Frequency Re-use,” Graham Smith (SR Technologies)
  - ✧ 11-15/0544, “Proposed text additions to 14/980 for frequency re-use,” Graham Smith (SR Technologies)
  - ✧ 11-15/0548, “Enterprise Scenario and DSC,” Graham Smith (SR Technologies)
  - ✧ 11-15/0588, “CCA revisited II,” Amin Jafarian (Newracom)
  - ✧ 11-15/0595, “Discussion on The Receiver Behavior for CCAC/DSC with BSS Color,” Yasuhiko Inoue (NTT)

- Simulation and Calibration
  - ✧ 11-15/0551, “OBSS Preamble Detection,” Suhwook Kim (LG Electronics)
  - ✧ 11-15/0552, “IEEE 802.11 performance in dense, cellular-like, outdoor deployments,” Richard Edgar (Imagination Technologies)
  - ✧ 11-15/0330, “OFDMA Numerology and Structure,” Sharnaz Azizi (Intel)
  - ✧ 11-15/0583, “OBSS Preamble Error Probability,” Jiyong Pan (Huawei)
  - ✧ 11-15/0590, “Traffic Model Updates to Evaluation Methodology,” Phil Barber (Huawei)

  - ~~✧ 11-14/1392, “Simulation results for Box-5 calibration,” Suhwook Kin (LG Electronics)~~
  - ✧ 11-15/0674, “Joint submission for Box 5 Calibration,” Suhwook Kin (LG Electronics)
  - ✧ 11-15/0581, “LSP Correlation Clarification for Scenario 4,” Daewon Lee (Newracom)
  - ✧ 11-15/0582, “Clarifications to Box 2 MIMO simulation calibrations,” Daewon Lee (Newracom)
  - ✧ 11-15/0373, “Mixed traffic configurations on simulation scenarios,” Yingpei Lin (Huawei)
    - Not presented since the contents of this submission was merged into 11-15/0590.
  - ✧ 11-15/0610, “Simulation Results for Box 5 Calibration,” Vida Ferdowsi (Newracom)
  - ✧ 11-15/0613, “Box 5 Calibration Result,” Chinghwa Yu (MediaTek)
  - ✧ 11-15/0623, “TGax simulation scenario “Box 5” – calibration results,” Guido Hiertz (Ericsson)

  - ✧ 11-15/0316, “Power Save Calibrations,” Hyeyoung Choi (LG Electronics)
  - ✧ 11-15/0564, “802.11ax Calibration and Modeling Adjacent Channel Interference,” Naveen Kakani (CSR)
  - ✧ 11-15/0576, “Latency and Power Consumption in State Transitions,” Chittabrata Ghosh (Intel)
  - ✧ 11-15/0592, “More Power Save Calibration Results,” Eric Wong (Apple)
  - ✧ 11-15/0598, “U-APSD Enhancement for HE,” Jarkko Kneckt (Nokia)
  - ✧ 11-15/0603, “Calibration Results for PSP and U-APSD,” Chittabrata Ghosh (Intel)

Goals for July 2015

- Continue to advance TG documents based on submissions.
  - ➢ Expectation is more submissions affecting the TG specification framework document will be considered.
- Technical Presentations.

Teleconferences

- One teleconference is planned before the July 2015 session.
  - ✧ Thursday, June 18th, 10:00 – 12:00 (ET)

March 2015 – Berlin, Germany

The original plan was to have nine sessions during the week, but one more session was added (Wednesday PM2).

Monday	Tuesday	Wednesday	Thursday
TGax (ad hoc)		**TGax (MU/Spatial Reuse)**	**TGax**
	TGax (PHY/MAC)		
TGax	**TGax**	**TGax**	**TGax**
		TGax	
	TGax		

Main documents

- Agenda: 11-15/0235r8, TGax March 2015 Meeting Agenda
- Closing report: 11-15/0465r0, TGax March 2015 Closing Report
- Minutes: 11-15/0309r1, TGax March 2015 Berlin Meeting Minutes

Achievements

13. Passed a number of motions affecting the TG specification framework:

- PHY motions related to LTF design and SIG-B.
- MAC motions related to Multi-User Block ACK and Multi-User Procedure
- MU motions related to ACK multiplexing
- Etc.

14. TG Documents.

- Approved new revisions of Simulation Scenarios and Evaluation Methodology TG documents.
  - ✧ https://mentor.ieee.org/802.11/dcn/14/11-14-0571-08-00ax-evaluation-methodology.docx
  - ✧ https://mentor.ieee.org/802.11/dcn/14/11-14-0980-09-00ax-simulation-scenarios.docx
- Other TG documents.
  - ✧ https://mentor.ieee.org/802.11/dcn/14/11-14-0882-04-00ax-tgax-channel-model-document.docx
  - ✧ https://mentor.ieee.org/802.11/dcn/14/11-14-1009-02-00ax-proposed-802-11ax-functional-requirements.doc

15. Technical Presentations

Following technical submissions have been covered during the week.

- MAC
  - ✧ 11-15/0320, "GCR-BA with Measurement Report Performance in OBSS," Yuichi Morioka (SONY)
  - ✧ 11-15/0336, "MAC Overhead Analysis of MU Transmissions," Xiaofei WANG (InterDigital)
  - ✧ 11-15/0362, "Beacon Transmission Issues," Yonggang Fang (ZTE)
  - ✧ 11-15/0365, "UL MU Procedure," Kiseon Ryu (LG Electronics)
  - ✧ 11-15/0366, "Multi-STA BA," Simone Merlin (Qualcomm)
  - ✧ 11-15/0376, "UL-MU MAC Throughput Under Non-Full Buffer Traffic," Tatsumi Uwai (Radrix Co. Ltd)
- Spatial Reuse

- 11-15/0300, “Potential of Modified Signal Detection Thresholds,” Gustav Wikstrom (Ericsson AB)
- 11-15/0318, “CCA Regime Evaluation Revisited,” Amin Jafarian (Newracom Inc.)
- 11-15/0319, “Impact of TPC coupled to DSC for legacy unfairness issue,” Masahito Mori (Sony)
- 11-15/0338, “Discussions on the Definition of CCA Threshold,” Akira Kishida (NTT)
- 11-15/0367, “OBSS preamble detection,” Gwen Barriac (Qualcomm)
- 11-15/0371, “Proposal and simulatin based evaluation of DSC-AP Algorithm,” Eduard Garcia-Villegas (UPC)
- 11-15/0374, “Further Considerations on Legacy Fairness with Enhanced CCA,” John Son (WILUS Institute)

- PHY
  - 11-15/0305, “Effective Subcarrier Assignment for DL-OFDMA,” Katsuo Yunoki (KDDI R&D Laboratories)
  - 11-15/0330, “OFDMA Numerology and Structure,” Shahrnaz Azizi (Intel Corporation)
  - 11-15/0344, “SIG field design principle for 11ax,” Young Hoon Kwon (Newracom)
  - 11-15/0349, “HE-LTF Proposal,” Hongyuan Zhang (Marvell)
  - 11-15/0358, “Numerology for 11ax,” Daewon Lee (Newracom)
  - 11-15/0360, “Preamble Auto-Detection for 802.11ax,” Sungho Moon (NEWRACOM)
  - 11-15/0364, “11ax Preamble design: training sequence,” Sigurd Schelstraete (Quantenna)
  - 11-15/0375, “Minimum Resource Granularity in OFDMA,” John Son (WILUS Institute)
  - 11-15/0378, “Channel Sensing in UL OFDMA,” Reza Hedayat (Newracom)
  - 11-15/0380, “Discussion on OFDMA scheduling for 802.11ax,” Le Liu (Huawei Technologies)
  - 11-15/0381, “HE-STF Proposal,” Yakun Sun (Marvell)
  - 11-15/0383, “Impact of number of sub-channels in OFDMA,” Leif Wilhelmsson (Ericsson)

- Multi-User
  - 11-15/0331, “Uplink Multi-User MIMO Protocol Design,” Yongho Seok (NEWRACOM)
  - 11-15/0333, “Throughput Comparison of Some Multi-user Schemes in 802.11ax,” Kome Oteri (InterDigital)
  - 11-15/0336, “MAC Overhead Analysis of MU Transmissions,” Xiaofei WANG (InterDigital)
  - 11-15/0353, “OFDMA Non-contiguous Channel Utilization,” Jinsoo Ahn (Yonsei univ.)
  - 11-15/0354, “Bandwidth granularity on UL-OFDMA data allocation,” Woojin Ahn (Yonsei Univ.)
  - 11-15/0363, “UL MU Synchronization Requirements,” Yonggang Fang (ZTE)
  - 11-15/0377, “Considerations on UL MU Resource Scheduling,” Leonardo Lanante (Kyutech)
  - 11-15/0379, “DL OFDMA Performance and ACK Aggregation,” Reza Hedayat (Newracom)
  - 11-15/0384, “Discussion on DL-OFDMA Sub-channel Indication Method,” Yu Cai (Lenovo)

- Simulation and Calibration
  - 11-14/1392, “Simulation results for Box-5 calibration,” Suhwook Kim (LG Electronics)
  - 11-14/1434, “SLS Box4 Calibration Results,” Russell Huang (MediaTek Inc.)
  - 11-15/0053, “Box5 Results of 11ac SS6,” Jiyong Pang ‘Huawei)
  - 11-15/0072, “U-APSD power saving calibration results,” Yanchun Li (Huawei)
  - 11-15/0125, “Box 1 and Box 2 Calibration Results,” Ron Porat (Broadcom)
  - 11-15/0304, “Evaluating Power Save Performance,” Joonsuk Kim (Apple)
  - 11-15/0306, “Power Save Mode Calibration Results,” Eric Wong (Apple)
  - 11-15/0307, “MAC calibration results for Test 4,” Ke Yao (ZTE Corp.)
  - 11-15/0308, “Simulation results for box 5,” Ke Yao (ZTE Corp.)
  - 11-15/0314, “Sleep States in IEEE 802.11ax Simulation Scenarios,” Chittabrata Ghosh (Intel)

- ✧ 11-15/0316, “Power Save Calibration,” Hyeyoung Choi (LG)
- ✧ 11-15/0326, “U-APSD Enhancements for HE,” Jarkko Kneckt (Nokia)
- ✧ 11-15/0327, “Microsleep for HE STA,” Jarkko Kneckt (Nokia)
- ✧ 11-15/0343, “In Situ Frame Size Measurements,” Chuck Lukaszewski (Aruba Networks)
- ✧ 11-15/0351, “Empirical Measurements of Channel Degradation Under Load,” Chuck Lukaszewski (Aruba Networks)
- ✧ 11-15/0357, “Scenario 1 CCA Simulation,” Knut Odman (Broadcom Corporation)
- ✧ 11-15/0359, “Clarification of MIMO Box2 calibration,” Jaehyun Ahn (Newracom)
- ✧ 11-15/0368, “Box 5 results for Single BSS Calibration Case,” Esa Tuomaala (Nokia)
- ✧ 11-15/0369, “MAC calibration test 4 simulation results,” Enrico-Henrik Rantala (Nokia)
- ✧ 11-15/0370, “MAC Calibration Results,” Guoqing Li (Apple)
- ✧ 11-15/0372, “Corrections on Reference Traffic Profile for Scenario 2 in Simulation Scenarios Document,” Yingpei Lin (Huawei)
- ✧ 11-15/0373, “Mixed traffic configurations on simulation scenarios,” Yingpei Lin (Huawei)
- ✧ 11-15/0382, “MAC calibration test 4 simulation results,” Yanchun Li (Huawei)
- ✧ 11-15/0441, “Proposed text to TGax Simulation Scenarios MAC test 4,” Enrico-Henrik Rantala (Nokia)

Goals for May 2015

- Continue to advance TG documents based on submissions.
  - ➢ Expectation is more submissions affecting the TG specification framework document will be considered.
- Technical Presentations.

Teleconferences

- Two teleconferences are planned before the May 2015 session.
  - ✧ Thursday, April 9th, 10:00 – 12:00 (ET)
  - ✧ Thursday, April 30th, 20:00 – 22:00 (ET)

January 2015 – Atlanta, GA

The original plan was to have nine sessions during the week, but one session was cancelled.

	Monday	Tuesday	Wednesday	Thursday
AM1			**TGax**	**TGax**
AM2	**TGax**	**TGax**		
PM1	**TGax**	**TGax**	**TGax**	**TGax (canceled)**
PM2				
PM3	**TGax**			

Main documents

- Agenda: 11-14/1578r6, TGax January 2015 Meeting Agenda
- Closing report: 11-15/0186r0, TGax January 2015 Closing Report
- Draft minutes: 11-15/0090r0, TGax January 2015 Atlanta Meeting Minutes

Achievements

16. TG Structure

- Ad hoc chairs elected.

MAC	PHY	MU	Spatial Reuse
Eric Wong (Apple)	Bo Sun (ZTE)	Sigurd Schelstraete (Quantenna)	Laurent Cariou (Orange)
Reza Hedayat (NEWRACOM)	Jianhan Liu (MediaTak)	Kiseon Ryu (LG Electronics)	Guido Hiertz (Ericsson AB)
Brian Hart (Cisco)	Yakun Sun (Marvell)	Kaushik Josiam (Samsung)	Jae Seung Lee (ETRI)

17. TG Documents.

- Passed a number of motions affecting the TG specification Framework.
- Approved new revisions of Simulation Scenarios and Evaluation Methodology TG documents.
  - ✧ TGax Simulation Scenarios (11-14/0980r6)
  - ✧ TGax Evaluation Methodology (11-14/0571r7).

18. Technical Presentations

Following technical submissions have been covered during the week.

- DSA and CCA
  - ✧ 15/0025, "DSC and Roaming," Graham Smith (SR Technologies)
  - ✧ 15/0027, "Simulation Based Evaluation DSC in residential scenario," M. Shahwaiz Afaqui (UPC)
  - ✧ 15/0045, "Performance Analysis of BSS Color and DSC," Masahito Mori (Sony)
  - ✧ 15/0050, "Modeling components impacting throughput gain from CCAT adjustment," Yu Wang (Ericsson AB)
  - ✧ 15/0085, "Legacy Fairness Issues of Enhanced CCA," John Son (WILUS Institute)
  - ✧ 15/0105, "Dynamic CCA Management," Sean Coffey (RealTek)

- OFDMA
  - ✧ 15/0034, "DL-OFDMA Map Frame," Katsuo Yunoki (KDDI Labs)
  - ✧ 15/0066, "Downlink OFDMA Protocol Design," Yongho Seok (Newracom)
  - ✧ 15/0079, "OFDM Numerology for 11ax," Daewon Lee (Newracom)
  - ✧ 15/0091, "UL-OFDMA Procedure in IEEE 802.11ax," Woojin Ahn (Yonsei Univ.)
  - ✧ 15/0092, "DL-OFDMA Procedure in IEEE 802.11ax," Jinsoo Ahn (Yonsei Univ.)

- MU
  - ✧ 15/0010, "draft for integrated UL DL MU MIMO Frame Format," Tae-Yoon Kim (Korea Univ.) – Not presented
  - ✧ 15/0029, "Discussion on integrated UL/DL MU-MIMO," Tae-Yoon Kim (Korea Univ.) – Not presented
  - ✧ 15/0040, "Discussion on integrated UL-DL MU-MIMO-MAC," TaeYoon Kim (Korea Univ.)
  - ✧ 15/0064, "Consideration on UL-MU overheads," Tomoko Adachi (Toshiba)
  - ✧ 15/0086, "Uplink MU Transmission and Legacy Coexistence," Reza Hedayat (NEWRACOM)
  - ✧ 15/0089, "MAC Efficiency Gain of Uplink Multi-user Transmission," Leonardo Lanante Jr (Kyushu Inst. of Tech.)

- MAC
  - ✧ 15/0035, "Scalable Channel Utilization," Katsuo Yunoki (KDDI R&D Laboratories)
  - ✧ 15/0037, "Structural Format Change," Kyonggi University
  - ✧ 15/0046, "11aa GCR-BA Performance in OBSS," Yuichi Morioka (Sony)
  - ✧ 15/0059, "Uplink RTS/CTS Control," Sigurd Schelstraete (Quantenna)

- PHY
  - ✧ 15/0048, "Non-Uniform Constellations for Higher Order QAMs," Daniel Schneider (Sony)
  - ✧ 15/0068, "Support of outdoor environments," Young Hoon Kwon (NEWRACOM)

- ✧ 15/0079, “OFDM Numerology for 11ax,” Daewon Lee (NEWRACOM)
- ✧ 15/0081, “Considerations on 11ax Auto-detection Methods,” Jaeyoung Song (KAIST)
- ✧ 15/0082, “Considerations on 11ax OFDMA Frequency Granularity,” Young-bin Kim (KAIST)
- ✧ 15/0097, “Performance Analysis of Frequency Selective Scheduling,” Ningbo Zhang (BUPT)
- ✧ 15/0099, “Payload Symbol Size for 11ax,” Sriram Venkateswaran (Broadcom)
- ✧ 15/0101, “Preamble structure for 11ax system,” Jiayin Zhang (Huawei)

- Simulation Scenario and Evaluation Methodology
  - ✧ 14/1342, “MAC Calibration Results,” Igor Kim (ETRI)
  - ✧ 14/1343, “Multicast Scenarios for MAC Calibration,” Igor Kim (ETRI)
  - ✧ 14/1392, “Simulation Results for Box-5 Calibration,” Suhwook Kim (LGE)
  - ✧ 14/1523, “Offline Discussion Minutes of SLS Calibration,” Jiyong Pang (Huawei)
  - ✧ 14/1590, “Multi-wall penetration loss model for HEW system level simulation,” Kejun Zhao et al. (National Engineering Research Center for Broadband Networks & Applications)
  - ✧ 14/1597, “PHY abstraction and performance for outdoor channel models,” Kejun Zhao et al. (National Engineering Research Center for Broadband Networks & Applications)
  - ✧ 15/0022, “MAC Calibration Results,” Xiaofei Wang (InterDigital)
  - ✧ 15/0044, “Proposed Changes to Simulation Scenarios,” Masahito Mori (Sony)
  - ✧ 15/0051, “Box5 Calibration Results,” Jiyong Pang (Huawei)
  - ✧ 15/0052, “Box5 Results of One BSS Case,” Jiyong Pang (Huawei)
  - ✧ 15/0053, “Box5 Results of 11ac SS6,” Jiyong Pang (Huawei)
  - ✧ 15/0061, “FPS Network Traffic Model,” Allan Jones (Activision)
  - ✧ 15/0065, “11ax EMD Revision Straw Poll,” Jiyong Pang (Huawei)
  - ✧ 15/0071, “MAC calibration test 4 results,” Yanchun Li (Huawei)
  - ✧ 15/0072, “U-APSD power saving calibration results,” Yanchun Li (Huawei)
  - ✧ 15/0073, “Simulation Results of Box5,” Ke Yao (ZTE)
  - ✧ 15/0078, “Clarification on calibration test cases,” Guoqing Li (Apple)
  - ✧ 15/0080, “MAC Calibration Results,” Geonjung Ko (WILUS Institute)
  - ✧ 15/0093, “Text Update on PHY Abstraction and SP,” Yakun Sun (Marvell)
  - ✧ 15/0103, “Power Save Calibration,” Yarkko Kneckt (Nokia)
  - ✧ 15/0104, “SLS MAC Test 4 Results,” Chinghwa Yu (MediaTek)

- Others
  - ✧ 15/0043, “In-band Full Duplex Radios and System Performance,” Kapseok Chang (ETRI)
  - ✧ 15/0075, “Operating Rules for TGax Ad Hoc groups,” Osama Aboul-Magd (TGax chair)
  - ✧ 15/0076, “Field Sample OBSS and Client Data,” Carol Ansley (ARRIS Group)

Goals for March 2015

- Continue to advance TG documents.
  - ➢ Expectation is more submissions affecting the TG specification framework document will be considered.
- Technical Presentations.

Teleconferences

- One teleconference is planned before the March 2015 session.
  - ✧ Thursday, February 26th, 10:00 – 12:00 (ET)

November 2014 – San Antonio, TX

The original plan was to have nine sessions during the week, but one session was cancelled.

	Monday	Tuesday	Wednesday	Thursday
AM1	**TGax (ad hoc)**			**TGax**
AM2		**TGax**		
PM1		**TGax**	**TGax**	**TGax**
PM2	**TGax**	**TGax**		
PM3		**TGax (cancelled)**		

Main documents

- Agenda: 11-14/1319r7, TGax November 2014 Meeting Agenda
- Closing report: 11-14/1536r0, TGax November 2014 Closing Report
- Draft minutes: 11-14/1460r0, TGax November 2014 Meeting Minutes

Achievements

19. Discussions on the TG Structure

- The TG approved a motion to create four ad hoc groups.
  - ✧ PHY, MAC, Multiuser and Spatial Reuse
- The TG approved a motion to have 3 co-chairs for each of the ad hocs.
- Ad hoc chairs election is scheduled for January 2015 meeting on Tuesday.
- Ad hoc meetings will start on March 2015
- Robert Stacy (Intel) was appointed as the technical editor of the TGax.

20. TG Documents – The group approved updated documents.

- The group approved the first version of TGax Specification Framework document (11-14/1453r2).
- The group approved new revisions of the following documents.
  - ✧ TGax Simulation Scenarios (11-14/0980r5)
  - ✧ TGax Evaluation Methodology (11-14/0571r6).

21. Technical Presentations

About 35 technical submissions covered during the week.

- Evaluation Methodology
  - ✧ 11-14/1388, "Consideration on PER Prediction for PHY Abstraction," Bo Sun (ZTE Corp)
  - ✧ 11-14/1418, "Further Study of Time Varying Interference and PHY Abstraction," Yakun Sun (Marvell)
  - ✧ 11-14/1420, "The Impact of Preamble Error on MAC System Performance," Po-Kai Huang (Intel)
  - ✧ 11-14/1424, "Proposed Changes to Evaluation Methodology and Simulation Scenario," Yuichi Morioka (Sony)
  - ✧ 11-14/1440, "A Few Corrections to Video Traffic Model," Guoqing Li (Apple)

- Simulation Scenarios and Calibration
  - ✧ 11-14/1177, "Discussion about Box5 Calibration," Jiyong Pang (Huawei)
  - ✧ 11-14/1342, "MAC Calibration Results," Igor Kim (ETRI)
  - ✧ 11-14/1343, "Multicast Scenarios for MAC Calibration," Igor Kim (ETRI)
  - ✧ 11-14/1392, "Simulation results for Box 5 calibration," Suhwook Kim (LG Electronics)
  - ✧ 11-14/1402, "Box1 and Box3 calibration results," Masahito Mori (Sony)
  - ✧ 11-14/1419, "SLS Box5 Calibration Results and Discussions," Yakun Sun (Marvell)
  - ✧ 11-14/1434, "TGax SLS Box4 Calibration Results," Russell Huang (MediaTek Inc.)

- 11-14/1441, “Simulation Setting of Box5 Calibration,” Jiyong Pang (Huawei)
- 11-14/1444, “Energy Efficiency Evaluation and Simulation Model,” Chinghwa Yu (MediaTek)
- 11-14/1449, “MAC Calibration Results,” Newracom
- 11-14/1450,” Box 0 calibration results,” Hongsup Lee (Newracom)
- 11-14/1451, “Box 1 and Box 2 Calibration Results,” Jaehyun Ahn (Newracom)

- Technology/Others
  - 11-14/1228, “Issues on 256-FFT per 20MHz,” Heejung Yu (NEWRACOM/YU)
  - 11-14/1380, “Efficiency Measurement for RTS/CTS,” Katsuo Yunoki (KDDI R&D Laboratories)
  - 11-14/1381, “Novel RTS/CTS Procedure,” Katsuo Yunoki (KDDI R&D Laboratories)
  - 11-14/1382, “Responses to the comments on doc.1169,” Katsuo Yunoki (KDDI R&D Laboratories)
  - 11-14/1397, “Discussion on Frame Structure for Future WLAN Systems with OFDMA,” Myeong-Jin Kim (Korea University)
  - 11-14/1403, “Performance Analysis of BSS Color and DSC,” Masahito Mori (Sony)
  - 11-14/1404, “11aa GCR-BA Performance in OBSS,” Yuichi Morioka (Sony)
  - 11-14/1416, “Observed protocol violations caused by DSC with roaming STAs,” Chuck Lukaszewski (Aruba Networks)
  - 11-14/1417, “HEW PPDU Transmission Discussion,” Yongho Seok (NEWRACOM)
  - 11-14/1426, “DSC and legacy coexistence,” Gustav Wikstrom et al. (Ericsson)
  - 11-14/1427, “DSC Performance,” Gustav Wikstrom et al. (Ericsson)
  - 11-14/1428, “Clear Channel Assessment for OFDMA PHY,” K. C. Chen (NTU) and D. J. Deng (NCUE)
  - 11-14/1431, “Issues on UL-OFDMA Transmission,” Young Hoon Kwon (Newracom)
  - 11-14/1433, “Protocol and signaling framework for OFDMA,” Sigurd Schelstraete (Quantenna)
  - 11-14/1435, “Considerations on OBSS Spatial Re-Use,” Jianhan Liu (Mediatek Inc.)
  - 11-14/1436, “Overhead Analysis for Simultaneous Downlink Transmissions,” Pengfei Xia (interdigita)
  - 11-14/1437, “Efficient Wider Bandwidth Operation in IEEE 802.11ax,” Jinsoo Ahn (Yonsei Univ)
  - 11-14/1439, “Preamble Considerations in Large Channel Delay Spread Scenarios,” Daewon Lee (Newracom)
  - 11-14/1442, “Considerations on DL OFDMA control mechanism,” Woojin Ahn (Yonsei Univ.)
  - 11-14/1443, “Adapting CCA and Receiver Sensitivity,” Esa Tuomaala (Nokia)
  - 11-14/1446, “Analysis of frequency and power requirements for UL-OFDM,” Leif Wilhelmsson (Ericsson)
  - 11-12/1448, “Considerations for Adaptive CCA,” Reza Hedayat (Newracom)
  - 11-14/1452, “Frequency selective scheduling in OFDMA,” Leif Wilhelmsson (Ericsson)

- Specification Framework
  - 11-14/1429, “Proposed 802.11ax specification framework document,” Minho Cheong (Newracom)
  - 11-14/1432, “Proposed 802.11ax specification framework – background,” Minho Cheong (Newracom)
  - 11-14/1447, “Proposed Spec Framework Document for 11ax considering potential tech features,” John Son (WILUS Institute), Young Doo Kim (SK Telecom)
  - 11-14/1453, “Spec Framework Proposal,” Robert Stacey (Intel)

Goals for January 2015

- Elect ad hoc chairs – 3 co-chairs/ad hoc group as agreed.
- Continue to advance TG documents.

- Technical Presentations.

Teleconferences

- One teleconference is planned before the January 2015 session.
  - ✧ Thursday, December 4th, 10:00 – 12:00 (ET)
    - ➢ Chair had sent out call for submissions on the TGax reflector.

September 2014 – Athens, Greece

TGax had nine sessions during the week.

	Monday	Tuesday	Wednesday	Thursday
AM1				**TGax**
AM2	**TGax**	**TGax**		
PM1		**TGax**	**TGax**	**TGax**
PM2	**TGax**	**TGax**		
PM3	**TGax**			

Main documents

- Agenda: 11-14/1033r5, TGax September 2014 Meeting Agenda
- Closing report: 11-14/1304r0, TGax September 2014 Closing Report
- Draft minutes: 11-14/1159r1, TGax September 2014 Meeting Minutes

Achievements

22. The group elected two vice chairs and discussed about the TG structure.

- Election of Vice Chairs took place during this meeting. The TG Vice Chairs are:
  - ✧ Simone Merlin (Qualcomm)
  - ✧ Ron Porat (Broadcom)
- The group started discussion on the Ad Hoc groups. Discussion will continue in future meetings.

23. The group approved minutes from the July 2014 San Diego meeting.

- 11-14/0864r0, July 2014 San Diego Meeting Minutes

24. TG Documents – The group approved updated documents.

- The TGax Simulation Scenarios (11-14/0980r4) and the TGax Evaluation Methodology (11-14/0571r5).
- The TGax Channel Model document (11-14-0882r4).
- The TGax Functional Requirements document (11-14-1009r2).

25. Technical Presentations

54 submissions were uploaded on the server and 52 of them were covered during the week.

- Functional Requirements
  - ✧ 11-14/0636, "Discussion on Functional Requirements," David Xun Yang (Huawei Technologies)
  - ✧ 11-14/0920, "Considerations of Functional Requirements Documents," David Xun Yang (Huawei Technologies)
  - ✧ 11-14/1009, "Proposed 802.11ax Functional Requirements," Lei Wang (Marvell)
  - ✧ 11-14/1164, "Meaningful 11ax Functional Requirements," Joe Kwak (InterDigital)
  - ✧ 11-14/1167, "TGax Functional Requirement Discussion," Yonggang Fang (ZTE)

- ✧ 11-14/1170, “Functional Requirements Discussions on Coex with Legacy STAs,” Masahito Mori (Sony)
- ✧ 11-14/1234, “Requirements Discussion,” Joseph Levy (InterDigital)

- Simulation Scenarios and Calibration
  - ✧ 11-14/0800, “Box 1 and Box 2 Calibration Results,” Nihae Jindal (Broadcom)
  - ✧ 11-14/1147, “MAC Simulator Calibration Results,” Shoko Shinohara, Akira Kishida (NTT)
  - ✧ 11-14/1175, “MAC Calibration results,” Suhwook Kim (LG Electronics)
  - ✧ 11-14/1177, “Discussion about Box5 Calibration,” Jiyong Pang (Huawei Technologies)
  - ✧ 11-14/1187, “The Effect of Preamble Error Model on MAC Simulator,” Po-Kai Huang (Intel)
  - ✧ 11-14/1191, “MAC calibration results,” Zhou Lan (Huawei Technologies)
  - ✧ 11-14/1192, “MAC calibration results comparison,” Zhou Lan (Huawei Technologies)
  - ✧ 11-14/1198, “Additional Test Cases for MAC calibration,” Gwen Barriac (Qualcomm)
  - ✧ 11-14/1217, “MAC Calibration Results for Test 1 and 2,” Esa Tuomaala (Nokia)
  - ✧ 11-14/1223, “Stadium Measurements,” Brian Hart (Cisco Systems)
  - ✧ 11-14/1226, “SLS Box 1&2 Calibration Results,” Russell Huang (MediaTek)
  - ✧ 11-14/1230, “MAC Calibration Result,” Chinghwa Yu (MediaTek)

- Evaluation Methodology
  - ✧ 11-14/1161, “Parameters for Power Save Mechanisms,” Eric Wong (Apple)
  - ✧ 11-14/1162, “Energy Efficiency Evaluation Methodology Follow Up,” Eric Wong (Apple)
  - ✧ 11-14/1174, “PHY Abstraction with Time Varying Interference,” Yakun Sun (Marvell)
  - ✧ 11-14/1176, “PHY abstraction tables for 11ax system level simulation,” Jiayin Zhang (Huawei Technologies)
  - ✧ 11-14/1221, “Traffic Generator for OBSS Calibration Case,” Chao-Chun Wang (MediaTek)

- Channel Model
  - ✧ 11-14/1214, “Impact of correlated shadowing in 802.11ax system evaluations,” Leif Wilhelmsson (Ericsson AB)
  - ✧ 11-14/1222, “Doppler Effect Evaluation for 11ax,” Jianhan Liu (MediaTek)

- Technology/Others
  - ✧ 11-14/1106, “WLAN Frame Collision Information,” Peng Shao (NEC Communication Systems)
  - ✧ 11-14/1148, “Consideration of asynchronous interference in OBSS environment,” Koichi Ishihara (NTT)
  - ✧ 11-14/1168, “802.11 TGax PHY Frame Structure Discussion for Enabling New Contention Mechanism,” Yonggang Fang (ZTE)
  - ✧ 11-14/1169, “DL-FDMA considerations,” Katsuo Yunoki (KDDI R&D Labs.)
  - ✧ 11-14/1171, “DSC Simulation Results for Scenario 3,” Masahiro Mori (Sony)
  - ✧ 11-14/1172, “Multicast Performance in OBSS,” Yuichi Morioka (Sony)
  - ✧ 11-14/1178, “Inter-BSS interference in WLANs,” Hyunduk Kang (ETRI)
  - ✧ 11-14/1179, “Considerations for Partial Band Interference between WLAN Systems,” Gwangzeen Ko (ETRI)
  - ✧ 11-14/1180, “Discussions on Interference between TD-LTE & WLAN around 2.4GHz Band,” Meng Yang (CATR)
  - ✧ 11-14/1181, “Measurements on A-MPDU performances under various channel conditions,” John Sun (WILUS Institute)
  - ✧ 11-14/1186, “Comparisons of Simultaneous Downlink Transmissions,” Pengfei Xia (InterDigital)
  - ✧ 11-14/1190, “Frame Exchange Control for Uplink Multi-user transmission,” Kaying Lv (ZTE)
  - ✧ 11-14/1199, “Effect of CCA in residential scenario part 2,” Gwen Barriac (Qualcomm)

- ✧ 11-14/1207, “OBSS reuse mechanism which preserves fairness,” Laurent Cariou (Orange)
- ✧ 11-14/1208, “MAC considerations on 802.11ax OFDMA,” Jinsoo Ahn (Yonsei Univ.)
- ✧ 11-14/1209, “Multiple RF operation for 802.11ax OFDMA,” Woojin Ahn (Yonsei Univ.)
- ✧ 11-14/1210, “HEW PPDU Format for Supporting MIMO-OFDMA,” Yongho Seok (NEWRACOM)
- ✧ 11-14/1211, “ACK Procedure for OFDMA,” Yongho Seok (NEWRACOM)
- ✧ 11-14/1216, “Consideration on Coexistence between LTE-U and 802.11 WLAN,” Jae Seung Lee (ETRI)
- ✧ 11-14/1224, “Link-Aware CCA,” Brian Hart (Cisco Systems)
- ✧ 11-14/1225, “Considerations on CCA for OBSS Opearation in 802.11ax,” Luo Jun (Huawei Technologies)
- ✧ 11-14/1227, “OFDMA Performance Analysis,” Tianyu Wu (MediaTek)
- ✧ 11-14/1128, “Issues on 256-FFT per 20MHz,” Heejung Yu (NEWRACOM)
- ✧ 11-14/1229, “Dynamic OFDM Symbol Duration,” Alan Jauh (MediaTek)
- ✧ 11-14/1232, “On MU Aggregation Mechanisms for 11ax,” Reza Hedyat (NEWRACOM)
- ✧ 11-14/1233, “Adaptive CCA for 11ax,” Reza Hedyat (NEWRACOM)

Goals for November 2014

- Continue to advance TG documents.
- Technical Presentations.

Teleconferences

- One teleconference is planned before the November 2014 session.
  - ✧ Thursday, October 9th, 10:00 – 12:00 (ET)
    - ➢ Chair had sent out call for submissions on the TGax reflector.

July 2014 – San Diego, CA

TGax had ten sessions during the week.

	Monday	Tuesday	Wednesday	Thursday
AM1	**TGax**		**TGax**	**TGax**
AM2		**TGax**		
PM1			**TGax**	**TGax**
PM2	**TGax**	**TGax**	**TGax**	
PM3		**TGax**		

Main documents

- Agenda: 11-14/0748r6, TGax July 2014 Meeting Agenda
- Closing report: 11-14/0984r1, TGax July 2014 Closing Report
- Draft minutes: 11-14/0864r0, July 2014 Meeting Minutes

Achievements

26. The group discussed on the TG structure.

- The group will have two vice chairs to be election during the initial meeting slot of TGax in September 2014.
  - ✧ Chair has sent out the call for nominations to the reflector.
- The group will have some ad hoc groups in the future, however, the discussion on the ad hoc structure was deferred.

27. The group approved minutes from the May 2014 Waikoloa meeting and Teleconference on July 2nd, 2014.

- 11-14/0655r3, May 2014 Waikoloa Meeting Minutes
- 11-14/0788r2, Minutes from the teleconference on July 2nd, 2014

28. TG Documents – The group discussed and approved following documents as current TG documents.

- The group approved new version of the Simulation Scenarios (11-14/0980r1) and Evaluation Methodology (11-14/0571r3) documents.
- The group approved the initial version of the TGax Channel Model document (11-14-0882r3).
- The group adopted the initial version of the TGax Selection Procedure (11-14-0938r4).
- The group had discussion on the Functional Requirements document.

29. Technical Presentations

More than 40 submissions were covered during the week.

- Simulation Scenarios and Calibration
  - 11-14/0799, "Modifications to Simulation Scenarios and Calibration Process," Nihar Jindal (Broadcom)
  - 11-14/0800, "Box 1 and Box 2 Calibration Results," Nihar Jindal (Broadcom)
  - 11-14/0803, "Packet Length for Box 0 Calibration," Wookbong Lee (LG Electronics)
  - 11-14/0850, "Clarification for MAC Calibration," Gwen Barriac (Qualcomm)
  - 11-14/0851, "Proposed Rate Control for MAC Simulator," Gwen Barriac (Qualcomm)
  - 11-14/0859, "Proposing a Stadium Scenario," Hakan Persson (Ericsson)
  - 11-14/0860, "Text proposal of a Stadium scenario to ax," Hakan Persson (Ericsson)
  - 11-14/0869, "MAC calibration results," Zhou Lan (Huawei)
  - 11-14/0871, "Further Calibration Results towards Integrated System Level Simulation," Jiyong Pang (Huawei)
  - 11-14/0892, "MAC Calibration Text to Simulation Scenarios," Jarkko Kneckt (Nokia)
  - 11-14/0894, "Calibration of System Level Simulators," Sayantan Choudhury (Nokia)
  - 11-14/0895, "Calibration of MAC simulator with OBSS Network Scenario," Chao-CHun Wang (MediaTek)

- Evaluation Methodology
  - 11-14/0571, " Evaluation Methodologies," Ron Porat (Broadcom)
  - 11-14/0810, "RBIR-based PHY Abstraction with Channel Estimation Error," Yukun Sun (Marvell)
  - 11-14/0811, "Overview on RBIR-based PHY Abstraction," Yukun Sun (Marvell)
  - 11-14/0827, "Energy Efficiency Evaluation Methodology," Eric Wong (Apple)
  - 11-14/0865, "ACI and AACI for 802.11ax System Simulations," Yu Cai (Huawei)
  - 11-14/0866, "Traffic modeling and system capacity performance measure," Johan Soder (Ericsson)
  - 11-14/0873, "PHY Abstraction Table for 11ax System Level Simulations," Jiayin Zhang (Huawei).
  - 11-14/0874, "Unified Traffic Model on Enterprise Scenario," Phillip Barber (Huawei)
  - 11-14/0875 "VoIP Traffic Model Content for 11ax TG Simulation Scenarios & Evaluation Methodology," Phillip Barber (Huawei)

- Channel Models
  - 11-14/0882, "IEEE 802.11ax Channel Model Document," Jianhan Liu (Mediatek inc.)
  - 11-14/0904 "In-Cabin WiFi Channel Channel: Preliminary Ray Tracing Simulations," Fan Bai (General Motors)

- Functional Requirements
  - 11-14/0567, "Proposed 802.11ax Functional Requirements," Lei Wang (Marvell)
  - 11-14/0818, "Synchronization Requirements," Yonggang Fang (ZTE)

- 11-14/0821, “Coexistence Requirements of 802.11 WLAN and LTE in Unlicensed Spectrum,” Alireza Babaei (CableLabs).
- 11-14/0835, “Functional Requirements Discussion,” Joe Kwak (InterDigital)

- Technology/Others
  - 11-14/0779, “Dynamic Sensitivity Control Practical Usage,” Graham Smith (DSP Group)
  - 11-14/0801, “Envisioning 11ax PHY Structure - Part II,” Dongguk Lim(LG Electronics)
  - 11-14/0802, “Consideration on UL MU transmission,” Jinyoung Chun (LG Electronics)
  - 11-14/0804, “Envisioning 11ax PHY Structure – Part I,” Jinsoo Choi (LG Electronics)
  - 11-14/0832, “Performance Evaluation of OBSS Densification,” Po-Kai Huang (Intel)
  - 11-14/0833, “Residential Scenario Sensitivity and Transmit Power Control Simulation Results,” Ron Murias (InterDigital)
  - 11-14/0838, “Discussion on dual-link STR in IEEE 802.11ax,” Jinsoo Ahn (Yonsei Univ)
  - 11-14/0839, “Discussion on OFDMA in IEEE 802.11ax,” Jinsoo Ahn (Yonsei Univ)
  - 11-14/0846, “Changing CCA in the Residential Environment,” Gwen Barriac (Qualcomm)
  - 11-14/0847, “Further Considerations on Enhanced CCA for 11ax,” John Son (WILUS Institute)
  - 11-14/0854, “DSC and Legacy Coexistence,” Yuichi Morioka (SONY)
  - 11-15/0855, “Techniques for Short Downlink Frames,” Brian Hart (Cisco Systems)
  - 11-15/0856, “Evaluating Dynamic CCA/Receiver Sensitivity Algorithms,” Brian Hart (Cisco Systems)
  - 11-14/0858, “Analysis on Multiplexing Schemes exploiting frequency selectivity,” Kaushik Josiam (Samsung)
  - 11-14/0861, “Impact of CCA adaptation on spatial reuse in dense residential scenario,” Sayantan Choudhury (Nokia)
  - 11-14/0868, “UL & DL DSC and TPC MAC simulations,” Johan Soder (Ericsson)
  - 11-14/0872, “A Protocol Framework for Dynamic CCA,” Sean Coffey (Realtek)
  - 11-14/0880, “Increased Network Throughput with Channel Width Related CCA and Rules,” James Wang (Mediatek)
  - 11-14/0889, “Performance Gains from CCA Optimization,” Nihar Jindal (Broadcom)

30. Timeline: There are no changes in the timeline.

- TGax initial timeline approved during the May 2014 Waikoloa session.
  - May 2014 - TG kick off
  - Nov. 2014 - start working on the Specification Framework
  - Jul. 2016 - Draft 1.0 to be ready
  - Mar. 2017 - Draft 2.0 to be ready
  - 1H/2019 - publication of the IEEE 802.11ax amendment

Goals for September 2014

- TG vice-chairs election.
- Continue to advance TG documents.
- Technical Presentations.

Teleconferences

- One teleconference is planned before the September 2014 session.
  - Thursday, August 14th, 10:00 – 12:00 (ET)
    - Chair had sent out call for submissions on the TGax reflector.

May 2014 – Waikoloa, Big Island, HI

TGax had nine sessions during the week.

	Monday	Tuesday	Wednesday	Thursday
AM1			**TGax**	**TGax**
AM2	**TGax**	**TGax**		
PM1				**TGax**
PM2	**TGax**	**TGax**		
PM3	**TGax**	**TGax**		

Main documents

- Agenda: 11-14/0478r5, TGax May 2014 Meeting Agenda
- Closing report: 11-14/0702r0, TGax May 2014 Closing Report
- Draft minutes: 11-14/0655r1, May 2014 Waikoloa Meeting Minutes

Achievements

31. The group elected the chairperson and the secretary.

- Chairperson: Osama Aboul-Magd (Huawei Technologies)
- Secretary: Yasuhiko Inoue (NTT)
- Other officer positions and TG structure will be discussed during the July 2014 meeting.

32. The group approved minutes from the March 2014 Beijing meeting and Teleconference on April 17th 2014.

- 11-14/0380r1, March 2014 Beijing Meeting Minutes
- 11-14/0530r0, Minutes from the teleconference on April 17th, 2014

33. TG Documents

- The group approved initial version of the Simulation Scenarios (11-14/0621r4) and Evaluation Methodology (11-14/0571r2) documents.
- The group started the discussion related to Functional Requirements document. Expectation is to approve the initial revision of the document in July.
- Discussion related to Channel Model document is expected to start in July.

34. Technical Presentations

40 submissions were covered during the week.

- 11-14/0527, "PHY Abstraction for TGax System Level Simulations", Pengfei Xia (InterDigital)
- 11-14/0546, "IEEE 802.11ax High Efficiency WLAN Packet measurements around Boulder Colorado", Jim Lansford (CSR)
- 11-14/0567, "Proposed 802.11ax Functional Requirements", Lei Wang (Marvell)
- 11-14/0571, "11ax Evaluation Methodologies", Ron Porat (Broadcom)
- 11-14/0577, "Path Loss Model for Scenario 1," Nihar Jindal (Broadcom)
- 11-14/0578, "Residential Scenario CCA/TPC Simulation Discussion," Frank La Sita (InterDigital)
- 11-14/0581, "Further Discussions on PHY Abstraction," Yakun Sun (Marvell)
- 11-14/0582, "Calibrating MAC Simulator Through Function Test," Jinjing Jiang (Marvell)
- 11-14/0583, "Further Discussions on Instantaneous SINR Calibration for System Simulation," Yakun Sun (Marvell)
- 11-14/0584, "System Level Simulations on Beamforming and Link Adaptation," Yan Zhang (Marvell)
- 11-14/0585, "PHY Abstractions for and IEEE 11ax PHY System Simulation and Integrated System Level Simulation," Jianhan Liu (MediaTek)
- 11-14/0586, "Automotive Considerations for the Simulation Scenarios," Igal Kotzer (General Motors)

- 11-14/0594, "Insert Virtual Desktop Infrastructure (VDI) Traffic Model Content for HEW Simulation Scenarios," Yingpei Lin (Huawei)
- 11-14/0595, "Edits on Some Traffic Content for HEW SG Simulation Scenarios," Yingpei Lin (Huawei)
- 11-14/0598, "Uplink multi-user MAC protocol for 11ax," Tran Thi Thao Nguyen (Kyushu Inst. of Tech.)
- 11-14/0600, "Proposed Calibration For MAC simulator," Gwen Barriac (Qualcomm)
- 11-14/0604, "Modeling and Evaluating Variable Bit rate Video Streaming for 802.11ax," Chao-Chun Wang (MediaTek)
- 11-14/612, "Calibration Procedures towards Integrated System Level Simulation," Jiayin Zhang (Huawei)
- 11-14/0613, "Discussions on adaptive frame length in MAC based on block ACK," Ningbo Zhang (BUPT)
- 11-14/0614, "Joint Coding and Modulation Diversity with LRA MMSE VP by QR precoding MIMO," Ningbo Zhang (BUPT)
- 11-14/0616, "CSMA/CA Enhancement Suggestion," Yonggang Fang (ZTE)
- 11-14/0617, "Discussion on timeline for 802.11ax," Laurent Cariou (Orange)
- 11-14/0620, "Link Adaptation for PHY SLS calibration," Jinyoung Chun (LG Electronics)
- 11-14/0621, "TGax Simulation Scenarios," Simone Merlin (Qualcomm)
- 11-14/0624, "Investigation on 1024 QAM feasibility in 11ax," Eunsung Park (LG Electronics)
- 11-14/0625, "Multi-channel operation in Simulation scenarios," Suhwook Kim (LG Electronics)
- 11-14/0626, "IEEE 802.11ax Functional Requirements," SangHyun Chang (Samsung)
- 11-14/0627, "Outdoor Channel Models for System Level Simulations," Kaushik Josiam (Samsung)
- 11-14/0628, "Measurements on CCA Thresholds in OBSS Environment," John Son (WILUS Institute), Young Doo Kim (SK Telecom)
- 11-14/0634, "Consideration on MAC system calibration," Zhou Lan (Huawei)
- 11-14/0635, "Dynamic Sensitivity Control Implementation," Graham Smith (DSP Group)
- 11-14/0636, "Consideration on functional requirements," Zhou Lan (Huawei)
- 11-14/0637, "Spatial Reuse and Coexistence with Legacy Devices," James Wang (MediaTek)
- 11-14/0647, "PHY abstraction method comparison," Tianyu Wu (MediaTek)
- 11-14/0648, "Performance Observation of a Dense Campus Network," Chinghwa Yu (MediaTek)
- 11-14/0649, "802.11ax Timeline Scenarios," Rolf de Vegt (Qualcomm)
- 11-14/0656, "How to Describe 802.11ax Functional Requirements," Minho Cheong
- 11-14/0660, "802.11ax Timeline," Minho Cheong (NEWRACOM)
- 11-14/0677, "Comparison of Calibration Methodology for MAC Simulation," Chinghwa Yu (MediaTek)
- 11-14/0682, "In Situ Spectrum Reuse Measurements in Indoor 20,000 Seat Arena," Chuck Lukaszewski (Aruba Networks)

35. Timeline

- The group approved initial timeline.
  - ✧ May 2014 - TG kick off
  - ✧ Nov. 2014 - start working on the Specification Framework
  - ✧ Jul. 2016 - Draft 1.0 to be ready
  - ✧ Mar. 2017 - Draft 2.0 to be ready
  - ✧ 1H/2019 - publication of the IEEE 802.11ax amendment

Goals for July 2014

- Continue to advance simulation scenarios (11-14/0621) and Evaluation Methodologies (11-14/0571) documents.
- Approve an initial Functional Requirements documents
- Approve an initial Channel Model document.

- Discuss and approve TG structure and process.
- Technical Presentations.

Teleconferences

- Three teleconferences are planned before the July 2014 session.
  - ✧ Wednesday, June 4th, 10:00 – 12:00 (ET)
  - ✧ Wednesday, June 18th, 20:00 – 22:00 (ET)
  - ✧ Wednesday, July 2nd, 10:00 – 12:00 (ET)

  Details of the meeting information will be announced on the reflector.

March 2014 – Beijing, China

HEW study group had seven sessions during the week.

	Monday	Tuesday	Wednesday	Thursday
AM1			**HEW**	**HEW**
AM2		**HEW**		
PM1				**HEW**
PM2	**HEW**	**HEW**		
PM3		**HEW**		

Main documents

- Agenda: 11-14/0219r4, HEW SG March 2014 Meeting Agenda
- Closing report: 11-14/0457r0, HEW SG March 2014 Closing Report
- Draft minutes: 11-14/0380r0, March 2014 Beijing Meeting Minutes

Achievements

36. The group approved minutes from the January 2014 Los Angeles meeting and teleconferences on February 6th 2014 and February 13th 2014.

- 11-14/0199r0, January 2014 Los Angeles Meeting Minutes
- 11-14/0229r2, Minutes from the teleconference on February 6th, 2014
- 11-14/0242r0, Minutes from the teleconference on February 13th, 2014

37. Addressed comments related to the PAR and CSD received from individuals and other IEEE 802 WGs. Resolutions of comments are contained in the following document:

- https://mentor.ieee.org/802.11/dcn/14/11-14-0424-00-0hew-hew-sg-par-and-csd-comments-and-resolutions.pptx

38. Updated the PAR and the CSD documents based on received comments:

- https://mentor.ieee.org/802.11/dcn/14/11-14-0165-01-0hew-802-11-hew-sg-proposed-par.docx
- https://mentor.ieee.org/802.11/dcn/14/11-14-0169-01-0hew-ieee-802-11-hew-sg-proposed-csd.docx

39. The group passed motions to approve revised PAR and CSD documents, and SG extension.

- Revised PAR (11-14/0165r1): Y/N/A = 94/0/1, Pass
- Revised CSD (11-14/0169r1): Y/N/A = 97/0/1, Pass
- SG extension: Y/N/A = 105/0/0, Pass
- **HEW SG has completed its work and the IEEE standard board approved 802.11ax project.**

40. **The group received more than 30 submissions in the categories of simulation scenarios, evaluation methodologies, channel models, functional requirements, technologies and selection procedure. Following submissions have been presented and discussed during the week.**
    - 11-13/1359r1, "HEW-Evaluation-Methodology" Ron Porat (Broadcom)
    - 11-14/0112r1, "Wi-Fi interference measurements in Korea - part II", Minho Cheong (NEWRACOM)
    - 11-14/0113r1, "Modeling of additional channel loss in dense WLAN environments", Minho Cheong (NEWRACOM)
    - 11-14/0294r2, "DSC Channel Selection and Legacy Sharing" Graham Smith (DSP Group)
    - 11-14/0301r0, "Multicast Considerations for HEW", Eisuke Sakai (Sony Corporation)
    - 11-14/0306r0, "Discussions on HEW Functional Requirements", Lei Wang (Marvell)
    - 11-14/0307r0, "PHY Calibration Results", Nihar Jindal (Broadcom)
    - 11-14/0328r2, "Dense Apartment Complex Throughput Calculations", Graham Smith (DSP Group)
    - 11-14/0329r0, "Channel Models for different links in Simulations", Kaushik Josiam (Samsung)
    - 11-14/0330r3, "HEW PHY Abstraction", Sameer Vermani (Qualcomm)
    - 11-14/0335r0, "Instantaneous SINR Calibration for System Simulation", Yakun Sun (Marvell)
    - 11-14/0336r0, "Calibration of Long-Term SINR for System Simulator" Yakun Sun (Marvell)
    - 11-14/0339r0, "A simplified STR Mechanism", Raja Banerjea (CSR)
    - 11-14/0340r0, "A simplified STR Mechanism – MAC", Raja Banerjea (CSR)
    - 11-14/0342r0, "Short Packet Optimizations", Naveen Kakani (CSR, Inc)
    - 11-14/0345r1, "Joint Coding and Modulation Diversity with RBD pre-coding for next generation WLAN", Zhanji Wu (BUPT)
    - 11-14/0350r0, "Suggestion on Evaluation Methodology", Jinyoung Chun (LG Electronics)
    - 11-14/0352r0, "Discussion on power save mode for real time traffic", Giwon Park (LG Electronics)
    - 11-14/0353r0, "Suggestion on PHY Abstraction for Evaluation Methodology", Dongguk Lim (LG Electronics)
    - 11-14/0355r0, "Simulation Scenario 1 Revised", Simone Merlin (Qualcomm)
    - 11-14/0356r0, "Calibration of System Level Simulators", Jarkko Kneckt (Nokia)
    - 11-14/0357r0, "Utilizing Unused Resources for Simultaneous Transmissions", Jarkko Kneckt (Nokia).
    - 11-14/0365r0, "Extended Intra-Vehicle Channel Model", Igal Kotzer (General Motors)
    - 11-14/0372r2, "System level simulations on increased spatial reuse", Liwen Chu (Marvell)
    - 11-14/0373r1, "Energy Efficiency in HEW", Pingping Xu, Wei Wang (Southeast University)
    - 11-14/0381r0, "Stadium scenario for HEW", Johan Soder, Filip Mestanov (Ericsson AB)
    - 11-14/0383r0, "Considerations on evaluation methodology for candidate HEW PHY&MAC techniques", Le Liu (Huawei)
    - 11-14/0385r0, "Simulation Methodology and Calibration", Gwen Barriac (Qualcomm)
    - 11-14/0386r0, "Discussions on MCS selection" , Tianyu Wu (MediaTek)
    - 11-14/0392r0, "Traffic Separation Scheme for Optimizing WLANs using PHY and MAC options", Takayuki Nishio (Kyoto University)
    - 11-14/0393r0, "Possible Indoor Channel Models for HEW System Simulations", Leif Wilhelmsson (Ericsson AB).
    - 11-14/0419r0, "802.11ax Spec Development Process Proposal", Rolf de Vegt (Qualcomm)

Goals for May 2014

- Meet as a new TG and will have officer elections.
- Continue the work on simulation scenarios, evaluation methodologies, channel models, and function requirements.

Teleconferences

- One teleconference planned before the May 2014 session.

- ✧ Thursday, April 17th, 10:00 – 12:00 (ET)
- ✧ Details to be announced.

January 2014 – Los Angeles, CA

HEW study group had nine sessions during the week.

	Monday	Tuesday	Wednesday	Thursday
AM1				**HEW**
AM2	**HEW**	**HEW**		
PM1				**HEW**
PM2	**HEW**	**HEW**	**HEW**	
PM3	**HEW**	**HEW**		

Main documents

- Agenda: 11-13/1506r5, HEW SG January 2014 Meeting Agenda
- Closing report: 11-14/0187r0, HEW SG January 2014 Closing Report
- Draft minutes: 11-14/0199r0, January 2014 Los Angeles Meeting Minutes

Achievements

1. **The group approved minutes from the November 2013 Dallas meeting and teleconferences on December 4th 2013, December 18th 2013 and January 8th, 2014..**
   - 11-13/1465r1, November 2013 Dallas Meeting Minutes
   - 11-13/1495r0, Minutes from the teleconference on December 4th, 2013
   - 11-13/1532r1, Minutes from the teleconference on December 18th, 2013
   - 11-14/0024r1, Minutes from the teleconference on January 8th, 2014

2. **The group resolved open issues related to the PAR and CSD.**

3. **The group received 28 submissions that were categorized into (1) PAR and 5 Criteria related submissions, and (2) Best Effort submissions. Best Effort submissions basically related to simulation scenario and evaluation methodology.**
   - **PAR and 5 Criteria related submissions**
     - ✧ 11-13/1410r6, “802.11 HEW Draft PAR and 5C”, Osama Aboul-Magd and All
     - ✧ 11-13/1489r5, “Airport Capacity Analysis”, Graham Smith (DSP Group)
     - ✧ 11-14/0026r1, “thoughts on hew par”, Yong Liu (Apple)
     - ✧ 11-14/0045r2, “E-Education Analysis”, Graham Smith (DSP Group)
     - ✧ 11-14/0058r1, “Pico Cell Use Case Analysis “, Graham Smith (DSP Group)
     - ✧ 11-14/0061r0, “Some findings from real world measurement”, Katsuo Yunoki (KDDI Labs)
     - ✧ 11-14/0065r1, “Comments on Draft HEW PAR”, Bill Carney (SONY)
     - ✧ 11-14/0101r2, “Comments on 802.11 HEW Draft PAR & 5C”, Rakesh Taori (Samsung Electronics)
     - ✧ 11-14/0106r0, “Discussion on HEW PAR”, Kiseon Ryu (LG Electronics)
     - ✧ 11-14/0119r2, “Suggested PAR Changes”, James Yee (MediaTek)
     - ✧ 11-14/0163r1, “Raising the PAR”, Mat Fischer (Broadcom)

   - **Best Effort submissions**
     - ✧ 11-14/0043r2, “PHY abstraction in system level simulation for HEW study”, Fei Tong (Samsung)

- ✧ 11-14/0051r0, “Wireless Office with Interference”, David Xun Yang (Huawei)
- ✧ 11-14/0053r0, “Further Considerations on Calibration of System Level Simulation”, Jiayin Zhang (Huawei)
- ✧ 11-14/0056r1, “Traffic Model on Virtual Desktop Infrastructure”, Yingpei Lin (Huawei)
- ✧ 11-14/0059r1, “Integrated System Level Simulation”, Jun Luo (Huawei)
- ✧ 11-14/0063r0, “Design Challenges for 802.11 HEW Radios”, Yu Cai (Huawei)
- ✧ 11-14/0070r0, “Joint MAC/PHY Evaluation Methodology”, Kaushik Josiam (Samsung)
- ✧ 11-14/0082r0, “Improved Spatial Reuse Feasibility – Part I”, Ron Porat (Broadcom)
- ✧ 11-14/0083r0, “Improved Spatial Reuse Feasibility – Part II”, Ron Porat (Broadcom)
- ✧ 11-14/0086r2, “Outdoor AP Measurement in Tokyo”, Tsugu Aoki (Toshiba)
- ✧ 11-14/0088r0, “Intra-Vehicular Channel Model”, Igal Kotzer (General Motors)
- ✧ 11-14/0095r0, “OFDM-IDMA Uplink Communication”, Leonardo Lanante (Kyushu Inst. Of Tech)
- ✧ 11-14/0107r0, “HEW Evaluation Metrics”, Yonggang Fang (ZTETX)
- ✧ 11-14/0116r1, “Long-Term SINR Calibration for System Level Simulation”, Yakun Sun (Marvell)
- ✧ 11-14/0117r0, “PHY Abstraction for HEW System Level Simulation”, Yakun Sun (Marvell)
- ✧ 11-14/0118r0, “Consideration on System Level Simulation”, Jinsoo Chio (LG Electronics)

4. The group passed motions to approve PAR and CSD.

- PAR: 11-14/0165r0, IEEE 802.11 HEW SG Proposed PAR
- CSD: 11-14/0169r0, IEEE 802.11 HEW SG Proposed CSD

Goals for the March 2014 Meeting

- Resolve comments expected from EC members and other IEEE 802 WGs
- Continue with presentations relevant to the SG topics.
  - ✧ Simulation scenarios
  - ✧ Evaluation Methodologies
  - ✧ Channel Models
  - ✧ Technology
  - ✧ etc.

Teleconferences

The group agreed to have four teleconferences before the March 2014 meeting.

- Thursday, February 6th, 2014: 20:00 – 22:00 (ET)
- Thursday, February 13th, 2014: 10:00 – 12:00 (ET)
- Thursday, February 20th, 2014: 10:00 – 12:00 (ET)
- Thursday, February 27th, 2014: 20:00 – 22:00 (ET)

November 2013 – Dallas, TX

HEW study group had ten sessions during the week.

	Monday	Tuesday	Wednesday	Thursday
AM1			**HEW**	**HEW**
AM2		**HEW**		
PM1		**HEW**	**HEW**	**HEW**
PM2	**HEW**	**HEW**	**HEW**	**HEW**

Main documents

- Agenda: 11-13/1263r5, HEW SG November 2013 Meeting Agenda

- Closing report: 11-13/1476r1, HEW SG November 2013 Closing Report
- Draft minutes: 11-13/1465r1, November 2013 Dallas Meeting Minutes

Achievements

1. **The group approved minutes from the September 2013 Nanjing meeting and teleconferences on October 3rd and October 30th, 2013.**
   - 11-13/1117r1, September 2013 Nanjing Meeting Minutes
   - 11-13/1275r1, Minutes from the teleconference on October 3rd , 2013
   - 11-13/1303r0, Minutes from the teleconference on October 30th, 2013

2. **The group received more than 40 submissions that were categorized into three categories, i.e., (1) Channel Mode/Simulation Scenarios and Evaluation Methodologies, (2) MAC/PHY technologies and (3) PAR proposals. Following submissions were presented during the week.**
   - **Channel Models, Simulation Scenarios and Evaluation Methodologies**
     - 11-13/1001r5, "HEW SG Simulation Scenarios", Simone Merlin (Qualcomm)
     - 11-13/1305r0, "Simplification on HEW traffic models", Bill Carney (Sony)
     - 11-13/1334r5, 11-13/1335r4, "Video Traffic Modeling", Guiqing Li (Intel)
     - 11-13/1359r0, "HEW Evaluation Methodology", Ron Porat (Broadcom)
     - 11-13/1370r0, "LTE OOB Interference to 2.4 GHz Band", Yonggang Fang (ZTE TX)
     - 11-13/1376r3, "Discussions on Penetration Loss", Jianhan Liu (MediaTek)
     - 11-13/1380r0, "Outdoor Channel Model Simulation Follow-up", Hongyuan Zhang (Marvell)
     - 11-13/1383r0, "System Level Simulation Parameters", Wookbong Lee (LG Electronics)
     -
     - 11-13/1387r1, "HEW channel modeling for system level simulation", Yan Zhang (Marvell)
     - 11-13/1390r0, "PHY Abstraction for HEW System Level Simulations", Yakun Sun (Marvell)
     - 11-13/1391r0, "About SINR conversion for PHY Abstraction", Yakun Sun (Marvell)
     - 11-13/1392r0, "Methodology of Calibrating System Level Simulation Results", Yakun Sun (Marvell)
     - 11-13/1401r0, "System Level Assessments for Outdoor HEW Deployments", Kaushik Josiam (Samsung)
     - 11-13/1406r0, "Traffic Modeling for HEW Simulations", Huai-Rong Shao (Samsung)
     - 11-13/1407r0, "Simulation based study of QoE", Chao-Chun Wang (MediaTek)
     - 11-13/1412r0, "How to use simulation scenarios in HEW", Minho Cheong (ETIR)
     - 11-13/1419r1, "Modifications to ITU Channel Model to Support 160MHz bandwidth of operation", Shahrnaz Azizi (Intel)
     - 11-13/1420r1, "HEW Considerations for the Vehicular Environment", Igal Kotzer (General Motors)
     - 11-13/1438r0, "Traffic Observation and Study on Virtual Desktop Infrastructure", Phillip Barber (Huawei Technologies)
     - 11-13/1456r1, "Considerations on WFA feedback", Simone Merlin (Qualcomm)

   - **MAC/PHY Technologies**
     - 11-13/1325r5, "IEEE 802.11ai overview", Hiroshi Mano (ATRD), chair of TGai
     - 11-13/1349r0, "Access Control Enhancement", Katsuo Yunoki (KDDI)
     - 11-13/1375r1, "Summary and Discussions of Proposals on Potential PHY Technologies in HEW", Jianhan Liu (MediaTek)
     - 11-13/1377r0, "DL efficiency enhancement in high density network", Kiseon Ryu (LG Electronics)
     - 11-13/1382r0, "Discussion on OFDMA in HEW", Jinsoo Choi (LG Electronics)
     - 11-13/1386r2, "Improving WLAN Efficiency and QoE – A Top Down Approach", Veli-Pekka Kentonen (7 Signals)

- 11-13/1388r0, “UL MU-MIMO transmission”, Jinyoung Chun (LG)
- 11-13/1395r2, “Simultaneous Transmission Technologies for HEW”, Koichi Ishihara (NTT)
- 11-13/1409r0, “Dual Wi-Fi: Dual Channel Wi-Fi for Congested WLANs with Asymmetric Traffic Loads”, Adriana Flores (Rice University)
- 11-13/1421r1, “STR Radios and STR Media Access”, Phillip Levis (Stanford University)
- 11-13/1440r0, “Argos | Practical Masive-MIMO”, Clayton Shepard (Rice University)

- **PAR proposals**
  - 11-13/1331r2, “Proposed direction and priorities for HEW”, Guido R. Hiertz (Ericsson)
  - 11-13/1333r0, “Power Efficiency PAR Requirements”, Chris Hansen (Covariant)
  - 11-13/1366r3, “Some propositions to progress towards the PAR definition”, Laurent Cariou (Orange)
  - 11-13/1361r0, “Discussion to derive HEW Functional Requirements”, Yasunao Misawa (KDDI)
  - 11-13/1389r1, “Discussion on HEW PAR”, HanGyu Cho (LG Electronics)
  - 11-13/1397r0, “Renewing 2.4 GHz”, Brian Hart (Cisco Systems)
  - 11-13/1398r0, “Requirements for HEW”, Akira Yamada (NTT DOCOMO)
  - 11-13/1404r0, “Some Thoughts on PAR”, and 11-13/1405r0, “HEW PAR”, Eldad Perahia (Intel)
  - 11-13/1450r0, “Summary of PAR Discussions”, Osama Aboul-Magd (HEW SG chair)
  - 11-13/1470r1 and 11-13/1471r1, “802.11 HEW proposed basis for PAR discussion”, Laurent Cariou (Orange)

3. **Discussed the WFA feedback on prioritization of the usage cases and approved a liaison letter back to WFA.**
   - Feedback from Wi-Fi Alliance:
     - 11-13/1443r0, Liaison from Wi-Fi Alliance - HEW Use Cases
   - Approved a liaison document to Wi-Fi Alliance:
     - 11-13/1446r0, IEEE 802.11 Liaison to WFA on Prioritization of High Efficiency WLAN (HEW) Usage Scenarios

4. **Started the discussion on the PAR.**
5. **The group passed a motion to extend the study group by 136/0/2.**

Goals for the January 2014

- Progress the work on the PAR and 5C.

Teleconferences

The group agreed to have three teleconferences before the January 2014 meeting.

- Wednesday, December 4th, 2013: 10:00 – 12:00 (ET)
- Wednesday, December 18th, 2013: 20:00 – 22:00 (ET)
- Wednesday, January 8th, 2014: 10:00 – 12:00 (ET)

September 2013 – Nanjing, China

HEW study group had nine sessions during the week.

	Monday	Tuesday	Wednesday	Thursday
AM1				**HEW**

AM2		**HEW**		
PM1			**HEW**	**HEW**
PM2	**HEW**	**HEW**	**HEW**	
Evening	**HEW**	**HEW**		

Main documents

- Agenda: 11-13/0951r7
- Closing report: 11-13/1231r1
- Draft minutes: 11-13/1117r1

Achievements

1. **The group approved minutes from the Geneva meeting and teleconference on August 28th, 2013.**
   - 11-13/0861r1, Minutes from face-to-face meeting in Geneva, July 2013
   - 11-13/1003r0, Minutes from the teleconference on August 28th, 2013
2. **50 submissions in the following categories were received and presented during the week.**
   - **Channel Models (CM)**
     - 11-13/0996r2, "Outdoor Channel Model Candidates for HEW", Kaushik Josiam (Samsung)
     - 11-13/1113r0, "Channel Modeling for Dense Wi-Fi Environments", Minho Cheong (ETRI)
     - 11-13/1125r3, "HEW Outdoor Channel Model Discussions", Hongyuan Zhang (Marvell)
     - 11-13/1135r4, "Summary of HEW Channel Models", Jianhan Liu (MediaTek)
     - 11-13/1146r1, "Update on HEW Channel Model", Shahrnaz Azizi (Intel Corp)
   - **Simulation Scenarios/Simulation Methodologies (SS/SM)**
     - 11-13/1000r2, "Simulation Scenarios", Simone Merlin (Qualcomm)
     - 11-13/1001r2, "Simulation Scenarios Document Template", Simone Merlin (Qualcomm)
     - 11-13/1079r0, "Outdoor Stadium Simulation Details Discussion", Joseph Levy (InterDigital)
     - 11-13/1080r0, "Markov Modeling of the Channel for HEW System Level Simulations", Joseph Levy (InterDigital)
     - 11-13/1081r0, "HEW Simulation Methodology", Sayantan Choudhury (Nokia).
     - 11-13/1083r0, "HEW SG Unified Simulation Scenarios", David Xun Yang (Huawei)
     - 11-13/1114r1, "Simulation Scenario for unplanned Wi-Fi Network", Jae Seung Lee (ETRI)
     - 11-13/1123r1, "Capacity Simulation of High Density Indoor WLAN Systems", Filip Mestanov (Ericsson AB)
     - 11-13/1133r0, "Virtual Desktop Infrastructure (VDI)", Yingpei Lin (Huawei Technologies)
     - 11-13/1153r0, "Simulation Scenario Proposal", Laurent Cariou (Orange)
     - 11-13/1159r1, "Video Performance Requirements and Simulation Parameters", Guoqing Li (Intel)
     - 11-13/1162r1, "Video Application Categories and Characteristics", Guoqing Li (Intel)
     - 11-13/1176r0, "Some Simulation Scenarios for HEW", Reza Hedayat (Cisco)
   - **Evaluation Methodologies (EM)**
     - 11-13/1051r1, "Evaluation Methodology", Ron Porat (Broadcom)
     - 11-13-1054r1, "HEW Evaluation Metrics Suggestions", Yonggang Fang (ZTETX)
     - 11-13/1059r0, "PHY Abstraction for HEW Evaluation Methodology", Dongguk Lim (LG Electronics)
     - 11-13/1131r0, "PHY Abstraction for HEW System Level Simulation", Jiayin Zhang (Huawei Technologies)
     - 11-13/1137r2, "The Definition of Performance Metrics for HEW", Haui-Rong Shao (Samsung)
     - 11-13/1144r1, "Simplified Traffic Model Based on Aggregated Network Statistics", William Carney (Sony)
     - 11-13/1158r0, "Video Traffic and Applications for HEW", William Carney (Sony)
   - **Functional Requirements (FR)**
     - 11-13/1097r0, "Functional Requirements for HEW PAR", Minho Cheong (ETRI)

- 11-13/1116r0, “Discussion on HEW Functional Requirements”, Jinsoo Choi (LG Electronics)

- **MAC/PHY Technologies (TECH)**
  - 11-13/1046r2, “Discussion for Massive MIMO for HEW”, Zhigang Wen (BUPT)
  - 11-13/1056r1, “Enhancement on resource utilization in OBSS environment”, Giwon Park (LG Electronics)
  - 11-13/1058r0, “Efficient wider bandwidth operation”, Kiseon Ryu (LG Electronics)
  - 11-13/1061r0, “Multicast Transmission for HEW”, Jeongki Kim (LG electronics)
  - 11-13/1073r1, “Access Control Enhancement“, Katsuo Yunoki (KDDI Labs)
  - 11-13/1074r0, “Occupied air time calculation for doc.1073r0”, Katsuo Yunoki (KDDI R&D Laboratories)
  - 11-13/1077r1, “EDCA Enhancements for HEW”, Hui Zhao (BUPT)
  - 11-13/1089r1, “D2D Technology for HEW”, Xiang Gao (BUPT)
  - 11-13/1090r2, “Non-linear pre-coding MIMO Scheme for next generation WLAN”, Xiang Gao (BUPT)
  - 11-13/1105r0, “Discussion on Access Mechanism for HEW”, Meng Yang (CATR)
  - 11-13/1122r1, “Considerations for In-Band Simultaneous Transmit and Receive (STR) feature in HEW”, Rakesh Taori (Samsung Electronics)
  - 11-13/1126r0, “Beamforming under OBSS Interference”, Hongyuan Zhang (Marvell)
  - 11-13/1168r0, “Requirements on WLAN Ad Push”, Hui Tian (BUPT)
  - 11-13/1169r0, “WLAN Cellular Offload in High Speed Moving Environment”, Hui Tian (BUPT)
  - 11-13/1154r0, “DL-MU-MIMO Transmission with Unequal Bandwidth”, Yongming Huang (Southeast University)
  - 11-13/1155r0, “Space Division Multiplex for OBSS Interference Suppression”, Yongming Huang (Southeast University)
  - 11-13/1156r0, “TXOP Redundancy NAV Clear”, Yongming Huang (Southeast University)
  - 11-13/1157r3, “Feasibility of Coordination Transmission for HEW”, Yunzhou Li (Tsunghua University)

- **General (GEN)**
  - 11-13/1057r0, “Legacy support on HEW frame structure”, Wookbong Lee (LG electronics)
  - 11-13/1100r0, “HEW SG Progress Review”, Osama Aboul-Magd (HEW SG)
  - 11-13/1115r0, “Possible vision of the HEW-driven Wi-Fi 2020”, Minho Cheong (ETRI)
  - 11-13/1163r0, “PAR and 5C: Comments based on 11n”, Sean Coffey (RealTek)
  - 11-13/1164r1, “Some PAR and 5C Requirements”, Paul Lambert (Marvell)

3. Straw Polls

Several straw polls were conducted to sense the group consensus on topics related to simulation scenarios, evaluation methodologies and channel models.

4. Timeline

The group reviewed the timeline. No changes.

5. Teleconferences

The HEW SG agreed to have three teleconferences before the November 2013 session.

- Wednesday, October 9th, 2013: 10:00 – 12:00 (ET)
- Wednesday, October 17th, 2013: 00:01 – 02:00 (ET)
- Wednesday, October 30th, 2013: 10:00 – 12:00 (ET)

Goals for the November 2013

- Hear presentations addressing SS/SM/EM/FR/CM/TECH
  - Attempt to consolidate documents related to the above areas of discussion.
  - Priority will be given to presentations with consolidated views
- Start discussion on PAR related issues

- Motion for SG extension
- WFA feedback on the usage cases

July 2013 – Geneva, Switzerland

HEW study group had nine sessions during the week.

Main documents

- Agenda: 11-13/0664r5
- Closing report: 11-13/0922r0
- Draft minutes: 11-13/0861r0

Achievements

1. **The group approved minutes from the face-to-face meeting in Waikoloa, HI and teleconferences held on June 5th and June 19th.**
   - 11-13/0560r2, May 2013 Waikoloa meeting minutes
   - 11-13/0663r1, Teleconference minutes 20130605
   - 11-13/0704r0, Teleconference minutes 20130619
2. **The group received over 35 submissions in areas of (1) Usage Models/Use Cases, (2) Functional Requirements, (3) Simulation Scenarios and Evaluation Methodology, (4) MAC/PHY techniques as listed below.**
   - **Usage Models/Use Cases**
     - 11-13/0657r3, "HEW SG usage models and requirements - Liaison with WFA" Laurent Cariou (Orange)
     - 11-13/0795r0, "HEW Usage Scenarios Categorization", Eldad Perahia (Intel)
     - 11-13/0802r1, "Proposed re-categorization of the HEW usage models", Yasuhiko Inoue (NTT)
     - 11-13/0761r0, "Interference Control Use Case for HEW", Fang Xie (CMCC)
     - 11-13/0836r0, "HEW Usage Models for Backhauls and Floor Automation", Minho Cheong (ETRI)
   - **Functional Requirements**
     - 11-13/0787r0, "Follow up requirements", Wu Tianyu (Huawei)
     - 11-13/0850r0, "Quantitative QoE Requirements for HEW", Huai-Rong Shao (Samsung)
     - 11-13/0798r1, "Functional Requirements in HEW", Jinsoo Choi (LG Electronics)
     - 11-13/0840r1, "HEW Functional Requirements Follow-up (Preliminary Version for Study Group discussions)", Minho Cheong (ETRI)
   - **Simulation Scenarios and Evaluation Methodology**
     - 11-13/0723r1, "HEW SG Evaluation Methodology Overview", Minyoung Park (Intel)
     - 11-13/0756r1, "HEW Channel Model", Vinko Erceg (Broadcom)
     - 11-13/0858r0, "Enhanced Channel Model for HEW", Shahrnaz Azizi (Intel)
     - 11-13/0728r1, "Network Optimization for Expected HEW Traffic Patterns", Bill Carney (Sony)
     - 11-13/0869r0, "Simulation scenarios and metrics for HEW", Thomas Derham (Orange)
     - 11-13/0872r1, "Clarifications on outdoor deployments", Laurent Cariou (Orange)
     - 11-13/0847r1, "Evaluation Criteria and Simulation Scenarios" Klaus Doppler (Nokia)
     - 11-13/0786r0, "Discussion on System Level Simulation Methodology" Wu Tianyu (Huawei)
     - 11-13/0757r1, "Evaluation Methodology and Simulation Scenarios" Nihar Jindal (Broadcom)
     - 11-13/0805r2, "On Definition of Dense Networks and Performance Metric", Jianhan Liu (MediaTek)
     - 11-13/0800r1, "HEW Study Group Documentation", Hemanth Sampath (Qualcomm)

- 11-13/0837r0, “Consideration for HEW Evaluation Methodology”, Minho Cheong (ETRI)

- **MAC/PHY techniques**
  - 11-13/0768r0, “TD-*u*CSMA”, Riccard Scopigno (ISMB)
  - 11-13/0843r0, “Further Evaluation on outdoor Wi-Fi”, Wookbong Lee (LG Electronics)
  - 11-13/0852r0, “Potential approach to improve WLAN BSS edge performance”, Juho Pirskanen (Renesas Mobile)
  - 11-13/0871r0, “Discussion on Potential Techniques for HEW”, Timo Koskela (Renesas Mobile)
  - 11-13/0877r0, “HEW Beamforming Enhancements”, James Wang (MediaTek)
  - 11-13/0764r1, “Full-duplex Technology for HEW”, Andre Bourdoux (IMEC)
  - 11-13/0765r2, “Full-duplex is an emerging radio paradigm that has the potential to improve the efficiency of future WLANs”, Hongliang Bian (China Telecom)
  - 11-13/0712r1, “A Brief Time of History”, Larry Taylor (DTC)
  - 11-13/0801r1, “Issues of Low Rate Transmissions”, Akira Kishida (NTT)
  - 11-13/0758r0, “Possible Approaches for HEW”, Katsuo Yunoki (KDDI Labs)
  - 11-13/0849r1, “New Techniques: Enabling Real World Improvement By Exposing Internal MAC state”, Brian Hart (Cisco)
  - 11-13/0854r1, “Consideration on Efficiency Enhancement”, SangHyun Chang (Samsung)
  - 11-13/0865r2, “Video Data Rate for HEW”, Huai-Rong Shao (Samsung)
  - 11-13/0878r0, “Efficiency enhancement for dense WLAN environment”, Jeongki Kim (LG Electronics)

3. **The group approved document 11-13/0657r6 as HEW SG initial draft of Usage Models and to send it to Wi-Fi Alliance asking for prioritization of the use cases and additional feedbacks.**

4. **The group also approved a liaison letter to the Wi-Fi Alliance contained in the document 11-13/902r1.**

5. **The group passed motion to extend the SG.**

6. **The group discusses the timeline.**
   - May 2013: Initial meeting
   - July 2013: Presentations, SG extension
   - September 2013: Presentations
   - November 2013: Presentations, Initial PAR & 5C, SG extension
   - January 2014: Presentations, Final version of PAR and 5C, WG approval
   - March 2014: Presentations, EC approval of PAR and 5C
   - May – June 2014: NesCom approval
   - July 2014: TG starts

7. **Teleconferences**

   The group agreed to have two teleconferences before the September 2013 meeting.
   - Wednesday, August 7th, 2013: 10:00 – 12:00 (ET)
   - Wednesday, August 28th, 2013: 20:00 – 22:00 (ET)

Next steps

During the September 2013 meeting, the HEW SG continues discussions on issues related to:
- Usage Models/Use Cases
- Functional Requirements
- Feasibility
- Scope and Process

May 2013 – Waikoloa, HI

Main documents

- Agenda: 11-13/0400r4
- Closing report: 11-13/0624r0
- Draft minutes: 11-13/0560r2

Achievements

1. The group decided leadership structure to have one chairperson and one secretary.

Ÿ Osama Aboul-Magd (Huawei Technologies) was elected as the chair of the HEW SG.

Ÿ Yasuhiko Inoue (NTT) was elected as the recording secretary of the HEW SG.

2. The group received 22 submissions as listed below.

Ÿ **Usage Models/Use Cases:**

- ✧ 11-13/0514r0, "HEW Usage Scenarios and Applications", Eldad Perahia (Intel)
- ✧ 11-13/0538r0, "Dense apartment building use case for HEW", Klaus Doppler (Nokia)
- ✧ 11-13/0554r0, "Use Cases", Minho Cheong (ETRI)
- ✧ 11-13/0567r0, "Proposed HEW Usage Models", Yasuhiko Inoue (NTT)
- ✧ 11-13/0527r2, "Usage Models for Next Generation", David Xun Yang (Huawei) and James Wang (MediaTek)
- ✧ 11-13/0534r1, "Direction and Use Cases for HEW", HanGyu Cho (LG Electronics)
- ✧ 11-13/0563r0, "D2D Technology for HEW", Zhanji Wu (BUPT) – not presented

Ÿ **Problem Statements:**

- ✧ 11-13/0505r0, "MAC Efficiency Analysis for HEW SG", Minyoung Park (Intel)
- ✧ 11-13/0545r1, "WLAN QoE, End User Perspective Opportunities to Improve", Veli-Pekka Ketonen (7 signals)
- ✧ 11-13/0523r2, "Understanding Current Situation of Public Wi-Fi Usage – Possible Requirements for HEW –", Katsuo Yunoki (KDDI Labs)
- ✧ 11-13/0539r0, "Efficient Frequency Spectrum Utilization", Yongho Seok (LG Electronics)
- ✧ 11-13/0544r3, "Discussions on 11ac PHY efficiency", Jianhan Liu (MediaTek)
- ✧ 11-13/0536r0, "HEW SG PHY Considerations For Outdoor Environment", Wookbong Lee (LG Electronics)
- ✧ 11-13/0576r3, "Performance Evaluation for 11ac", Wu Tianyu (Huawei Technologies)
- ✧ 11-13/0556r1, "Wi-Fi interference measurements in Korea – Part 1", Minho Cheong (ETRI)
- ✧ 11-13/0549r0, "A perspective on what any High Efficiency Wireless TG should and should not do", Brian Hart (Cisco Systems)

Ÿ **Requirements:**

- ✧ 11-13/0524r2, "HEW Finctional Requirements", Wu Tianyu (Huawei Technologies)
- ✧ 11-13/0555r2, "Considerations on Functional Requirements for HEW", Minho Cheoung (ETRI)

Ÿ **Scenarios and Metrics**

- ✧ 11-13/0503r0, "Discussion on Basic Technical Aspects for HEW", Juho Pirskanen (Renesas Mobile)
- ✧ 11-13/0542r0, "HEW Scenarios and Goals", Simone Merlin (Qualcomm)
- ✧ 11-13/0486r1, "HEW – Metrics, Targets and Simulation Scenarios", Ron Porat (Broadcom)
- ✧ 11-13/0520r1, "HEW scenarios and evaluation metrics", Thomas Derham (Orange)

Ÿ **Technical Feasibility**

- ✧ 11-13/0558r1, "Coexistence and Optimization of Wireless LAN: Time, Frequency, Space, Power, and Load", Jim Lansford (CSR)

3. **Liaison to the Wi-Fi Alliance**
   - Ÿ The group agreed to ask the Wi-Fi Alliance for input about priority of the use cases.
   - Ÿ Laurent Cariou (Orange) volunteers to develop the use case document.

4. **Project planning**
   - Ÿ The group discussed about the project plan based on the submission 11-13/0616r2 by Phil Barber (Huawei)
   - Ÿ Discussion to be continued in the July meeting.

5. **Teleconferences**
   - Ÿ The group agreed to have two teleconferences before the July 2013 Plenary to develop a use case document to be shared with the Wi-Fi Alliance.
     - ✧ June 5th: 10:00 – 12:00 (ET)
     - ✧ June 19th: 20:00 – 22:00 (ET)

Next Steps

- During July 2013 session, the HEW SG will continue discussions on:
  - ➢ Usage Cases
  - ➢ Functional Requirements
  - ➢ Feasibility
  - ➢ Scope and Process

Related documents

Documents referenced in the motion that led to the creation of the study group

- https://mentor.ieee.org/802.11/dcn/13/11-13-0339-10-0wng-high-efficiency-wlan-straw-poll.ppt

Press release document

- https://mentor.ieee.org/802.11/dcn/13/11-13-0418-02-0000-proposed-edits-to-hew-press-release.doc

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Appendix BD

IEEE 802.11, The Working Group for Wireless LANs Standards

This page is maintained by Stephen McCann . Comments are welcome.

IEEE 802.11 WG LETTER BALLOTS

Note - percentage results are rounded to the nearest integer

Note - Links to documents in the voting members' private area (such as drafts) will stop functioning once the project is complete, e.g., whe its output document has been published by the IEEE-SA.

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
288	TGbi	Technical TGbi Draft 1.00	LB# 288	Draft	Draft P802.11bi_D1.0.pdf	2025-01-27	2025-02-27	31	Pool	640
									Approve	309
				Redlined Doc	N/A				Disapprove	38
				Resolution Doc	N/A				Abstain	63
									Return%	64
				Comment	Template				Approve%	89
				Pool	LB# 288 Voters					
287	TGbk	Recirculation TGbk Draft 3.00	LB# 287	Draft	Draft P802.11bk_D3.0.pdf	2024-08-01	2024-08-15	14	Pool	559
									Approve	342
				Redlined Doc	Draft P802.11bk_D3.0_redline_compared_to_D2.0.pdf				Disapprove	6
				Resolution Doc	11-24-1011-02-00bk-lb286-cid-resolution-status-for-d2-0.xlsx				Abstain	47
									Return%	71
				Comment	Template				Approve%	98
				Pool	LB# 287 Voters					
286	TGbk	Recirculation TGbk Draft 2.00	LB# 286	Draft	Draft P802.11bk_D2.0.pdf	2024-04-10	2024-04-26	16	Pool	559
									Approve	321
				Redlined Doc	Draft P802.11bk_D2.0_redline_compared_to_D1.0.pdf				Disapprove	10
				Resolution Doc	11-24-0013-08-00bk-lb279-comments-on-d1-0.xlsx				Abstain	53
									Return%	69
				Comment	Template				Approve%	97
				Pool	LB# 286 Voters					
285	TGbf	Recirculation TGbf Draft 4.00	LB# 285	Draft	Draft P802.11bf_D4.0.pdf	2024-04-10	2024-04-26	16	Pool	491
									Approve	354
				Redlined Doc	Draft P802.11bf_D4.0_redline_compared_to_D3.0.pdf				Disapprove	13
				Resolution Doc	11-24-0028-14-00bf-lb281-comments-and-approved-resolutions.xlsx				Abstain	38
									Return%	82
				Comment	Template				Approve%	96
				Pool	LB# 285 Voters					
284	TGbh	Recirculation TGbh Draft 4.00	LB# 284	Draft	Draft P802.11bh_D4.0.pdf	2024-03-21	2024-04-06	16	Pool	527
									Approve	356
				Redlined Doc	Draft P802.11bh_D4.0 Redline Compared to D3.0.pdf				Disapprove	2
				Resolution Doc	11-24-0380-02-00bh-ieee-802-11bh-lb283-comments.xlsx				Abstain	52
									Return%	78
				Comment	Template				Approve%	99
				Pool	LB# 284 Voters					
283	TGbh	Recirculation TGbh Draft 3.00	LB# 283	Draft	Draft P802.11bh_D3.0.pdf	2024-02-09	2024-02-24	15	Pool	527
									Approve	341
				Redlined Doc	Draft P802.11bh_D3.0 Redline Compared to D2.0.pdf				Disapprove	8
				Resolution Doc	11-24-0040-10-00bh-ieee-802-11bh-lb282-comments.xlsx				Abstain	55
									Return%	77
				Comment	Template				Approve%	98
				Pool	LB# 283 Voters					
282	TGbh	Recirculation TGbh Draft 2.00	LB# 282	Draft	Draft P802.11bh_D2.0.pdf	2023-12-11	2024-01-05	25	Pool	527
									Approve	322
				Redlined Doc	Draft P802.11bh_D2.0 Redline Compared to D1.0.pdf				Disapprove	19
				Resolution Doc	11-23-1152-32-00bh-ieee-802-11bh-lb274-comments.xlsx				Abstain	52
									Return%	75
				Comment	Template				Approve%	94
				Pool	LB# 282 Voters					
281	TGbf	Recirculation TGbf Draft 3.00	LB# 281	Draft	Draft P802.11bf_D3.0.pdf	2023-12-05	2024-01-04	30	Pool	491
									Approve	335
				Redlined Doc	Draft P802.11bf_D3.0_redline_compared_to_D2.0.pdf				Disapprove	27
				Resolution Doc	11-23-1394-12-00bf-lb276-comments-and-approved-resolutions.xlsx				Abstain	42
									Return%	82
				Comment	Template				Approve%	93
				Pool	LB# 281 Voters					
280	TGbe	Recirculation TGbe Draft 5.00	LB# 280	Draft	Draft P802.11be_D5.0.pdf	2023-12-01	2023-12-16	15	Pool	491
									Approve	397
				Redlined Doc	Draft P802.11be_D5.0_redline_D4.0.pdf				Disapprove	21
				Resolution Doc	11-23-1375-25-00be-ieee-802-11be-lb275-comments.xlsx				Abstain	5

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
									Return%	86
				Comment	Template				Approve%	95
				Pool	LB# 280 Voters					
279	TGbk	Technical TGbk Draft 1.00	LB# 279	Draft	Draft P802.11bk_D1.0.pdf	2023-11-28	2023-12-28	30	Pool	559
									Approve	290
				Redlined Doc	N/A				Disapprove	16
				Resolution Doc	N/A				Abstain	46
									Return%	63
				Comment	Template				Approve%	95
				Pool	LB# 279 Voters					
278	WG Tech Ed	Technical WG Tech Ed Draft 1.00	LB# 278	Draft	Draft P802.11-2020_Cor2_D1.0.pdf	2023-09-25	2023-10-25	30	Pool	535
									Approve	272
				Redlined Doc	N/A				Disapprove	1
				Resolution Doc	N/A				Abstain	25
									Return%	56
				Comment	Template				Approve%	100
				Pool	LB# 278 Voters					
277	TGme	Recirculation TGme Draft 4.00	LB# 277	Draft	Draft P802.11REVme_D4.0.pdf	2023-08-10	2023-08-30	20	Pool	485
									Approve	338
				Redlined Doc	Draft P802.11REVme_D4.0 Redline Compared to D3.0.pdf				Disapprove	13
				Resolution Doc	11-22-0065-23-000m-revme-wg-ballot-comments.xls				Abstain	21
									Return%	77
				Comment	Template				Approve%	96
				Pool	LB# 277 Voters					
276	TGbf	Recirculation TGbf Draft 2.00	LB# 276	Draft	Draft P802.11bf_D2.0.pdf	2023-07-26	2023-08-20	25	Pool	491
									Approve	291
				Redlined Doc	Draft P802.11bf_D2.0_redline_compared_to_D1.0.pdf				Disapprove	48
				Resolution Doc	11-23-0314-21-00bf-lb272-comments-and-approved-resolutions.xlsx				Abstain	49
									Return%	79
				Comment	Template				Approve%	86
				Pool	LB# 276 Voters					
275	TGbe	Recirculation TGbe Draft 4.00	LB# 275	Draft	Draft P802.11be_D4.0.pdf	2023-07-24	2023-08-13	20	Pool	491
									Approve	364
				Redlined Doc	Draft P802.11be_D4.0_redline_D3.0.pdf				Disapprove	40
				Resolution Doc	11-23-0272-36-00be-ieee-802-11be-lb271-comments.xlsx				Abstain	4
									Return%	83
				Comment	Template				Approve%	90
				Pool	LB# 275 Voters					
274	TGbh	Technical TGbh Draft 1.00	LB# 274	Draft	Draft P802.11bh_D1.0.pdf	2023-06-01	2023-07-01	30	Pool	527
									Approve	247
				Redlined Doc	N/A				Disapprove	22
				Resolution Doc	N/A				Abstain	52
									Return%	61
				Comment	Template				Approve%	92
				Pool	LB# 274 Voters					
273	TGme	Recirculation TGme Draft 3.00	LB# 273	Draft	Draft P802.11REVme_D3.0.pdf	2023-04-12	2023-05-07	25	Pool	485
									Approve	321
				Redlined Doc	Draft P802.11REVme_D3.0 Redline Compared to D2.0.pdf				Disapprove	25
				Resolution Doc	11-22-0065-17-000m-revme-wg-ballot-comments.xls				Abstain	18
									Return%	75
				Comment	Template				Approve%	93
				Pool	LB# 273 Voters					
272	TGbf	Technical TGbf Draft 1.00	LB# 272	Draft	Draft P802.11bf_D1.0.pdf	2023-01-30	2023-03-02	31	Pool	491
									Approve	244
				Redlined Doc	N/A				Disapprove	70
				Resolution Doc	N/A				Abstain	46
									Return%	73
				Comment	Template				Approve%	78
				Pool	LB# 272 Voters					
271	TGbe	Technical TGbe Draft 3.00	LB# 271	Draft	Draft P802.11be_D3.0.pdf	2023-01-30	2023-03-02	31	Pool	491
									Approve	302
				Redlined Doc	N/A				Disapprove	76
				Resolution Doc	N/A				Abstain	6
									Return%	78
				Comment	Template				Approve%	80
				Pool	LB# 271 Voters					
270	TGme	Recirculation TGme Draft 2.00	LB# 270	Draft	Draft P802.11REVme_D2.0.pdf	2022-10-17	2022-11-11	25	Pool	485
									Approve	282
				Redlined Doc	Draft P802.11REVme_D2.0 Redline Compared to D1.0.pdf				Disapprove	44
				Resolution Doc	11-22-0065-12-000m-revme-wg-ballot-comments.xls				Abstain	25
									Return%	72
				Comment	Template				Approve%	87
				Pool	LB# 270 Voters					
269	TGbb	Recirculation TGbb Draft 4.00	LB# 269	Draft	Draft P802.11bb_D4.0.pdf	2022-09-16	2022-10-01	15	Pool	485
									Approve	301
				Redlined Doc	Draft P802.11bb_D4.0_redline compared to D3.0.pdf				Disapprove	2
				Resolution Doc	11-22-1498-06-00bb-lb267-poll-comments.xlsx				Abstain	71

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
									Return%	77
				Comment	Template				Approve%	99
				Pool	LB# 269 Voters					
268	TGbc	Recirculation TGbc Draft 4.00	LB# 268	Draft	Draft P802.11bc_D4.0.pdf	2022-08-10	2022-08-25	15	Pool	369
									Approve	236
				Redlined Doc	Draft P802.11bc Redline D4.0 to D3.0.pdf				Disapprove	12
				Resolution Doc	11-22-0686-16-00bc-lb264-comments-on-p802-11bc-d3-0.xlsx				Abstain	35
									Return%	77
				Comment	Template				Approve%	95
				Pool	LB# 268 Voters					
267	TGbb	Recirculation TGbb Draft 3.00	LB# 267	Draft	Draft P802.11bb_D3.0.pdf	2022-08-01	2022-08-31	30	Pool	485
									Approve	281
				Redlined Doc	Draft P802.11bb_D3.0_redline compared to D2.1.pdf				Disapprove	15
				Resolution Doc	11-22-0949-07-00bb-comments-from-cc-against-d2-1.xlsx				Abstain	75
									Return%	76
				Comment	Template				Approve%	95
				Pool	LB# 267 Voters					
266	TGbe	Technical TGbe Draft 2.00	LB# 266	Draft	Draft P802.11be_D2.0.pdf	2022-05-25	2022-07-04	40	Pool	512
									Approve	228
				Redlined Doc	N/A				Disapprove	127
				Resolution Doc	N/A				Abstain	11
									Return%	71
				Comment	Template				Approve%	64
				Pool	LB# 266 Voters					
265	WG Tech Ed	Recirculation WG Tech Ed Draft 2.10	LB# 265	Draft	Draft P802.11-2020_Cor1_D2.1.pdf	2022-05-17	2022-06-01	15	Pool	511
									Approve	290
				Redlined Doc	Draft P802.11-2020-Cor1_D2.1 Redline Compared to D1.0.pdf				Disapprove	1
				Resolution Doc	11-22-0648-04-0000-comments-on-p802-11-cor1-d1-0.xlsx				Abstain	36
									Return%	64
				Comment	Template				Approve%	100
				Pool	LB# 265 Voters					
264	TGbc	Recirculation TGbc Draft 3.00	LB# 264	Draft	Draft P802.11bc Redline D3.0 to D2.0.pdf	2022-04-08	2022-04-28	20	Pool	380
									Approve	228
				Redlined Doc	Draft P802.11bc Redline D3.0 to D2.0.pdf				Disapprove	19
				Resolution Doc	11-21-1758-29-00bc-lb257-comments-on-p802-11bc-d2-0.xlsx				Abstain	34
									Return%	74
				Comment	Template				Approve%	92
				Pool	LB# 264 Voters					
263	TGbb	Recirculation TGbb Draft 2.00	LB# 263	Draft	Draft P802.11bb_D2.0.pdf	2022-04-07	2022-04-22	15	Pool	485
									Approve	271
				Redlined Doc	Draft P802.11bb_D2.0 redline compared to D1.0.pdf				Disapprove	18
				Resolution Doc	11-22-0074-20-00bb-lb260-comments.xlsx				Abstain	68
									Return%	74
				Comment	Template				Approve%	94
				Pool	LB# 263 Voters					
262	WG Tech Ed	Technical WG Tech Ed Draft 1.00	LB# 262	Draft	Draft P802.11-2020_Cor1_D1.0.pdf	2022-03-15	2022-04-14	30	Pool	511
									Approve	260
				Redlined Doc	N/A				Disapprove	3
				Resolution Doc	N/A				Abstain	41
									Return%	59
				Comment	Template				Approve%	99
				Pool	LB# 262 Voters					
261	TGbd	Recirculation TGbd Draft 4.00	LB# 261	Draft	Draft P802.11bd_D4.0.pdf	2022-03-15	2022-03-30	15	Pool	340
									Approve	245
				Redlined Doc	Draft P802.11bd_D4.0 Redline Compared to D3.0.pdf				Disapprove	3
				Resolution Doc	11-21-2018-07-00bd-tgbd-lb259-comments.xlsx				Abstain	26
									Return%	81
				Comment	Template				Approve%	99
				Pool	LB# 261 Voters					
260	TGbb	Technical TGbb Draft 1.00	LB# 260	Draft	P802.11bb_D1.0.pdf	2021-12-03	2022-01-12	40	Pool	485
									Approve	221
				Redlined Doc	N/A				Disapprove	34
				Resolution Doc	N/A				Abstain	59
									Return%	65
				Comment	Template				Approve%	87
				Pool	LB# 260 Voters					
259	TGbd	Recirculation TGbd Draft 3.00	LB# 259	Draft	Draft P802.11bd_D3.0.pdf	2021-12-01	2021-12-16	15	Pool	340
									Approve	223
				Redlined Doc	Draft P802.11bd_D3.0 Redline Compared to D2.0.pdf				Disapprove	15
				Resolution Doc	11-21-1296-07-00bd-tgbd-lb254-comments.xlsx				Abstain	29
									Return%	79
				Comment	Template				Approve%	94
				Pool	LB# 259 Voters					
258	TGme	Technical TGme Draft 1.00	LB# 258	Draft	Draft P802.11REVme_D1.0.pdf	2021-12-01	2022-01-10	40	Pool	485
									Approve	243
				Redlined Doc	Draft P802.11REVme_D1.0 Redline Compared to D0.0.pdf				Disapprove	45
				Resolution Doc	N/A				Abstain	25

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
									Return%	65
				Comment	Template				Approve%	84
				Pool	LB# 258 Voters					
257	TGbc	Recirculation TGbc Draft 2.00	LB# 257	Draft	Draft P802.11bc_D2.0.pdf	2021-10-08	2021-10-28	20	Pool	369
									Approve	198
				Redlined Doc	Draft P802.11bc Redline D2.0 to D1.0.pdf				Disapprove	22
				Resolution Doc	11-20-1985-49-00bc-lb-252-comments-on-p802-11bc-draft-1-0.xlsx				Abstain	34
									Return%	69
				Comment	Template				Approve%	90
				Pool	LB# 257 Voters					
256	TGaz	Recirculation TGaz Draft 4.00	LB# 256	Draft	Draft P802.11az_D4.0.pdf	2021-09-21	2021-10-01	10	Pool	329
									Approve	262
				Redlined Doc	Draft P802.11az_D4.0_redline_compared_to_D3.0.pdf				Disapprove	5
				Resolution Doc	11-21-1471-02-00az-lb-255-comments.xlsx				Abstain	24
									Return%	88
				Comment	Template				Approve%	98
				Pool	LB# 256 Voters					
255	TGaz	Recirculation TGaz Draft 4.00	LB# 255	Draft	Draft P802.11az_D4.0.pdf	2021-08-23	2021-09-07	15	Pool	329
									Approve	253
				Redlined Doc	Draft P802.11az_D4.0_redline_compared_to_D3.0.pdf				Disapprove	14
				Resolution Doc	11-21-0258-08-00az-lb253-comments.xlsx				Abstain	24
									Return%	88
				Comment	Template				Approve%	95
				Pool	LB# 255 Voters					
254	TGbd	Recirculation TGbd Draft 2.00	LB# 254	Draft	Draft P802.11bd_D2.0.pdf	2021-07-12	2021-08-01	20	Pool	340
									Approve	200
				Redlined Doc	Draft P802.11bd_D2.0 Redline Compared to D1.0.pdf				Disapprove	26
				Resolution Doc	11-20-1887-11-00bd-tgbd-lb251-comments.xlsx				Abstain	28
									Return%	75
				Comment	Template				Approve%	88
				Pool	LB# 254 Voters					
253	TGaz	Recirculation TGaz Draft 3.00	LB# 253	Draft	Draft P802.11az_D3.0.pdf	2021-01-26	2021-02-10	15	Pool	329
									Approve	231
				Redlined Doc	Draft P802.11az_D3.0_redline_compared_to_D2.0.pdf				Disapprove	31
				Resolution Doc	11-20-0017-12-00az-lb249-comment.xlsx				Abstain	25
									Return%	87
				Comment	Template				Approve%	88
				Pool	LB# 253 Voters					
252	TGbc	Technical TGbc Draft 1.00	LB# 252	Draft	Draft P802.11bc_D1.0.pdf	2020-11-20	2020-12-20	30	Pool	369
									Approve	153
				Redlined Doc	N/A				Disapprove	32
				Resolution Doc	N/A				Abstain	32
									Return%	59
				Comment	Template				Approve%	83
				Pool	LB# 252 Voters					
251	TGbd	Technical TGbd Draft 1.00	LB# 251	Draft	Draft P802.11bd_D1.0.pdf	2020-10-19	2020-11-18	30	Pool	340
									Approve	174
				Redlined Doc	N/A				Disapprove	39
				Resolution Doc	N/A				Abstain	21
									Return%	69
				Comment	Template				Approve%	82
				Pool	LB# 251 Voters					
250	TGba	Recirculation TGba Draft 6.00	LB# 250	Draft	Draft P802.11ba D6.0.pdf	2020-01-17	2020-02-01	15	Pool	329
									Approve	266
				Redlined Doc	Draft P802.11ba_D6.0_Redline_Compared_to_D5.0.pdf				Disapprove	4
				Resolution Doc	11-19-2162-02-00ba-comments-on-tgba-d5-0.xlsx				Abstain	23
									Return%	89
				Comment	Template				Approve%	99
				Pool	LB# 250 Voters					
249	TGaz	Recirculation TGaz Draft 2.00	LB# 249	Draft	Draft P802.11az_D2.0.pdf	2019-12-09	2020-01-03	25	Pool	329
									Approve	219
				Redlined Doc	Draft P802.11az_D2.0 redline compared to D1.0.pdf				Disapprove	33
				Resolution Doc	11-20-1719-05-00az-tgaz-lb240-comment-resolution.docx				Abstain	28
									Return%	85
				Comment	Template				Approve%	87
				Pool	LB# 249 Voters					
248	TGba	Recirculation TGba Draft 5.00	LB# 248	Draft	Draft P802.11ba D5.0.pdf	2019-12-02	2019-12-17	15	Pool	329
									Approve	258
				Redlined Doc	Draft P802.11ba_D5.0_Redline_Compared_to_D4.0.pdf				Disapprove	12
				Resolution Doc	11-19-1770-08-00ba-comments-on-tgba-d4-0.xlsx				Abstain	22
									Return%	89
				Comment	Template				Approve%	96
				Pool	LB# 248 Voters					
247	TGax	Recirculation TGax Draft 6.00	LB# 247	Draft	Draft P802.11ax_D6.0.pdf	2019-11-26	2019-12-11	15	Pool	303
									Approve	271
				Redlined Doc	Draft P802.11ax_D6.0 Redline Compared to D5.0.pdf				Disapprove	7
				Resolution Doc	11-19-1782-10-00ax-comments-on-d5-0.xlsx				Abstain	3

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
									Return%	93
				Comment	Template				Approve%	97
				Pool	LB# 247 Voters					
246	TGay	Recirculation TGay Draft 5.00	LB# 246	Draft	Draft P802.11ay_D5.0.pdf	2019-10-24	2019-11-08	15	Pool	322
									Approve	260
				Redlined Doc	Draft P802.11ay_D5.0 redline compared to D4.0.pdf				Disapprove	3
				Resolution Doc	11-19-1180-05-00ay-comments-on-tgay-d4-0.xlsx				Abstain	25
									Return%	89
				Comment	Template				Approve%	99
				Pool	LB# 246 Voters					
245	TGmd	Recirculation TGmd Draft 3.00	LB# 245	Draft	Draft P802.11REVmd_D3.0.pdf	2019-10-13	2019-10-30	17	Pool	254
									Approve	213
				Redlined Doc	Draft P802.11REVmd_D3.0 Redline Compared to D2.0.pdf				Disapprove	8
				Resolution Doc	11-19-1837-02-000m-revmd-wg-lb245-comment-resolutions.xls				Abstain	7
									Return%	90
				Comment	Template				Approve%	96
				Pool	LB# 245 Voters					
244	TGax	Recirculation TGax Draft 5.00	LB# 244	Draft	Draft P802.11ax_D5.0.pdf	2019-10-06	2019-10-24	18	Pool	303
									Approve	258
				Redlined Doc	Draft P802.11ax_D5.0 Redline Compared to D4.0.pdf				Disapprove	17
				Resolution Doc	11-19-0292-29-00ax-comments-on-tgax-d4-0.xlsx				Abstain	4
									Return%	92
				Comment	Template				Approve%	94
				Pool	LB# 244 Voters					
243	TGba	Recirculation TGba Draft 4.00	LB# 243	Draft	Draft P802.11ba D4.0.pdf	2019-09-27	2019-10-15	18	Pool	329
									Approve	238
				Redlined Doc	Draft P802.11ba_D4.0_Redline_Compared_to_D3.0.pdf				Disapprove	27
				Resolution Doc	11-19-1016-10-00ba-comments-on-tgba-d3-0.xlsx				Abstain	24
									Return%	88
				Comment	Template				Approve%	90
				Pool	LB# 243 Voters					
242	TGay	Recirculation TGay Draft 4.00	LB# 242	Draft	Draft P802.11ay_D4.0.pdf	2019-06-20	2019-07-08	18	Pool	322
									Approve	259
				Redlined Doc	Draft P802.11ay_D4.0 redline compared to D3.0.pdf				Disapprove	6
				Resolution Doc	11-19-0297-08-00ay-comments-on-11ay-d3-0.xlsx				Abstain	25
									Return%	90
				Comment	Template				Approve%	98
				Pool	LB# 242 Voters					
241	TGba	Recirculation TGba Draft 3.00	LB# 241	Draft	Draft P802.11ba D3.0.pdf	2019-06-03	2019-06-18	15	Pool	329
									Approve	214
				Redlined Doc	Draft P802.11ba_D3.0_Redline_Compared_to_D2.1.pdf				Disapprove	40
				Resolution Doc	11-19-0312-12-00ba-comments-on-tgba-d2-0.xlsx				Abstain	26
									Return%	85
				Comment	Template				Approve%	84
				Pool	LB# 241 Voters					
240	TGaz	Technical TGaz Draft 1.00	LB# 240	Draft	Draft P802.11az_D1.0.pdf	2019-02-05	2019-03-09	32	Pool	329
									Approve	186
				Redlined Doc	P802.11az_D1.0_Redline compared to D0.6.pdf				Disapprove	49
				Resolution Doc	N/A				Abstain	29
									Return%	80
				Comment	Template				Approve%	79
				Pool	LB# 240 Voters					
239	TGay	Recirculation TGay Draft 3.00	LB# 239	Draft	Draft P802.11ay_D3.0.pdf	2019-02-04	2019-02-28	24	Pool	322
									Approve	243
				Redlined Doc	Draft P802.11ay_D3.0 redline compared to D2.0.pdf				Disapprove	18
				Resolution Doc	11-18-1483-07-00ay-comment-database-on-d2-0.xlsx				Abstain	30
									Return%	90
				Comment	Template				Approve%	93
				Pool	LB# 239 Voters					
238	TGax	Recirculation TGax Draft 4.00	LB# 238	Draft	Draft P802.11ax_D4.0.pdf	2019-02-01	2019-02-25	24	Pool	303
									Approve	260
				Redlined Doc	Draft P802.11ax_D4.0 Redline Compared to D3.0.pdf				Disapprove	22
				Resolution Doc	11-18-1123-24-00ax-comments-on-tgax-d3-0.xlsx				Abstain	3
									Return%	94
				Comment	Template				Approve%	92
				Pool	LB# 238 Voters					
237	TGba	Technical TGba Draft 2.00	LB# 237	Draft	Draft P802.11ba D2.0.pdf	2019-01-30	2019-03-03	32	Pool	329
									Approve	202
				Redlined Doc	Draft P802.11ba_D2.0_Redline_Compared_to_D1.0.pdf				Disapprove	43
				Resolution Doc	11-18-1794-11-00ba-comments-on-tgba-d1-0.xlsx				Abstain	26
									Return%	82
				Comment	Template				Approve%	82
				Pool	LB# 237 Voters					
236	TGmd	Recirculation TGmd Draft 2.00	LB# 236	Draft	Draft P802.11REVmd_D2.0.pdf	2018-12-11	2019-01-10	30	Pool	254
									Approve	199
				Redlined Doc	Draft P802.11REVmd_D2.0 Redline Compared to D1.0.pdf				Disapprove	16
				Resolution Doc	11-18-0611-29-000m-revmd-wg-ballot-comments.xls				Abstain	7

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
									Return%	87
				Comment	Template				Approve%	93
				Pool	LB# 236 Voters					
235	TGba	Technical TGba Draft 1.00	LB# 235	Draft	Draft P802.11ba D1.0.pdf	2018-09-24	2018-10-24	30	Pool	319
									Approve	159
				Redlined Doc	Draft P802.11ba_D1.0_Redline_Compared_to_D0.4.pdf				Disapprove	62
				Resolution Doc	N/A				Abstain	23
									Return%	76
				Comment	Template				Approve%	72
				Pool	LB# 235 Voters					
234	TGay	Technical TGay Draft 2.00	LB# 234	Draft	Draft P802.11ay_D2.0.pdf	2018-08-01	2018-08-31	30	Pool	322
									Approve	219
				Redlined Doc	Draft P802.11ay_D2.0 redline compared to D1.0.pdf				Disapprove	17
				Resolution Doc	11-18-0067-11-00ay-11ay-d1-0-comment-database.xlsx				Abstain	29
									Return%	82
				Comment	Template				Approve%	93
				Pool	LB# 234 Voters					
233	TGax	Technical TGax Draft 3.00	LB# 233	Draft	Draft P802.11ax_D3.0.pdf	2018-06-01	2018-07-01	30	Pool	303
									Approve	212
				Redlined Doc	Draft P802.11ax_D3.0 Redline Compared to D2.0.pdf				Disapprove	33
				Resolution Doc	11-17-1682-13-00ax-comments-on-tgax-d2-0.xlsx				Abstain	4
									Return%	82
				Comment	Template				Approve%	87
				Pool	LB# 233 Voters					
232	TGmd	Technical TGmd Draft 1.00	LB# 232	Draft	Draft P802.11REVmd_D1.0.pdf	2018-02-05	2018-03-17	40	Pool	254
									Approve	166
				Redlined Doc	Draft P802.11REVmd_D1.0 Redline Compared to D0.1.pdf				Disapprove	29
				Resolution Doc	11-17-0914-13-000m-revmd-wg-cc-comments.xls				Abstain	11
									Return%	81
				Comment	Template				Approve%	85
				Pool	LB# 232 Voters					
231	TGay	Technical TGay Draft 1.00	LB# 231	Draft	Draft P802.11ay_D1.0.pdf	2017-11-24	2018-01-07	44	Pool	288
									Approve	147
				Redlined Doc	Draft P802.11ay_D1.0 Redline Compared to D0.8.pdf				Disapprove	51
				Resolution Doc	N/A				Abstain	31
									Return%	80
				Comment	Template				Approve%	74
				Pool	LB# 231 Voters					
230	TGax	Technical TGax Draft 2.00	LB# 230	Draft	Draft P802.11ax_D2.0.pdf	2017-10-05	2017-11-04	30	Pool	329
									Approve	137
				Redlined Doc	Draft P802.11ax_D2.0 Redline Compared to D1.0.pdf				Disapprove	81
				Resolution Doc	11-17-0010-14-00ax-comments-on-tgax-d1-0.xlsx				Abstain	8
									Return%	69
				Comment	Template				Approve%	63
				Pool	LB# 230 Voters					
229	TGak	Recirculation TGak Draft 4.00	LB# 229	Draft	Draft P802.11ak_D4.0.pdf	2017-03-15	2017-03-30	15	Pool	359
									Approve	202
				Redlined Doc	Draft P802.11ak_D4.0 Redline.pdf				Disapprove	10
				Resolution Doc	11-17-0025-09-00ak-11ak-wg-lb-comments.xlsx				Abstain	41
									Return%	70
				Comment	Template				Approve%	95
				Pool	LB# 229 Voters					
228	TGaj	Recirculation TGaj Draft 5.00	LB# 228	Draft	Draft P802.11aj_D5.0.pdf	2017-02-17	2017-03-04	15	Pool	377
									Approve	247
				Redlined Doc	Draft P802.11aj_D5.0 Redline.pdf				Disapprove	14
				Resolution Doc	11-16-1639-02-00aj-lb226-comments-database.xlsx				Abstain	51
									Return%	83
				Comment	Template				Approve%	95
				Pool	LB# 228 Voters					
227	TGak	Recirculation TGak Draft 3.00	LB# 227	Draft	Draft P802.11ak_D3.0.pdf	2016-12-21	2017-01-10	20	Pool	359
									Approve	198
				Redlined Doc	Draft P802.11ak_D3.0 Redline.pdf				Disapprove	12
				Resolution Doc	11-15-0556-34-00ak-lb212-working-group-ballot-comments.xlsx				Abstain	43
									Return%	70
				Comment	Template				Approve%	94
				Pool	LB# 227 Voters					
226	TGaj	Recirculation TGaj Draft 4.00	LB# 226	Draft	Draft P802.11aj_D4.0.pdf	2016-12-06	2016-12-21	15	Pool	377
									Approve	234
				Redlined Doc	Draft P802.11aj_D4.0 Redline.pdf				Disapprove	21
				Resolution Doc	11-16-1129-02-00aj-lb223-comments-database.xlsx				Abstain	55
									Return%	82
				Comment	Template				Approve%	92
				Pool	LB# 226 Voters					
225	TGax	Technical TGax Draft 1.00	LB# 225	Draft	Draft P802.11ax_D1.0.pdf	2016-12-01	2017-01-08	38	Pool	371
									Approve	145
				Redlined Doc	Draft P80211ax_D1.0 Redline Compared to D0.5.pdf				Disapprove	106
				Resolution Doc	N/A				Abstain	25

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
									Return%	74
				Comment	Template				Approve%	58
				Pool	LB# 225 Voters					
224	TGaq	Recirculation TGaq Draft 7.00	LB# 224	Draft	Draft P802.11aq_D7.0.pdf	2016-09-10	2016-09-25	15	Pool	357
									Approve	226
				Redlined Doc	Draft P802.11aq_D7.0 Redline.pdf				Disapprove	7
				Resolution Doc	11-16-1108-03-00aq-lb222-wg-comments-for-11aq-draft-6-0.xlsx				Abstain	47
									Return%	78
				Comment	Template				Approve%	97
				Pool	LB# 224 Voters					
223	TGaj	Recirculation TGaj Draft 3.00	LB# 223	Draft	Draft P802.11aj_D3.0.pdf	2016-08-15	2016-08-30	15	Pool	377
									Approve	221
				Redlined Doc	Draft P802.11aj_D3.0 Redline.pdf				Disapprove	27
				Resolution Doc	11-16-0811-02-00aj-lb220-comments-database.xlsx				Abstain	57
									Return%	81
				Comment	Template				Approve%	89
				Pool	LB# 223 Voters					
222	TGaq	Recirculation TGaq Draft 6.00	LB# 222	Draft	Draft P802.11aq_D6.0.pdf	2016-08-04	2016-08-19	15	Pool	357
									Approve	223
				Redlined Doc	Draft P802.11aq_D6.0 Redline.pdf				Disapprove	10
				Resolution Doc	11-16-0982-04-00aq-lb221-wg-comments-for-11aq-draft-5-0.xlsx				Abstain	47
									Return%	78
				Comment	Template				Approve%	96
				Pool	LB# 222 Voters					
221	TGaq	Recirculation TGaq Draft 5.00	LB# 221	Draft	Draft P802.11aq_D5.0.pdf	2016-07-04	2016-07-19	15	Pool	357
									Approve	218
				Redlined Doc	Draft P802.11aq_D5.0 Redline.pdf				Disapprove	16
				Resolution Doc	11-16-0553-04-00aq-lb219-wg-comments-for-11aq-draft-4-0.xlsx				Abstain	46
									Return%	78
				Comment	Template				Approve%	93
				Pool	LB# 221 Voters					
220	TGaj	Recirculation TGaj Draft 2.00	LB# 220	Draft	Draft P802.11aj_D2.0.pdf	2016-06-15	2016-06-30	15	Pool	377
									Approve	218
				Redlined Doc	Draft P802.11aj_D2.0 Redline.pdf				Disapprove	28
				Resolution Doc	11-16-0193-04-00aj-lb217-comments-database.xlsx				Abstain	53
									Return%	79
				Comment	Template				Approve%	89
				Pool	LB# 220 Voters					
219	TGaq	Recirculation TGaq Draft 4.00	LB# 219	Draft	Draft P802.11aq_D4.0.pdf	2016-04-06	2016-04-21	15	Pool	357
									Approve	213
				Redlined Doc	Draft P802.11aq_D4.0 Redline.pdf				Disapprove	17
				Resolution Doc	11-15-1377-17-00aq-lb216-wg-ballot-comments-for-11aq-draft-3-0.xlsx				Abstain	45
									Return%	77
				Comment	Template				Approve%	93
				Pool	LB# 219 Voters					
218	TGak	Recirculation TGak Draft 2.00	LB# 218	Draft	Draft P802.11ak_D2.0.pdf	2016-02-24	2016-03-10	15	Pool	361
									Approve	174
				Redlined Doc	Draft P802.11ak_D2.0 Redline.pdf				Disapprove	17
				Resolution Doc	11-15-0556-19-00ak-lb212-working-group-ballot-comments.xlsx				Abstain	33
									Return%	62
				Comment	Template				Approve%	91
				Pool	LB# 218 Voters					
217	TGaj	Technical TGaj Draft 1.00	LB# 217	Draft	Draft P802.11aj_D1.0.pdf	2015-12-21	2016-01-20	30	Pool	368
									Approve	221
				Redlined Doc	N/A				Disapprove	30
				Resolution Doc	N/A				Abstain	31
									Return%	77
				Comment	Template				Approve%	88
				Pool	LB# 217 Voters					
216	TGaq	Technical TGaq Draft 3.00	LB# 216	Draft	Draft P802.11aq_D3.0.pdf	2015-10-08	2015-11-07	30	Pool	358
									Approve	202
				Redlined Doc	N/A				Disapprove	16
				Resolution Doc	N/A				Abstain	39
									Return%	72
				Comment	Template				Approve%	93
				Pool	LB# 216 Voters					
215	TGah	Recirculation TGah Draft 5.00	LB# 215	Draft	Draft P802.11ah_D5.0.pdf	2015-09-18	2015-10-03	15	Pool	330
									Approve	262
				Redlined Doc	N/A				Disapprove	6
				Resolution Doc	11-15-0525-02-00ah-tgah-lb211-comments-on-d5-0.xlsx				Abstain	15
									Return%	86
				Comment	Template				Approve%	98
				Pool	LB# 215 Voters					
214	TGai	Recirculation TGai Draft 6.00	LB# 214	Draft	Draft P802.11ai_D6.0.pdf	2015-07-16	2015-07-31	15	Pool	336
									Approve	252
				Redlined Doc	Draft P802.11ai_D6.0 Redline.pdf				Disapprove	7
				Resolution Doc	11-15-0772-08-00ai-lb213comments-for-draft-5-0.xlsx				Abstain	21

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
									Return%	83
				Comment	Template				Approve%	97
				Pool	LB# 214 Voters					
213	TGai	Recirculation TGai Draft 5.00	LB# 213	Draft	Draft P802.11ai_D5.0.pdf	2015-06-11	2015-06-26	15	Pool	336
									Approve	238
				Redlined Doc	Draft P802.11ai_D5.0 Redline.pdf				Disapprove	20
				Resolution Doc	11-15-0281-20-00ai-tbai-lb209-comments-on-draft-d4-0.xlsx				Abstain	21
									Return%	83
				Comment	Template				Approve%	92
				Pool	LB# 213 Voters					
212	TGak	Technical TGak Draft 1.00	LB# 212	Draft	Draft P802.11ak_D1.0.pdf	2015-04-06	2015-05-06	30	Pool	361
									Approve	134
				Redlined Doc	N/A				Disapprove	24
				Resolution Doc	N/A				Abstain	27
									Return%	51
				Comment	Template				Approve%	85
				Pool	LB# 212 Voters					
211	TGah	Recirculation TGah Draft 5.00	LB# 211	Draft	Draft P802.11ah_D5.0.pdf	2015-04-01	2015-04-16	15	Pool	330
									Approve	248
				Redlined Doc	Draft P802.11ah_D5.0 Redline.pdf				Disapprove	19
				Resolution Doc	11-15-0261-07-00ah-tgah-lb207-comments-on-d4-0.xlsx				Abstain	16
									Return%	86
				Comment	Template				Approve%	93
				Pool	LB# 211 Voters					
210	TGmc	Recirculation TGmc Draft 4.00	LB# 210	Draft	Draft P802.11REVmc_D4.0.pdf	2015-03-11	2015-03-26	15	Pool	325
									Approve	241
				Redlined Doc	N/A				Disapprove	10
				Resolution Doc	11-13-0233-56-0000-revmc-wg-ballot-comments.xls				Abstain	18
									Return%	83
				Comment	Template				Approve%	96
				Pool	LB# 210 Voters					
209	TGai	Recirculation TGai Draft 4.00	LB# 209	Draft	Draft P802.11ai_D4.0.pdf	2015-02-09	2015-02-24	15	Pool	336
									Approve	230
				Redlined Doc	Draft P802.11ai_D4.0 Redline.pdf				Disapprove	25
				Resolution Doc	11-14-1351-30-00ai-tgai-lb204-comments-for-draft-3-0.xlsx				Abstain	22
									Return%	82
				Comment	Template				Approve%	90
				Pool	LB# 209 Voters					
208	TGaq	Technical TGaq Draft 1.00	LB# 208	Draft	Draft P802.11aq_D1.0.pdf	2015-02-02	2015-03-04	30	Pool	363
									Approve	139
				Redlined Doc	N/A				Disapprove	52
				Resolution Doc	N/A				Abstain	42
									Return%	64
				Comment	Template				Approve%	73
				Pool	LB# 208 Voters					
207	TGah	Recirculation TGah Draft 4.00	LB# 207	Draft	Draft P802.11ah_D4.0.pdf	2015-01-30	2015-02-14	15	Pool	330
									Approve	245
				Redlined Doc	Draft P802.11ah_D4.0 Redline.pdf				Disapprove	19
				Resolution Doc	11-14-1372-09-00ah-tgah-lb205-comments-on-d3-0.xlsx				Abstain	18
									Return%	85
				Comment	Template				Approve%	93
				Pool	LB# 207 Voters					
206	TGmc	Recirculation TGmc Draft 4.00	LB# 206	Draft	Draft P802.11REVmc_D4.0.pdf	2015-01-28	2015-02-17	20	Pool	325
									Approve	237
				Redlined Doc	Draft P802.11REVmc_D4.0 Redline.pdf				Disapprove	14
				Resolution Doc	11-13-0233-51-0000-revmc-wg-ballot-comments.xls				Abstain	18
									Return%	83
				Comment	Template				Approve%	94
				Pool	LB# 206 Voters					
205	TGah	Recirculation TGah Draft 3.00	LB# 205	Draft	Draft P802.11ah_D3.0.pdf	2014-10-10	2014-10-25	15	Pool	330
									Approve	234
				Redlined Doc	Draft P802.11ah_D3.0_Redline.pdf				Disapprove	27
				Resolution Doc	11-14-0796-11-00ah-tgah-lb203-comments-on-d2-0.xlsx				Abstain	17
									Return%	84
				Comment	Template				Approve%	90
				Pool	LB# 205 Voters					
204	TGai	Recirculation TGai Draft 3.00	LB# 204	Draft	Draft P802.11ai_D3.0.pdf	2014-09-29	2014-10-14	15	Pool	336
									Approve	214
				Redlined Doc	Draft P802.11ai_D3.0 Redline.pdf				Disapprove	28
				Resolution Doc	11-14-0565-24-00ai-tgai-lb201-comments-for-draft-2-0.xlsx				Abstain	28
									Return%	80
				Comment	Template				Approve%	88
				Pool	LB# 204 Voters					
203	TGah	Technical TGah Draft 2.00	LB# 203	Draft	Draft P802.11ah_D2.0.pdf	2014-06-05	2014-07-05	30	Pool	330
									Approve	204
				Redlined Doc	N/A				Disapprove	43
				Resolution Doc	11-13-1336-16-00ah-tgah-lb200-comments-on-d1-0.xlsx				Abstain	24

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
									Return%	82
				Comment	Template				Approve%	83
				Pool	LB# 203 Voters					
202	TGmc	Recirculation TGmc Draft 3.00	LB# 202	Draft	Draft P802.11REVmc_D3.0.pdf	2014-06-03	2014-06-23	20	Pool	325
									Approve	219
				Redlined Doc	Draft P802.11REVmc_D3.0 Redline.pdf				Disapprove	24
				Resolution Doc	11-13-0233-32-0000-revmc-wg-ballot-comments.xls				Abstain	19
									Return%	81
				Comment	Template				Approve%	90
				Pool	LB# 202 Voters					
201	TGai	Technical TGai Draft 2.00	LB# 201	Draft	Draft P802.11ai_D2.0.pdf	2014-04-07	2014-05-07	30	Pool	336
									Approve	195
				Redlined Doc	Draft P802.11ai_D2.0 Redline.pdf				Disapprove	34
				Resolution Doc	11-13-1076-34-00ai-tgai-lb-198-comments-for-d1-0.xlsx				Abstain	28
									Return%	76
				Comment	Template				Approve%	85
				Pool	LB# 201 Voters					
200	TGah	Technical TGah Draft 1.00	LB# 200	Draft	Draft P802.11ah_D1.0.pdf	2013-10-05	2013-11-04	30	Pool	323
									Approve	144
				Redlined Doc	N/A				Disapprove	54
				Resolution Doc	N/A				Abstain	18
									Return%	67
				Comment	Template				Approve%	73
				Pool	LB# 200 Voters					
199	TGmc	Recirculation TGmc Draft 2.00	LB# 199	Draft	Draft P802.11REVmc_D2.0.pdf	2013-10-03	2013-10-23	20	Pool	325
									Approve	207
				Redlined Doc	Draft P802.11REVmc_D2.0 Redline.pdf				Disapprove	23
				Resolution Doc	11-13-0233-18-0000-revmc-wg-ballot-comments.xls				Abstain	22
									Return%	78
				Comment	Template				Approve%	90
				Pool	LB# 199 Voters					
198	TGai	Technical TGai Draft 1.00	LB# 198	Draft	Draft P802.11ai_D1.0.pdf	2013-08-13	2013-09-12	30	Pool	334
									Approve	147
				Redlined Doc	N/A				Disapprove	51
				Resolution Doc	N/A				Abstain	22
									Return%	66
				Comment	Template				Approve%	74
				Pool	LB# 198 Voters					
197	TGaf	Recirculation TGaf Draft 5.00	LB# 197	Draft	Draft P802.11af_D5.0.pdf	2013-07-17	2013-08-01	15	Pool	300
									Approve	228
				Redlined Doc	N/A				Disapprove	3
				Resolution Doc	11-12-1017-50-00af-tgaf-wg-lb-comment-resolutions.xlsx				Abstain	7
									Return%	79
				Comment	Template				Approve%	99
				Pool	LB# 197 Voters					
196	TGaf	Recirculation TGaf Draft 5.00	LB# 196	Draft	Draft P802.11af_D5.0.pdf	2013-05-30	2013-06-14	15	Pool	300
									Approve	215
				Redlined Doc	Draft P802.11af_D5.0 Redline.pdf				Disapprove	14
				Resolution Doc	11-12-1017-46-00af-tgaf-wg-lb-comment-resolutions.xlsx				Abstain	8
									Return%	79
				Comment	Template				Approve%	94
				Pool	LB# 196 Voters					
195	TGaf	Recirculation TGaf Draft 4.00	LB# 195	Draft	Draft P802.11af_D4.0.pdf	2013-04-02	2013-04-17	15	Pool	300
									Approve	211
				Redlined Doc	Draft P802.11af_D4.0 Redline.pdf				Disapprove	19
				Resolution Doc	11-12-1017-38-00af-tgaf-wg-lb-comment-resolutions.xlsx				Abstain	7
									Return%	79
				Comment	Template				Approve%	92
				Pool	LB# 195 Voters					
194	TGac	Recirculation TGac Draft 5.00	LB# 194	Draft	Draft P802.11ac_D5.0.pdf	2013-03-20	2013-04-04	15	Pool	300
									Approve	252
				Redlined Doc	N/A				Disapprove	10
				Resolution Doc	11-13-0199-03-00ac-lb191-comments-tgac-d5-0.xls				Abstain	10
									Return%	91
				Comment	Template				Approve%	96
				Pool	LB# 194 Voters					
193	TGmc	Technical TGmc Draft 1.00	LB# 193	Draft	Draft P802.11REVmc_D1.0.pdf	2013-01-31	2013-03-02	30	Pool	325
									Approve	197
				Redlined Doc	N/A				Disapprove	26
				Resolution Doc	N/A				Abstain	22
									Return%	75
				Comment	Template				Approve%	88
				Pool	LB# 193 Voters					
192	TGaf	Recirculation TGaf Draft 3.00	LB# 192	Draft	Draft P802.11af_D3.0.pdf	2013-01-24	2013-02-08	15	Pool	300
									Approve	194
				Redlined Doc	Draft P802.11af_D3.0 Redline.pdf				Disapprove	30
				Resolution Doc	11-12-1017-30-00af-tgaf-wg-lb-comment-resolutions.xlsx				Abstain	8

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
									Return%	77
				Comment	Template				Approve%	87
				Pool	LB# 192 Voters					
191	TGac	Recirculation TGac Draft 5.00	LB# 191	Draft	Draft P802.11ac_D5.0.pdf	2013-01-17	2013-02-01	15	Pool	300
									Approve	249
				Redlined Doc	Draft P802.11ac_D5.0 Redline.pdf				Disapprove	12
				Resolution Doc	11-12-1277-10-00ac-lb190-comments-tgac-d4-0.xls				Abstain	10
									Return%	90
				Comment	Template				Approve%	95
				Pool	LB# 191 Voters					
190	TGac	Recirculation TGac Draft 4.00	LB# 190	Draft	Draft P802.11ac_D4.0.pdf	2012-10-17	2012-11-01	15	Pool	300
									Approve	242
				Redlined Doc	Draft P802.11ac_D4.0 Redline.pdf				Disapprove	15
				Resolution Doc	11-12-0752-17-00ac-lb188-comments-tgac-d3-0.xls				Abstain	14
									Return%	90
				Comment	Template				Approve%	94
				Pool	LB# 190 Voters					
189	TGaf	Technical TGaf Draft 2.00	LB# 189	Draft	Draft P802.11af_D2.0.pdf	2012-07-20	2012-08-19	30	Pool	300
									Approve	163
				Redlined Doc	N/A				Disapprove	43
				Resolution Doc	N/A				Abstain	14
									Return%	73
				Comment	Template				Approve%	79
				Pool	LB# 189 Voters					
188	TGac	Recirculation TGac Draft 3.00	LB# 188	Draft	Draft P802.11ac_D3.0.pdf	2012-06-05	2012-06-25	20	Pool	300
									Approve	233
				Redlined Doc	Draft P802.11ac_D3.0 Redline.pdf				Disapprove	24
				Resolution Doc	11-12-0223-24-00ac-lb187-comment-tgac-d2-0.xls				Abstain	14
									Return%	90
				Comment	Template				Approve%	91
				Pool	LB# 188 Voters					
187	TGac	Technical TGac Draft 2.00	LB# 187	Draft	Draft P802.11ac_D2.0.pdf	2012-01-19	2012-02-18	30	Pool	300
									Approve	223
				Redlined Doc	N/A				Disapprove	28
				Resolution Doc	N/A				Abstain	19
									Return%	90
				Comment	Template				Approve%	89
				Pool	LB# 187 Voters					
186	TGad	Recirculation TGad Draft 5.00	LB# 186	Draft	Draft P802.11ad_D5.0.pdf	2011-11-09	2011-11-24	15	Pool	278
									Approve	197
				Redlined Doc	N/A				Disapprove	11
				Resolution Doc	11-11-1374-02-00ad-lb185-comment-database.xlsx				Abstain	21
									Return%	82
				Comment	Template				Approve%	95
				Pool	LB# 186 Voters					
185	TGad	Recirculation TGad Draft 5.00	LB# 185	Draft	Draft P802.11ad_D5.0.pdf	2011-09-21	2011-10-06	15	Pool	278
									Approve	196
				Redlined Doc	Draft P802.11ad_D5.0 Redline.pdf				Disapprove	13
				Resolution Doc	11-11-1113-05-00ad-lb183-comment-database.xlsx				Abstain	19
									Return%	82
				Comment	Template				Approve%	94
				Pool	LB# 185 Voters					
184	TGaa	Recirculation TGaa Draft 6.00	LB# 184	Draft	Draft P802.11aa_D6.0.pdf	2011-08-16	2011-08-31	15	Pool	257
									Approve	151
				Redlined Doc	N/A				Disapprove	8
				Resolution Doc	11-11-1118-01-00aa-proposed-resolutions-to-lb182-comments.xls				Abstain	38
									Return%	77
				Comment	Template				Approve%	95
				Pool	LB# 184 Voters					
183	TGad	Recirculation TGad Draft 4.00	LB# 183	Draft	Draft P802.11ad_D4.0.pdf	2011-07-25	2011-08-09	15	Pool	278
									Approve	195
				Redlined Doc	Draft P802.11ad_D4.0 Redline.pdf				Disapprove	11
				Resolution Doc	11-11-0850-06-00ad-lb177-comment-database.xlsx				Abstain	22
									Return%	82
				Comment	Template				Approve%	95
				Pool	LB# 183 Voters					
182	TGaa	Recirculation TGaa Draft 6.00	LB# 182	Draft	Draft P802.11aa_D6.0.pdf	2011-07-25	2011-08-09	15	Pool	257
									Approve	149
				Redlined Doc	Draft P802.11aa_D6.0 Redline.pdf				Disapprove	9
				Resolution Doc	11-11-0876-07-00aa-lb179-comments.xlsx				Abstain	38
									Return%	76
				Comment	Template				Approve%	94
				Pool	LB# 182 Voters					
181	TGae	Recirculation TGae Draft 5.00	LB# 181	Draft	Draft P802.11ae_D5.0.pdf	2011-07-20	2011-08-04	15	Pool	278
									Approve	182
				Redlined Doc	Draft P802.11ae_D5.0 Redline.pdf				Disapprove	7
				Resolution Doc	11-11-0888-08-00ae-lb-180-comment-resolutions.xls				Abstain	35

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
									Return%	81
				Comment	Template				Approve%	96
				Pool	LB# 181 Voters					
180	TGae	Recirculation TGae Draft 4.00	LB# 180	Draft	Draft P802.11ae_D4.0.pdf	2011-06-03	2011-06-18	15	Pool	278
									Approve	180
				Redlined Doc	Draft P802.11ae_D4.0 Redline.pdf				Disapprove	8
				Resolution Doc	11-11-0598-07-00ae-tgae-lb-176-comment-resolutions.xls				Abstain	35
									Return%	80
				Comment	Template				Approve%	96
				Pool	LB# 180 Voters					
179	TGaa	Recirculation TGaa Draft 5.00	LB# 179	Draft	Draft P802.11aa_D5.0.pdf	2011-06-02	2011-06-17	15	Pool	257
									Approve	142
				Redlined Doc	Draft P802.11aa_D5.0 Redline.pdf				Disapprove	15
				Resolution Doc	11-11-0523-08-00aa-lb175-comments.xls				Abstain	39
									Return%	76
				Comment	Template				Approve%	90
				Pool	LB# 179 Voters					
178	TGac	Technical TGac Draft 1.00	LB# 178	Draft	Draft P802.11ac_D1.0.pdf	2011-05-26	2011-06-25	30	Pool	315
									Approve	148
				Redlined Doc	N/A				Disapprove	52
				Resolution Doc	N/A				Abstain	16
									Return%	69
				Comment	Template				Approve%	74
				Pool	LB# 178 Voters					
177	TGad	Recirculation TGad Draft 3.00	LB# 177	Draft	Draft P802.11ad_D3.0.pdf	2011-05-17	2011-06-01	15	Pool	278
									Approve	188
				Redlined Doc	Draft P802.11ad_D3.0 Redline.pdf				Disapprove	16
				Resolution Doc	11-11-0508-07-00ad-lb174-comment-database.xlsx				Abstain	24
									Return%	82
				Comment	Template				Approve%	92
				Pool	LB# 177 Voters					
176	TGae	Recirculation TGae Draft 3.00	LB# 176	Draft	Draft P802.11ae_D3.0.pdf	2011-04-11	2011-04-26	15	Pool	278
									Approve	163
				Redlined Doc	Draft P802.11ae_D3.0 Redline.pdf				Disapprove	21
				Resolution Doc	11-11-0255-03-00ae-tgae-lb-172-comment-resolutions.xls				Abstain	37
									Return%	79
				Comment	Template				Approve%	89
				Pool	LB# 176 Voters					
175	TGaa	Recirculation TGaa Draft 4.00	LB# 175	Draft	Draft P802.11aa_D4.0.pdf	2011-03-25	2011-04-09	15	Pool	257
									Approve	135
				Redlined Doc	Draft P802.11aa_D4.0 Redline.pdf				Disapprove	23
				Resolution Doc	11-11-0267-03-00aa-lb173-comments.xls				Abstain	37
									Return%	76
				Comment	Template				Approve%	85
				Pool	LB# 175 Voters					
174	TGad	Recirculation TGad Draft 2.00	LB# 174	Draft	Draft P802.11ad_D2.0.pdf	2011-03-21	2011-04-05	15	Pool	278
									Approve	175
				Redlined Doc	Draft P802.11ad_D2.0 Redline.pdf				Disapprove	25
				Resolution Doc	11-10-1220-21-00ad-lb168-comment-database.xlsx				Abstain	25
									Return%	81
				Comment	Template				Approve%	88
				Pool	LB# 174 Voters					
173	TGaa	Recirculation TGaa Draft 3.00	LB# 173	Draft	Draft P802.11aa_D3.0.pdf	2011-02-09	2011-02-24	15	Pool	257
									Approve	127
				Redlined Doc	Draft P802.11aa_D3.0 Redline.pdf				Disapprove	30
				Resolution Doc	11-10-1441-10-00aa-lb170-comments.xls				Abstain	37
									Return%	75
				Comment	Template				Approve%	81
				Pool	LB# 173 Voters					
172	TGae	Recirculation TGae Draft 2.00	LB# 172	Draft	Draft P802.11ae_D2.0.pdf	2011-02-03	2011-02-18	15	Pool	278
									Approve	155
				Redlined Doc	Draft P802.11ae_D2.0 Redline.pdf				Disapprove	26
				Resolution Doc	11-10-1221-24-00ae-tgae-lb169-comment-resolutions.xls				Abstain	38
									Return%	79
				Comment	Template				Approve%	86
				Pool	LB# 172 Voters					
171	TGaf	Technical TGaf Draft 1.00	LB# 171	Draft	Draft P802.11af_D1.0.pdf	2011-01-25	2011-02-24	30	Pool	300
									Approve	125
				Redlined Doc	N/A				Disapprove	76
				Resolution Doc	N/A				Abstain	35
									Return%	79
				Comment	Template				Approve%	62
				Pool	LB# 171 Voters					
170	TGaa	Recirculation TGaa Draft 2.00	LB# 170	Draft	Draft P802.11aa_D2.0.pdf	2010-11-23	2010-12-08	15	Pool	257
									Approve	117
				Redlined Doc	Draft P802.11aa_D2.0 Redline.pdf				Disapprove	32
				Resolution Doc	11-10-1395-02-00aa-lb164-consolidated-comments-editorial-notes.xls				Abstain	36

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
									Return%	72
				Comment	Template				Approve%	79
				Pool	LB# 170 Voters					
169	TGae	Technical TGae Draft 1.00	LB# 169	Draft	Draft P802.11ae_D1.0.pdf	2010-09-27	2010-10-27	30	Pool	278
									Approve	134
				Redlined Doc	N/A				Disapprove	32
				Resolution Doc	N/A				Abstain	40
									Return%	74
				Comment	Template				Approve%	81
				Pool	LB# 169 Voters					
168	TGad	Technical TGad Draft 1.00	LB# 168	Draft	Draft P802.11ad_D1.0.pdf	2010-09-24	2010-10-24	30	Pool	278
									Approve	163
				Redlined Doc	N/A				Disapprove	24
				Resolution Doc	N/A				Abstain	26
									Return%	77
				Comment	Template				Approve%	87
				Pool	LB# 168 Voters					
167	TGmb	Recirculation TGmb Draft 5.00	LB# 167	Draft	Draft P802.11REVmb_D5.0.pdf	2010-08-04	2010-08-19	15	Pool	246
									Approve	172
				Redlined Doc	Draft P802.11REVmb_D5.0 Redline.pdf				Disapprove	15
				Resolution Doc	11-09-0706-15-000m-revmb-wg-ballot-comments.xls				Abstain	25
									Return%	86
				Comment	Template				Approve%	92
				Pool	LB# 167 Voters					
166	TGs	Recirculation TGs Draft 7.00	LB# 166	Draft	Draft P802.11s_D7.0.pdf	2010-07-29	2010-08-13	15	Pool	248
									Approve	167
				Redlined Doc	Draft P802.11s_D7.0 Redline.pdf				Disapprove	9
				Resolution Doc	11-10-0725-09-000s-lb-165-comment-resolutions.xls				Abstain	34
									Return%	85
				Comment	Template				Approve%	95
				Pool	LB# 166 Voters					
165	TGs	Recirculation TGs Draft 6.00	LB# 165	Draft	Draft P802.11s_D6.0.pdf	2010-06-13	2010-06-28	15	Pool	248
									Approve	157
				Redlined Doc	Draft P802.11s_D6.0 Redline Compared to P802.11s_D5.0.pdf				Disapprove	20
				Resolution Doc	11-10-0478-09-000s-lb-161-comment-resolutions.xls				Abstain	33
									Return%	85
				Comment	Template				Approve%	89
				Pool	LB# 165 Voters					
164	TGaa	Technical TGaa Draft 1.00	LB# 164	Draft	Draft P802.11aa_D1.0.pdf	2010-06-10	2010-07-10	30	Pool	257
									Approve	112
				Redlined Doc	N/A				Disapprove	31
				Resolution Doc	N/A				Abstain	37
									Return%	70
				Comment	Template				Approve%	78
				Pool	LB# 164 Voters					
163	TGmb	Recirculation TGmb Draft 4.00	LB# 163	Draft	Draft P802.11REVmb_D4.0.pdf	2010-06-10	2010-06-25	15	Pool	246
									Approve	164
				Redlined Doc	Draft P802.11REVmb_D4.0 Redline.pdf				Disapprove	20
				Resolution Doc	11-09-0706-12-000m-revmb-wg-ballot-comments.xls				Abstain	28
									Return%	86
				Comment	Template				Approve%	89
				Pool	LB# 163 Voters					
162	TGmb	Recirculation TGmb Draft 3.00	LB# 162	Draft	Draft P802.11REVmb_D3.0.pdf	2010-03-31	2010-04-25	25	Pool	246
									Approve	167
				Redlined Doc	Draft P802.11REVmb_D3.0 Redline.pdf				Disapprove	20
				Resolution Doc	11-09-0706-10-000m-revmb-wg-ballot-comments.xls				Abstain	25
									Return%	86
				Comment	Template				Approve%	89
				Pool	LB# 162 Voters					
161	TGs	Recirculation TGs Draft 5.00	LB# 161	Draft	Draft P802.11s_D5.0.pdf	2010-03-31	2010-04-15	15	Pool	248
									Approve	159
				Redlined Doc	Draft P802.11s_D5.0 Redline Compared to P802.11s_D4.0.pdf				Disapprove	19
				Resolution Doc	11-10-0032-13-000s-lb-159-comment-resolutions.xls				Abstain	32
									Return%	85
				Comment	Template				Approve%	89
				Pool	LB# 161 Voters					
160	TGmb	Recirculation TGmb Draft 2.00	LB# 160	Draft	Draft P802.11REVmb_D2.0.pdf	2009-12-11	2010-01-08	28	Pool	246
									Approve	166
				Redlined Doc	Draft P802.11REVmb_D2.0 Redline.pdf				Disapprove	20
				Resolution Doc	11-09-0706-06-000m-revmb-wg-ballot-comments.xls				Abstain	25
									Return%	86
				Comment	Template				Approve%	89
				Pool	LB# 160 Voters					
159	TGs	Recirculation TGs Draft 4.00	LB# 159	Draft	Draft P802.11s_D4.0.pdf	2009-12-09	2010-01-08	30	Pool	248
									Approve	150
				Redlined Doc	Draft P802.11s_D4.0 Redline.pdf				Disapprove	27
				Resolution Doc	11-09-0471-24-000s-lb-147-comment-resolutions.xls				Abstain	33

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
									Return%	85
				Comment	Template				Approve%	85
				Pool	LB# 159 Voters					
158	TGp	Recirculation TGp Draft 9.00	LB# 158	Draft	Draft P802.11p_D9.0.pdf	2009-09-25	2009-10-10	15	Pool	232
									Approve	171
				Redlined Doc	Draft P802.11p_D9.0 Redline.pdf				Disapprove	12
				Resolution Doc	11-09-0927-03-000p-lb154-tgp-comment-resolution-master.xls				Abstain	29
									Return%	91
				Comment	Template				Approve%	93
				Pool	LB# 158 Voters					
157	TGz	Recirculation TGz Draft 6.00	LB# 157	Draft	Draft P802.11z_D6.0.pdf	2009-08-11	2009-08-26	15	Pool	254
									Approve	187
				Redlined Doc	Draft P802.11z_D6.0 Redline.pdf				Disapprove	8
				Resolution Doc	11-09-0739-04-000z-tgz-lb153-comment-spreadsheet.xls				Abstain	38
									Return%	92
				Comment	Template				Approve%	96
				Pool	LB# 157 Voters					
156	TGu	Recirculation TGu Draft 8.00	LB# 156	Draft	Draft P802.11u_D8.0.pdf	2009-08-03	2009-08-18	15	Pool	213
									Approve	148
				Redlined Doc	Draft P802.11u_D8.0 Redline.pdf				Disapprove	11
				Resolution Doc	11-09-0692-14-000u-lb152-comment-spreadsheet.xls				Abstain	35
									Return%	91
				Comment	Template				Approve%	93
				Pool	LB# 156 Voters					
155	TGv	Recirculation TGv Draft 7.00	LB# 155	Draft	Draft P802.11v_D7.0.pdf	2009-07-23	2009-08-07	15	Pool	254
									Approve	176
				Redlined Doc	Draft P802.11v_D7.0 Redline.pdf				Disapprove	16
				Resolution Doc	11-09-0676-07-000v-lb-150-comments.xls				Abstain	38
									Return%	91
				Comment	Template				Approve%	92
				Pool	LB# 155 Voters					
154	TGp	Recirculation TGp Draft 8.00	LB# 154	Draft	Draft P802.11p_D8.0.pdf	2009-07-21	2009-08-05	15	Pool	232
									Approve	163
				Redlined Doc	Draft P802.11p_D8.0 Redline.pdf				Disapprove	20
				Resolution Doc	11-09-0688-03-000p-LB151-TGp Comment Resolution Master2.xls				Abstain	28
									Return%	91
				Comment	Template				Approve%	89
				Pool	LB# 154 Voters					
153	TGz	Recirculation TGz Draft 5.00	LB# 153	Draft	Draft P802.11z_D5.0.pdf	2009-06-08	2009-06-23	15	Pool	254
									Approve	183
				Redlined Doc	Draft P802.11z_D5.0 Redline.pdf				Disapprove	15
				Resolution Doc	11-09-0313-03-000z-tgz-lb143-comment-spreadsheet.xls				Abstain	34
									Return%	91
				Comment	Template				Approve%	92
				Pool	LB# 153 Voters					
152	TGu	Recirculation TGu Draft 7.00	LB# 152	Draft	Draft P802.11u_D7.0.pdf	2009-06-04	2009-06-19	15	Pool	213
									Approve	142
				Redlined Doc	Draft P802.11u_D7.0 Redline.pdf				Disapprove	19
				Resolution Doc	11-09-0489-13-000u-lb148-comment-spreadsheet.xls				Abstain	33
									Return%	91
				Comment	Template				Approve%	88
				Pool	LB# 152 Voters					
151	TGp	Recirculation TGp Draft 7.00	LB# 151	Draft	Draft P802.11p_D7.0.pdf	2009-05-29	2009-06-13	15	Pool	232
									Approve	158
				Redlined Doc	Draft P802.11p_D7.0 Redline.pdf				Disapprove	27
				Resolution Doc	11-09-0432-05-000p-lb144-tgp-comment-resolution-master.xls				Abstain	26
									Return%	91
				Comment	Template				Approve%	85
				Pool	LB# 151 Voters					
150	TGv	Recirculation TGv Draft 6.00	LB# 150	Draft	Draft P802.11v_D6.0.pdf	2009-05-28	2009-06-12	15	Pool	254
									Approve	172
				Redlined Doc	Draft P802.11v_D6.0 Redline Compared to P802.11v_D5.0.pdf				Disapprove	20
				Resolution Doc	11-09-0434-04-000v-lb146.xls				Abstain	38
									Return%	91
				Comment	Template				Approve%	90
				Pool	LB# 150 Voters					
149	TGmb	Technical TGmb Draft 1.00	LB# 149	Draft	Draft P802.11REVmb_D1.0.pdf	2009-05-18	2009-06-27	40	Pool	246
									Approve	155
				Redlined Doc	N/A				Disapprove	23
				Resolution Doc	N/A				Abstain	29
									Return%	84
				Comment	Template				Approve%	87
				Pool	LB# 149 Voters					
148	TGu	Recirculation TGu Draft 6.00	LB# 148	Draft	Draft P802.11u_D6.0.pdf	2009-04-09	2009-04-24	15	Pool	213
									Approve	142
				Redlined Doc	Draft P802.11u_D6.0 Redline.pdf				Disapprove	15
				Resolution Doc	11-09-0245-10-000u-lb142-comment-spreadsheet.xls				Abstain	35

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
									Return%	90
				Comment	Template				Approve%	90
				Pool	LB# 148 Voters					
147	TGs	Technical TGs Draft 3.00	LB# 147	Draft	Draft P802.11s_D3.0.pdf	2009-04-04	2009-05-04	30	Pool	248
									Approve	132
				Redlined Doc	N/A				Disapprove	35
				Resolution Doc	N/A				Abstain	34
									Return%	81
				Comment	Template				Approve%	79
				Pool	LB# 147 Voters					
146	TGv	Recirculation TGv Draft 5.00	LB# 146	Draft	Draft P802.11v_D5.0.pdf	2009-03-20	2009-04-04	15	Pool	254
									Approve	155
				Redlined Doc	Draft P802.11v_D5.0 Redline Compared to P802.11v_D4.0.pdf				Disapprove	32
				Resolution Doc	11-08-1467-04-000v-lb140-comments.xls				Abstain	41
									Return%	90
				Comment	Template				Approve%	83
				Pool	LB# 146 Voters					
145	TGs	Procedural TGs Draft 3.00	LB# 145	Draft	Draft P802.11s_D3.0.pdf	2009-03-19	2009-04-03	15	Pool	247
									Approve	166
				Redlined Doc	N/A				Disapprove	6
				Resolution Doc	N/A				Abstain	24
									Return%	79
				Comment	Template				Approve%	97
				Pool	LB# 145 Voters					
144	TGp	Recirculation TGp Draft 6.00	LB# 144	Draft	Draft P802.11p_D6.0.pdf	2009-03-16	2009-03-31	15	Pool	232
									Approve	161
				Redlined Doc	Draft P802.11p_6.0 Redline.pdf				Disapprove	20
				Resolution Doc	11-08-1452-06-000p-lb141-tgp-comment-resolution-master.xls				Abstain	29
									Return%	91
				Comment	Template				Approve%	89
				Pool	LB# 144 Voters					
143	TGz	Recirculation TGz Draft 4.00	LB# 143	Draft	Draft P802.11z_D4.0.pdf	2009-02-18	2009-03-05	15	Pool	254
									Approve	170
				Redlined Doc	Draft P802.11z_D4.0 Redline.pdf				Disapprove	23
				Resolution Doc	11-09-0097-02-000z-lb139-comment-resolution.xls				Abstain	37
									Return%	91
				Comment	Template				Approve%	88
				Pool	LB# 143 Voters					
142	TGu	Recirculation TGu Draft 5.00	LB# 142	Draft	Draft P802.11u_D5.0.pdf	2009-02-05	2009-02-20	15	Pool	213
									Approve	125
				Redlined Doc	Draft P802.11u_D5.0 Redline.pdf				Disapprove	27
				Resolution Doc	11-08-1225-25-000u-lb137-comment-spreadsheet.xls				Abstain	39
									Return%	90
				Comment	Template				Approve%	82
				Pool	LB# 142 Voters					
141	TGp	Recirculation TGp Draft 5.00	LB# 141	Draft	Draft P802.11p_D5.0.pdf	2008-11-20	2008-12-05	15	Pool	232
									Approve	149
				Redlined Doc	Draft P802.11p_D5.0 Redline Compared to P802.11p_D4.0.pdf				Disapprove	26
				Resolution Doc	11-08-0514-06-000p-lb125-tgp-comment-resolution-master.xls				Abstain	35
									Return%	91
				Comment	Template				Approve%	85
				Pool	LB# 141 Voters					
140	TGv	Technical TGv Draft 4.00	LB# 140	Draft	Draft P802.11v_D4.0.pdf	2008-11-19	2008-12-19	30	Pool	254
									Approve	149
				Redlined Doc	Draft P802.11v_D4.0 Redline.pdf				Disapprove	36
				Resolution Doc	11-08-0801-05-000v-lb133-comments.xls				Abstain	40
									Return%	89
				Comment	Template				Approve%	81
				Pool	LB# 140 Voters					
139	TGz	Technical TGz Draft 3.00	LB# 139	Draft	Draft P802.11z_D3.0.pdf	2008-11-18	2008-12-18	30	Pool	254
									Approve	155
				Redlined Doc	N/A				Disapprove	29
				Resolution Doc	N/A				Abstain	41
									Return%	89
				Comment	Template				Approve%	84
				Pool	LB# 139 Voters					
138	TGn	Recirculation TGn Draft 7.00	LB# 138	Draft	Draft P802.11n_D7.0.pdf	2008-11-17	2008-12-02	15	Pool	325
									Approve	281
				Redlined Doc	N/A				Disapprove	14
				Resolution Doc	11-08-1417-00-000n-p802-11n-wg-ballot-unsatisfied-comments.xls				Abstain	20
									Return%	97
				Comment	Template				Approve%	95
				Pool	LB# 138 Voters					
137	TGu	Recirculation TGu Draft 4.00	LB# 137	Draft	Draft P802.11u_D4.0.pdf	2008-09-23	2008-10-08	15	Pool	213
									Approve	118
				Redlined Doc	Draft P802.11u_D4.0 Redline.pdf				Disapprove	34
				Resolution Doc	11-08-0722-27-000u-lb-132-comment-spreadsheet.xls				Abstain	37

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
									Return%	89
				Comment	Template				Approve%	78
				Pool	LB# 137 Voters					
136	TGn	Recirculation TGn Draft 7.00	LB# 136	Draft	Draft P802.11n_D7.0.pdf	2008-09-15	2008-09-30	15	Pool	325
									Approve	276
				Redlined Doc	Draft P802.11n_D7.0 Redline.pdf				Disapprove	17
				Resolution Doc	11-08-0958-02-000n-tgn-lb134-composite-comments.xls				Abstain	21
									Return%	97
				Comment	Template				Approve%	94
				Pool	LB# 136 Voters					
135	TGz	Technical TGz Draft 2.00	LB# 135	Draft	Draft P802.11z_D2.0.pdf	2008-07-21	2008-08-20	30	Pool	242
									Approve	99
				Redlined Doc	N/A				Disapprove	51
				Resolution Doc	N/A				Abstain	48
									Return%	82
				Comment	Template				Approve%	66
				Pool	LB# 135 Voters					
134	TGn	Recirculation TGn Draft 6.00	LB# 134	Draft	Draft P802.11n_D6.0.pdf	2008-07-21	2008-08-05	15	Pool	325
									Approve	266
				Redlined Doc	Draft P802.11n_D6.0 Redline.pdf				Disapprove	27
				Resolution Doc	11-08-0713-02-000n-tgn-lb129-composite-comments.xls				Abstain	21
									Return%	97
				Comment	Template				Approve%	91
				Pool	LB# 134 Voters					
133	TGv	Technical TGv Draft 3.00	LB# 133	Draft	Draft P802.11v_D3.0.pdf	2008-06-13	2008-07-13	30	Pool	213
									Approve	106
				Redlined Doc	Draft P802.11v_D3.0 Redline.pdf				Disapprove	47
				Resolution Doc	11-08-0265-04-000v-lb123-comments.xls				Abstain	28
									Return%	85
				Comment	Template				Approve%	69
				Pool	LB# 133 Voters					
132	TGu	Technical TGu Draft 3.00	LB# 132	Draft	Draft P802.11u_D3.0.pdf	2008-06-12	2008-07-12	30	Pool	213
									Approve	113
				Redlined Doc	Draft P802.11u_D3.0 Redline.pdf				Disapprove	34
				Resolution Doc	N/A				Abstain	35
									Return%	85
				Comment	Template				Approve%	77
				Pool	LB# 132 Voters					
131	TGv	Procedural TGv Draft 2.02	LB# 131	Draft	Draft P802.11v_D2.02.pdf	2008-05-28	2008-06-12	15	Pool	213
									Approve	175
				Redlined Doc	Draft P802.11v_D2.02 Redline.pdf				Disapprove	14
				Resolution Doc	11-08-0265-04-000v-lb123-comments.xls				Abstain	18
									Return%	97
				Comment	Template				Approve%	93
				Pool	LB# 131 Voters					
130	TGu	Procedural TGu Draft 3.00	LB# 130	Draft	Draft P802.11u_D3.0.pdf	2008-05-27	2008-06-11	15	Pool	212
									Approve	159
				Redlined Doc	Draft P802.11u_D3.0 Redline.pdf				Disapprove	8
				Resolution Doc	N/A				Abstain	19
									Return%	88
				Comment	Template				Approve%	95
				Pool	LB# 130 Voters					
129	TGn	Recirculation TGn Draft 5.00	LB# 129	Draft	Draft P802.11n_D5.0.pdf	2008-05-23	2008-06-12	20	Pool	325
									Approve	261
				Redlined Doc	Draft P802.11n_D5.0 Redline.pdf				Disapprove	29
				Resolution Doc	11-08-0460-02-000n-tgn-lb124-composite-comments.xls				Abstain	23
									Return%	96
				Comment	Template				Approve%	90
				Pool	LB# 129 Voters					
128	TGw	Recirculation TGw Draft 6.00	LB# 128	Draft	Draft P802.11w_D6.0.pdf	2008-04-03	2008-04-18	15	Pool	427
									Approve	266
				Redlined Doc	11-08-0448-00-000w-Redlined Draft P802.11w_D6.0 Compared To Draft P802.11w_5.0.pdf				Disapprove	8
				Resolution Doc	11-08-0261-05-000w-lb121-comment-resolution.xls				Abstain	54
									Return%	77
				Comment	Template				Approve%	97
				Pool	LB# 128 Voters					
127	TGz	Technical TGz Draft 1.00	LB# 127	Draft	Draft P802.11z_D1.0.pdf	2008-04-03	2008-05-03	30	Pool	233
									Approve	103
				Redlined Doc	N/A				Disapprove	59
				Resolution Doc	N/A				Abstain	47
									Return%	90
				Comment	Template				Approve%	64
				Pool	LB# 127 Voters					
126	TGs	Technical TGs Draft 2.00	LB# 126	Draft	Draft P802.11s_D2.0.pdf	2008-04-03	2008-05-03	30	Pool	233
									Approve	103
				Redlined Doc	N/A				Disapprove	67
				Resolution	N/A				Abstain	36

COMPLETED BALLOTS, from LB101 onwards

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LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
				Doc					Return%	88
				Comment	Template				Approve%	61
				Pool	LB# 126 Voters					
125	TGp	Technical TGp Draft 4.00	LB# 125	Draft	Draft P802.11p D4.0.pdf	2008-04-03	2008-05-03	30	Pool	233
									Approve	136
				Redlined Doc	index.html				Disapprove	37
				Resolution Doc	index.html				Abstain	32
									Return%	88
				Comment	Template				Approve%	79
				Pool	LB# 125 Voters					
124	TGn	Recirculation TGn Draft 4.00	LB# 124	Draft	index.html	2008-03-28	2008-04-12	15	Pool	325
									Approve	253
				Redlined Doc	index.html				Disapprove	34
				Resolution Doc	11-07-2783-08-000n-tgn-lb115-editor-comments.xls				Abstain	25
									Return%	96
				Comment	Template				Approve%	88
				Pool	LB# 124 Voters					
123	TGv	Technical TGv Draft 2.00	LB# 123	Draft	Draft P802.11v_D2.0.pdf	2008-02-14	2008-03-15	30	Pool	261
									Approve	126
				Redlined Doc	index.html				Disapprove	62
				Resolution Doc	index.html				Abstain	34
									Return%	85
				Comment	Template				Approve%	67
				Pool	LB# 123 Voters					
122	TGu	Technical TGu Draft 2.00	LB# 122	Draft	Draft P802.11u_D2.0.pdf	2008-02-14	2008-03-15	30	Pool	261
									Approve	125
				Redlined Doc	index.html				Disapprove	53
				Resolution Doc	index.html				Abstain	37
									Return%	82
				Comment	Template				Approve%	70
				Pool	LB# 122 Voters					
121	TGw	Recirculation TGw Draft 5.00	LB# 121	Draft	P802.11w_D5.0.pdf	2008-02-05	2008-02-20	15	Pool	427
									Approve	259
				Redlined Doc	index.html				Disapprove	14
				Resolution Doc	index.html				Abstain	55
									Return%	77
				Comment	Template				Approve%	95
				Pool	LB# 121 Voters					
120	TGv	Procedural TGv Draft 1.04	LB# 120	Draft	Draft P802.11v_D1.04.pdf	2008-01-29	2008-02-13	15	Pool	297
									Approve	213
				Redlined Doc	index.html				Disapprove	13
				Resolution Doc	index.html				Abstain	27
									Return%	85
				Comment	Template				Approve%	94
				Pool	LB# 120 Voters					
119	TGu	Procedural TGu Draft 2.00	LB# 119	Draft	Draft P802.11u_D2.0.pdf	2008-01-27	2008-02-11	15	Pool	297
									Approve	203
				Redlined Doc	index.html				Disapprove	16
				Resolution Doc	index.html				Abstain	33
									Return%	85
				Comment	Template				Approve%	93
				Pool	LB# 119 Voters					
118	TGk	Technical TGk	LB# 118	Draft	11-07-2959-02-000k-11k-sponsor-ballot-recirc-2-comment-resolutions(1).xls	2007-12-13	2008-01-05	23	Pool	299
									Approve	175
				Redlined Doc	N/A				Disapprove	0
				Resolution Doc	N/A				Abstain	20
									Return%	65
				Comment	Template				Approve%	100
				Pool	LB# 118 Voters					
117	TGw	Recirculation TGw Draft 4.00	LB# 117	Draft	Draft P802.11w_D4.0.pdf	2007-12-12	2008-01-05	24	Pool	427
									Approve	245
				Redlined Doc	11-07-2943-00-000w-Redlined document D4.0-vs-3.0.pdf				Disapprove	21
				Resolution Doc	11-07-2697-07-000w-lb114-comment-resolutions.xls				Abstain	60
									Return%	76
				Comment	Template				Approve%	92
				Pool	LB# 117 Voters					
116	TGy	Recirculation TGy Draft 6.00	LB# 116	Draft	Draft P802.11y_D6.0.pdf	2007-11-23	2007-12-08	15	Pool	347
									Approve	271
				Redlined Doc	11-07-2902-00-000y Redlined Draft P802.11y_D6.0 Compared To Draft P802.11y_D5.0.pdf				Disapprove	2
				Resolution Doc	11-07-2623-05-000y-d5-comments.xls				Abstain	54
									Return%	94
				Comment	Template				Approve%	99
				Pool	LB# 116 Voters					
115	TGn	Recirculation TGn Draft 3.00	LB# 115	Draft	Draft P802.11n_D3.0.pdf	2007-10-07	2007-10-27	20	Pool	325
									Approve	240
				Redlined Doc	index.html				Disapprove	43
				Resolution	index.html				Abstain	27

COMPLETED BALLOTS, from LB101 onwards

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LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
				Doc					Return%	95
				Comment	Template				Approve%	85
				Pool	LB# 115 Voters					
114	TGw	Recirculation TGw Draft 3.00	LB# 114	Draft	Draft P802.11w_D3.0.pdf	2007-10-04	2007-10-19	15	Pool	427
									Approve	245
				Redlined Doc	11-07-2562-00-000w-D3.0-v-2.0-redline.pdf				Disapprove	21
				Resolution Doc	11-07-0714-13-000w-lb-102-comment-resolution-spreadsheet.xls				Abstain	59
									Return%	76
				Comment	Template				Approve%	92
				Pool	LB# 114 Voters					
112	TGy	Recirculation TGy Draft 5.00	LB# 112	Draft	Draft P802.11y_D5.0.pdf	2007-09-28	2007-10-13	15	Pool	347
									Approve	257
				Redlined Doc	11-07-2607-00-000y-tgy-redline-between-Draft-5.0-and-4.0.pdf				Disapprove	11
				Resolution Doc	11-07-2333-07-000y-d4-comments.xls				Abstain	59
									Return%	94
				Comment	Template				Approve%	96
				Pool	LB# 112 Voters					
111	TGk	Technical TGk	LB# 111	Draft	11-07-2289-05-000k-tgk-sponsor-ballot-comment-resolutions.xls	2007-08-27	2007-09-11	15	Pool	278
									Approve	196
				Redlined Doc	N/A				Disapprove	22
				Resolution Doc	N/A				Abstain	35
									Return%	91
				Comment	Template				Approve%	90
				Pool	LB# 111 Voters					
110	TGp	Technical TGp Draft 3.00	LB# 110	Draft	Draft P802.11p_D3.0.pdf	2007-08-13	2007-09-12	30	Pool	278
									Approve	143
				Redlined Doc	N/A				Disapprove	50
				Resolution Doc	N/A				Abstain	58
									Return%	90
				Comment	Template				Approve%	74
				Pool	LB# 110 Voters					
109	TGy	Recirculation TGy Draft 4.00	LB# 109	Draft	Draft P802.11y_D4.0.pdf	2007-08-06	2007-08-21	15	Pool	347
									Approve	250
				Redlined Doc	11-07-2268-00-000y-tgy-redline-between Draft 4.0 and 3.0.pdf				Disapprove	17
				Resolution Doc	11-07-2019-06-000y-d3-comments.xls				Abstain	60
									Return%	94
				Comment	Template				Approve%	94
				Pool	LB# 109 Voters					
108	TGv	Technical TGv Draft 1.00	LB# 108	Draft	Draft P802.11v_D1.0.pdf	2007-07-31	2007-08-30	30	Pool	278
									Approve	132
				Redlined Doc	N/A				Disapprove	77
				Resolution Doc	N/A				Abstain	38
									Return%	89
				Comment	Template				Approve%	63
				Pool	LB# 108 Voters					
107	TGu	Technical TGu Draft 1.00	LB# 107	Draft	Draft P802.11u_D1.0.pdf	2007-06-08	2007-07-08	30	Pool	299
									Approve	111
				Redlined Doc	index.html				Disapprove	62
				Resolution Doc	index.html				Abstain	48
									Return%	74
				Comment	Template				Approve%	64
				Pool	LB# 107 Voters					
106	TGy	Recirculation TGy Draft 3.00	LB# 106	Draft	Draft P802.11y_D3.0.pdf	2007-06-05	2007-06-20	15	Pool	347
									Approve	242
				Redlined Doc	index.html				Disapprove	24
				Resolution Doc	index.html				Abstain	60
									Return%	94
				Comment	Template				Approve%	91
				Pool	LB# 106 Voters					
105	TGr	Recirculation TGr Draft 6.00	LB# 105	Draft	Draft P802.11r_D6.0.pdf	2007-05-28	2007-06-13	16	Pool	518
									Approve	360
				Redlined Doc	index.html				Disapprove	11
				Resolution Doc	index.html				Abstain	65
									Return%	84
				Comment	Template				Approve%	97
				Pool	LB# 105 Voters					
104	TGy	Recirculation TGy Draft 2.00	LB# 104	Draft	Draft P802.11y_D2.0.pdf	2007-04-19	2007-05-05	16	Pool	347
									Approve	221
				Redlined Doc	index.html				Disapprove	41
				Resolution Doc	index.html				Abstain	62
									Return%	93
				Comment	Template				Approve%	84
				Pool	LB# 104 Voters					
103	TGk	Recirculation TGk Draft 7.00	LB# 103	Draft	Draft P802.11k_D7.0.pdf	2007-04-18	2007-05-05	17	Pool	514
									Approve	363
				Redlined Doc	index.html				Disapprove	29
				Resolution Doc	index.html				Abstain	39

COMPLETED BALLOTS, from LB101 onwards

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LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
									Return%	84
				Comment	Template				Approve%	93
				Pool	LB# 103 Voters					
102	TGw	Recirculation TGw Draft 2.00	LB# 102	Draft	Draft P802.11w_D2.0.pdf	2007-04-07	2007-05-02	25	Pool	427
									Approve	227
				Redlined Doc	index.html				Disapprove	29
				Resolution Doc	index.html				Abstain	61
									Return%	74
				Comment	Template				Approve%	89
				Pool	LB# 102 Voters					
101	TGt	Technical TGt Draft 1.00	LB# 101	Draft	Draft-P802.11.2_D1.0.pdf	2007-04-16	2007-05-16	30	Pool	307
									Approve	163
				Redlined Doc	N/A				Disapprove	52
				Resolution Doc	N/A				Abstain	57
									Return%	89
				Comment	Template				Approve%	76
				Pool	LB# 101 Voters					
99	TGt	Procedural TGt Draft 0.14	LB# 99	Draft	Draft P802.11.2_D0.14.pdf	2007-03-28	2007-04-12	15	Pool	323
									Approve	244
				Redlined Doc	N/A				Disapprove	16
				Resolution Doc	N/A				Abstain	38
									Return%	92
				Comment	Template				Approve%	94
				Pool	LB# 99 Voters					
98	TGr	Recirculation TGr Draft 5.00	LB# 98	Draft	Draft P802.11r_D5.0.pdf	2007-03-20	2007-04-04	15	Pool	518
									Approve	350
				Redlined Doc	11-07-0471-00-000r-P802-11r-D5-0-redline.pdf				Disapprove	19
				Resolution Doc	11-06-1895-18-000r-d4-comments.xls				Abstain	67
									Return%	84
				Comment	Template				Approve%	95
				Pool	LB# 98 Voters					
97	TGn	Technical TGn Draft 2.00	LB# 97	Draft	Draft-P802.11n_D2.0.pdf	2007-02-07	2007-03-09	30	Pool	325
									Approve	231
				Redlined Doc	index.html				Disapprove	46
				Resolution Doc	N/A				Abstain	28
									Return%	94
				Comment	Template				Approve%	83
				Pool	LB# 97 Voters					
96	TGk	Recirculation TGk Draft 7.00	LB# 96	Draft	Draft P802.11k_D7.0.pdf	2007-01-29	2007-02-13	15	Pool	514
									Approve	361
				Redlined Doc	11-07-0119-00-000k-D7.0-Redlined-Changes-from-D6.0.pdf				Disapprove	30
				Resolution Doc	11-06-1739-18-000k-lb-90-EDITOR-comment-resolution-worksheet.xls				Abstain	38
									Return%	83
				Comment	Template				Approve%	92
				Pool	LB# 96 Voters					
95	TGn	Procedural TGn Draft 2.00	LB# 95	Draft	Draft P802.11n_D1.10.pdf	2007-01-22	2007-02-06	15	Pool	332
									Approve	293
				Redlined Doc	N/A				Disapprove	6
				Resolution Doc	N/A				Abstain	14
									Return%	94
				Comment	Template				Approve%	98
				Pool	LB# 95 Voters					
94	TGy	Technical TGy Draft 1.00	LB# 94	Draft	Draft P802.11y_D1.0.pdf	2006-12-08	2007-01-07	30	Pool	347
									Approve	182
				Redlined Doc	N/A				Disapprove	59
				Resolution Doc	N/A				Abstain	71
									Return%	90
				Comment	Template				Approve%	76
				Pool	LB# 94 Voters					
93	TGs	Technical TGs Draft 1.00	LB# 93	Draft	Draft P802.11s_D1.0.pdf	2006-12-07	2007-01-06	30	Pool	347
									Approve	128
				Redlined Doc	N/A				Disapprove	138
				Resolution Doc	N/A				Abstain	36
									Return%	87
				Comment	Template				Approve%	48
				Pool	LB# 93 Voters					
92	TGp	Technical TGp Draft 2.00	LB# 92	Draft	Draft P802.11p_D2.0.pdf	2006-12-06	2007-01-05	30	Pool	347
									Approve	166
				Redlined Doc	11-06-1885-00-000p-Draft P802.11p_D2.0-Redline.pdf				Disapprove	83
				Resolution Doc	11-06-0553-07-000p-lb81-11p-d1-0-comment-resolutions.xls				Abstain	62
									Return%	90
				Comment	Template				Approve%	67
				Pool	LB# 92 Voters					
91	TGr	Recirculation TGr Draft 4.00	LB# 91	Draft	Draft P802.11r_D4.0.pdf	2006-11-20	2006-12-04	14	Pool	518
									Approve	335
				Redlined Doc	11-06-1850-00-000r-P802.11r-D4.0-redline.pdf				Disapprove	30
				Resolution Doc	11-06-1576-11-000r-d3-comments.xls				Abstain	70

COMPLETED BALLOTS, from LB101 onwards

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LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
									Return%	84
				Comment	Template				Approve%	92
				Pool	LB# 91 Voters					
90	TGk	Recirculation TGk Draft 6.00	LB# 90	Draft	P802.11k-D6.0.pdf	2006-11-01	2006-11-16	15	Pool	514
									Approve	354
				Redlined Doc	11-06-1583-00-000k-redlined-version-draft-d6.0.pdf				Disapprove	36
				Resolution Doc	11-06-1366-08-000k-tgk-lb86-comment-resolution-spreadsheet.xls				Abstain	39
									Return%	83
				Comment	Template				Approve%	91
				Pool	LB# 90 Voters					
89	TGk	Procedural TGk Draft 6.00	LB# 89	Draft	P802.11k-D6.0.pdf	2006-10-13	2006-10-30	17	Pool	424
									Approve	236
				Redlined Doc	11-06-1583-00-000k-redlined-version-draft-d6.0.pdf				Disapprove	14
				Resolution Doc	11-06-1366-08-000k-tgk-lb86-comment-resolution-spreadsheet.xls				Abstain	25
									Return%	65
				Comment	Template				Approve%	94
				Pool	LB# 89 Voters					
88	TGw	Technical TGw Draft 1.00	LB# 88	Draft	P802.11w-D1.0.pdf	2006-10-10	2006-11-19	40	Pool	427
									Approve	202
				Redlined Doc	N/A				Disapprove	34
				Resolution Doc	N/A				Abstain	59
									Return%	69
				Comment	Template				Approve%	86
				Pool	LB# 88 Voters					
87	TGr	Recirculation TGr Draft 3.00	LB# 87	Draft	11-06-1540-00-000r-P802-11r-D3-0-redline.pdf	2006-09-29	2006-10-14	15	Pool	518
									Approve	318
				Redlined Doc	N/A				Disapprove	50
				Resolution Doc	11-06-0537-34-000r-d2-comments.xls				Abstain	65
									Return%	84
				Comment	Template				Approve%	86
				Pool	LB# 87 Voters					
86	TGk	Recirculation TGk Draft 5.00	LB# 86	Draft	P802.11k_D5.0.pdf	2006-09-01	2006-09-16	15	Pool	514
									Approve	325
				Redlined Doc	11-06-1311-00-0000-redlined-document-11k-draft-d5.0.doc				Disapprove	59
				Resolution Doc	11-06-0891-18-000k-LB83-may-to-jun-com-merge.xls				Abstain	44
									Return%	83
				Comment	Template				Approve%	85
				Pool	LB# 86 Voters					
85	TGk	Procedural TGk Draft 5.00	LB# 85	Draft	P802.11k_D5.0.pdf	2006-08-10	2006-08-26	16	Pool	452
									Approve	246
				Redlined Doc	11-06-1311-00-0000-redlined-document-11k-draft-d5.0.pdf				Disapprove	65
				Resolution Doc	11-06-0891-18-000k-LB83-may-to-jun-com-merge.xls				Abstain	46
									Return%	79
				Comment	Template				Approve%	79
				Pool	LB# 85 Voters					
84	TGn	Technical TGn Draft 1.00	LB# 84	Draft	P802.11n-D1.0.pdf	2006-03-19	2006-04-29	41	Pool	435
									Approve	149
				Redlined Doc	N/A				Disapprove	171
				Resolution Doc	N/A				Abstain	32
									Return%	81
				Comment	Template				Approve%	47
				Pool	LB# 84 Voters					
83	TGk	Recirculation TGk Draft 4.00	LB# 83	Draft	P802.11k-D4.0-changes.doc	2006-03-16	2006-03-31	15	Pool	514
									Approve	308
				Redlined Doc	N/A				Disapprove	73
				Resolution Doc	11-05-1049-69-000k-11k-lb78-comment-resolution-spreadsheet.xls				Abstain	44
									Return%	83
				Comment	Template				Approve%	81
				Pool	LB# 83 Voters					
82	TGr	Recirculation TGr Draft 2.00	LB# 82	Draft	P802.11r-D2.0-changes.pdf	2006-03-15	2006-04-04	20	Pool	518
									Approve	316
				Redlined Doc	N/A				Disapprove	44
				Resolution Doc	11-06-1284-29-000r-lb79-11r-d1-0-comment-resolutions.xls				Abstain	69
									Return%	83
				Comment	Template				Approve%	88
				Pool	LB# 82 Voters					
81	TGp	Technical TGp Draft 1.00	LB# 81	Draft	P802.11p_D1.0.pdf	2006-03-02	2006-04-11	40	Pool	486
									Approve	167
				Redlined Doc	N/A				Disapprove	117
				Resolution Doc	N/A				Abstain	63
									Return%	71
				Comment	Template				Approve%	59
				Pool	LB# 81 Voters					
80	TGp	Procedural TGp Draft 0.26	LB# 80	Draft	P802.11p_D0.26.pdf	2006-02-03	2006-02-18	15	Pool	486
									Approve	217
				Redlined Doc	N/A				Disapprove	72
				Resolution Doc	N/A				Abstain	56

COMPLETED BALLOTS, from LB101 onwards

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LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
									Return%	71
				Comment	Template				Approve%	75
				Pool	LB# 80 Voters					
79	TGr	Technical TGr Draft 1.00	LB# 79	Draft	P802.11r-D1.0.pdf	2005-11-25	2006-01-04	40	Pool	518
									Approve	268
				Redlined Doc	N/A				Disapprove	64
				Resolution Doc	N/A				Abstain	72
									Return%	78
				Comment	Template				Approve%	81
				Pool	LB# 79 Voters					
78	TGk	Technical TGk Draft 3.00	LB# 78	Draft	P802.11k-D3.0.pdf	2005-10-03	2005-11-12	40	Pool	514
									Approve	295
				Redlined Doc	N/A				Disapprove	75
				Resolution Doc	N/A				Abstain	33
									Return%	78
				Comment	Template				Approve%	80
				Pool	LB# 78 Voters					
77	TGma	Technical TGma Draft 4.00	LB# 77	Draft	P802.11-REVma-D4.0.pdf	2005-09-09	2005-09-19	10	Pool	542
									Approve	411
				Redlined Doc	N/A				Disapprove	15
				Resolution Doc	N/A				Abstain	19
									Return%	82
				Comment	Template				Approve%	96
				Pool	LB# 77 Voters					
76	TGma	Technical TGma Draft 3.00	LB# 76	Draft	P802.11-REVma-D3.0.pdf	2005-08-08	2005-08-19	11	Pool	542
									Approve	397
				Redlined Doc	N/A				Disapprove	20
				Resolution Doc	N/A				Abstain	21
									Return%	81
				Comment	Template				Approve%	95
				Pool	LB# 76 Voters					
75	TGma	Technical TGma Draft 2.00	LB# 75	Draft	P802.11REV-ma-D2.0.pdf	2005-07-07	2005-07-17	10	Pool	542
									Approve	387
				Redlined Doc	N/A				Disapprove	26
				Resolution Doc	N/A				Abstain	19
									Return%	80
				Comment	Template				Approve%	94
				Pool	LB# 75 Voters					
74	TGma	Technical TGma Draft 1.00	LB# 74	Draft	P802.11REV-ma-D1.0.pdf	2005-03-29	2005-05-08	40	Pool	542
									Approve	348
				Redlined Doc	N/A				Disapprove	36
				Resolution Doc	N/A				Abstain	23
									Return%	75
				Comment	Template				Approve%	91
				Pool	LB# 74 Voters					
73	TGk	Technical TGk Draft 2.00	LB# 73	Draft	P802.11k-D2.0.pdf	2005-02-03	2005-03-15	40	Pool	493
									Approve	253
				Redlined Doc	N/A				Disapprove	42
				Resolution Doc	11-04-0964-37-000k-lb71-comment-spreadsheet.xls				Abstain	25
									Return%	65
				Comment	Template				Approve%	86
				Pool	LB# 73 Voters					
71	TGk	Technical TGk Draft 1.00	LB# 71	Draft	P802.11k-D1.0.pdf	2004-08-02	2004-09-11	40	Pool	412
									Approve	329
				Redlined Doc	N/A				Disapprove	18
				Resolution Doc	N/A				Abstain	27
									Return%	91
				Comment	Template				Approve%	95
				Pool	LB# 71 Voters					
68	TGj	Recirculation TGj Draft 1.40	LB# 68	Draft	P802_11j-D1.4-redlined.pdf	2004-04-05	2004-04-20	15	Pool	464
									Approve	273
				Redlined Doc	N/A				Disapprove	13
				Resolution Doc	11-04-0411-02-000j-tgj-comment-resolution-lb66.xls				Abstain	24
									Return%	67
				Comment	Template				Approve%	95
				Pool	LB# 68 Voters					
67	TGe	Recirculation TGe Draft 8.00	LB# 67	Draft	P802_11E-D8.0-redlined.pdf	2004-02-24	2004-03-10	15	Pool	321
									Approve	262
				Redlined Doc	N/A				Disapprove	16
				Resolution Doc	11-04-0181-05-000e-letter-ballot-65-comments.xls				Abstain	23
									Return%	94
				Comment	Template				Approve%	94
				Pool	LB# 67 Voters					
66	TGj	Recirculation TGj Draft 1.30	LB# 66	Draft	P802_11j-D1.3redlined.pdf	2004-02-04	2004-03-11	36	Pool	464
									Approve	258
				Redlined Doc	N/A				Disapprove	17
				Resolution Doc	11-04-0042-05-000j-tgj-comment-resolution-lb64.xls				Abstain	27

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
									Return%	65
				Comment	Template				Approve%	94
				Pool	LB# 66 Voters					
65	TGe	Recirculation TGe Draft 7.00	LB# 65	Draft	P802_11E-D7.0-redlined.pdf	2004-01-31	2004-02-15	15	Pool	321
									Approve	258
				Redlined Doc	N/A				Disapprove	19
				Resolution Doc	11-04-1001-06-000e-letter-ballot-63-comments.xls				Abstain	24
									Return%	94
				Comment	Template				Approve%	93
				Pool	LB# 65 Voters					
64	TGj	Technical TGj Draft 1.20	LB# 64	Draft	P802_11j-D1.2.doc	2003-12-05	2004-01-14	40	Pool	463
									Approve	212
				Redlined Doc	N/A				Disapprove	27
				Resolution Doc	11-03-337r6-W-TGj_Letter_Ballot_Comment_Resolution_May_2003.xls				Abstain	24
									Return%	57
				Comment	Template				Approve%	89
				Pool	LB# 64 Voters					
63	TGe	Recirculation TGe Draft 6.00	LB# 63	Draft	P802_11E-D6.0-redlined.pdf	2003-12-04	2003-12-20	16	Pool	321
									Approve	248
				Redlined Doc	N/A				Disapprove	30
				Resolution Doc	11-03-0658-17-000e-letter-ballot-59-comments.xls				Abstain	23
									Return%	94
				Comment	Template				Approve%	89
				Pool	LB# 63 Voters					
62	TGi	Recirculation TGi Draft 7.00	LB# 62	Draft	802_11i-D7.0-redlined.doc	2003-10-20	2003-11-04	15	Pool	321
									Approve	264
				Redlined Doc	N/A				Disapprove	14
				Resolution Doc	11-03-0808-00-000i-LB61Comments.xls				Abstain	21
									Return%	93
				Comment	Template				Approve%	95
				Pool	LB# 62 Voters					
61	TGi	Recirculation TGi Draft 6.00	LB# 61	Draft	802.11i-D6.0-redlined.doc	2003-09-24	2003-10-09	15	Pool	321
									Approve	257
				Redlined Doc	N/A				Disapprove	21
				Resolution Doc	11-03-0659-04-000i-LB60-Comments.xls				Abstain	21
									Return%	93
				Comment	Template				Approve%	92
				Pool	LB# 61 Voters					
60	TGi	Recirculation TGi Draft 5.00	LB# 60	Draft	802.11i-D5.0-redlined.doc	2003-08-04	2003-08-19	15	Pool	321
									Approve	243
				Redlined Doc	N/A				Disapprove	36
				Resolution Doc	11-03-452r6-I-LB57-Comments.xls				Abstain	20
									Return%	93
				Comment	Template				Approve%	87
				Pool	LB# 60 Voters					
59	TGe	Recirculation TGe Draft 5.00	LB# 59	Draft	P802_11E-D5.0-changes-with-4.0-marked.pdf	2003-08-01	2003-08-22	21	Pool	321
									Approve	248
				Redlined Doc	N/A				Disapprove	7
				Resolution Doc	11-03-020r13-E-Merged_Letter_Ballot_51_Comments.xls				Abstain	8
									Return%	82
				Comment	Template				Approve%	97
				Pool	LB# 59 Voters					
57	TGi	Recirculation TGi Draft 4.00	LB# 57	Draft	802_11i-D4_0-redlined.doc	2003-05-22	2003-06-06	15	Pool	321
									Approve	218
				Redlined Doc	N/A				Disapprove	61
				Resolution Doc	11-03-033r10-I-LB52-Comments.xls				Abstain	19
									Return%	93
				Comment	Template				Approve%	78
				Pool	LB# 57 Voters					
56	TGj	Technical TGj Draft 1.00	LB# 56	Draft	P802_11j-D1_0.doc	2003-04-01	2003-05-12	41	Pool	394
									Approve	196
				Redlined Doc	N/A				Disapprove	93
				Resolution Doc	N/A				Abstain	5
									Return%	75
				Comment	Template				Approve%	68
				Pool	LB# 56 Voters					
54	TGg	Recirculation TGg Draft 6.10	LB# 54	Draft	802.11g-D6.1-tracking.doc	2003-01-20	2003-02-04	15	Pool	321
									Approve	184
				Redlined Doc	N/A				Disapprove	22
				Resolution Doc	11-03-068r12-G-LB50_Comment_Resolution.xls				Abstain	58
									Return%	82
				Comment	Template				Approve%	89
				Pool	LB# 54 Voters					
52	TGi	Technical TGi Draft 3.00	LB# 52	Draft	802.11i-D3.0.pdf	2002-12-02	2003-01-12	41	Pool	321
									Approve	209
				Redlined Doc	N/A				Disapprove	65
				Resolution Doc	N/A				Abstain	21

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
									Return%	92
				Comment	Template				Approve%	76
				Pool	LB# 52 Voters					
51	TGe	Technical TGe Draft 4.00	LB# 51	Draft	P802_11E-D4_0.pdf	2002-11-28	2003-01-08	41	Pool	321
									Approve	228
				Redlined Doc	N/A				Disapprove	47
				Resolution Doc	N/A				Abstain	21
									Return%	92
				Comment	Template				Approve%	83
				Pool	LB# 51 Voters					
50	TGg	Technical TGg Draft 5.00	LB# 50	Draft	802.11g-D5.0.doc	2002-11-27	2003-01-08	42	Pool	321
									Approve	256
				Redlined Doc	N/A				Disapprove	34
				Resolution Doc	N/A				Abstain	18
									Return%	96
				Comment	Template				Approve%	88
				Pool	LB# 50 Voters					
49	TGg	Recirculation TGg Draft 4.00	LB# 49	Draft	802.11g-D4.0.pdf	2002-10-17	2002-11-01	15	Pool	382
									Approve	217
				Redlined Doc	N/A				Disapprove	33
				Resolution Doc	2-535.zip				Abstain	25
									Return%	72
				Comment	Template				Approve%	87
				Pool	LB# 49 Voters					
48	TGh	Recirculation TGh Draft 2.20	LB# 48	Draft	802-11-h-D2.2.pdf	2002-10-17	2002-11-01	15	Pool	356
									Approve	241
				Redlined Doc	N/A				Disapprove	7
				Resolution Doc	11-02-515r7-H-Comments_form_LB42.xls				Abstain	17
									Return%	74
				Comment	Template				Approve%	97
				Pool	LB# 48 Voters					
42	TGh	Recirculation TGh	LB# 42	Draft	index.html	2002-07-23	2002-09-01	40	Pool	360
									Approve	208
				Redlined Doc	N/A				Disapprove	24
				Resolution Doc	N/A				Abstain	39
									Return%	75
				Comment	Template				Approve%	90
				Pool	LB# 42 Voters					
41	TGg	Technical TGg	LB# 41	Draft	index.html	2002-07-23	2002-09-01	40	Pool	382
									Approve	194
				Redlined Doc	N/A				Disapprove	40
				Resolution Doc	N/A				Abstain	15
									Return%	65
				Comment	Template				Approve%	83
				Pool						
39	TGe	Technical TGe	LB# 39	Draft	P802_11E-D3_0.pdf	2002-05-23	2002-07-02	40	Pool	365
									Approve	106
				Redlined Doc	N/A				Disapprove	110
				Resolution Doc	N/A				Abstain	44
									Return%	71
				Comment					Approve%	49
				Pool						
38	TGf	Recirculation TGf	LB# 38	Draft	802.11f-D3.1.pdf	2002-05-08	2002-06-16	39	Pool	291
									Approve	221
				Redlined Doc	N/A				Disapprove	9
				Resolution Doc	N/A				Abstain	25
									Return%	88
				Comment	Template				Approve%	96
				Pool	LB# 38 Voters					
36	TGh	Technical TGh	LB# 36	Draft	P802_11H-D2_0.pdf	2002-03-26	2002-05-05	40	Pool	330
									Approve	165
				Redlined Doc	N/A				Disapprove	52
				Resolution Doc	N/A				Abstain	53
									Return%	82
				Comment					Approve%	76
				Pool						
35	TGi	Technical TGi	LB# 35	Draft	P802_11i-D2_0.pdf	2002-03-25	2002-05-04	40	Pool	338
									Approve	143
				Redlined Doc	N/A				Disapprove	43
				Resolution Doc	N/A				Abstain	78
									Return%	78
				Comment					Approve%	77
				Pool						
33	TGg	Technical TGg	LB# 33	Draft		2002-01-31	2002-03-11	39	Pool	286
									Approve	86
				Redlined Doc	N/A				Disapprove	104
				Resolution Doc	N/A				Abstain	41

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
									Return%	81
				Comment					Approve%	45
				Pool						
32	TGf	Technical TGf	LB# 32	Draft		2002-01-29	2002-03-10	40	Pool	290
									Approve	145
				Redlined Doc	N/A				Disapprove	31
				Resolution Doc	N/A				Abstain	19
									Return%	67
				Comment					Approve%	82
				Pool						
30	TGe	Technical TGe	LB# 30	Draft		2001-12-05	2002-01-16	42	Pool	266
									Approve	101
				Redlined Doc	N/A				Disapprove	84
				Resolution Doc	N/A				Abstain	33
									Return%	82
				Comment					Approve%	55
				Pool						
29	TGh	Technical TGh	LB# 29	Draft		2001-07-25	2001-09-03	40	Pool	None
									Approve	None
				Redlined Doc	N/A				Disapprove	None
				Resolution Doc	N/A				Abstain	None
									Return%	0
				Comment					Approve%	None
				Pool						
28	TGf	Technical TGf	LB# 28	Draft		2001-07-25	2001-09-03	40	Pool	None
									Approve	None
				Redlined Doc	N/A				Disapprove	None
				Resolution Doc	N/A				Abstain	None
									Return%	0
				Comment					Approve%	None
				Pool						
27	TGe	Technical TGe	LB# 27	Draft		2001-04-05	2001-05-15	40	Pool	None
									Approve	None
				Redlined Doc	N/A				Disapprove	None
				Resolution Doc	N/A				Abstain	None
									Return%	0
				Comment					Approve%	None
				Pool						
26	TGf	Technical TGf	LB# 26	Draft		2001-04-05	2001-05-15	40	Pool	None
									Approve	None
				Redlined Doc	N/A				Disapprove	None
				Resolution Doc	N/A				Abstain	None
									Return%	0
				Comment					Approve%	None
				Pool						
22	TGd	Recirculation TGd	LB# 22	Draft		2000-06-12	2000-06-26	14	Pool	None
									Approve	None
				Redlined Doc	N/A				Disapprove	None
				Resolution Doc	N/A				Abstain	None
									Return%	0
				Comment					Approve%	None
				Pool						
21	TGd	Recirculation TGd	LB# 21	Draft		2000-03-27	2000-04-04	8	Pool	None
									Approve	None
				Redlined Doc	N/A				Disapprove	None
				Resolution Doc	N/A				Abstain	None
									Return%	0
				Comment					Approve%	None
				Pool						
15	TGb	Technical TGb	LB# 15	Draft		1998-09-30	1998-11-09	40	Pool	None
									Approve	None
				Redlined Doc	N/A				Disapprove	None
				Resolution Doc	N/A				Abstain	None
									Return%	0
				Comment					Approve%	None
				Pool						

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Appendix BE

The Wayback Machine - https://web.archive.org/web/20161013111044/http://www.ieee802.or…

Status of Project IEEE 802.11ax

High Efficiency WLAN (HEW)

Osama Aboul-Magd (Huawei Technologies), Chair
Simone Merlin (Qualcomm), Vice Chair
Ron Porat (Broadcom), Vice Chair
Yasuhiko Inoue (NTT), Secretary
Robert Stacy (Intel), Technical Editor

Background

In May 2013, the High Efficiency WLAN Study Group (HEW SG), a study group within IEEE 802.11 working group had started its activity to consider the improvement of spectrum efficiency to enhance the system throughput/area in high density scenarios of APs and/or STAs.

The study group was created based on the following straw poll and motion:
<Straw Poll>
Do you support starting a new study group called “high efficiency WLAN” to enhance 802.11 PHY and MAC in 2.4 and 5GHz with a focus on:

- Improving spectrum efficiency and area throughput
- Improving real world performance in indoor and outdoor deployments
  - in the presence of interfering sources, dense heterogeneous networks
  - in moderate to heavy user loaded APs

<Motion>
Request an approval by IEEE 802 LMSC to form an 802.11 Study Group to consider High-efficiency WLAN [as described in doc 11-13-0339r2] with the intent of creating a PAR and five criteria.

The HEW SG has successfully developed PAR and CSD documents and the project 802.11ax has started in May 2014.

Task Group Documents – the latest revisions (as of March 30th, 2015)

- 11-14-0165-01 PAR and 11-14-0169-01 CSD
- 11-14-0938-04 TGax Selection Procedure
- 11-14-0980-16 TGax Simulation Scenarios
- 11-14-0571-12 TGax Evaluation Methodology
- 11-14-0882-04 TGax Channel Models
- 11-14-1009-02 TGax Functional Requirements
- 11-15-0132-17 TGax Specification Framework

September 2016 – Warsaw, Poland

The TGax had 11 sessions during the week.
Six out of eleven sessions were assigned to the ad hoc group sessions.

	Tuesday		Wednesday		Thursday
			TGax (full)		
	TGax (MU)	TGax (MAC)			TGax (full)
			TGax (PHY)	TGax (MAC)	TGax (full)
Gax IAC)	TGax (PHY)	TGax (MAC)	TGax (MU)	TGax (MAC)	TGax (full)
Gax SR)					

Main documents

- TGax Agenda: 11-16-1077-06, TGax September 2016 Meeting Agenda
  - TGax PHY ad hoc agenda and motions: 11-16-1246-06, TGax PHY Ad Hoc Sep 2016 Meeting Agenda
    - TGax PHY ad hoc meeting minutes: 11-16-1276-00, September 2016 Warsaw PHY Ad Hoc Meeting Minutes
  - TGax MAC ad hoc agenda: 11-16-1247-02, TGax MAC Ad Hoc September 2016 Meeting Agenda
    - TGax MAC ad hoc meeting minutes: 11-16-1252-01, September 2016 Warsaw TGax MAC Ad hoc Meeting Minutes
  - TGax Multi-User ad hoc agenda: 11-16-1244-01, TGax MU Ad-hoc Agenda September 2016
    - TGax Multi-User ad hoc meeting minutes: 11-16-1275-00, IEEE 802.11 TGax, MU Ad hoc September 2016 TGax Meeting Minutes
  - TGax Spatial Reuse ad hoc agenda: 11-16-1245-02, TGax Spatial Reuse Ad-hoc Agenda September 2016 Meeting
    - TGax Multi-User ad hoc meeting minutes: 11-16-1300-00, TGax Spatial Reuse ad hoc group meeting minutes
- Closing report: 11-16-1284-00, TGax September 2016 Closing Report
- Draft TGax minutes: 11-16-1231-00, IEEE 802.11 TGax September 2016 Warsaw Meeting Minutes

Achievements

1. Work Completed

- **TGax received about 90 submissions.**
  - Number of submissions: PHY/MAC/MU/SR/TG = 28/43/12/9/6.

  The TG completed the discussion of all the submissions.
  Exact count of resolved CIDs will be published by the Editor.
- **The TG editor is planning to have draft revision D0.5 ready based on resolved comments.**

2. Technical Presentations

90 technical submissions were received.
Here is the list of submissions:

- **Submissions – MAC (43 submissions)**
  - 11-16-0864, "Comment Resolutions on Clause 6 & 8 comments," Yasuhiko Inoue (NTT)
  - 11-16-0869, "Misc. TWT comment resolution," Zhou Lan (Broadcom)
  - 11-16-0881, "Comment resolution on ROMI," Jayh Park (LG Electronics)
  - 11-16-0882, "Comment resolution on TOMI," Alfred Asterjadhi (Qualcomm)
  - 11-16-0883, "Comment resolution for CID152," JayhPark (LG Electronics)
  - 11-16-0884, "Spec. Text for HE Operation element and AID Assign Rule," Jianhan Liu (MediaTek)
  - 11-16-0913, "SU Multi-TID Rules," Jarkko Kneckt (Apple)
  - 11-16-0917, "Text for TID value of ALL ACK signaling," Woojin Ahn (WILUS)

- ✧ 11-16-0918, “Discussions on Partial BSS Color,” Geonjung Ko (WILUS)
- ✧ 11-16-0924, “NAV resetting with RTS/MU-RTS,” Weiming Xing (ZTE)
- ✧ 11-16-0925, “Spec text on NAV resetting with RTS/MU-RTS,” Weiming Xing (ZTE)
- ✧ 11-16-0941, “CR HE Fragmentation - part 2,” Ming Gan (Huawei)
- ✧ 11-16-0942, “CR Service Field,” Ming Gan (Huawei)
- ✧ 11-16-0960, “AP access procedure for UL MU operation,” Jinsoo Ahn (Yonsei Univ.)
- ✧ 11-16-0961, “Consideration on Multi-STA BlockAck Optimization,” Hanseul Hong (Yonsei Univ.)
- ✧ 11-16-0962, “EDCA rules-follow up 1,” Jing Ma (NICT)
- ✧ 11-16-0963, “EDCA rules-follow up 2,” Jing Ma (NICT)
- ✧ 11-16-0998, “Rules for 2 EDCA parameters,” Laurent Cariou (Intel)
- ✧ 11-16-1110, “Comment Resolution on subclause 10.22.2 and 10.22.4,” Yongho Seok (Newracom)
- ✧ 11-16-1131, “Comment Resolution on MU Ack Policy,” Yongho Seok (Newracom)
- ✧ 11-16-1154, “MAC CR for CID 966,” Weiming Xing (ZTE)
- ✧ 11-16-1157, “Comment resolution on SU_MU ACK procedures,” Jeongki Kim (LG Electronics)
- ✧ 11-16-1173, “Comment Resolution on Two NAVs - Part II,” Po-Kai Huang (Intel)
- ✧ 11-16-1180, “Proposed text changes for MU EDCA parameters,” Laurent Cariou (Intel)
- ✧ 11-16-1181, “CW value after UL MU procedure,” Woojin Ahn (WILUS)
- ✧ 11-16-1182, “HE Sounding Feedback Segmentation,” Liwen Chu (Marvell)
- ✧ 11-16-1183, “MU RTS CTS data rate comment,” Liwen Chu (Marvell)
- ✧ 11-16-1184, “A-MPDU 25.10 25.10.2 comment resolution, ” Liwen Chu (Marvell)
- ✧ 11-16-1185, “A-MPDU 25.10.3 comment resolution,” Liwen Chu (Marvell)
- ✧ 11-16-1186, “A-MPDU Content Comment Resolution,” Liwen Chu (Marvell)
- ✧ 11-16-1188, “MAC Capabilities in HE Capabilities IE,” Alfred Asterjadhi (Qualcomm)
- ✧ 11-16-1189, “CC0-TWT operation,” Alfred Asterjadhi (Qualcomm)
- ✧ 11-16-1195, “MAC Clarifications,” Alfred Asterjadhi (Qualcomm)
- ✧ 11-16-1204, “Intra-PPDU Power Save for a Multiple BSSID Set Case,” Geonjung Ko (Wilus)
- ✧ 11-16-1205, “Text for Intra-PPDU Power Save for a Multiple BSSID Set Case,” Geonjung Ko (Wilus)
- ✧ 11-16-1210, “Comment Resolution on MU acknowledgement procedure,” Junichi Iwatani (NTT)
- ✧ 11-16-1211, “CR_CID_122_576_972_2598,” Huizao Wang (Quantenna)
- ✧ 11-16-1213, “CR TWT and HE element related,” Matt Fischer (Broadcom)
- ✧ 11-16-1220, “MU mode EDCA control,” Jinsoo Ahn (Yonsei Univ.)
- ✧ 11-16-1234, “Spec Text for TWT Protection field,” Hanseul Hong (Yonsei Univ.)
- ✧ 11-16-1236, “Text for Partial BSS Color and AID Assignment Rule,” Geonjung Ko (Wilus)
- ✧ 11-16-1237, “Setting Quiet Time Period,” Chao-Chun Wang (MediaTek)
- ✧ 11-16-1238, “Setting Quiet Time Period - text,” Chao-Chun Wang (MediaTek) – not available

- **Submissions – PHY (28 submissions)**
  - ✧ 11-16-1133, “11ax sounding modes reduction,” Yan Zhang (Marvell)
  - ✧ 11-16-1134, “11ax spec text on sounding modes reduction,” Yan Zhang (Marvell)
  - ✧ 11-16-1135, “11ax comment resolutions for clause 26.3.5,” Yan Zhang (Marvell)
  - ✧ 11-16-1136, “11ax comment resolutions for clause 26.3.8,” Yan Zhang (Marvell)
  - ✧ 11-16-1137, “11ax comment resolutions for clause 26.3.9,” Yan Zhang (Marvell)
  - ✧ 11-16-1138, “11ax comment resolutions for clause 26.3.10,” Yan Zhang (Marvell)
  - ✧ 11-16-1148, “CR HE-SIG-A part III,” Ross Jian Yu (Huawei)
  - ✧ 11-16-1149, “CR HE-SIG-A part II,” Ross Jian Yu (Huawei)
  - ✧ 11-16-1150, “CR Packet Extension part I,” Ross Jian Yu (Huawei)
  - ✧ 11-16-1160, “Comment Resolution for CID 355,” Eunsung Park (LG Electronics)

- 11-16-1167, "UL MU Clarifications," Ron Porat (Broadcom)
- 11-16-1168, "DCM TBDs," Sriram Venkateswaran (Broadcom)
- 11-16-1169, "CR Duplicate MU MIMO," Sriram Venkateswaran (Broadcom)
- 11-16-1170, "HE PHY Capabilities," Lochan Verma (Qualcomm)
- 11-16-1171, "PHY Miscellaneous Part-1," Lochan Verma (Qualcomm)
- 11-16-1176, "PHY CR Miscellaneous Part-2," Lochan Verma (Qualcomm)
- 11-16-1179, "PHY section editorial comments on D0.4," Sungeun Lee (Cypress)
- 11-16-1190, "Tx Quality Requirements," Daewon Lee (Newracom)
- 11-16-1191, "Comment Resolution for CIDs on PHY Transmit Spec," Daewon Lee (Newracom)
- 11-16-1192, "Comment Resolution for CID 1450," Daewon Lee (Newracom)
- 11-16-1193, "HE variant HT Control - HE Link Adaptation," Daewon Lee (Newracom)
- 11-16-1194, "Removal of Unnecessary PHY TBDs," Daewon Lee (Newracom)
- 11-16-1202, "CR HE-LTF," Ming Gan (Huawei)
- 11-16-1227, "cr-on-26-3-7," Shahrnaz Azizi (Intel)
- 11-16-1232, "Text change proposal of TXTIME in 26.3.19 and 26.4.3," Daewon Lee (Newracom)
- 11-16-1233, "CR for DCM related CID 503, 504 and 2750," Daewon Lee (Newracom)
- 11-16-1240, "Packet Extension Factor calculation fix," Yan Zhang (Marvell)
- 11-16-1242, "spec text for packet extension factor calculation fix," Yan Zhang (Marvell)

- **Submissions – Multi-User (12 submissions)**
  - 11-16-0773, "Comment Resolution Section 25.6 HE Sounding," Raja Banerjea (Qualcomm)
  - 11-16-0929, "CR - UL MU Operation," Simone Merlin (Qualcomm)
  - 11-16-1152, "DL OFDMA Ack rule for uplink trigger based PPDU," Ming Gan (Huawei)
  - 11-16-1158, "Comment resolution on OFDMA random access procedure," Jeongki Kim (LG Electronics)
  - 11-16-1162, "Comment Resolution on Retransmission of OFDMA Random Access," Yunbo Li (Huawei)
  - 11-16-1163, "Concluding OFDMA M-BA transmission," Zhou Lan (Broadcom)
  - 11-16-1177, "comment-resolution-TXOP-truncation," Young Hoon Kwon (Newracom)
  - 11-16-1199, "Proposed text changes for DL OFDMA Acknowledge rule for trigger based PPDU," Ming Gan (Huawei)
  - 11-16-1222, "Comment Resolution on UL OFDMA Random Access," Chittabrata Ghosh (Intel)
  - 11-16-1224, "Random Access Parameter Set (RAPS) element," Chittabrata Ghosh (Intel)
  - 11-16-1239, "Trigger Frame MU BAR part 1," Raja Banerjea (Qualcomm)
  - 11-16-1241, "Trigger Frame MU BAR part 2," Raja Banerjea (Qualcomm)

- **Submissions – Spatial Reuse (9 submissions)**
  - 11-16-0945, "Clarification for OBSS_PD-based SR parameters," Matt Fischer (Broadcom)
  - 11-16-0947, "Proposed text changes for OBSS_PD-based SR parameters," Laurent Cariou (Intel)
  - 11-16-1064, "Unified SR approach DSC, ATPC and Inter-BSS," Graham Smith (SR Technologies)
  - 11-16-1155, "SR Comment Resolution for CID994," Kaiying Lv (ZTE) – not available
  - 11-16-1161, "Simulation-based evaluation of OBSS_PD-based SR default parameters," Tanguy Ropitault (NIST)
  - 11-16-1178, "comment-resolution-SR-RSSI," Young Hoon Kwon (Newracom)
  - 11-16-1216, "SR Field SRP Table for HE-Trigger-Based PPDU," James Wang (MediaTek)
  - 11-16-1223, "CR for Section 25.9.2 OBSS_PD Spatial reuse," Laurent Cariou (Intel)
  - 11-16-1225, "Heads We Win, Tails We Don't Lose: Proposals for Dynamic CCA," Sean Coffey (RealTek)

- **Submissions – TG (6 submissions)**
  - ✧ 11-15-1095, "OFDMA performance in 11ax," Suhwook Kim (LG Electronics)
  - ✧ 11-16-1143, "11ax PAR Verification," Paul Cheng (MediaTek)
  - ✧ 11-16-1159, "Summary of Mandatory or Optional Features of 802.11ax," Joonsuk Kim (Apple)
  - ✧ 11-16-1166, "Meeting PAR requirements with UL OFDMA," Sriram Venkateswaran (Broadcom)
  - ✧ 11-16-1198, "Preliminary 11ax PAR Verification," Jiyong Pang (Huawei)
  - ✧ 11-16-1219, "Considerations on CR for 2665 and 2715," Jing Ma (NICT)

3. Timeline

Current Timeline	Modified Timeline
● May 2014: start of the TG	● May 2014: start of the TG
● Nov. 2014: First draft of the TG SFD was approved	● Nov. 2014: First draft of the TG SFD was approved
● Jan. 2016: proposed TG draft	● Jan. 2016: proposed TG draft
● March 2016: Draft D0.1 was approved and CC started	● March 2016: Draft D0.1 was approved and CC started
● September 2016: Draft 1.0 and WG letter ballot	● November 2016: Draft 1.0 and WG letter ballot
● March 2017: Draft 2.0 and recirculation	● May 2017: Draft 2.0 and recirculation
● July 2017: MDR (Mandatory Document Review)	● November 2017 : MDR (Mandatory Document Review)
● November 2017: Formation of SB pool	● January 2018: Formation of SB pool
● March 2018: Sponsor Ballot	● March 2018: Sponsor Ballot
● December 2018: RevCom	● December 2018: RevCom

Goals for November 2016

- **Continue with Comment Resolutions.**
- **Prepare draft D1.0 and start a WG LB**

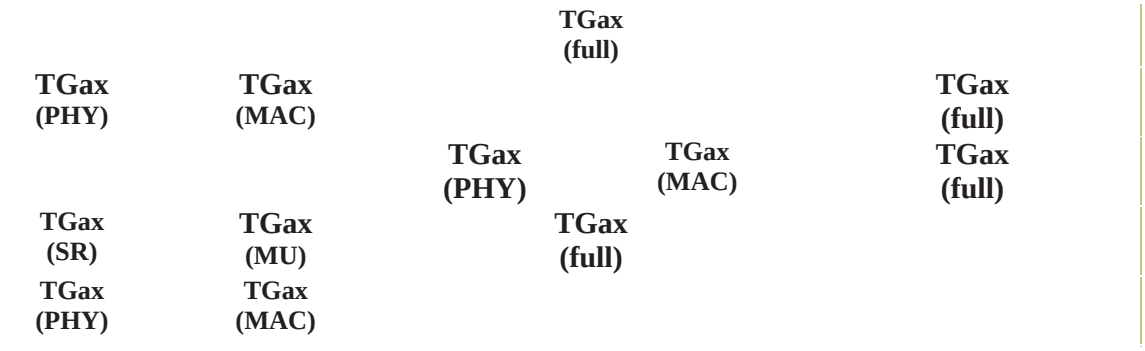
Teleconferences

- **Weekly teleconferences are planned after July 2016 session.**
  - ✧ **Thursday, September 29th, October 20th 10:00 – 12:00 (ET).**
  - ✧ **Thursday, October 13th: 20:00 – 22:00 (ET)**
  - ✧ **Thursday, October 27th and November 17th; 10:00 – 12:00 (ET)**

July 2016 – San Diego, CA

The TGax planned to have 10 sessions during the week.
Four out of ten sessions were assigned to the ad hoc group sessions.

Tuesday Wednesday Thursday



Main documents

- TGax Agenda: 11-16-0779-06, TGax July 2016 Meeting Agenda
  - TGax PHY ad hoc agenda and motions: 11-16-1007-03, TGax PHY Ad Hoc July 2016 Meeting Agenda
    - TGax PHY ad hoc meeting minutes: 11-16-1040-00, IEEE 802.11 TGax July 2016 San Diego PHY Ad Hoc Meeting Minutes
  - TGax MAC ad hoc agenda: 11-16-0997-01, TGax MAC Ad Hoc July 2016 Meeting Agenda
    - TGax MAC ad hoc meeting minutes: 11-16-1000-02, IEEE 802.11 TGax, MAC Ad hoc July 2016 San Diego TGax MAC Ad hoc Meeting Minutes
  - TGax Multi-User ad hoc agenda: 11-16-1012-00, TGax MU Ad-hoc Agenda July 2016 Agenda
    - TGax Multi-User ad hoc meeting minutes: 11-16-1027-00, IEEE 802.11 TGax, MU Ad hoc July 2016 TGax Meeting Minutes
  - TGax Spatial Reuse ad hoc agenda: 11-16-1016-01, TGax Spatial Reuse Ad-hoc Group Agenda
    - TGax Multi-User ad hoc meeting minutes: 11-16-1022-00, TGax Spatial Reuse ad hoc group meeting minutes

- Closing report: 11-16-1051-00, TGax July 2016 Closing Report
- Draft TGax minutes: 11-16-0967-00, IEEE 802.11 TGax July 2016 San Diego Meeting Minutes

Achievements

4. Work Completed

- **TGax received about 90 submissions.**
  - Number of submissions: PHY/MAC/MU/SR/TG = 26/34/12/10/8.

  Most of the submissions are proposed resolutions for the comments on the draft 0.1.
  A number of submissions were proposing new text to be added to the draft.
  - **A long list of submissions are yet to be considered.**
- **Approved the resolutions of about 230 comments discussed during telecons.**
- **Approved the resolutions of about 230 comments discussed during telecons.**
  - **Exact count of resolved CIDs will be published by the Editor.**
- **The TG editor is planning to have draft revision D0.3 ready based on resolved comments.**

5. Technical Presentations

90 technical submissions were received.
Here is the list of submissions:

- **Submissions – PHY (26 submissions)**
  - 11-16-0816, "Comment Resolution for CID 2183," Daewon Lee (Newracom)
  - 11-16-0872, "CR HE-SIG-A Part II," Ross Jian Yu (Huawei Technologies)
  - 11-16-0873, "CR HE-SIG-A Part I," Ross Jian Yu (Huawei Technologies)
  - 11-16-0891, "LDPC for 1024QAM," Hongyuan Zhang (Marvell)
  - 11-16-0892, "Spec Text on LDPC for 1024QAM," Hongyuan Zhang (Marvell)
  - 11-16-0893, "11ax Extended Range PPDU," Bin Tian (Qualcomm)

- 11-16-0894, "HE-LTF Capabilities," Hongyuan Zhang (Marvell)
- 11-16-0895, "Spec Text for HE-LTF Capabilities," Hongyuan Zhang (Marvell)
- 11-16-0896, "11ax Beamformee Capabilities," Hongyuan Zhang (Marvell)
- 11-16-0897, "Spec Text for Beamformee Capabilities," Hongyuan Zhang (Marvell)
- 11-16-0898, "BW Field in HE-MU Format," Hongyuan Zhang (Marvell)
- 11-16-0899, "Spec Text for BW Field in HE-MU Format," Hongyuan Zhang (Marvell)
- 11-16-0900, "PHY Comment Resolution for CID 1052 and 2519," Bin Tian (Qualcomm)
- 11-16-0903, "Gamma phase rotation for HE PPDU," Yujin Noh (Newracom)
- 11-16-0904, "Proposed text for gamma phase rotation for HE PPDU," Yujin Noh (Newracom)
- 11-16-0906, "RU restriction on 20MHz operating STAs," Joonsuk Kim (Apple)
- 11-16-0908, "CR - proposed text on RU restriction of 20MHz STAs," Joonsuk Kim (Apple)
- 11-16-0910, "Minimum Occupied Bandwidth," Ron Porat (Broadcom)
- 11-16-0914, "Bit field finalization of HE-SIG-A," Lochan Verma (Qualcomm)
- 11-16-0915, "Text for bit field finalization of HE-SIG-A," Lochan Verma (Qualcomm)
- 11-16-0920, "PHY comment resolution for CID 1659,493,494," Xiaogang Chen (Intel)
- 11-16-0922, "PHY CR 1024 QAM," Sriram Venkateswaran (Broadcom)
- 11-16-0923, "PHY CR DCM Constellation Mapping," Sriram Venkateswaran (Broadcom)
- 11-16-0928, "CR on Section 26.3.9.8 - HE-SIG-B," Kaushik Josiam
- 11-16-0937, "11ax Comment Resolutions for Clauses 26.3.2-26.3.9.3-26.3.9.4-26.3.9.5-26.3.10.2- 26.3.10.13," Rui Cao (Marvell)
- 11-16-0964, "Considerations on MAC-PHY interactions during SR operations," Jing Ma (NICT)

- **Submissions – MAC (34 submissions)**
  - 11-16-0828, "HE Fragmentation - part 1," Alfred Asterjadhi (Qualcomm)
  - 11-16-0829, "Comment Resolution for Section 10.24.10 Block Ack/GCR block ack," Reza Hedayat (Newracom)
  - 11-16-0844, "CC0-Intra_PPDU_PS," Alfred Asterjadhi (Qualcomm)
  - 11-16-0856, "Issue of Buffer Status reporting," Stephane Baron (Canon)
  - 11-16-0860, "comment resolution on A-MPDU format, » Yongho Seok (Newracom)
  - 11-16-0861, "comment resolution on mu acknowledgment procedure," Yongho Seok (Newracom)
  - 11-16-0862, "comment resolution on subclause 25.11," Yongho Seok (Newracom)
  - 11-16-0864, "d0.1 comment resolution on clause 6," Yasuhiko Inoue (NTT)
  - 11-16-0867, "CIDs for CIDs: Section 9.3.1.9.3 Compressed BA format," George Cherian (Qualcomm)
  - 11-16-0868, "CIDs for Section 9.3.1.9.7 Multi STA BAs, " George Cherian (Qualcomm)
  - 11-16-0869, "Comment resolution section 9.3 TWT," Zhou Lan (Broadcom)
  - 11-16-0871, "Trigger Frame Per User Info Order," Zhou Lan (Broadcom)
  - 11-16-0877, "Comment resolution on CID 783 (TXOP Duration field format)," Jeongki Kim (LG Electronics)
  - 11-16-0878, "Comment resolution on CID 782 (Intra-PPDU PS)," Jeongki Kim (LG Electronics)
  - 11-16-0881, "Comment resolution on ROMI," Jayh Park (LG Electronics)
  - 11-16-0882, "Comment resolution on TOMI," Jayh Park (LG Electronics)
  - 11-16-0883, "Comment resolution for CID 152," Jayh Park (LG Electronics)
  - 11-16-0884, "Spec. Text for HE Operation element and AID Assign Rule," Jianhan Liu (MediaTek)
  - 11-16-0890, "Comment Resolution on NAV Setting of Single and Multiple Protection and Control Response," Po-Kai Huang (Intel)
  - 11-16-0913, "SU Multi-TID Rules," Jarkko Kneckt (Apple)
  - 11-16-0916, "TID value of ALL ACK signaling," Woojin Ahn (Wilus Institute)
  - 11-16-0917, "Text for TID value of ALL ACK signaling," Woojin Ahn (Wilus Institute)

- 11-16-0918, “Discussions on Partial BSS Color,” Geonjung Ko (Wilus Institute)
- 11-16-0924, “NAV resetting with RTS/MU-RTS,” Weimin Xing (ZTE)
- 11-16-0925, "Spex text on NAV resetting with RTS/MU-RTS,” Weimin Xing (ZTE)
- 11-16-0941, “CR HE Fragmentation - part 2,” Ming Gan (Huawei technologies)
- 11-16-0942, “CR Service Field,” Ming Gan (Huawei Technologies)
- 11-16-0951, “Setting for TXOP Duration Field,” Po-Kai Huang (Intel)
- 11-16-0952, “Spec text trigger frame per user info order,” Zhou Lan (Broadcom)
- 11-16-0953, “Comment Resolution and Spec Text for Setting for TXOP Duration field,” Po-Kai Huang (Intel)
- 11-16-0960, “AP access procedure for UL MU operation,” Jinsoo Ahn (Yonsei Univ.)
- 11-16-0961, “Consideration on Multi-STA BlockAck Optimization,” Hanseul Hong (Yonsei Univ.)
- 11-16-0962, “EDCA rules follow up 1,” Jing Ma (NICT)
- 11-16-0963, “EDCA rules follow up 2,” Jing Ma (NICT)
- 11-16-0966, “CID 71 and CID 190 Resolutions,” Jarkko Kneckt (Apple)
- 11-16-0998, “2 sets of EDCA parameters,” Laurent Cariou (Intel)

- **Submissions – Multi-User (12 submissions)**
  - 11-16-0866, “Comment Resolution of Section 26.3.13 MU-MIMO,” Kome Oteri (InterDigital)
  - 11-16-0875, “CR for the section 10.3.2.8a CS Condition to Respond CTS,” Kiseon Ryu (LG Electronics)
  - 11-16-0876, “CR for the section 25.5.2.4 UL MU CS CCA and CS Required Bit,” Kiseon Ryu (LG Electronics)
  - 11-16-0880, “UL MU Transmission Rules - EDCA backoff,” Jayh Park (LG Electronics)
  - 11-16-0885, “Comment Resolution on UL MU CS NAV Consideration,” Po-Kai Huang (Intel)
  - 11-16-0886, “Comment Resolution for some UL MU CS TBD,” Po-Kai Huang (Intel)
  - 11-16-0887, “Spec Text for MU-RTS restriction on HE MU PPDU,” Po-Kai Huang (Intel)
  - 11-16-0926, “Soliciting UL_MU_ACK,” Raja Banerjea (Qualcomm)
  - 11-16-0929, “CR - UL MU Operation,” Simone Merlin (Qualcomm)
  - 11-16-0930, “CR - DL MU Operation,” Simone Merlin (Qualcomm)
  - 11-16-0938, “Comment Resolution for Sub-clause 25.10.4,” Chittabrata Ghosh (Intel)
  - 11-16-0958, “UL OFDMA for Unassociated STAs,” Leonardo Lanante (Kyushu Institute of Tech.)

- **Submissions – Spatial Reuse (10 submission)**
  - 11-16-0879, “Comment resolution on SR for VHT PPDUs,” Jeongki Kim (LG Electronics)
  - 11-16-0889, “Comment Resolution for Spatial Reuse (Intra BSS detection),” Young Hoon Kwon (Newracom)
  - 11-16-0901, “Clarification of SR Fields in HE Trigger Based PPDU,” Daewon Lee (Newracom)
  - 11-16-0902, “Proposed Text Changes for SR Fields in HE Trigger-Based PPDU,” Daewon Lee (Newracom)
  - 11-16-0905, “SR Fields Clarification,” Ron Porat (Broadcom)
  - 11-16-0919, “Discussions on SR Fields in HE Trigger-based PPDU,” Geonjung Ko (Wilus Institute)
  - 11-16-0310, “DSC Proposal Text,” Graham Smith (SR Technologies)
  - 11-16-0945, “Clarifications for OBSS_PD-based SR parameters,” Laurent Cariou (Intel)
  - 11-16-0947, “Proposed text changes for OBSS_PD-based SR parameters,” Laurent Cariou (Intel)
  - 11-16-0957, “Comment Resolutions on OBSS_PD Conditions in 25.9.3,” James Wang (MediaTek)

- **Submissions – TG (8 submissions)**
  - ✧ 11-15-1095, "OFDMA Performance in 11ax," Suhwook Kim (LG Electronics)
  - ✧ 11-16-0835, "EIFS," Alfred Asterjadhi (Qualcomm)
  - ✧ 11-16-0870, "Conclusing MAC Trigger Padding," Zhou Lan (Broadcom)
  - ✧ 11-16-0907, "20MHz HE devices," Joonsuk Kim (Apple)
  - ✧ 11-16-0909, "CR – proposed text on 20 MHz devices," Joonsuk Kim (Apple)
  - ✧ 11-16-0949, "MAC trigger frame padding follow up," Zhou Lan (Broadcom)
  - ✧ 11-16-0965, "On High Efficiency WLAN (HEW) TG PAR Scope," Osama Aboul-Magd (Huawei Technologies)

6. Timeline

- **May 2014: start of the TG**
- **Nov. 2014: First draft of the TG SFD was approved**
- **Jan. 2016: proposed TG draft**
- **March 2016: Draft D0.1 was approved and CC started**
- **September 2016: Draft 1.0 and WG letter ballot**
- **March 2017: Draft 2.0 and recirculation**
- **July 2017: MDR (Mandatory Document Review)**
- **November 2017: Formation of SB pool**
- **March 2018: Sponsor Ballot**
- **December 2018: RevCom**

Goals for September 2016

- **Continue with Comment Resolutions.**

Teleconferences

- **Weekly teleconferences are planned after July 2016 session.**
  - ✧ **Thursday, August 4th; 20:00 – 22:00 (ET) →Approved during May 2016 meeting.**
  - ✧ **Thursday, August 11th, 25th, and September 8th: 10:00 – 12:00 (ET)**
  - ✧ **Thursday, August 18rd, September 1st, and 22nd; 20:00 – 22:00 (ET)**

May 2016 – Waikoloa, HI

The TGax planned to have 10 sessions during the week.
Six out of ten sessions were assigned to the ad hoc group sessions.

	Tuesday		Wednesday		Thursday
	TGax (PHY)	TGax (MAC/SR)			TGax (full)
			TGax (PHY)	TGax (MAC/SR)	
Gax C/SR)	TGax (PHY)	TGax (MU)	TGax (MAC)	TGax (MAC/SR)	TGax (full)
Gax MU)		TGax (full)			

Main documents

- TGax Agenda: 11-16-0512-04, TGax May 2016 Meeting Agenda
  - TGax PHY ad hoc agenda and motions: 11-16-0693-03, TGax PHY Ad Hoc May 2016 Meeting Agenda
    - TGax PHY ad hoc meeting minutes: 11-16-0755-00, TGax May 2016 Waikoloa PHY Ad Hoc Meeting Minutes
  - TGax MAC and SR ad hoc agenda: 11-16-0698-04, TGax MAC and Spatial Reuse Ad Hoc Agenda May 2016 Meeting
    - TGax MAC and Spatial Reuse ad hoc meeting minutes: 11-16-0701-00, Combined Spatial Reuse & MAC ad hoc group meeting minutes
  - TGax Multi-User ad hoc agenda: 11-16-0697-02, TGax MU Ad-hoc Agenda May 2016 Agenda
    - TGax Multi-User ad hoc meeting minutes: 11-16-0716-00, May 2016 Waikoloa TGax MU Ad hoc Meeting minutes
- Closing report: 11-16-0739-00, TGax May 2016 Closing Report
- Draft TGax minutes: 11-16-0686-00, TGax May 2016 Waikoloa Meeting Minutes

Achievements

7. Work Completed

- **TGax received about 70 submissions.**
  - Number of submissions: PHY/MAC/MUSR/TG = 33/18/9/3/6.

  Majority of the submission were requesting changes to the TG Specification Framework.
  Few submissions were addressing comment resolution mainly of the PHY clause.
- **Agreed to terminate the Specification Framework process. The frame of reference is Draft D0.1**
  - Future submissions shall bring text to continue developing the TG draft
  - The TG Technical Editor is planning to generate draft D0.2 based on outcome of this meeting
- **Approved the resolutions of about 200 comments, most of them addressing the PHY clause**
- **Revisited and accepted a new modified timeline.**

8. Technical Presentations

70 technical submissions have been covered during the week.
A list of the submissions is also available in the agenda document.

- Submissions – PHY (33 submissions)
  - 11-16/0608, "Beamforming Feedback Report Structure," Sameer Vermani (Qualcomm)
  - 11-16/0610, "CR HE-SIG-A Part I," Ross Jian Yu (Huawei Technologies)
  - 11-16/0611, "Remaining Issues in Trigger Frame Design," Sameer Vermani (Qualcomm)
  - 11-16/0613, "SIG-B Related Issues," Lochan Verma (Qualcomm)
  - 11-16/0614, "Comment Resolution on Clause 26.1.1 Part 1," Lochan Verma (Qualcomm)
  - 11-16/0615, "Comment Resolution on Clause 26.3.12 Part 1," Lochan Verma (Qualcomm)
  - 11-16/0617, "Remaining Topics in Power Control," Bin Tian (Qualcomm)
  - 11-16/0618, "11ax CSD Design," Bin Tian (Qualcomm)
  - 11-16/0619, "PAPR Reduction of HE-SIGB," Bin Tian (Qualcomm)
  - 11-16/0620, "DCM PHY Parameters," Hongyuan Zhang (Marvell)
  - 11-16/0621, "DCM Interleaver," Tianyu Wu (MediaTek)
  - 11-16/0622, "16 QAM Napping for DCM," Sudhir Srinivasa (Marvell)
  - 11-16/0623, "CR on Section 26.3.10.12," Bin Tian (Qualcomm)
  - 11-16/0625, "CR on Section 26.3.6," Bin Tian (Qualcomm)
  - 11-16/0626, "Feedback Element Compression for 802.11ax," Kome Oteri (InterDigital Communications)
  - 11-16/0633, "Left over Issues in RU Signaling for HE-SIGB," Yan Zhang (Marvell)
  - 11-16/0634, "11ax Comment Resolutions for Clauses 26.3.2," Yan Zhang (Marvell)

- ✧ 11-16/0635, "BW indication for Non-contiguous Channel Bonding," Yunbo Li (Huawei Technologies)
- ✧ 11-16/0636, "TXOP Duration field in HE-SIG-A," Jeongki Kim (LG Electronics)
- ✧ 11-16/0637, "Load balancing indication for MU-MIMO over 484-tone and larger RU in OFDMA," Ming Gan (Huawei Technologies)
- ✧ 11-16/0638, "Discussions for Non-contiguous Channel Bonding," John Son (Wilus)
- ✧ 11-16/0639, "Follow-up on HE-SIG-B user-specific field," Jinsoo Choi (LG Electronics)
- ✧ 11-16/0649, "Feedback Tone Map and Quantization," Sriram Venkateswaran (Broadcom)
- ✧ 11-16/0652, "Power scaling of 4 extra tones," Xiaogang Chen (Intel)
- ✧ 11-16/0653, "CR on section 26.3.3," Xiaogang Chen (Intel)
- ✧ 11-16/0654, "CP and LTF Options and Signaling," Ron Porat (Broadcom)
- ✧ 11-16/0655, "On MCS0 DCM Modulation and DCM Capability," Jianhan Liu (MediaTek)
- ✧ 11-16/0656, "1024QAM Modulation," Jianhan Liu (MediaTek)
- ✧ 11-16/0658, "CR on 26.3.7.1," Jinsoo Choi (LG Electronics)
- ✧ 11-16/0659, "CR on 26.3.9.9 and 26.3.5," Eunsung Park (LG Electronics)
- ✧ 11-16/0663, "CR on Secition 26.2.2," Ke Yao (ZTE)
- ✧ 11-16/0681, "Comment Resolution CID 215 2486," Daewon Lee (Newracom)
- ✧ 11-16/0682, "CR CID on PHY data field other," Daewon Lee (Newracom)

- Submissions – MAC (18 submissions)
  - ✧ 11-16/0583, "Backoff Procedure Handling Upon TF Reception," Yu Wang (Ericsson)
  - ✧ 11-16/0584, "Need of SDU Fragmentation to Reduce Padding Ratio in UL-OFDMA Transmission," Yu Wang (Ericsson)
  - ✧ 11-16/0588, "Channel State Estimation based Bidirectional Initialized Random Access," Bo Li (Northwestern Polytechnical Univ.)
  - ✧ 11-16/0590, "Multi-BSS Association for Edge Users' Throughput Improvements," Mao Yang (Northwestern Polytechnical Univ.)
  - ✧ 11-16/0616, "BlockAck generation and selection rules," Alfred Asterjadhi (Qualcomm)
  - ✧ 11-16/0627, "ROM Recovery Rules," Jayh Hyunhee Park (LG Electronics)
  - ✧ 11-16/0628, "Buffer Status Report in HE Control field," Jayh Hyunhee Park (LG Electronics)
  - ✧ 11-16/0640, "BSS Color Collision," Geonjung Ko (Wilus Institute)
  - ✧ 11-16/0641, "Regarding HE fragmentation," Woojin Ahn (Yonsei Univ.)
  - ✧ 11-16/0643, "HE Control Scheduling," Liwen Chu (Marvell)
  - ✧ 11-16/0644, "SS Allocation in Trigger," Liwen Chu (Marvell)
  - ✧ 11-16/0645, "MU Minimum MPDU Start Spacing," Liwen Chu (Marvell)
  - ✧ 11-16/0646, "HE Beamforming Feedback," Liwen Chu (Marvell)
  - ✧ 11-16/0657, "In-device Multi-radio Coexistence and UL MU operation," Robert Stacy (Intel)
  - ✧ 11-16/0673, "Multi-User EDCA," Jinsoo Ahn (Yonsei Univ.)
  - ✧ 11-16/0674, "EIFS excess problem of Acknowledgement for UL MU procedure," Hanseul Hon (Yonsei Univ.)
  - ✧ 11-16/0675, "comment resolution for CID2383," Yonggang Fang (ZTE)
  - ✧ 11-16/0684, "Channel Access Efficiency," Evgeny Khorov (IITP)

- Submissions – Multi-User (9 submissions)
  - ✧ 11-16/0582, "Random Access RU Allocation in the Trigger Frame," Evgeny Khorov (IITP)
  - ✧ 11-16/0591, "Issues related to OCW management," Patrice Nezou (Canon)
  - ✧ 11-16/0592, "Follow up on Issue related to unused UL OFDMA RUs," Stephane Baron (Canon)
  - ✧ 11-16/0648, "MU-RTS/CTS PHY Format," Po-Kai Huang (Intel)
  - ✧ 11-16/0661, "Adaptive Random Access UL OFDMA," Leonardo Lanante (Kyushu Institute of Technology)

- ✧ 11-16/0662, “Further consideration on channel access rule to facilitate MU transmission opportunity,” Jing Ma (NICT)
- ✧ 11-16/0664, “Consideration on backoff procedure for UL MU transmission,” Jing Ma (NICT)
- ✧ 11-16/0665, “Some Notes on Interference Alignment for Downlink Multi-User MIMO,” Dzevdan Kapetanovic (Ericsson)
- ✧ 11-16/0667, “Signaling of Multi-TID Aggregation Limit,” Chittabrata Ghosh (Intel)

- Submissions – Spatial Reuse (3 submission)
  - ✧ 11-16/0581, “Proposed changes to SR clause,” Soma Tayamon (Ericsson)
  - ✧ 11-16/0589, “Fractional-Backoff Procedure and Dynamic CCA,” Bo Li (Northwestern Polytechnical University)
  - ✧ 11-16/0647, “Consideration of Spatial Reuse for Trigger Frame,” Po-Kai Huang (Intel)

- Submissions – TG (6 submissions)
  - ✧ 11-16/0571, “QoS Handling of Trigger Frame,” Yu Wang (Ericsson)
  - ✧ 11-16/0597, “TG ax Indoor Enterprise Scenarios, Color, DSC and TPC,” Graham Smith (SR Technologies)
  - ✧ 11-16/0604, “Simulation-based evaluation of DSC in enterprise scenario,” Tanguy Ropitault (NIST)
  - ✧ 11-16/0609, “HE NDPA frame format,” Ross Jian Yu (Huawei)
  - ✧ 11-16/0612, “Mandatory/Optional Issues for 802.11ax,” Sameer Vermani (Qualcomm)
  - ✧ 11-16/0629, “Box 5 Calibration Results,” Marik Hsiao (MediaTek)

9. Timeline

Current Timeline	Modified Timeline
● **May 2014: start of the TG**	● **May 2014: start of the TG**
● **Nov. 2014: First draft of the TG SFD was approved**	● **Nov. 2014: First draft of the TG SFD was approved**
● **Jan. 2016: proposed TG draft**	● **Jan. 2016: proposed TG draft**
● **March 2016: Draft D0.1 was approved and CC started**	● **March 2016: Draft D0.1 was approved and CC started**
● **July 2016: Draft 1.0 and WG letter ballot**	● **September 2016: Draft 1.0 and WG letter ballot**
● **March 2017: Draft 2.0 and recirculation**	● **March 2017: Draft 2.0 and recirculation**
● **Jan 2018: Sponsor Ballot**	● **July 2017: MDR (Mandatory Document Review)**
	● **November 2017: Formation of SB pool**
	● **March 2018: Sponsor Ballot**
	● **December 2018: RevCom**

Goals for July 2016

- Continue with Comment Resolutions.

Teleconferences

- Weekly teleconferences are planned after May 2016 session.
  - ✧ Thursday, June 2nd, 16th, 30th, and July 14th: 10:00 – 12:00 (ET)
  - ✧ Thursday, June 23rd, July 7th, and August 4th 20:00 – 22:00 (ET)

March 2016 – Macau

The TGax planned to have 9 sessions during the week.
Five out of nine sessions were assigned to the ad hoc group sessions.

	Tuesday		Wednesday		Thursday
	TGax (PHY)	**TGax (MAC)**			**TGax (full)**
			TGax (PHY)	**TGax (MAC)**	
	TGax (SR)	**TGax (MAC)**	**TGax (MAC)**	**TGax (MU)**	**TGax (full)**
Gax MU)		TGax (full)			

Main documents

- TGax Agenda: 11-16-0235-07, TGax March 2016 Meeting Agenda
  - ➢ TGax PHY ad hoc agenda and motions: 11-16-0421-03, TGax PHY Ad Hoc March 2016 Meeting Agenda
    - ✧ TGax PHY ad hoc meeting minutes: 11-16-0509-00, TGax March 2016 Macau PHY Ad Hoc Meeting Minutes
  - ➢ TGax MAC ad hoc agenda: 11-16-0427-04, TGax MAC Ad Hoc March 2016 Meeting Agenda
    - ✧ TGax MAC ad hoc meeting minutes: 11-16-0439-01, Mar 2016 Macau TGax MAC Ad hoc Meeting Minutes
  - ➢ TGax Multi-User ad hoc agenda: 11-16-0419-02, TGax MU Ad-hoc Agenda March 2016 Agenda
    - ✧ TGax Multi-User ad hoc meeting minutes: 11-16-0466-00, March 2016 Macau TGax MU Ad hoc Meeting minutes
  - ➢ TGax Spatial Reuse ad hoc agenda and motions: 11-16-0422-02, 802.11ax Spatial Reuse Ad Hoc Group Agenda
    - ✧ TGax Spatial Reuse ad hoc minutes: 11-16-0537-00, Spatial Reuse ad hoc group March 2016 minutes
- Closing report: 11-16-0475-00, TGax March 2016 Closing Report
- Draft TGax minutes: 11-16-0415-00, TGax March 2016 Macau Meeting Minutes

Achievements

10. TG Documents

- **Passed a number of affecting all aspects of the TG Specification Framework:**
  - ✧ PHY – 22 motions passed.
  - ✧ MAC – 17 motions passed.
  - ✧ MU – 9 motions passed.
  - ✧ SR – 2 motions passes.
- **Latest revision of the Specification Framework is available at;**
  - ✧ https://mentor.ieee.org/802.11/dcn/15/11-15-0132-16-00ax-spec-framework.docx
- **Other TG documents**

- ✧ Simulation Scenario https://mentor.ieee.org/802.11/dcn/14/11-14-0980-16-00ax-simulation-scenarios.docx
- ✧ Evaluation Methodology https://mentor.ieee.org/802.11/dcn/14/11-14-0571-12-00ax-evaluation-methodology.docx
- ✧ Channel Model https://mentor.ieee.org/802.11/dcn/14/11-14-0882-04-00ax-tgax-channel-model-document.docx
- ✧ Functional Requirements https://mentor.ieee.org/802.11/dcn/14/11-14-1009-02-00ax-proposed-802-11ax-functional-requirements.doc

11. Technical Presentations

48 technical submissions have been covered during the week.
A list of the submissions is available in the agenda document.

- Submissions – PHY (12 submissions)
  - ✧ 11-15/1354, "SIGA fields and Bitwidths," Ron Porat (Broadcom)
  - ✧ 11-16/0203, "Signalling Support for Full Bandwidth MU-MIMO Compressed SIG-B Mode," Lei Huang (Panasonic)
  - ✧ 11-16/0319, "I-Q Decoupled OFDM: A Solution To I/Q Imbalance," Shouxing Simon Qu (Blackberry)
  - ✧ 11-16/0335, "HE-STF sequences for 160/80+80MHz," Eunsung Park (LG Electronics)
  - ✧ 11-16/0343, "Spectral Mask Discussion," Hongyuan Zhang (Marvell)
  - ✧ 11-16/0344, "PHY Padding Related Issues," Hongyuan Zhang (Marvell)
  - ✧ 11-16/0346, "11ax Pilot Sequence," Bin Tian (Qualcomm)
  - ✧ 11-16/0349, "HE-SIG-B Compression Mode," Kaushik Josiam (Samsung)
  - ✧ 11-16/0367, "Power Scaling of L-LTF and L-STF," Yakun Sun (Marvell)
  - ✧ 11-16/0389, "Sounding Design," Sriram Venkateswaran (Broadcom)
  - ✧ 11-16/0395, "Preamble transmission for Uplink OFDMA," Ming Gan (Huawei)
  - ✧ 11-16/0397, "HE-SIG-B Signaling Discussions," John Son (WILUS Institute)

- Submissions – MAC (18 submissions)
  - ✧ 11-16/0297, "Results for beacon collisions," Evgeny Khorov (IITP RAS)
  - ✧ 11-16/0345, "Simultaneous NAK for MU GCR-BA," Jinsoo Ahn (Yonsei Univ.)
  - ✧ 11-16/0347, "Fragmentation for MU frames-Follow up on parameters," Alfred Asterjadhi (Qualcomm)
  - ✧ 11-16/0352, "Considerations on MU initial link setup," Woojin Ahn (Yonsei Univ.)
  - ✧ 11-16/0353, "MU-RTS/CTS for TWT Protection," Hanseul Hong (Yonsei Univ.)
  - ✧ 11-16/0358, "Maximal A-MPDU Size," Liwen Chu (Marvell)
  - ✧ 11-16/0359, "Management ACK," Liwen Chu (Marvell)
  - ✧ 11-16/0361, "Ack Policy of UL MU frame," Jeongki Kim (LG Electronics)
  - ✧ 11-16/0362, "Multi-TID Aggregation Limit," Chittabrata Ghosh (Intel)
  - ✧ 11-16/0365, "Multi-STA BA Design," Xiaofei Wang (InterDigital)
  - ✧ 11-16/0368, "MAC padding options for legacy trigger frame," Zhou Lan (Broadcom)
  - ✧ 11-16/0369, "M-BA aggregated trigger frame," Zhou Lan (Broadcom)
  - ✧ 11-16/0377, "Sounding Sequences Clarifications," Simone Merlin (Qualcomm)
  - ✧ 11-16/0378, "Extended BA Bitmap," Simone Merlin (Qualcomm)
  - ✧ 11-16/0383, "RU Signaling in Trigger Frame," Yunbo Li (Huawei)
  - ✧ 11-16/0396, "Issues on BSS Color Bits Collision," Geonjung Ko (WILUS Institute)
  - ✧ 11-16/0399, "Considerations on Trigger Frame for Random Access Procedure," Evgeny Khorov (IITP RAS)
  - ✧ 11-16/0404, "BlockAck Bitmap," Dengyu Qiao (Huawei)

- Submissions – Multi-User (6 submissions)
  - ✧ 11-16/0331, "Power Control for Multi-User Transmission in 802.11ax," Kome Oteri (InterDigital)
  - ✧ 11-16/0333, "Issue related to unused UL OFDMA RUs," Stephane Baron (Canon)

- ✧ 11-16/0340, "Random Access UL MU Resource Allocation and Indication," Leonardo Lanante (Kyushu Institute of Technology)
- ✧ 11-16/0371, "Further consideration for MU-RTS/CTS," Jin Ma (NICT)
- ✧ 11-16/0379, "Trigger Frame Format," Simone Merlin (Qualcomm)
- ✧ 11-16/0413, "Power Control for UL MU," Arjun Bharadwaj (Qualcomm)

- Submissions – Spatial Reuse (7 submission)
  - ✧ 11-16/0212, "Enterprise Scenario DSC and Color," Graham Smith (SR Technplogies)
  - ✧ 11-16/0310, "DSC Proposed Text," Graham Smith (SR Technplogies)
  - ✧ 11-16/0350, "Enterprise Scenario TPC and DSC," Graham Smith (SR Technplogies)
  - ✧ 11-16/0360, "Simulation results of spatial reuse with various MCSs," Junichi Iwatani (NTT)
  - ✧ 11-16/0382, "Discussion on Spatial Reuse Operations in 11ax," Yunbo Li (Huawei)
  - ✧ 11-16/0403, "Spatial Re-Use with Adaptive CCA and TPC Simulation," Frank Hsu (MediaTek)
  - ✧ 11-16/0414, "Adjustment Rules for Adaptive CCA and TPC," James Wang (MediaTek)

- Submissions – TG (5 submissions)
  - ✧ 11-15/1095, "OFDMA Performance in 11ax," Suhwook Kim (LG Electronics)
  - ✧ 11-16/0066, "Views on UL MU Features," Joonsuk Kim (Apple)
  - ✧ 11-16/0355, "Snapshot of Residential Use 2016," Carol Ansley (ARRIS Group)
  - ✧ 11-16/0364, "AID Assign Rules Based on BSS Color and HE Operation Element," Jianhan Liu (MediaTek)
  - ✧ 11-16/0394, "Achieving High Efficiency in Medium Access via Roster Mode," Sean Coffey (RealTek)

12. Draft Specification

- The TGax approved version 0.1 of the draft specification.
- **TG Motion:**
- **Move to accept document 11-16/0024r1 as the TG draft specification D0.1, and start a 21 day comment collection period.**
  - ➢ The submission is available at: https://mentor.ieee.org/802.11/dcn/16/11-16-0024-01-00ax-proposed-draft-specification.docx
  - ➢ **Move: Robert Stacey, Second: Simone Merlin**
  - ➢ **Y/N/A: 75/0/5, motion passes.**

Goals for May 2016

- Comment Resolution.
- Technical presentations.
- Revisit the timeline based on the number of comments received.

Teleconferences

- Four teleconferences are planned before the March 2016 session.
  - ✧ Thursday, April 14th, 10:00 – 12:00 (ET)
  - ✧ Thursday, April 21st, 20:00 – 22:00 (ET)
  - ✧ Thursday, April 28th, 10:00 – 12:00 (ET)
  - ✧ Thursday, May 5th, 20:00 – 22:00 (ET)

January 2016 – Atlanta, GA

The TGax planned to have 10 sessions during the week.
Four out of ten sessions were assigned to the ad hoc group sessions.

	Tuesday		Wednesday	Thursday
			TGax (full)	
	TGax (PHY)	TGax (MAC)		TGax (full)
	TGax (PHY)	TGax (MAC)	TGax (full)	
TGax MAC)			TGax (full)	TGax (full)
	TGax (MU)			

Main documents

- TGax Agenda: 11-15-1516-03, TGax January 2016 Meeting Agenda
  - TGax PHY ad hoc agenda: 11-16-0108-02, TGax PHY Ad Hoc Jan 2016 Meeting Agenda
  - TGax MAC ad hoc agenda: 11-16-0109-02, TGax MAC Ad Hoc January 2016 Meeting Agenda
  - TGax Multi-User ad hoc agenda: 11-16-0147-01, TGax MU Ad-hoc January 2016 Agenda
- Closing report: 11-16-0187-00, TGax January 2016 Closing Report
- Draft TGax minutes: 11-16-0096-00, TGax January 2016 Atlanta Meeting Minutes
  - TGax PHY ad hoc meeting minutes: 11-16-0119-00, January 2016 Atlanta PHY Ad Hoc Meeting Minutes
  - TGax MAC ad hoc meeting minutes: 11-16-0110-00, Jan 2016 Atlanta TGax MAC Ad hoc Meeting Minutes
  - TGax Multi-User ad hoc meeting minutes: 11-16-0150-00, January 2016 Atlanta TGax MU Ad hoc Meeting minutes

Achievements

13. TG Documents

- **Passed a number of affecting all aspects of the TG Specification Framework:**
  - PHY – 30 motions passed.
  - MAC – 9 motions passed.
  - MU – 7 motions passed.
- **Latest revision of the Specification Framework is available at;**
  - https://mentor.ieee.org/802.11/dcn/15/11-15-0132-15-00ax-spec-framework.docx
- **Other TG documents**
  - Simulation Scenario https://mentor.ieee.org/802.11/dcn/14/11-14-0980-16-00ax-simulation-scenarios.docx
  - Evaluation Methodology https://mentor.ieee.org/802.11/dcn/14/11-14-0571-12-00ax-evaluation-methodology.docx
  - Channel Model https://mentor.ieee.org/802.11/dcn/14/11-14-0882-04-00ax-tgax-channel-model-document.docx
  - Functional Requirements https://mentor.ieee.org/802.11/dcn/14/11-14-1009-02-00ax-proposed-802-11ax-functional-requirements.doc

14. Technical Presentations

48 technical submissions have been covered during the week.

A list of the submissions is available in the agenda document.

- Submissions – PHY (22 submissions)
  - 11-16/0030, "Maximum Tone Grouping Size for 802.11ax Feedback with MU-MIMO," Kome Oteri (InterDigital)
  - 11-16/0033, "1x HE-LTF for ULMUMIMO," Hongyuan Zhang (Marvell)
  - 11-16/0034, "Beamforming with HE-LTF Compression," Hongyuan Zhang (Marvell)
  - 11-16/0036, "CRC Generation for HE-SIG," Yakun Sun (Marvell)
  - 11-16/0037, "Continuous Puncturing for HE-SIGB Encoding," Yakun Sun (Marvell)
  - 11-16/0038, "Sequence for 1x LTF," Daewon Lee (Newracom)
  - 11-16/0039, "RU Allocation in SIG-B," Daewon Lee (Newracom)
  - 11-16/0040, "Issues with Compressed SIG-B Mode," Yujin Noh (Newracom)
  - 11-16/0041, "Link Adaptation for HE WLAN," Yujin Noh (Newracom)
  - 11-16/0044, "MCS Levels and TX EVM Requirement for 1024 QAM," Eunsung Park (LG Electronics)
  - 11-16/0045, "Flexible Wider Bandwidth Transmission," John Son (WILUS)
  - 11-16/0046, "Content for the extra tones in LSIG and RLSIG," Jiayin Zhang (Huawei)
  - 11-16/0047, "Discussion on the HE Extended Range SU PPDU," Jiayin Zhang (Huawei)
  - 11-16/0052, "Remaining HE-LTF Sequence Design," Le Liu (Huawei)
  - 11-16/0053, "Requirements for UL MU Transmissions," Arjun Bharadwaj (Qualcomm)
  - 11-16/0056, "On QPSK DCM Modulation and LDPC Tone Mapper for DCM," Jianhan Liu (MediaTek)
  - 11-16/0071, "Packet Extension Follow Up," Ron Porat (Broadcom)
  - 11-16/0079, "Allocation sizes for BCC in OFDMA," Ken Taniguchi (Toshiba)
  - 11-16/0080, "1x/2x/4x OFDM Symbol in HE SU PPDU with BCC," Heejung Yu (Yeungnam Univ./NEWRACOM)
  - 11-16/0088, "Ng for Compressed Beamforming feedback," Sriram Venkateswaran (Broadcom)
  - 11-16/0089, "Single Stream Pilots in UL MU MIMO," Sriram Venkateswaran (Broadcom)
  - 11-16/0104, "Rate Matching for HE-SIG-B," Daewon Lee (Newracom)

- Submissions – MAC (12 submissions)
  - 11-16/0015, "Explicit Block Ack Request in DL MU PPDU," Yongho Seok (Newracom)
  - 11-16/0017, "Beacon Collision Avoidance," Evgeny Khorov (IITP)
  - 11-16/0018, "TDMA for Eliminating Hidden Station Effect in Dense Networks," Evgeny Khorov (IITP)
  - 11-16/0028, "Follow Up for Multi-STA BA for SU Transmissions," Xiaofei Wang (InterDigital)
  - 11-16/0029, "TXOP Truncation Enhancement," Xiaofei Wang (InterDigital)
  - 11-16/0042, "BSS Color Settings for a Multiple BSSID Set," Geonjung Ko (WILUS)
  - 11-16/0050, "Fragmentation for MU frames-Follow up on acks," Alfred Asterjadhi (Qualcomm)
  - 11-16/0051, "Response Give Trigger Type," David Xun Yang (Huawei)
  - 11-16/0068, "BSS Color and Multiple BSSID," Liwen Chu (Marvell)
  - 11-16/0069, "Multi-TID A-MPDU in MU Transmission," Liwen Chu (Marvell)
  - 11-16/0087, "NAV cancellation issues on MU protection," Jinsoo Ahn (Yonsei Univ.)
  - 11-16/0102, "High Efficiency Medium Access via Rosters," Sean Coffey (RealTek)

- Submissions – Multi-User (9 submissions)
  - 11-16/0031, "Proposed UL MU CS Rules," Lei Wang (Marvell)
  - 11-16/0048, "Protection using MU RTS/CTS," Young Hoon Kwon (Newracom)
  - 11-16/0054, "UL MU CCA Response," Kaiying Lv (ZTE)
  - 11-16/0057, "Indication for UL MU Carrier Sensing," Kiseon Ryu (LG Electronics)
  - 11-16/0065, "Duration/ID field in UL-MU," Tomo Adachi (Toshiba)
  - 11-16/0066, "Views on UL-MU Features," Joonsuk Kim (Apple)

- ✧ 11-16/0067, "MAC Padding in Trigger Frame," Liwen Chu (Marvell)
- ✧ 11-16/0085, "Congestion control for UL MU random access," Woojin Ahn (Yonsei Univ.)
- ✧ 11-16/0091, "Regarding HE NDPA frame for DL Sounding Sequence," Narendar Madhavan (Toshiba)

- Submissions – Spatial Reuse (1 submission)
  - ✧ 11-16/0060, "Recipient-aware Spatial Reuse," Reza Hedayat (Newracom)

- Submissions – TG (4 submissions)
  - ✧ 11-15/1095, "OFDMA Performance in 11ax," Suhwook Kim (LG Electronics)
  - ✧ 11-16/0024, "Proposed draft specification," Robert Stacy (Intel)
  - ✧ 11-16/0043, "Clarification of SFD Texts," John Son (WILUS)
  - ✧ 11-16/0059, "Non-contiguous Channel Bonding in 11ax," Yunbo Li (Huawei)

15. Draft Specification

- Document 11-16/0024r0 was submitted by the TG Editor and it includes a "draft" draft specification.
- The submission was reviewed by the TG Editor and is available on mentor to be reviewed by TG members.
- The submission is available at: https://mentor.ieee.org/802.11/dcn/16/11-16-0024-00-00ax-proposed-draft-specification.docx

16. Plan for Progressing TG Draft

- Approve the TG draft specification during the March 2016 meeting.
- Draft 0.1
- Start a comment collection (CC) for 30 days on draft 0.1 – Ends some time in April.
- Comment resolution (May and July)
- Draft 1.0 in July 2016 and start WG LB.

Goals for March 2016

- Discuss Proposals affecting the TG Specification Framework document
- Approve D0.1 of the TG Draft
- Approve a 30-day Comment Collection Process.

Teleconferences

- Three teleconferences are planned before the March 2016 session.
  - ✧ Thursday, February 4th, 10:00 – 12:00 (ET)
  - ✧ Thursday, February 18th, 20:00 – 22:00 (ET)
  - ✧ Thursday, March 3rd, 10:00 – 12:00 (ET)

November 2015 – Dallas, TX

The TGax planed to have 10 sessions during the week.
One more session was added during the WG opening week plenary session due to the large number of submissions.
Five out of eleven sessions were assigned to the ad hoc group sessions.

Tuesday	Wednesday	Thursday

		TGax		TGax
TGax (PHY)	TGax (MAC)			TGax
TGax (MU)	TGax (SR)	TGax (PHY)	TGax (SR)	TGax
		TGax (PHY)	TGax (MU)	
TGax (PHY)	TGax (MAC)			

Main documents

- TGax Agenda: 11-15-1232-04, TGax November 2015 Meeting Agenda
  - TGax PHY ad hoc agenda: 11-15-1385-03, TGax PHY Ad Hoc Nov 2015 Meeting Agenda
  - TGax MAC ad hoc agenda: 11-15-1382-03, TGax MAC ad hoc Nov 2015 Meeting Agenda
  - TGax Multi-User ad hoc agenda: 11-15-1418-02, TGax MU Ad-hoc November 2015 Agenda
  - TGax Spatial Reuse ad hoc agenda: 11-15-1403-06, 802.11ax Spatial Reuse Ad Hoc Group Agenda
- Closing report: 11-15-1457-00, TGax November 2015 Closing Report
- Draft TGax minutes: 11-15-1368-01, TGax November 2015 Dallas Meeting Minutes
  - TGax PHY ad hoc meeting minutes: 11-15-1442-00, November 2015 Dallas PHY Ad Hoc Meeting Minutes
  - TGax MAC ad hoc meeting minutes: 11-15-1414-00, Nov 2015 Dallas TGax MAC Ad hoc Meeting Minutes
  - TGax Multi-User ad hoc meeting minutes: 11-15-1423-01, November 2015 Dallas TGax MU Ad hoc Meeting minutes
  - TGax Spatial Reuse ad hoc meeting minutes: 11-15-1421-01, Minutes of the IEEE 802.11ax Spatial Reuse ad hoc group meeting – Dallas, November 2015

Achievements

17. TG Documents

- **Passed a number of affecting all aspects of the TG Specification Framework:**
  - PHY – 33 motions passed.
  - MAC – 16 motions passed.
  - MU – 12 motions passed.
  - SR – 1 motion passed.
- **Latest revision of the Specification Framework is available at;**
  - https://mentor.ieee.org/802.11/dcn/15/11-15-0132-10-00ax-spec-framework.docx
- **Approved new revisions of the TGax Simulation Scenario and Evaluation Methodology documents.**
  - Simulation Scenario https://mentor.ieee.org/802.11/dcn/14/11-14-0980-16-00ax-simulation-scenarios.docx
  - Evaluation Methodology https://mentor.ieee.org/802.11/dcn/14/11-14-0571-11-00ax-evaluation-methodology.docx
- Other documents
  - https://mentor.ieee.org/802.11/dcn/14/11-14-0882-04-00ax-tgax-channel-model-document.docx
  - https://mentor.ieee.org/802.11/dcn/14/11-14-1009-02-00ax-proposed-802-11ax-functional-requirements.doc

18. Technical Presentations

83 technical submissions have been covered during the week.
A list of the submissions is available in the agenda document.

- Submissions – PHY

- ✧ 11-15-1059, “SIG-B Encoding Structure Part II,” Ron Porat (Broadcom)
- ✧ 11-15-1289, “Non-Uniform Constellations for 1024-QAM,” Thomas Handte (Sony)
- ✧ 11-15-1303, “LTF Sequence Designs,” Sungho Moon (Newracom)
- ✧ 11-15-1304, “Supported Resource Allocations in SIG-B,” Sungho Moon (Newracom)
- ✧ 11-15-1305, “STBC and Padding Discussions” Hongyuan Zhang (Marvell)
- ✧ 11-15-1309, “Extended Range Support for 11ax,” Sameer Vermani (Qualcomm)
- ✧ 11-15-1310, “11ax LDPC Tone Mapper for 160MHz,” Bin Tian (Qualcomm)
- ✧ 11-15-1311, “11ax Spectral Mask,” Bin Tian (Qualcomm)
- ✧ 11-15-1315, “HE-SIG-B Mapping and Compression,” Kaushik Josiam (Samsung)
- ✧ 11-15-1320, “Maximum Tone Grouping Size for 802.11ax Feedback,” Kome Oteri (InterDigital)
- ✧ 11-15-1321, “Reducing Explicit MIMO Compressed Beamforming Feedback Overhead for 802.11a,” Kome Oteri (InterDigital)
- ✧ 11-15-1322, “Channel Estimation Enhancement and Transmission Efficiency Improvement Using Beam-Change Indication and 1x HE-LTF,” Jianhan Liu (MediaTek)
- ✧ 11-15-1323, “HE-STF Sequence,” Ensung Park (LG Electronics)
- ✧ 11-15-1324, “MCS for HE-SIG-B,” Dongguk Lim (LG Electronics)
- ✧ 11-15-1327, “Diversity Mode in OFDMA,” Yujin Noh (Newracom)
- ✧ 11-15-1329, “Link Adaptation for HE WLAN,” Yujin Noh (Newracom)
- ✧ 11-15-1331, “PHY Padding Capability Signaling,” Daewon Lee (Newracom)
- ✧ 11-15-1332, “Implicit Sounding for HE WLAN,” Daewon Lee (Newracom)
- ✧ 11-15-1334, “HE-LTF Sequence Design,” Le Liu (Huawei)
- ✧ 11-15-1335, “HE-SIG-B Contents,” Le Liu (Huawei)
- ✧ 11-15-1347, “Strategies to reduce MIMO feedback overhead,” Filippo Tosato (Toshiba)
- ✧ 11-15-1349, “Sounding for Uplink Transmission,” Sungho Moon (Newracom)
- ✧ 11-15-1350, “Spatial Configuration And Signaling for MU-MIMO,” Yakun Sun (Marvell)
- ✧ 11-15-1353, “Preamble Formats,” Ron Porat (Broadcom)
- ✧ 11-15-1354, “SIGA fields and Bitwidths,” Ron Porat (Broadcom)
- ✧ 11-15-1357, “Extra tones in the preamble,” Xiaogang Chen (Intel)
- ✧ 11-15-1372, “L-LENGTH Equation Updates,” Hongyuan Zhang (Marvell)

- Submissions – MAC
  - ✧ 11-15-1265, “RTSCTS for UL DL OFDMA Control,” Cheeha Kim (POSTECH)
  - ✧ 11-15-1278, “HE MU Acknowledgment Procedure,” Yongho Seok (Newracom)
  - ✧ 11-15-1300, “DL MU transmission sequence,” Yong Hoon Kwon (Newracom)
  - ✧ 11-15-1318, “Fragmentation for MU frames-Follow up,” Alfred Asterjadhi (Qualcomm)
  - ✧ 11-15-1319, “Scheduled Trigger frames-Follow up,” Alfred Asterjadhi (Qualcomm)
  - ✧ 11-15-1330, “A method of transmitting Multi-STA Block frame,” Jeongki Kim (LG Electronics)
  - ✧ 11-15-1341, “Reception Status of Frames Transmitted in Random Access RUs,” Tomoko Adachi (Toshiba)
  - ✧ 11-15-1344, “Trigger Frame Format,” Simone Merlin (Qualcomm)
  - ✧ 11-15-1345, “Trigger type specific information,” Kiseon Ryu (LG Electronics)
  - ✧ 11-15-1346, “Ack Policy for UL MU Ack transmission,” Kiseon Ryu (LG Electronics)
  - ✧ 11-15-1351, “Rate MCS Selection Rules for M-BA and DL OFDMA BA,” Liwen Chu (Marvell)
  - ✧ 11-15-1352, “broadcast STAID in HE SIG B,” Liwen Chu (Marvell)
  - ✧ 11-15-1355, “Considerations for TDLS transmission in 11ax,” Yingpei Lin (Huawei)
  - ✧ 11-15-1359, “System Performance Evaluation of 802.11ae,” Yu Wang (Ericsson)

- Submissions – Multi-User
  - ✧ 11-15-1280, “Traffic priority for random Multi User Uplink OFDMA,” Stephane Baron (Canon)
  - ✧ 11-15-1301, “NAV Rule for UL MU Response,” Yingpei Lin (Huawei)

- ✧ 11-15-1312, “MU BAR Frame Format,” Reza Hedayat (Newracom)
- ✧ 11-15-1314, “I/Q Imbalance Impact to TGax OFDMA Uplink Reception,” Rui Yang (InterDigital)
- ✧ 11-15-1325, “MU-RTS/CTS Follow Up,” Po-Kai Huang (Intel)
- ✧ 11-15-1326, “NAV Consideration for UL MU Response Follow Up,” Po-Kai Huang (Intel)
- ✧ 11-15-1328, “Scheduling information for UL OFDMA Acknowledgement,”Yujin Noh (Newracom)
- ✧ 11-15-1340, “NDP Announcement for HE Sequence,” Narendar Madhavan (Toshiba)
- ✧ 11-15-1364, “Signaling Trigger Information for STAs in 11ax,” Chittabrata Ghosh (Intel)
- ✧ 11-15-1369, “Random access based buffer status report,” Woojin Ahn (Yunsei Univ.)
- ✧ 11-15-1370, “UL OFDMA Random Access Control,” Jinsoo Ahn (Yonsei Univ.)
- ✧ 11-15-1374, “Consideration for protecting cascading MU DL/UL transmission with MU RTS/CTS,” Jing Ma (NICT)

- Submissions – Spatial Reuse
  - ✧ 11-15-1259, “Use of TG ax Scenarios for Spatial Reuse,” Graham Smith (SR Tecnologies)
  - ✧ 11-15-1284, “Simulation results for spatial reuse in 11ax,” Jinmin Kim (LG Electronics)
  - ✧ 11-15-1313, “Considerations for Spatial Reuse,” Reza Hedayat (Newracom)
  - ✧ 11-15-1316, “DSC calibration results with NS-3,” M. Shahwaiz Afaqui (T.U. Catalonia)
  - ✧ 11-15-1336, “BSS Color Field Size Measurements,” Chuck Lukaszewski (Aruba-HP)
  - ✧ 11-15-1337, “Secondary Channel CCA of HE STA,” John Son (Willus Institute)
  - ✧ 11-15-1338, “Improving Spatial Reuse During OBSS UL MU Procedure,” Geonjung Ko (Willus Institute)
  - ✧ 11-15-1348, “Multiple NAVs for Spatial Reuse,” Sigurd Schelstraete (Quantenna)
  - ✧ 11-15-1427, “Drivers of the dynamic CCA adaptation,” Eduard Garcia-Villegas (Technical Univ. of Catalonia)

- Submissions – TG
  - ✧ 11-15-1288, “An issue of wider bandwidth operation at real denser environment,” Katsuo Yunoki (KDDI R&D Labs)
  - ✧ 11-15-1302, “System Level Simulator Evaluation with/without Capture Effect,” Vida Ferdowsi (Newracom)
  - ✧ 11-15-1360, “Implications of wrap-around for TGax Scenario 3 and Scenario 4 – follow-up,” Marcin Filo (Univ. of Surrey)
  - ✧ 11-15-1361, “Energy consumption with Scheduled PSP,” Dmitry Akhmetov (Intel)
  - ✧ 11-15-1362, “On TGax Scenario 4 channel model – follow-up,” Marcin Filo (Univ. of Surrey)
  - ✧ 11-15-1363, “Regulatory Landscape for Narrowband Transmissions in 11ax,” Ilan Sutskover (Intel)
  - ✧ 11-15-1373, “Updated Box5 Calibration Results,” Narendar Madhavan (Toshiba)
  - ✧ 11-15-1375, “11ax Support for IoT - Requirements and Technological Implications,” Shimo Shilo (Huawei)

Goals for January 2016

- Continue to advance TG documents based on submissions.
  - ➢ Priority to the TG Specification Framework document.
- TG timeline indicates draft D0.1 will be available in January 2016.
- Technical Presentations.

Teleconferences

- One teleconference is planned before the January 2016 session.
  - ✧ Thursday, December 10th, 10:00 – 12:00 (ET)

September 2015 – Bangkok, Thailand

Originally, TGax planned to have ten sessions during the week.
Two more sessions were added during the WG opening week plenary session due to the large number of submissions.
Six out of twelve sessions were assigned to the ad hoc sessions.

	Tuesday		Wednesday		Thursday
			TGax		TGax
	TGax (PHY)	TGax (MAC)			
Gax IAC)	TGax (MU)	TGax (SR)	TGax (PHY)	TGax (SR)	TGax
	TGax		TGax		
Gax IAC)	TGax (MU)	TGax (SR)			

Main documents

- TGax Agenda: 11-15-0987-06, TGax September 2015 Meeting Agenda
  - TGax PHY ad hoc agenda: 11-15-1125-04, TGax PHY Ad Hoc September 2015 Meeting Agenda
  - TGax MAC ad hoc agenda: 11-15-1126-03, TGax MAC ad hoc September 2015 Meeting Agenda
  - TGax Multi-User ad hoc agenda: 11-15-1141-02, TGax MU ad-hoc September 2015 Agenda
  - TGax Spatial Reuse ad hoc agenda: 11-15-1143-03, TGax Spatial Reuse Ad Hoc September 2015 Meeting Agenda
- Closing report: 11-15-1190-00, TGax September 2015 Closing Report
- Draft TGax minutes: 11-15-1093-00, TGax September 2015 Bangkok Meeting Minutes
  - TGax PHY ad hoc meeting minutes: 11-15-1205-00, September 2015 Bangkok PHY Ad Hoc Meeting Minutes
  - TGax MAC ad hoc meeting minutes: 11-15-1130-02, September 2015 TGax MAC Ad hoc Meeting Minutes
  - TGax Multi-User ad hoc meeting minutes: 11-15-1160-00, September 2015 TGax MU Ad hoc Meeting minutes
  - TGax Spatial Reuse ad hoc meeting minutes: 11-15-1206-00, Minutes of the IEEE 802.11ax Spatial Reuse ad hoc group meeting – Bangkok, September 2015

Achievements

19. TG Documents

- **Passed a number of affecting all aspects of the TG Specification Framework:**
  - PHY – 29 motions passed.
  - MAC – 12 motions passed.
  - MU – 15 motions passed.
  - SR – 4 motions passed.
- **Latest revision of the Specification Framework is available at;**
  - https://mentor.ieee.org/802.11/dcn/15/11-15-0132-09-00ax-spec-framework.docx
- **Approved new revisions of the TGax Simulation Scenario and Evaluation Methodology documents.**
  - Simulation Scenario https://mentor.ieee.org/802.11/dcn/14/11-14-0980-14-00ax-simulation-scenarios.docx
  - Evaluation Methodology https://mentor.ieee.org/802.11/dcn/14/11-14-0571-10-00ax-evaluation-methodology.docx
- Other documents

- ✧ https://mentor.ieee.org/802.11/dcn/14/11-14-0882-04-00ax-tgax-channel-model-document.docx
- ✧ https://mentor.ieee.org/802.11/dcn/14/11-14-1009-02-00ax-proposed-802-11ax-functional-requirements.doc

20. Technical Presentations

83 technical submissions have been covered during the week.
A list of the submissions is available in the agenda document.

- PHY
  - ✧ 11-15-0579, "Preamble Design and Auto-detection," Hongyuan Zhang (Marvell)
  - ✧ 11-15-0580, "11ax Coding Discussion," Hongyuan Zhang (Marvell)
  - ✧ 11-15-0602, "HE-LTF squence for UL MU-MIMO," Xiaogang Chen (Intel)
  - ✧ 11-15-0810, "HE PHY Padding and Packet Extension," Hongyuan Zhang (Marvell)
  - ✧ 11-15-0823, "Preamble Design and Auto-Detection for 11ax," Sungho Moon (Newracom)
  - ✧ 11-15-0826, "HE-SIG-A Transmission for Range Extension," Jiayin Zhang (Huawei)
  - ✧ 11-15-0853, "Extensible Preamble Format Design," Leonardo Lanante (Kyutech)
  - ✧ 11-15-1031, "DL MU Signaling," Katsuo Yunoki (KDDI)
  - ✧ 11-15-1051, "HE NDP frame for sounding," Young Hoon Kwon (Newracom)
  - ✧ 11-15-1059, "SIG-B Encoding Structure Part II," Ron Porat (Broadcom)
  - ✧ 11-15-1066, "HE-SIG-B Contents," Kaushik Josiam (Samsung)
  - ✧ 11-15-1068, "Reliable Transmission Scheme for HE-SIG-B and Data," Jianhan Liu (MediaTek)
  - ✧ 11-15-1070, "1024 QAM Proposal," Eunsung Park (LG Electronics)
  - ✧ 11-15-1071, "Tone Grouping Factors and NDP format for 11ax," Sameer Vermani (Qualcomm)
  - ✧ 11-15-1075, "Number of BSS Color bits," Junichi Iwatani (NTT)
  - ✧ 11-15-1077, "HE-SIG-A Content," Jiayin Zhang (Huawei)
  - ✧ 11-15-1088, "LTF Design for Uplink MU-MIMO," Daewon Lee (Newracom)
  - ✧ 11-15-1089, "Considerations on PHY Padding and Packet Extension in 11ax," Yujin Noh (Newracom)
  - ✧ 11-15-1091, "Considerations on Range Extension with SIG-A Repetition," Yujin Noh (Newracom)
  - ✧ 11-15-1092, "Support of 1x/2x/4x OFDM Symbol in HE SU PPDU," Heejung Yu (Yeungnam Univ.)
  - ✧ 11-15-1106, "SIG-B Structure," Reza Hedayat (Newracom)
  - ✧ 11-15-1111, "SIG-B Resource Unit Allocation Coding," Amin Jafarian (Newracom)
  - ✧ 11-15-1119, "Discussions on HE SIG-A Structure," John Son (Wilus Institute)
  - ✧ 11-15-1122, "Identifiers in HE PPDUs for power saving," Alfed Asterjadhi (Qualcomm)

- MAC
  - ✧ 11-15-1013, "802.11ae & 802.11ax," Guido R. Hiertz (Ericsson)
  - ✧ 11-15-1014, "Multiple BSSID Element," Guido R. Hiertz (Ericsson)
  - ✧ 11-15-1015, "Proxy ARB in 802.11ax," Guido R. Hiertz (Ericsson)
  - ✧ 11-15-1033, "Data field in HE PPDU," Yongho Seok (Newracom)
  - ✧ 11-15-1034, "Notification of Operating Mode Changes," Yongho Seok (Newracom)
  - ✧ 11-15-1044, "Further Study of 11ax Multicast," Kazuyuki Sakoda (Sony)
  - ✧ 11-15-1052, "Bandwidth for UL MU transmission," Young Hoon Kwon (Newracom)
  - ✧ 11-15-1060, "Receive Operating Mode Indication for Power Save," Eric Wong (Apple)
  - ✧ 11-15-1063, "11ax Channel access procedure," Chao-Chun Wang (MediaTek)
  - ✧ 11-15-1067, "MU TXOP truncation," Jeongki Kim (LG Electronics)
  - ✧ 11-15-1096, "Recovery Procedures in Cascading Sequences," John Son (Wilus Institute)
  - ✧ 11-15-1098, "ACK/BA frame for UL MU under cascading structure," Narendar Madhavan (Toshiba)
  - ✧ 11-15-1114, "Airtime Analysis of EDCA," Sean Coffey (RealTek)
  - ✧ 11-15-1115, "High Efficiency in Accessing the Medium," Sean Coffey (RealTek)

- 11-15-1116, “Trigger Frame Channel Access,” Jinsoo Ahn (Yonsei Univ.)
- 11-15-1120, “Buffer Status Report,” Alfred Asterjadhi (Qualcomm)
- 11-15-1121, “HE A-Control field,” Alfred Asterjadhi (Qualcomm)
- 11-15-1137, “Triggered OFDMA Random Access Observations,” Russell Huang (MediaTek)

- Multi-User
  - 11-15-1043, “Overall Protocol of UL MU BA for Multicast Transmission,” Kazuyuki Sakoda (Sony)
  - 11-15-1047, “RU selection process upon TF-R reception,” Stephane Baron (Canon)
  - 11-15-1053, “Multiuser Block ACK Request (MU-BAR),” Guoqing Li (Apple)
  - 11-15-1057, “Multiple Resource Unit Allocation for TGax OFDMA,” Kome Oteri (InterDigital)
  - 11-15-1062, “NAV Consideration for UL MU Response to Trigger frame,” Po-Kai Huang (Intel)
  - 11-15-1065, “11ax uplink Multi-TID aggregation,” Chao-Chun Wang (MediaTek)
  - 11-15-1086, “Consideration on multi-STA BA frame indication,” Jing Ma (NICT)
  - 11-15-1097, “Reducing Channel Sounding Protocol Overhead for 11ax,” Narendar Madhavan (Toshiba)
  - 11-15-1102, “Fragmentation with MU Operation,” Chittabrata Ghosh (Intel)
  - 11-15-1103, “DL Sounding Sequence with UL MU Feedback,” Chittabrata Ghosh (Intel)
  - 11-15-1105, “UL OFDMA-based Random Access Procedure,” Chittabrata Ghosh (Intel)
  - 11-15-1107, “Power Save with Random Access,” Chittarata Ghosh (Intel)
  - 11-15-1117, “Regarding UL MU protection,” Woojin Ahn (Yonei Univ.)
  - 11-15-1123, “Acknowledgement to DL MU,” Liwen Chu (Marvell)
  - 11-15-1129, “Feedback overhead in DL-MU-MIMO,” Filippo Tosato (Toshiba)

- Spatial Reuse
  - 11-15-1045, “Dynamic CCA control and TPC Simulation Results with SS1-SS3,” Takeshi Itagaki (Sony)
  - 11-15-1058, “CCA consideration for UL MU transmission,” Kiseon Ryu (LG Electronics)
  - 11-15-1069, “Adaptive CCA and TPC,” James Wang (MediaTek)
  - 11-15-1081, “Further consideration on receive behaviour based on the cascading structure and the BSS color scheme,” Jing Ma (NICT)
  - 11-15-1082, “Analysis of BSS and ESS Structure During Concurrent SR Transmissions,” Chuck Lukaszewski (Aruba/HP)
  - 11-15-1083, “Cost/Benefit Analysis of SR Techniques,” Chuck Lukaszewski (Aruba/HP)
  - 11-15-1101, “DSC/DCCA Calibration with TGax Agreed Scenarios,” Masahito Mori (Sony)
  - 11-15-1104, “TXOP Considerations for Spatial Reuse,” Reza Hedayat (Newracom)
  - 11-15-1109, “OBSS NAV and PD Threshold Rule for Spatial Reuse,” Rossi Jun Luo (Huawei)
  - 11-15-1110, “BSS TXOP,” Amin Jafarian (Newracom)
  - 11-15-1118, “Discussions on Spatial Reuse Enhancement,” Geonjung Ko (WILUS)
  - 11-15-1138, “To DSC or not to DSC,” Filip Mestanov (Ericsson)

- Simulation and Calibration and others
  - 11-15/1039, “Spatial Reuse Measurements,” Chuck Lukaszewski (Aruba Networks, a HP company)
  - 11-15-1046, “MAC calibration results,” Stephane Baron (Canon)
  - 11-15-1048, “On TGax Scenario 4 channel model,” Marcin Filo (Univ. of Surrey)
  - 11-15-1049, “Implications of wrap-around for TGax Scenario 3 and Scenario 4,” Marcin Filo (Univ. of Surrey)
  - 11-15-1056, “Clarifying Link Level Simulator Assumptions,” Kome Oteri (InterDigital)
  - 11-15-1087, “MU BFee Interference channel feedback,” Sigurd Schelstraete (Quantenna)
  - 11-15-1095, “OFDMA performance in 11ax,” Suhwook Kim (LG Electronics)

- ✧ 11-15-1099, "Power Save Simulation Results," Hyeyoung Choi (LG Electronics)
- ✧ 11-15-1100, "Discussion on Deep and Shallow Sleep States," Chittabrata Ghosh (Intel)
- ✧ 11-15-1113, "Box5 Calibration results," Vida Ferdowsi (Newracom)
- ✧ 11-15-1134, "11ax Support for IoT," Shimi Shilo (Huawei)
- ✧ 11-15-1135, "Results for SS6 calibration case for single BSS and OBSS," Esa Tuomaala (Nokia)

Goals for November 2015

- Continue to advance TG documents based on submissions.
  - ➢ Priority to the TG Specification Framework document.
- Technical Presentations.

Teleconferences

- One teleconference is planned before the November 2015 session.
  - ✧ Thursday, October 15th, 10:00 – 12:00 (ET)

July 2015 – Waikoloa, HI

Originally, TGax planned to have nine sessions during the week.
Two more sessions were added during the mid-week plenary session (marked red).
Four out of eleven sessions were ad hoc sessions.

Tuesday		Wednesday		Thursday
				TGax
TGax (PHY)	**TGax (MAC)**			**TGax**
TGax (Multi-User)	**TGax (Spatial Reuse)**	**TGax (PHY)**	**TGax (MAC)**	**TGax**
		TGax (PHY)	**TGax (Multi-User)**	**TGax**
	TGax			

Main documents

- TGax Agenda: 11-15-0735-05, TGax July 2015 Meeting Agenda
  - ➢ TGax PHY ad hoc agenda: 11-15-0898-03, TGax PHY Ad Hoc Jul 2015 Meeting Agenda
  - ➢ TGax MAC ad hoc agenda: 11-15-0888-02, TGax MAC ad hoc July 2015 Meeting Agenda
  - ➢ TGax Multi-User ad hoc agenda: 11-15-0899-02, TGax MU ad-hoc July 2015 Agenda
  - ➢ TGax Spatial Reuse ad hoc agenda: 11-15-0911-01, 802.11ax Spatial Reuse Ad Hoc Group
- Closing report: 11-15-0963-00, TGax July 2015 Closing Report
- Draft TGax minutes: 11-15-0884-00, TGax July 2015 Waikoloa Meeting Minutes
  - ➢ TGax PHY ad hoc meeting minutes: 11-15-0913-00, July 2015 Hawaii PHY Ad Hoc Meeting Minutes
  - ➢ TGax MAC ad hoc meeting minutes: 11-15-0922-01, July 2015 Hawaii TGax MAC Ad hoc Meeting Minutes
  - ➢ TGax Multi-User ad hoc meeting minutes: 11-15-0949-01, July 2015 Hawaii TGax MU Ad hoc Meeting minutes

- TGax Spatial Reuse ad hoc meeting minutes: 11-15-0971-01, Minutes of the IEEE 802.11ax Spatial Reuse ad hoc group meeting

Achievements

21. TG Documents

- **Passed a number of PHY, MAC and MU motions affecting the TGax Specification Framework:**
  - PHY Motions: SIG-A, SIG-B, Pilots, etc.
  - MAC Motions: Trigger frame, etc.
  - MU Motions: Trigger frame for random access, MU CTS, etc.
- **Latest revision of the Specification Framework is available at;**
  - https://mentor.ieee.org/802.11/dcn/15/11-15-0132-07-00ax-spec-framework.docx
- **Approved new revisions of the TGax Simulation Scenario and Evaluation Methodology documents.**
  - Simulation Scenario https://mentor.ieee.org/802.11/dcn/14/11-14-0980-14-00ax-simulation-scenarios.docx
  - Evaluation Methodology https://mentor.ieee.org/802.11/dcn/14/11-14-0571-10-00ax-evaluation-methodology.docx
- Other documents
  - https://mentor.ieee.org/802.11/dcn/14/11-14-0882-04-00ax-tgax-channel-model-document.docx
  - https://mentor.ieee.org/802.11/dcn/14/11-14-1009-02-00ax-proposed-802-11ax-functional-requirements.doc

22. Technical Presentations

More than 70 technical submissions have been covered during the week.
A list of the submissions is available in the agenda document.

- PHY
  - 11-15-0579, "preamble design and autodetection," Hongyuan Zhang (Marvell)
  - 11-15-0580, "11ax coding discussion," Hongyuan Zhang (Marvell)
  - 11-15-0602, "HE-LTF sequence for UL MU-MIMO," Qinghua Li (Intel)
  - 11-15-0805, "SIG-B field for HEW PPDU," Young Hoon Kwon (Newracom)
  - 11-15-0810, "HE PHY Padding and Packet Extension," Hongyuan Zhang (Marvell)
  - 11-15-0812, "Pilot Design for Data Section," Sameer Vermani (Qualcomm)
  - 11-15-0813, "CP Indication for UL MU Transmission," Zhigang Rong (Huawei)
  - 11-15-0816, "Interleaver and Tone Mapper for OFDMA," Yakun Sun (Marvell)
  - 11-15-0817, "P Matrix for HE-LTF," Yakun Sun (Marvell)
  - 11-15-0819, "11ax OFDMA Tone Plan Leftover Tones and Pilot Structure," Bin Tian (Qualcomm)
  - 11-15-0821, "HE SIG-B Structure," Joonsuk Kim (Apple)
  - 11-15-0822, "SIG-A Structure in 11ax Preamble," Jianhan Liu (MediaTek)
  - 11-15-0823, "Preamble Design and Auto-Detection for 11ax," Sungho Moon (Newracom)
  - 11-15-0824, "Pilot Design for 11ax Downlink Transmissions," Yujin Noh (Newracom)
  - 11-15-0826, "HE-SIG-A transmission for range extension," Jiayin Zhang (Huawei)
  - 11-15-0827, "Considerations on HE-SIG-A and B," Katsuo Yunoki (KDDI Labs)
  - 11-15-0832, "Performance evaluation of SU/MU MIMO in OFDMA," Jiayin Zhang (Huawei)
  - 11-15-0845, "LTF Design for Uplink MU-MIMO," Daewon Lee (Newracom)
  - 11-15-0853, "Extensible Preamble Format Design," Leonardo Lanante (Kyushu Institute of Technology)
  - 11-15-0865, "Discussion of ACI performance and ACI requirements for IEEE 802.11ax," Leif Wilhelmsson (Ericsson AB)
  - 11-15-0868, "Impact of Frequency Selective Scheduling Feedback for OFDMA," Hakan Persson (Ericsson)

- 11-15-0873, “SIG-B Encoding Structure,” Ron Porat (Broadcom)
- 11-15-0887, “Efficient padding for last OFDM symbol,” Heejung Yu (Newracom)

- MAC
  - 11-15-0615, “DL OFDMA Bandwidth,” Liwen Chu (Marvell)
  - 11-15-0803, “Frame Collision Information Management,” Peng Shao (NEC Communication Systems)
  - 11-15-0831, “Broadcast and Unicast (Trigger) in DL MU,” Liwen Chu (Marvell)
  - 11-15-0841, “Cascading Structure,” David Xun Yang (Huawei Technologies)
  - 11-15-0851, “HE Trigger Frame Format,” John Son (WILUS Institute)
  - 11-15-0856, “Compressed Uplink Trigger Frame,” Vida Ferdowsi (Newracom)
  - 11-15-0871, “Efficiency enhancement for 802.11ax,” Guido R. Hiertz (Ericsson)
  - 11-15-0872, “802.11ai and 802.11ax,” Guido R. Hiertz (Ericsson)
  - 11-15-0874, “Minimal data rates management frame transmissions in 2.4 GHz,” Guido R. Hiertz (Ericsson)
  - 11-15-0876, “Duration and MAC Padding for MU PPDU,” Simone Merlin (Qualcomm)
  - 11-15-0877, “Trigger Frame Format,” Simone Merlin (Qualcomm)
  - 11-15-0878, “Issues on Trigger Frame Retransmission,” Jinsoo Ahn (Yonsei Univ.)
  - 11-15-0880, “Scheduled Trigger frames,” Alfred Asterjadhi (Qualcomm)
  - 11-15-0914, “Enlarged minimal contention window size,” Guido R. Hiertz (Ericsson)

- Multi-User
  - 11-15-0800, “Multiplexing of Acknowledgements for Multicast Transmission,” Yusuke Tanaka (Sony)
  - 11-15-0806, “Protection for MU transmission,” Young Hoon Kwon (Newracom)
  - 11-15-0818, “Further Analysis of Feedback and Frequency Selective Scheduling (FSS) for TGax OFDMA,” Kome Oteri (InterDigital Communication)
  - 11-15-0829, “Uplink ACK and BA Multiplexing,” Reza Hedayat (Newracom)
  - 11-15-0843, “UL MU OFDMA analysis,” Yonggang Fang (ZTE)
  - 11-15-0852, “Transmission Interval of Trigger Frames,” Leonardo Lanante (Kyushu Institute of Technology)
  - 11-15-0854, “DL OFDMA Signalling,” Tomoko Adachi (Toshiba)
  - 11-15-0855, “How to collect STAs’ Tx demands for UL MU,” Tomoko Adachi (Toshiba)
  - 11-15-0858, “MU BFee Interference channel feedback,” Sigurd Schelstraete (Quantenna)
  - 11-15-0859, “A mechanism for incremental updates to MU precoding,” Sigurd Schelstraete (Quantenna)
  - 11-15-0867, “MU-RTS/CTS for DL MU,” Po-kai Huang (Intel)
  - 11-15-0875, “Random Access with Trigger Frames using OFDMA,” Chittabrata Ghosh (Intel)
  - 11-15-0881, “Regarding buffer status of UL-STAs in UL-OFDMA,” Woojin Ahn (Yonsei Univ.)

- Spatial Reuse
  - 11-15-0797, “NAV Operation for Spatial Reuse,” Yongho Seok (Newracom)
  - 11-15-0801, “DCCA/DSC Reference Simulation Results,” Masahito Mori (Sony)
  - 11-15-0804, “Outdoor Enterprise Scenario and DSC,” Graham Smith (SR Technologies)
  - 11-15-0807, “DSC Summary,” Graham Smith (SR Technologies)
  - 11-15-0811, “Topics for Consideration for Spatial Reuse,” Xiaofei Wang (InterDigital)
  - 11-15-0882, “DSC leveraging uplink RTS/CTS control,” M. Shahwaiz Afaqui (Technical University of Catalonia)
  - 11-15-0883, “Follow Up Discussion on The Receiver Behavior,” Yasuhiko Inoue (NTT)
  - 11-15-0886, “DSC Calibration Results,” Chinghwa Yu (MediaTek)

- Simulation and Calibration and others

- 11-15-0754, "WLAN Packet traffic and efficiency analysis," Jim Lansford (CSR)
- 11-15-0781, "Summary of Power Save Calibration Results," Eric Wong (Apple)
- 11-15-0787, "Power Save Calibration Results," Eric Wong (Apple)
- 11-15-0788, "Box 1 and Box 2 calibration results," Takeshi Itagaki (Sony)
- 11-15-0789, "Proposed Changes to Evaluation Methodologies," Allan Jones (Activision)
- 11-15-0802, "Box5 Calibration Results of SS6," Jiyong Pang (Huawei)
- 11-15-0814, "Simulation Results for Box5 Calibration," Ke Yao (ZTE)
- 11-15-0833, "Calibration results for PSP and UAPSD for 20, 40 and 80MHz bands," Dmitry Akhmetov (Intel)
- 11-15-0680, "Reference Box5 Calibration Assumptions and Parameters," Jiyong Pang (Huawei)
- 11-15-0849, "Simulation Results for Box5 Calibration," Rongzhen Yang (Intel)
- 11-15-0869, "OFDMA and VoIP Capacity," Hakan Persson (Ericsson)
- 11-15-0870, "802.11ax in 2.4 GHz," Guido R. Hiertz (Ericsson)
- 11-15-0885, "Box 5 Calibration Results," ChingHwa Yu (MediaTek)

Goals for September 2015

- Continue to advance TG documents based on submissions.
  - Priority to the TG Specification Framework document.
- Technical Presentations.

Teleconferences

- One teleconference is planned before the September 2015 session.
  - Thursday, August 20th, 10:00 – 12:00 (ET)

May 2015 – Vancouver, BC, Canada

TGax had eight sessions during the week. Four out of eight sessions were ad hoc sessions.

	Tuesday		Wednesday		Thursday
					TGax
	TGax (Multi-User)	**TGax (Spatial Reuse)**			
TGax (MAC)	**TGax (PHY)**	**TGax (Spatial Reuse)**	**TGax (PHY)**	**TGax (Multi-User)**	**TGax**
			TGax		

Main documents

- TGax Agenda: 11-15-0500-08, TGax May 2015 Meeting Agenda
  - TGax PHY ad hoc agenda: 11-15-0640-04, TGax PHY Ad Hoc May 2015 Meeting Agenda
  - TGax MAC ad hoc agenda: 11-15-0599-02, TGax MAC ad hoc May 2015 Meeting Agenda
  - TGax Multi-User ad hoc agenda: 11-15-0645-01, TGax MU ad-hoc May 2015 Agenda
  - TGax Spatial Reuse ad hoc agenda: 11-15-0650-02, 802.11ax Spatial Reuse Ad Hoc Group
- Closing report: 11-15-00692-01, TGax May 2015 Closing Report
- Draft TGax minutes: 11-15-0622-00, TGax May 2015 Vancouver Meeting Minutes
  - TGax PHY ad hoc meeting minutes: 11-15-0651-02, May 2015 Vancouver PHY Ad Hoc Meeting Minutes

- TGax MAC ad hoc meeting minutes: 11-15-0637-00, May 2015 Vancouver TGax MAC Ad hoc Meeting Minutes
- TGax Multi-User ad hoc meeting minutes: 11-15-0679-00, May 2015 Vancouver Multi-User ad hoc Meeting minutes
- TGax Spatial Reuse ad hoc meeting minutes: 11-15-0662-01, May 2015 Vancouver Spatial Reuse ad hoc Meeting Minutes

Achievements

23. TG Documents

- **Passed a number of PHY and MAC motions affecting the TGax Specification Framework:**
  - PHY Motions: Tone Plans, STF design, SIG-B, etc.
  - MAC Motions: Enhancing multi-STA BA and aspects of the trigger frame
- **Latest revision of the Specification Framework is available at;**
  - https://mentor.ieee.org/802.11/dcn/15/11-15-0132-05-00ax-spec-framework.docx
- **Approved new revisions of the TGax Evaluation Methodology documents.**
  - https://mentor.ieee.org/802.11/dcn/14/11-14-0571-09-00ax-evaluation-methodology.docx
- Other documents
  - https://mentor.ieee.org/802.11/dcn/14/11-14-0980-12-00ax-simulation-scenarios.docx
  - https://mentor.ieee.org/802.11/dcn/14/11-14-0882-04-00ax-tgax-channel-model-document.docx
  - https://mentor.ieee.org/802.11/dcn/14/11-14-1009-02-00ax-proposed-802-11ax-functional-requirements.doc

24. Technical Presentations

More than 50 technical submissions have been covered during the week.
A list of the submissions is available in the agenda document.

- PHY
  - 11-15/0550, "L-preamble issues for UL-OFDMA," Katsuo Yunoki (KDDI Labs)
  - 11-15/0553, "Enhancing Performance of Hybrid-ARQ with Linear Constellation Precoding," Muhammad Mehboob Fareed (King Abdullah Univ. of Science and Technology)
  - 11-15/0569, "Performance of 1x, 2x, and 4x HE-LTF," Kome Oteri (InterDigital)
  - 11-15/0572, "Inefficiency of 256-FFT per 20MHz," Heejung Yu (Yeungnam Univ./Newracom)
  - 11-15/0574, "SIG structure for UL PPDU," Young Hoon Kwon (Newracom)
  - 11-15/0575, "Preamble Structure in 802.11ax," Yujin Noh (Newracom)
  - 11-15/0577, "Pilot Design for 11ax," Daewon Lee (Newracom)
  - 11-15/0579, "Preamble design and auto-detection," Hongyuan Zhang (Marvell)
  - 11-15/0580, "11ax coding discussion," Hongyuan Zhang (Marvell)
  - 11-15/0584, "Considerations on LTF Sequence Design," Sungho Moon (Newracom)
  - 11-15/0600, "Non Uniform Constellations for 1024QAM," Daniel Schneider (Sony)
  - 11-15/0602, "HE-LTF sequence for UL MU-MIMO," Qinghua Li (Intel)
  - 11-15/0621, "Design Principles for HE Preamble," John Son (WILUS)
  - 11-15/0381, "HE-STF Proposal," Yakun Sun (Marvell)

- MAC
  - 11-15/0567, "Multi-STA BA for SU Transmissions," Xiaofei Wang (InterDigital)
  - 11-15/0604, "Random Access with Trigger Frames using OFDMA," Chittabrata Ghosh (Intel)
  - 11-15/0611, "Multi-STA Block ACK Protection," Jinsoo Ahn (Yonsei Univ.)
  - 11-15/0615, "UL OFDMA Bandwidth," Liwen Chu (Marvell)
  - 11-15/0617, "Duration and MAC Padding for UL MU PPDUs," Gang Ding (Qualcomm)
  - 11-15/0626, "Further consideration for Multi-STA Block ACK frame," Jeongki Kim (LG)

- Multi-User
  - 11-15/0378, “Channel Sensing in UL OFDMA,” Reza Hedayat (Newracom)
  - 11-15/0568, “Frequency Selective Scheduling (FSS) for TGax OFDMA,” Kome Oteri (InterDigital)
  - 11-15/0586, “Frequency Diversity Options in OFDMA,” Reza Hedayat (Newracom)
  - 11-15/0587, “Uplink ACK and BA Multiplexing,” Reza Hedayat (Newracom)
  - 11-15/0597, “Beamformed HE PPDU,” Yongho Seok (Newracom)
  - 11-15/0608, “Regarding trigger frame in UL MU,” Tomo Adachi (Toshiba)
  - 11-15/0612, “Multi Channel availability for UL-OFDMA,” Woojin Ahn (Yonsei Univ.)

- Spatial Reuse
  - 11-15/0543, “Simulation Scenario changes for Frequency Re-use,” Graham Smith (SR Technologies)
  - 11-15/0544, “Proposed text additions to 14/980 for frequency re-use,” Graham Smith (SR Technologies)
  - 11-15/0548, “Enterprise Scenario and DSC,” Graham Smith (SR Technologies)
  - 11-15/0588, “CCA revisited II,” Amin Jafarian (Newracom)
  - 11-15/0595, “Discussion on The Receiver Behavior for CCAC/DSC with BSS Color,” Yasuhiko Inoue (NTT)

- Simulation and Calibration
  - 11-15/0551, “OBSS Preamble Detection,” Suhwook Kim (LG Electronics)
  - 11-15/0552, “IEEE 802.11 performance in dense, cellular-like, outdoor deployments,” Richard Edgar (Imagination Technologies)
  - 11-15/0330, “OFDMA Numerology and Structure,” Sharnaz Azizi (Intel)
  - 11-15/0583, “OBSS Preamble Error Probability,” Jiyong Pan (Huawei)
  - 11-15/0590, “Traffic Model Updates to Evaluation Methodology,” Phil Barber (Huawei)

  - ~~11-14/1392, “Simulation results for Box-5 calibration,” Suhwook Kin (LG Electronics)~~
  - 11-15/0674, “Joint submission for Box 5 Calibration,” Suhwook Kin (LG Electronics)
  - 11-15/0581, “LSP Correlation Clarification for Scenario 4,” Daewon Lee (Newracom)
  - 11-15/0582, “Clarifications to Box 2 MIMO simulation calibrations,” Daewon Lee (Newracom)
  - 11-15/0373, “Mixed traffic configurations on simulation scenarios,” Yingpei Lin (Huawei)
    - Not presented since the contents of this submission was merged into 11-15/0590.
  - 11-15/0610, “Simulation Results for Box 5 Calibration,” Vida Ferdowsi (Newracom)
  - 11-15/0613, “Box 5 Calibration Result,” Chinghwa Yu (MediaTek)
  - 11-15/0623, “TGax simulation scenario “Box 5” – calibration results,” Guido Hiertz (Ericsson)

  - 11-15/0316, “Power Save Calibrations,” Hyeyoung Choi (LG Electronics)
  - 11-15/0564, “802.11ax Calibration and Modeling Adjacent Channel Interference,” Naveen Kakani (CSR)
  - 11-15/0576, “Latency and Power Consumption in State Transitions,” Chittabrata Ghosh (Intel)
  - 11-15/0592, “More Power Save Calibration Results,” Eric Wong (Apple)
  - 11-15/0598, “U-APSD Enhancement for HE,” Jarkko Kneckt (Nokia)
  - 11-15/0603, “Calibration Results for PSP and U-APSD,” Chittabrata Ghosh (Intel)

Goals for July 2015

- Continue to advance TG documents based on submissions.

- Expectation is more submissions affecting the TG specification framework document will be considered.
- Technical Presentations.

Teleconferences

- One teleconference is planned before the July 2015 session.
  - Thursday, June 18th, 10:00 – 12:00 (ET)

March 2015 – Berlin, Germany

The original plan was to have nine sessions during the week, but one more session was added (Wednesday PM2).

Monday	Tuesday	Wednesday	Thursday
TGax (ad hoc)		**TGax (MU/Spatial Reuse)**	**TGax**
	TGax (PHY/MAC)		
TGax	**TGax**	**TGax**	**TGax**
		TGax	
	TGax		

Main documents

- Agenda: 11-15/0235r8, TGax March 2015 Meeting Agenda
- Closing report: 11-15/0465r0, TGax March 2015 Closing Report
- Minutes: 11-15/0309r1, TGax March 2015 Berlin Meeting Minutes

Achievements

25. Passed a number of motions affecting the TG specification framework:

- PHY motions related to LTF design and SIG-B.
- MAC motions related to Multi-User Block ACK and Multi-User Procedure
- MU motions related to ACK multiplexing
- Etc.

26. TG Documents.

- Approved new revisions of Simulation Scenarios and Evaluation Methodology TG documents.
  - https://mentor.ieee.org/802.11/dcn/14/11-14-0571-08-00ax-evaluation-methodology.docx
  - https://mentor.ieee.org/802.11/dcn/14/11-14-0980-09-00ax-simulation-scenarios.docx
- Other TG documents.
  - https://mentor.ieee.org/802.11/dcn/14/11-14-0882-04-00ax-tgax-channel-model-document.docx
  - https://mentor.ieee.org/802.11/dcn/14/11-14-1009-02-00ax-proposed-802-11ax-functional-requirements.doc

27. Technical Presentations

Following technical submissions have been covered during the week.

- MAC
  - 11-15/0320, "GCR-BA with Measurement Report Performance in OBSS," Yuichi Morioka (SONY)

- ✧ 11-15/0336, “MAC Overhead Analysis of MU Transmissions,” Xiaofei WANG (InterDigital)
- ✧ 11-15/0362, “Beacon Transmission Issues,” Yonggang Fang (ZTE)
- ✧ 11-15/0365, “UL MU Procedure,” Kiseon Ryu (LG Electronics)
- ✧ 11-15/0366, “Multi-STA BA,” Simone Merlin (Qualcomm)
- ✧ 11-15/0376, “UL-MU MAC Throughput Under Non-Full Buffer Traffic,” Tatsumi Uwai (Radrix Co. Ltd)

- Spatial Reuse
  - ✧ 11-15/0300, “Potential of Modified Signal Detection Thresholds,” Gustav Wikstrom (Ericsson AB)
  - ✧ 11-15/0318, “CCA Regime Evaluation Revisited,” Amin Jafarian (Newracom Inc.)
  - ✧ 11-15/0319, “Impact of TPC coupled to DSC for legacy unfairness issue,” Masahito Mori (Sony)
  - ✧ 11-15/0338, “Discussions on the Definition of CCA Threshold,” Akira Kishida (NTT)
  - ✧ 11-15/0367, “OBSS preamble detection,” Gwen Barriac (Qualcomm)
  - ✧ 11-15/0371, “Proposal and simulatin based evaluation of DSC-AP Algorithm,” Eduard Garcia-Villegas (UPC)
  - ✧ 11-15/0374, “Further Considerations on Legacy Fairness with Enhanced CCA,” John Son (WILUS Institute)

- PHY
  - ✧ 11-15/0305, “Effective Subcarrier Assignment for DL-OFDMA,” Katsuo Yunoki (KDDI R&D Laboratories)
  - ✧ 11-15/0330, “OFDMA Numerology and Structure,” Shahrnaz Azizi (Intel Corporation)
  - ✧ 11-15/0344, “SIG field design principle for 11ax,” Young Hoon Kwon (Newracom)
  - ✧ 11-15/0349, “HE-LTF Proposal,” Hongyuan Zhang (Marvell)
  - ✧ 11-15/0358, “Numerology for 11ax,” Daewon Lee (Newracom)
  - ✧ 11-15/0360, “Preamble Auto-Detection for 802.11ax,” Sungho Moon (NEWRACOM)
  - ✧ 11-15/0364, “11ax Preamble design: training sequence,” Sigurd Schelstraete (Quantenna)
  - ✧ 11-15/0375, “Minimum Resource Granularity in OFDMA,” John Son (WILUS Institute)
  - ✧ 11-15/0378, “Channel Sensing in UL OFDMA,” Reza Hedayat (Newracom)
  - ✧ 11-15/0380, “Discussion on OFDMA scheduling for 802.11ax,” Le Liu (Huawei Technologies)
  - ✧ 11-15/0381, “HE-STF Proposal,” Yakun Sun (Marvell)
  - ✧ 11-15/0383, “Impact of number of sub-channels in OFDMA,” Leif Wilhelmsson (Ericsson)

- Multi-User
  - ✧ 11-15/0331, “Uplink Multi-User MIMO Protocol Design,” Yongho Seok (NEWRACOM)
  - ✧ 11-15/0333, “Throughput Comparison of Some Multi-user Schemes in 802.11ax,” Kome Oteri (InterDigital)
  - ✧ 11-15/0336, “MAC Overhead Analysis of MU Transmissions,” Xiaofei WANG (InterDigital)
  - ✧ 11-15/0353, “OFDMA Non-contiguous Channel Utilization,” Jinsoo Ahn (Yonsei univ.)
  - ✧ 11-15/0354, “Bandwidth granularity on UL-OFDMA data allocation,” Woojin Ahn (Yonsei Univ.)
  - ✧ 11-15/0363, “UL MU Synchronization Requirements,” Yonggang Fang (ZTE)
  - ✧ 11-15/0377, “Considerations on UL MU Resource Scheduling,” Leonardo Lanante (Kyutech)
  - ✧ 11-15/0379, “DL OFDMA Performance and ACK Aggregation,” Reza Hedayat (Newracom)
  - ✧ 11-15/0384, “Discussion on DL-OFDMA Sub-channel Indication Method,” Yu Cai (Lenovo)

- Simulation and Calibration
  - ✧ 11-14/1392, “Simulation results for Box-5 calibration,” Suhwook Kim (LG Electronics)
  - ✧ 11-14/1434, “SLS Box4 Calibration Results,” Russell Huang (MediaTek Inc.)

- ✧ 11-15/0053, “Box5 Results of 11ac SS6,” Jiyong Pang ‘Huawei)
- ✧ 11-15/0072, “U-APSD power saving calibration results,” Yanchun Li (Huawei)
- ✧ 11-15/0125, “Box 1 and Box 2 Calibration Results,” Ron Porat (Broadcom)
- ✧ 11-15/0304, “Evaluating Power Save Performance,” Joonsuk Kim (Apple)
- ✧ 11-15/0306, “Power Save Mode Calibration Results,” Eric Wong (Apple)
- ✧ 11-15/0307, “MAC calibration results for Test 4,” Ke Yao (ZTE Corp.)
- ✧ 11-15/0308, “Simulation results for box 5,” Ke Yao (ZTE Corp.)
- ✧ 11-15/0314, “Sleep States in IEEE 802.11ax Simulation Scenarios,” Chittabrata Ghosh (Intel)
- ✧ 11-15/0316, “Power Save Calibration,” Hyeyoung Choi (LG)
- ✧ 11-15/0326, “U-APSD Enhancements for HE,” Jarkko Kneckt (Nokia)
- ✧ 11-15/0327, “Microsleep for HE STA,” Jarkko Kneckt (Nokia)
- ✧ 11-15/0343, “In Situ Frame Size Measurements,” Chuck Lukaszewski (Aruba Networks)
- ✧ 11-15/0351, “Empirical Measurements of Channel Degradation Under Load,” Chuck Lukaszewski (Aruba Networks)
- ✧ 11-15/0357, “Scenario 1 CCA Simulation,” Knut Odman (Broadcom Corporation)
- ✧ 11-15/0359, “Clarification of MIMO Box2 calibration,” Jaehyun Ahn (Newracom)
- ✧ 11-15/0368, “Box 5 results for Single BSS Calibration Case,” Esa Tuomaala (Nokia)
- ✧ 11-15/0369, “MAC calibration test 4 simulation results,” Enrico-Henrik Rantala (Nokia)
- ✧ 11-15/0370, “MAC Calibration Results,” Guoqing Li (Apple)
- ✧ 11-15/0372, “Corrections on Reference Traffic Profile for Scenario 2 in Simulation Scenarios Document,” Yingpei Lin (Huawei)
- ✧ 11-15/0373, “Mixed traffic configurations on simulation scenarios,” Yingpei Lin (Huawei)
- ✧ 11-15/0382, “MAC calibration test 4 simulation results,” Yanchun Li (Huawei)
- ✧ 11-15/0441, “Proposed text to TGax Simulation Scenarios MAC test 4,” Enrico-Henrik Rantala (Nokia)

Goals for May 2015

- Continue to advance TG documents based on submissions.
  - ➢ Expectation is more submissions affecting the TG specification framework document will be considered.
- Technical Presentations.

Teleconferences

- Two teleconferences are planned before the May 2015 session.
  - ✧ Thursday, April 9th, 10:00 – 12:00 (ET)
  - ✧ Thursday, April 30th, 20:00 – 22:00 (ET)

January 2015 – Atlanta, GA

The original plan was to have nine sessions during the week, but one session was cancelled.

	Monday	Tuesday	Wednesday	Thursday
AM1			**TGax**	**TGax**
AM2	**TGax**	**TGax**		
PM1	**TGax**	**TGax**	**TGax**	**TGax (canceled)**
PM2				
PM3	**TGax**			

Main documents

- Agenda: 11-14/1578r6, TGax January 2015 Meeting Agenda
- Closing report: 11-15/0186r0, TGax January 2015 Closing Report
- Draft minutes: 11-15/0090r0, TGax January 2015 Atlanta Meeting Minutes

Achievements

28. TG Structure

- Ad hoc chairs elected.

MAC	PHY	MU	Spatial Reuse
Eric Wong (Apple)	Bo Sun (ZTE)	Sigurd Schelstraete (Quantenna)	Laurent Cariou (Orange)
Reza Hedayat (NEWRACOM)	Jianhan Liu (MediaTak)	Kiseon Ryu (LG Electronics)	Guido Hiertz (Ericsson AB)
Brian Hart (Cisco)	Yakun Sun (Marvell)	Kaushik Josiam (Samsung)	Jae Seung Lee (ETRI)

29. TG Documents.

- Passed a number of motions affecting the TG specification Framework.
- Approved new revisions of Simulation Scenarios and Evaluation Methodology TG documents.
  - ✧ TGax Simulation Scenarios (11-14/0980r6)
  - ✧ TGax Evaluation Methodology (11-14/0571r7).

30. Technical Presentations

Following technical submissions have been covered during the week.

- DSA and CCA
  - ✧ 15/0025, "DSC and Roaming," Graham Smith (SR Technologies)
  - ✧ 15/0027, "Simulation Based Evaluation DSC in residential scenario," M. Shahwaiz Afaqui (UPC)
  - ✧ 15/0045, "Performance Analysis of BSS Color and DSC," Masahito Mori (Sony)
  - ✧ 15/0050, "Modeling components impacting throughput gain from CCAT adjustment," Yu Wang (Ericsson AB)
  - ✧ 15/0085, "Legacy Fairness Issues of Enhanced CCA," John Son (WILUS Institute)
  - ✧ 15/0105, "Dynamic CCA Management," Sean Coffey (RealTek)

- OFDMA
  - ✧ 15/0034, "DL-OFDMA Map Frame," Katsuo Yunoki (KDDI Labs)
  - ✧ 15/0066, "Downlink OFDMA Protocol Design," Yongho Seok (Newracom)
  - ✧ 15/0079, "OFDM Numerology for 11ax," Daewon Lee (Newracom)
  - ✧ 15/0091, "UL-OFDMA Procedure in IEEE 802.11ax," Woojin Ahn (Yonsei Univ.)
  - ✧ 15/0092, "DL-OFDMA Procedure in IEEE 802.11ax," Jinsoo Ahn (Yonsei Univ.)

- MU
  - ✧ 15/0010, "draft for integrated UL DL MU MIMO Frame Format," Tae-Yoon Kim (Korea Univ.) – Not presented
  - ✧ 15/0029, "Discussion on integrated UL/DL MU-MIMO," Tae-Yoon Kim (Korea Univ.) – Not presented
  - ✧ 15/0040, "Discussion on integrated UL-DL MU-MIMO-MAC," TaeYoon Kim (Korea Univ.)
  - ✧ 15/0064, "Consideration on UL-MU overheads," Tomoko Adachi (Toshiba)
  - ✧ 15/0086, "Uplink MU Transmission and Legacy Coexistence," Reza Hedayat (NEWRACOM)
  - ✧ 15/0089, "MAC Efficiency Gain of Uplink Multi-user Transmission," Leonardo Lanante Jr (Kyushu Inst. of Tech.)

- MAC
  - 15/0035, "Scalable Channel Utilization," Katsuo Yunoki (KDDI R&D Laboratories)
  - 15/0037, "Structural Format Change," Kyonggi University
  - 15/0046, "11aa GCR-BA Performance in OBSS," Yuichi Morioka (Sony)
  - 15/0059, "Uplink RTS/CTS Control," Sigurd Schelstraete (Quantenna)

- PHY
  - 15/0048, "Non-Uniform Constellations for Higher Order QAMs," Daniel Schneider (Sony)
  - 15/0068, "Support of outdoor environments," Young Hoon Kwon (NEWRACOM)
  - 15/0079, "OFDM Numerology for 11ax," Daewon Lee (NEWRACOM)
  - 15/0081, "Considerations on 11ax Auto-detection Methods," Jaeyoung Song (KAIST)
  - 15/0082, "Considerations on 11ax OFDMA Frequency Granularity," Young-bin Kim (KAIST)
  - 15/0097, "Performance Analysis of Frequency Selective Scheduling," Ningbo Zhang (BUPT)
  - 15/0099, "Payload Symbol Size for 11ax," Sriram Venkateswaran (Broadcom)
  - 15/0101, "Preamble structure for 11ax system," Jiayin Zhang (Huawei)

- Simulation Scenario and Evaluation Methodology
  - 14/1342, "MAC Calibration Results," Igor Kim (ETRI)
  - 14/1343, "Multicast Scenarios for MAC Calibration," Igor Kim (ETRI)
  - 14/1392, "Simulation Results for Box-5 Calibration," Suhwook Kim (LGE)
  - 14/1523, "Offline Discussion Minutes of SLS Calibration," Jiyong Pang (Huawei)
  - 14/1590, "Multi-wall penetration loss model for HEW system level simulation," Kejun Zhao et al. (National Engineering Research Center for Broadband Networks & Applications)
  - 14/1597, "PHY abstraction and performance for outdoor channel models," Kejun Zhao et al. (National Engineering Research Center for Broadband Networks & Applications)
  - 15/0022, "MAC Calibration Results," Xiaofei Wang (InterDigital)
  - 15/0044, "Proposed Changes to Simulation Scenarios," Masahito Mori (Sony)
  - 15/0051, "Box5 Calibration Results," Jiyong Pang (Huawei)
  - 15/0052, "Box5 Results of One BSS Case," Jiyong Pang (Huawei)
  - 15/0053, "Box5 Results of 11ac SS6," Jiyong Pang (Huawei)
  - 15/0061, "FPS Network Traffic Model," Allan Jones (Activision)
  - 15/0065, "11ax EMD Revision Straw Poll," Jiyong Pang (Huawei)
  - 15/0071, "MAC calibration test 4 results," Yanchun Li (Huawei)
  - 15/0072, "U-APSD power saving calibration results," Yanchun Li (Huawei)
  - 15/0073, "Simulation Results of Box5," Ke Yao (ZTE)
  - 15/0078, "Clarification on calibration test cases," Guoqing Li (Apple)
  - 15/0080, "MAC Calibration Results," Geonjung Ko (WILUS Institute)
  - 15/0093, "Text Update on PHY Abstraction and SP," Yakun Sun (Marvell)
  - 15/0103, "Power Save Calibration," Yarkko Kneckt (Nokia)
  - 15/0104, "SLS MAC Test 4 Results," Chinghwa Yu (MediaTek)

- Others
  - 15/0043, "In-band Full Duplex Radios and System Performance," Kapseok Chang (ETRI)
  - 15/0075, "Operating Rules for TGax Ad Hoc groups," Osama Aboul-Magd (TGax chair)
  - 15/0076, "Field Sample OBSS and Client Data," Carol Ansley (ARRIS Group)

Goals for March 2015

- Continue to advance TG documents.
  - Expectation is more submissions affecting the TG specification framework document will be considered.

- Technical Presentations.

Teleconferences

- One teleconference is planned before the March 2015 session.
  - ✧ Thursday, February 26th, 10:00 – 12:00 (ET)

November 2014 – San Antonio, TX

The original plan was to have nine sessions during the week, but one session was cancelled.

	Monday	Tuesday	Wednesday	Thursday
AM1	**TGax (ad hoc)**			**TGax**
AM2		**TGax**		
PM1		**TGax**	**TGax**	**TGax**
PM2	**TGax**	**TGax**		
PM3		**TGax (cancelled)**		

Main documents

- Agenda: 11-14/1319r7, TGax November 2014 Meeting Agenda
- Closing report: 11-14/1536r0, TGax November 2014 Closing Report
- Draft minutes: 11-14/1460r0, TGax November 2014 Meeting Minutes

Achievements

31. Discussions on the TG Structure

- The TG approved a motion to create four ad hoc groups.
  - ✧ PHY, MAC, Multiuser and Spatial Reuse
- The TG approved a motion to have 3 co-chairs for each of the ad hocs.
- Ad hoc chairs election is scheduled for January 2015 meeting on Tuesday.
- Ad hoc meetings will start on March 2015
- Robert Stacy (Intel) was appointed as the technical editor of the TGax.

32. TG Documents – The group approved updated documents.

- The group approved the first version of TGax Specification Framework document (11-14/1453r2).
- The group approved new revisions of the following documents.
  - ✧ TGax Simulation Scenarios (11-14/0980r5)
  - ✧ TGax Evaluation Methodology (11-14/0571r6).

33. Technical Presentations

About 35 technical submissions covered during the week.

- Evaluation Methodology
  - ✧ 11-14/1388, “Consideration on PER Prediction for PHY Abstraction,” Bo Sun (ZTE Corp)
  - ✧ 11-14/1418, “Further Study of Time Varying Interference and PHY Abstraction,” Yakun Sun (Marvell)
  - ✧ 11-14/1420, “The Impact of Preamble Error on MAC System Performance,” Po-Kai Huang (Intel)

- 11-14/1424, "Proposed Changes to Evaluation Methodology and Simulation Scenario," Yuichi Morioka (Sony)
- 11-14/1440, "A Few Corrections to Video Traffic Model," Guoqing Li (Apple)

- Simulation Scenarios and Calibration
  - 11-14/1177, "Discussion about Box5 Calibration," Jiyong Pang (Huawei)
  - 11-14/1342, "MAC Calibration Results," Igor Kim (ETRI)
  - 11-14/1343, "Multicast Scenarios for MAC Calibration," Igor Kim (ETRI)
  - 11-14/1392, "Simulation results for Box 5 calibration," Suhwook Kim (LG Electronics)
  - 11-14/1402, "Box1 and Box3 calibration results," Masahito Mori (Sony)
  - 11-14/1419, "SLS Box5 Calibration Results and Discussions," Yakun Sun (Marvell)
  - 11-14/1434, "TGax SLS Box4 Calibration Results," Russell Huang (MediaTek Inc.)
  - 11-14/1441, "Simulation Setting of Box5 Calibration," Jiyong Pang (Huawei)
  - 11-14/1444, "Energy Efficiency Evaluation and Simulation Model," Chinghwa Yu (MediaTek)
  - 11-14/1449, "MAC Calibration Results," Newracom
  - 11-14/1450," Box 0 calibration results," Hongsup Lee (Newracom)
  - 11-14/1451, "Box 1 and Box 2 Calibration Results," Jaehyun Ahn (Newracom)

- Technology/Others
  - 11-14/1228, "Issues on 256-FFT per 20MHz," Heejung Yu (NEWRACOM/YU)
  - 11-14/1380, "Efficiency Measurement for RTS/CTS," Katsuo Yunoki (KDDI R&D Laboratories)
  - 11-14/1381, "Novel RTS/CTS Procedure," Katsuo Yunoki (KDDI R&D Laboratories)
  - 11-14/1382, "Responses to the comments on doc.1169," Katsuo Yunoki (KDDI R&D Laboratories)
  - 11-14/1397, "Discussion on Frame Structure for Future WLAN Systems with OFDMA," Myeong-Jin Kim (Korea University)
  - 11-14/1403, "Performance Analysis of BSS Color and DSC," Masahito Mori (Sony)
  - 11-14/1404, "11aa GCR-BA Performance in OBSS," Yuichi Morioka (Sony)
  - 11-14/1416, "Observed protocol violations caused by DSC with roaming STAs," Chuck Lukaszewski (Aruba Networks)
  - 11-14/1417, "HEW PPDU Transmission Discussion," Yongho Seok (NEWRACOM)
  - 11-14/1426, "DSC and legacy coexistence," Gustav Wikstrom et al. (Ericsson)
  - 11-14/1427, "DSC Performance," Gustav Wikstrom et al. (Ericsson)
  - 11-14/1428, "Clear Channel Assessment for OFDMA PHY," K. C. Chen (NTU) and D. J. Deng (NCUE)
  - 11-14/1431, "Issues on UL-OFDMA Transmission," Young Hoon Kwon (Newracom)
  - 11-14/1433, "Protocol and signaling framework for OFDMA," Sigurd Schelstraete (Quantenna)
  - 11-14/1435, "Considerations on OBSS Spatial Re-Use," Jianhan Liu (Mediatek Inc.)
  - 11-14/1436, "Overhead Analysis for Simultaneous Downlink Transmissions," Pengfei Xia (interdigita)
  - 11-14/1437, "Efficient Wider Bandwidth Operation in IEEE 802.11ax," Jinsoo Ahn (Yonsei Univ)
  - 11-14/1439, "Preamble Considerations in Large Channel Delay Spread Scenarios," Daewon Lee (Newracom)
  - 11-14/1442, "Considerations on DL OFDMA control mechanism," Woojin Ahn (Yonsei Univ.)
  - 11-14/1443, "Adapting CCA and Receiver Sensitivity," Esa Tuomaala (Nokia)
  - 11-14/1446, "Analysis of frequency and power requirements for UL-OFDM," Leif Wilhelmsson (Ericsson)
  - 11-12/1448, "Considerations for Adaptive CCA," Reza Hedayat (Newracom)
  - 11-14/1452, "Frequency selective scheduling in OFDMA," Leif Wilhelmsson (Ericsson)

- Specification Framework
  - 11-14/1429, "Proposed 802.11ax specification framework document," Minho Cheong (Newracom)
  - 11-14/1432, "Proposed 802.11ax specification framework – background," Minho Cheong (Newracom)
  - 11-14/1447, "Proposed Spec Framework Document for 11ax considering potential tech features," John Son (WILUS Institute), Young Doo Kim (SK Telecom)
  - 11-14/1453, "Spec Framework Proposal," Robert Stacey (Intel)

Goals for January 2015

- Elect ad hoc chairs – 3 co-chairs/ad hoc group as agreed.
- Continue to advance TG documents.
- Technical Presentations.

Teleconferences

- One teleconference is planned before the January 2015 session.
  - Thursday, December 4th, 10:00 – 12:00 (ET)
    - Chair had sent out call for submissions on the TGax reflector.

September 2014 – Athens, Greece

TGax had nine sessions during the week.

	Monday	Tuesday	Wednesday	Thursday
AM1				**TGax**
AM2	**TGax**	**TGax**		
PM1		**TGax**	**TGax**	**TGax**
PM2	**TGax**	**TGax**		
PM3	**TGax**			

Main documents

- Agenda: 11-14/1033r5, TGax September 2014 Meeting Agenda
- Closing report: 11-14/1304r0, TGax September 2014 Closing Report
- Draft minutes: 11-14/1159r1, TGax September 2014 Meeting Minutes

Achievements

34. The group elected two vice chairs and discussed about the TG structure.

- Election of Vice Chairs took place during this meeting. The TG Vice Chairs are:
  - Simone Merlin (Qualcomm)
  - Ron Porat (Broadcom)
- The group started discussion on the Ad Hoc groups. Discussion will continue in future meetings.

35. The group approved minutes from the July 2014 San Diego meeting.

- 11-14/0864r0, July 2014 San Diego Meeting Minutes

36. TG Documents – The group approved updated documents.

- The TGax Simulation Scenarios (11-14/0980r4) and the TGax Evaluation Methodology (11-14/0571r5).
- The TGax Channel Model document (11-14-0882r4).
- The TGax Functional Requirements document (11-14-1009r2).

37. Technical Presentations

54 submissions were uploaded on the server and 52 of them were covered during the week.

- Functional Requirements
  - ✧ 11-14/0636, "Discussion on Functional Requirements," David Xun Yang (Huawei Technologies)
  - ✧ 11-14/0920, "Considerations of Functional Requirements Documents," David Xun Yang (Huawei Technologies)
  - ✧ 11-14/1009, "Proposed 802.11ax Functional Requirements," Lei Wang (Marvell)
  - ✧ 11-14/1164, "Meaningful 11ax Functional Requirements," Joe Kwak (InterDigital)
  - ✧ 11-14/1167, "TGax Functional Requirement Discussion," Yonggang Fang (ZTE)
  - ✧ 11-14/1170, "Functional Requirements Discussions on Coex with Legacy STAs," Masahito Mori (Sony)
  - ✧ 11-14/1234, "Requirements Discussion," Joseph Levy (InterDigital)

- Simulation Scenarios and Calibration
  - ✧ 11-14/0800, "Box 1 and Box 2 Calibration Results," Nihae Jindal (Broadcom)
  - ✧ 11-14/1147, "MAC Simulator Calibration Results," Shoko Shinohara, Akira Kishida (NTT)
  - ✧ 11-14/1175, "MAC Calibration results," Suhwook Kim (LG Electronics)
  - ✧ 11-14/1177, "Discussion about Box5 Calibration," Jiyong Pang (Huawei Technologies)
  - ✧ 11-14/1187, "The Effect of Preamble Error Model on MAC Simulator," Po-Kai Huang (Intel)
  - ✧ 11-14/1191, "MAC calibration results," Zhou Lan (Huawei Technologies)
  - ✧ 11-14/1192, "MAC calibration results comparison," Zhou Lan (Huawei Technologies)
  - ✧ 11-14/1198, "Additional Test Cases for MAC calibration," Gwen Barriac (Qualcomm)
  - ✧ 11-14/1217, "MAC Calibration Results for Test 1 and 2," Esa Tuomaala (Nokia)
  - ✧ 11-14/1223, "Stadium Measurements," Brian Hart (Cisco Systems)
  - ✧ 11-14/1226, "SLS Box 1&2 Calibration Results," Russell Huang (MediaTek)
  - ✧ 11-14/1230, "MAC Calibration Result," Chinghwa Yu (MediaTek)

- Evaluation Methodology
  - ✧ 11-14/1161, "Parameters for Power Save Mechanisms," Eric Wong (Apple)
  - ✧ 11-14/1162, "Energy Efficiency Evaluation Methodology Follow Up," Eric Wong (Apple)
  - ✧ 11-14/1174, "PHY Abstraction with Time Varying Interference," Yakun Sun (Marvell)
  - ✧ 11-14/1176, "PHY abstraction tables for 11ax system level simulation," Jiayin Zhang (Huawei Technologies)
  - ✧ 11-14/1221, "Traffic Generator for OBSS Calibration Case," Chao-Chun Wang (MediaTek)

- Channel Model
  - ✧ 11-14/1214, "Impact of correlated shadowing in 802.11ax system evaluations," Leif Wilhelmsson (Ericsson AB)
  - ✧ 11-14/1222, "Doppler Effect Evaluation for 11ax," Jianhan Liu (MediaTek)

- Technology/Others
  - ✧ 11-14/1106, "WLAN Frame Collision Information," Peng Shao (NEC Communication Systems)
  - ✧ 11-14/1148, "Consideration of asynchronous interference in OBSS environment," Koichi Ishihara (NTT)
  - ✧ 11-14/1168, "802.11 TGax PHY Frame Structure Discussion for Enabling New Contention Mechanism," Yonggang Fang (ZTE)
  - ✧ 11-14/1169, "DL-FDMA considerations," Katsuo Yunoki (KDDI R&D Labs.)
  - ✧ 11-14/1171, "DSC Simulation Results for Scenario 3," Masahiro Mori (Sony)
  - ✧ 11-14/1172, "Multicast Performance in OBSS," Yuichi Morioka (Sony)
  - ✧ 11-14/1178, "Inter-BSS interference in WLANs," Hyunduk Kang (ETRI)

- 11-14/1179, "Considerations for Partial Band Interference between WLAN Systems," Gwangzeen Ko (ETRI)
- 11-14/1180, "Discussions on Interference between TD-LTE & WLAN around 2.4GHz Band," Meng Yang (CATR)
- 11-14/1181, "Measurements on A-MPDU performances under various channel conditions," John Sun (WILUS Institute)
- 11-14/1186, "Comparisons of Simultaneous Downlink Transmissions," Pengfei Xia (InterDigital)
- 11-14/1190, "Frame Exchange Control for Uplink Multi-user transmission," Kaying Lv (ZTE)
- 11-14/1199, "Effect of CCA in residential scenario part 2," Gwen Barriac (Qualcomm)
- 11-14/1207, "OBSS reuse mechanism which preserves fairness," Laurent Cariou (Orange)
- 11-14/1208, "MAC considerations on 802.11ax OFDMA," Jinsoo Ahn (Yonsei Univ.)
- 11-14/1209, "Multiple RF operation for 802.11ax OFDMA," Woojin Ahn (Yonsei Univ.)
- 11-14/1210, "HEW PPDU Format for Supporting MIMO-OFDMA," Yongho Seok (NEWRACOM)
- 11-14/1211, "ACK Procedure for OFDMA," Yongho Seok (NEWRACOM)
- 11-14/1216, "Consideration on Coexistence between LTE-U and 802.11 WLAN," Jae Seung Lee (ETRI)
- 11-14/1224, "Link-Aware CCA," Brian Hart (Cisco Systems)
- 11-14/1225, "Considerations on CCA for OBSS Opearation in 802.11ax," Luo Jun (Huawei Technologies)
- 11-14/1227, "OFDMA Performance Analysis," Tianyu Wu (MediaTek)
- 11-14/1128, "Issues on 256-FFT per 20MHz," Heejung Yu (NEWRACOM)
- 11-14/1229, "Dynamic OFDM Symbol Duration," Alan Jauh (MediaTek)
- 11-14/1232, "On MU Aggregation Mechanisms for 11ax," Reza Hedyat (NEWRACOM)
- 11-14/1233, "Adaptive CCA for 11ax," Reza Hedyat (NEWRACOM)

Goals for November 2014

- Continue to advance TG documents.
- Technical Presentations.

Teleconferences

- One teleconference is planned before the November 2014 session.
  - Thursday, October 9th, 10:00 – 12:00 (ET)
    - Chair had sent out call for submissions on the TGax reflector.

July 2014 – San Diego, CA

TGax had ten sessions during the week.

	Monday	Tuesday	Wednesday	Thursday
AM1	**TGax**		**TGax**	**TGax**
AM2		**TGax**		
PM1			**TGax**	**TGax**
PM2	**TGax**	**TGax**	**TGax**	
PM3		**TGax**		

Main documents

- Agenda: 11-14/0748r6, TGax July 2014 Meeting Agenda

- Closing report: 11-14/0984r1, TGax July 2014 Closing Report
- Draft minutes: 11-14/0864r0, July 2014 Meeting Minutes

Achievements

38. The group discussed on the TG structure.

- The group will have two vice chairs to be election during the initial meeting slot of TGax in September 2014.
  - ✧ Chair has sent out the call for nominations to the reflector.
- The group will have some ad hoc groups in the future, however, the discussion on the ad hoc structure was deferred.

39. The group approved minutes from the May 2014 Waikoloa meeting and Teleconference on July 2nd, 2014.

- 11-14/0655r3, May 2014 Waikoloa Meeting Minutes
- 11-14/0788r2, Minutes from the teleconference on July 2nd, 2014

40. TG Documents – The group discussed and approved following documents as current TG documents.

- The group approved new version of the Simulation Scenarios (11-14/0980r1) and Evaluation Methodology (11-14/0571r3) documents.
- The group approved the initial version of the TGax Channel Model document (11-14-0882r3).
- The group adopted the initial version of the TGax Selection Procedure (11-14-0938r4).
- The group had discussion on the Functional Requirements document.

41. Technical Presentations

More than 40 submissions were covered during the week.

- Simulation Scenarios and Calibration
  - ✧ 11-14/0799, "Modifications to Simulation Scenarios and Calibration Process," Nihar Jindal (Broadcom)
  - ✧ 11-14/0800, "Box 1 and Box 2 Calibration Results," Nihar Jindal (Broadcom)
  - ✧ 11-14/0803, "Packet Length for Box 0 Calibration," Wookbong Lee (LG Electronics)
  - ✧ 11-14/0850, "Clarification for MAC Calibration," Gwen Barriac (Qualcomm)
  - ✧ 11-14/0851, "Proposed Rate Control for MAC Simulator," Gwen Barriac (Qualcomm)
  - ✧ 11-14/0859, "Proposing a Stadium Scenario," Hakan Persson (Ericsson)
  - ✧ 11-14/0860, "Text proposal of a Stadium scenario to ax," Hakan Persson (Ericsson)
  - ✧ 11-14/0869, "MAC calibration results," Zhou Lan (Huawei)
  - ✧ 11-14/0871, "Further Calibration Results towards Integrated System Level Simulation," Jiyong Pang (Huawei)
  - ✧ 11-14/0892, "MAC Calibration Text to Simulation Scenarios," Jarkko Kneckt (Nokia)
  - ✧ 11-14/0894, "Calibration of System Level Simulators," Sayantan Choudhury (Nokia)
  - ✧ 11-14/0895, "Calibration of MAC simulator with OBSS Network Scenario," Chao-CHun Wang (MediaTek)

- Evaluation Methodology
  - ✧ 11-14/0571, " Evaluation Methodologies," Ron Porat (Broadcom)
  - ✧ 11-14/0810, "RBIR-based PHY Abstraction with Channel Estimation Error," Yukun Sun (Marvell)
  - ✧ 11-14/0811, "Overview on RBIR-based PHY Abstraction," Yukun Sun (Marvell)
  - ✧ 11-14/0827, "Energy Efficiency Evaluation Methodology," Eric Wong (Apple)
  - ✧ 11-14/0865, "ACI and AACI for 802.11ax System Simulations," Yu Cai (Huawei)
  - ✧ 11-14/0866, "Traffic modeling and system capacity performance measure," Johan Soder (Ericsson)
  - ✧ 11-14/0873, "PHY Abstraction Table for 11ax System Level Simulations," Jiayin Zhang (Huawei).
  - ✧ 11-14/0874, "Unified Traffic Model on Enterprise Scenario," Phillip Barber (Huawei)

- 11-14/0875 "VoIP Traffic Model Content for 11ax TG Simulation Scenarios & Evaluation Methodology," Phillip Barber (Huawei)

- Channel Models
  - 11-14/0882, "IEEE 802.11ax Channel Model Document," Jianhan Liu (Mediatek inc.)
  - 11-14/0904 "In-Cabin WiFi Channel Channel: Preliminary Ray Tracing Simulations," Fan Bai (General Motors)

- Functional Requirements
  - 11-14/0567, "Proposed 802.11ax Functional Requirements," Lei Wang (Marvell)
  - 11-14/0818, "Synchronization Requirements," Yonggang Fang (ZTE)
  - 11-14/0821, "Coexistence Requirements of 802.11 WLAN and LTE in Unlicensed Spectrum," Alireza Babaei (CableLabs).
  - 11-14/0835, "Functional Requirements Discussion," Joe Kwak (InterDigital)

- Technology/Others
  - 11-14/0779, "Dynamic Sensitivity Control Practical Usage," Graham Smith (DSP Group)
  - 11-14/0801, "Envisioning 11ax PHY Structure - Part II," Dongguk Lim(LG Electronics)
  - 11-14/0802, "Consideration on UL MU transmission," Jinyoung Chun (LG Electronics)
  - 11-14/0804, "Envisioning 11ax PHY Structure – Part I," Jinsoo Choi (LG Electronics)
  - 11-14/0832, "Performance Evaluation of OBSS Densification," Po-Kai Huang (Intel)
  - 11-14/0833, "Residential Scenario Sensitivity and Transmit Power Control Simulation Results," Ron Murias (InterDigital)
  - 11-14/0838, "Discussion on dual-link STR in IEEE 802.11ax," Jinsoo Ahn (Yonsei Univ)
  - 11-14/0839, "Discussion on OFDMA in IEEE 802.11ax," Jinsoo Ahn (Yonsei Univ)
  - 11-14/0846, "Changing CCA in the Residential Environment," Gwen Barriac (Qualcomm)
  - 11-14/0847, "Further Considerations on Enhanced CCA for 11ax," John Son (WILUS Institute)
  - 11-14/0854, "DSC and Legacy Coexistence," Yuichi Morioka (SONY)
  - 11-15/0855, "Techniques for Short Downlink Frames," Brian Hart (Cisco Systems)
  - 11-15/0856, "Evaluating Dynamic CCA/Receiver Sensitivity Algorithms," Brian Hart (Cisco Systems)
  - 11-14/0858, "Analysis on Multiplexing Schemes exploiting frequency selectivity," Kaushik Josiam (Samsung)
  - 11-14/0861, "Impact of CCA adaptation on spatial reuse in dense residential scenario," Sayantan Choudhury (Nokia)
  - 11-14/0868, "UL & DL DSC and TPC MAC simulations," Johan Soder (Ericsson)
  - 11-14/0872, "A Protocol Framework for Dynamic CCA," Sean Coffey (Realtek)
  - 11-14/0880, "Increased Network Throughput with Channel Width Related CCA and Rules," James Wang (Mediatek)
  - 11-14/0889, "Performance Gains from CCA Optimization," Nihar Jindal (Broadcom)

42. Timeline: There are no changes in the timeline.

- TGax initial timeline approved during the May 2014 Waikoloa session.
  - May 2014 - TG kick off
  - Nov. 2014 - start working on the Specification Framework
  - Jul. 2016 - Draft 1.0 to be ready
  - Mar. 2017 - Draft 2.0 to be ready
  - 1H/2019 - publication of the IEEE 802.11ax amendment

Goals for September 2014

- TG vice-chairs election.
- Continue to advance TG documents.
- Technical Presentations.

Teleconferences

- One teleconference is planned before the September 2014 session.
  - ✧ Thursday, August 14th, 10:00 – 12:00 (ET)
    - ➢ Chair had sent out call for submissions on the TGax reflector.

May 2014 – Waikoloa, Big Island, HI

TGax had nine sessions during the week.

	Monday	Tuesday	Wednesday	Thursday
AM1			**TGax**	**TGax**
AM2	**TGax**	**TGax**		
PM1				**TGax**
PM2	**TGax**	**TGax**		
PM3	**TGax**	**TGax**		

Main documents

- Agenda: 11-14/0478r5, TGax May 2014 Meeting Agenda
- Closing report: 11-14/0702r0, TGax May 2014 Closing Report
- Draft minutes: 11-14/0655r1, May 2014 Waikoloa Meeting Minutes

Achievements

43. The group elected the chairperson and the secretary.

- Chairperson: Osama Aboul-Magd (Huawei Technologies)
- Secretary: Yasuhiko Inoue (NTT)
- Other officer positions and TG structure will be discussed during the July 2014 meeting.

44. The group approved minutes from the March 2014 Beijing meeting and Teleconference on April 17th 2014.

- 11-14/0380r1, March 2014 Beijing Meeting Minutes
- 11-14/0530r0, Minutes from the teleconference on April 17th, 2014

45. TG Documents

- The group approved initial version of the Simulation Scenarios (11-14/0621r4) and Evaluation Methodology (11-14/0571r2) documents.
- The group started the discussion related to Functional Requirements document. Expectation is to approve the initial revision of the document in July.
- Discussion related to Channel Model document is expected to start in July.

46. Technical Presentations

40 submissions were covered during the week.

- 11-14/0527, "PHY Abstraction for TGax System Level Simulations", Pengfei Xia (InterDigital)
- 11-14/0546, "IEEE 802.11ax High Efficiency WLAN Packet measurements around Boulder Colorado", Jim Lansford (CSR)
- 11-14/0567, "Proposed 802.11ax Functional Requirements", Lei Wang (Marvell)
- 11-14/0571, "11ax Evaluation Methodologies", Ron Porat (Broadcom)
- 11-14/0577, "Path Loss Model for Scenario 1," Nihar Jindal (Broadcom)
- 11-14/0578, "Residential Scenario CCA/TPC Simulation Discussion," Frank La Sita (InterDigital)
- 11-14/0581, "Further Discussions on PHY Abstraction," Yakun Sun (Marvell)

- 11-14/0582, "Calibrating MAC Simulator Through Function Test," Jinjing Jiang (Marvell)
- 11-14/0583, "Further Discussions on Instantaneous SINR Calibration for System Simulation," Yakun Sun (Marvell)
- 11-14/0584, "System Level Simulations on Beamforming and Link Adaptation," Yan Zhang (Marvell)
- 11-14/0585, "PHY Abstractions for and IEEE 11ax PHY System Simulation and Integrated System Level Simulation," Jianhan Liu (MediaTek)
- 11-14/0586, "Automotive Considerations for the Simulation Scenarios," Igal Kotzer (General Motors)
- 11-14/0594, "Insert Virtual Desktop Infrastructure (VDI) Traffic Model Content for HEW Simulation Scenarios," Yingpei Lin (Huawei)
- 11-14/0595, "Edits on Some Traffic Content for HEW SG Simulation Scenarios," Yingpei Lin (Huawei)
- 11-14/0598, "Uplink multi-user MAC protocol for 11ax," Tran Thi Thao Nguyen (Kyushu Inst. of Tech.)
- 11-14/0600, "Proposed Calibration For MAC simulator," Gwen Barriac (Qualcomm)
- 11-14/0604, "Modeling and Evaluating Variable Bit rate Video Streaming for 802.11ax," Chao-Chun Wang (MediaTek)
- 11-14/612, "Calibration Procedures towards Integrated System Level Simulation," Jiayin Zhang (Huawei)
- 11-14/0613, "Discussions on adaptive frame length in MAC based on block ACK," Ningbo Zhang (BUPT)
- 11-14/0614, "Joint Coding and Modulation Diversity with LRA MMSE VP by QR precoding MIMO," Ningbo Zhang (BUPT)
- 11-14/0616, "CSMA/CA Enhancement Suggestion," Yonggang Fang (ZTE)
- 11-14/0617, "Discussion on timeline for 802.11ax," Laurent Cariou (Orange)
- 11-14/0620, "Link Adaptation for PHY SLS calibration," Jinyoung Chun (LG Electronics)
- 11-14/0621, "TGax Simulation Scenarios," Simone Merlin (Qualcomm)
- 11-14/0624, "Investigation on 1024 QAM feasibility in 11ax," Eunsung Park (LG Electronics)
- 11-14/0625, "Multi-channel operation in Simulation scenarios," Suhwook Kim (LG Electronics)
- 11-14/0626, "IEEE 802.11ax Functional Requirements," SangHyun Chang (Samsung)
- 11-14/0627, "Outdoor Channel Models for System Level Simulations," Kaushik Josiam (Samsung)
- 11-14/0628, "Measurements on CCA Thresholds in OBSS Environment," John Son (WILUS Institute), Young Doo Kim (SK Telecom)
- 11-14/0634, "Consideration on MAC system calibration," Zhou Lan (Huawei)
- 11-14/0635, "Dynamic Sensitivity Control Implementation," Graham Smith (DSP Group)
- 11-14/0636, "Consideration on functional requirements," Zhou Lan (Huawei)
- 11-14/0637, "Spatial Reuse and Coexistence with Legacy Devices," James Wang (MediaTek)
- 11-14/0647, "PHY abstraction method comparison," Tianyu Wu (MediaTek)
- 11-14/0648, "Performance Observation of a Dense Campus Network," Chinghwa Yu (MediaTek)
- 11-14/0649, "802.11ax Timeline Scenarios," Rolf de Vegt (Qualcomm)
- 11-14/0656, "How to Describe 802.11ax Functional Requirements," Minho Cheong
- 11-14/0660, "802.11ax Timeline," Minho Cheong (NEWRACOM)
- 11-14/0677, "Comparison of Calibration Methodology for MAC Simulation," Chinghwa Yu (MediaTek)
- 11-14/0682, "In Situ Spectrum Reuse Measurements in Indoor 20,000 Seat Arena," Chuck Lukaszewski (Aruba Networks)

47. Timeline

- The group approved initial timeline.
  - ✧ May 2014 - TG kick off
  - ✧ Nov. 2014 - start working on the Specification Framework

- ✧ Jul. 2016 - Draft 1.0 to be ready
- ✧ Mar. 2017 - Draft 2.0 to be ready
- ✧ 1H/2019 - publication of the IEEE 802.11ax amendment

Goals for July 2014

- Continue to advance simulation scenarios (11-14/0621) and Evaluation Methodologies (11-14/0571) documents.
- Approve an initial Functional Requirements documents
- Approve an initial Channel Model document.
- Discuss and approve TG structure and process.
- Technical Presentations.

Teleconferences

- Three teleconferences are planned before the July 2014 session.
  - ✧ Wednesday, June 4th, 10:00 – 12:00 (ET)
  - ✧ Wednesday, June 18th, 20:00 – 22:00 (ET)
  - ✧ Wednesday, July 2nd, 10:00 – 12:00 (ET)

  Details of the meeting information will be announced on the reflector.

March 2014 – Beijing, China

HEW study group had seven sessions during the week.

	Monday	Tuesday	Wednesday	Thursday
AM1			**HEW**	**HEW**
AM2		**HEW**		
PM1				**HEW**
PM2	**HEW**	**HEW**		
PM3		**HEW**		

Main documents

- Agenda: 11-14/0219r4, HEW SG March 2014 Meeting Agenda
- Closing report: 11-14/0457r0, HEW SG March 2014 Closing Report
- Draft minutes: 11-14/0380r0, March 2014 Beijing Meeting Minutes

Achievements

48. The group approved minutes from the January 2014 Los Angeles meeting and teleconferences on February 6th 2014 and February 13th 2014.

- 11-14/0199r0, January 2014 Los Angeles Meeting Minutes
- 11-14/0229r2, Minutes from the teleconference on February 6th, 2014
- 11-14/0242r0, Minutes from the teleconference on February 13th, 2014

49. Addressed comments related to the PAR and CSD received from individuals and other IEEE 802 WGs. Resolutions of comments are contained in the following document:

- https://mentor.ieee.org/802.11/dcn/14/11-14-0424-00-0hew-hew-sg-par-and-csd-comments-and-resolutions.pptx

50. Updated the PAR and the CSD documents based on received comments:

- https://mentor.ieee.org/802.11/dcn/14/11-14-0165-01-0hew-802-11-hew-sg-proposed-par.docx
- https://mentor.ieee.org/802.11/dcn/14/11-14-0169-01-0hew-ieee-802-11-hew-sg-proposed-csd.docx

51. The group passed motions to approve revised PAR and CSD documents, and SG extension.

- Revised PAR (11-14/0165r1): Y/N/A = 94/0/1, Pass
- Revised CSD (11-14/0169r1): Y/N/A = 97/0/1, Pass
- SG extension: Y/N/A = 105/0/0, Pass
- **HEW SG has completed its work and the IEEE standard board approved 802.11ax project.**

52. The group received more than 30 submissions in the categories of simulation scenarios, evaluation methodologies, channel models, functional requirements, technologies and selection procedure. Following submissions have been presented and discussed during the week.

- 11-13/1359r1, "HEW-Evaluation-Methodology" Ron Porat (Broadcom)
- 11-14/0112r1, "Wi-Fi interference measurements in Korea - part II", Minho Cheong (NEWRACOM)
- 11-14/0113r1, "Modeling of additional channel loss in dense WLAN environments", Minho Cheong (NEWRACOM)
- 11-14/0294r2, "DSC Channel Selection and Legacy Sharing" Graham Smith (DSP Group)
- 11-14/0301r0, "Multicast Considerations for HEW", Eisuke Sakai (Sony Corporation)
- 11-14/0306r0, "Discussions on HEW Functional Requirements", Lei Wang (Marvell)
- 11-14/0307r0, "PHY Calibration Results", Nihar Jindal (Broadcom)
- 11-14/0328r2, "Dense Apartment Complex Throughput Calculations", Graham Smith (DSP Group)
- 11-14/0329r0, "Channel Models for different links in Simulations", Kaushik Josiam (Samsung)
- 11-14/0330r3, "HEW PHY Abstraction", Sameer Vermani (Qualcomm)
- 11-14/0335r0, "Instantaneous SINR Calibration for System Simulation", Yakun Sun (Marvell)
- 11-14/0336r0, "Calibration of Long-Term SINR for System Simulator" Yakun Sun (Marvell)
- 11-14/0339r0, "A simplified STR Mechanism", Raja Banerjea (CSR)
- 11-14/0340r0, "A simplified STR Mechanism – MAC", Raja Banerjea (CSR)
- 11-14/0342r0, "Short Packet Optimizations", Naveen Kakani (CSR, Inc)
- 11-14/0345r1, "Joint Coding and Modulation Diversity with RBD pre-coding for next generation WLAN", Zhanji Wu (BUPT)
- 11-14/0350r0, "Suggestion on Evaluation Methodology", Jinyoung Chun (LG Electronics)
- 11-14/0352r0, "Discussion on power save mode for real time traffic", Giwon Park (LG Electronics)
- 11-14/0353r0, "Suggestion on PHY Abstraction for Evaluation Methodology", Dongguk Lim (LG Electronics)
- 11-14/0355r0, "Simulation Scenario 1 Revised", Simone Merlin (Qualcomm)
- 11-14/0356r0, "Calibration of System Level Simulators", Jarkko Kneckt (Nokia)
- 11-14/0357r0, "Utilizing Unused Resources for Simultaneous Transmissions", Jarkko Kneckt (Nokia).
- 11-14/0365r0, "Extended Intra-Vehicle Channel Model", Igal Kotzer (General Motors)
- 11-14/0372r2, "System level simulations on increased spatial reuse", Liwen Chu (Marvell)
- 11-14/0373r1, "Energy Efficiency in HEW", Pingping Xu, Wei Wang (Southeast University)
- 11-14/0381r0, "Stadium scenario for HEW", Johan Soder, Filip Mestanov (Ericsson AB)
- 11-14/0383r0, "Considerations on evaluation methodology for candidate HEW PHY&MAC techniques", Le Liu (Huawei)
- 11-14/0385r0, "Simulation Methodology and Calibration", Gwen Barriac (Qualcomm)
- 11-14/0386r0, "Discussions on MCS selection" , Tianyu Wu (MediaTek)
- 11-14/0392r0, "Traffic Separation Scheme for Optimizing WLANs using PHY and MAC options", Takayuki Nishio (Kyoto University)
- 11-14/0393r0, "Possible Indoor Channel Models for HEW System Simulations", Leif Wilhelmsson (Ericsson AB).

- 11-14/0419r0, "802.11ax Spec Development Process Proposal", Rolf de Vegt (Qualcomm)

Goals for May 2014

- Meet as a new TG and will have officer elections.
- Continue the work on simulation scenarios, evaluation methodologies, channel models, and function requirements.

Teleconferences

- One teleconference planned before the May 2014 session.
  - ✧ Thursday, April 17th, 10:00 – 12:00 (ET)
  - ✧ Details to be announced.

January 2014 – Los Angeles, CA

HEW study group had nine sessions during the week.

	Monday	Tuesday	Wednesday	Thursday
AM1				**HEW**
AM2	**HEW**	**HEW**		
PM1				**HEW**
PM2	**HEW**	**HEW**	**HEW**	
PM3	**HEW**	**HEW**		

Main documents

- Agenda: 11-13/1506r5, HEW SG January 2014 Meeting Agenda
- Closing report: 11-14/0187r0, HEW SG January 2014 Closing Report
- Draft minutes: 11-14/0199r0, January 2014 Los Angeles Meeting Minutes

Achievements

1. **The group approved minutes from the November 2013 Dallas meeting and teleconferences on December 4th 2013, December 18th 2013 and January 8th, 2014..**
   - 11-13/1465r1, November 2013 Dallas Meeting Minutes
   - 11-13/1495r0, Minutes from the teleconference on December 4th, 2013
   - 11-13/1532r1, Minutes from the teleconference on December 18th, 2013
   - 11-14/0024r1, Minutes from the teleconference on January 8th, 2014

2. **The group resolved open issues related to the PAR and CSD.**

3. **The group received 28 submissions that were categorized into (1) PAR and 5 Criteria related submissions, and (2) Best Effort submissions. Best Effort submissions basically related to simulation scenario and evaluation methodology.**
   - **PAR and 5 Criteria related submissions**
     - ✧ 11-13/1410r6, "802.11 HEW Draft PAR and 5C", Osama Aboul-Magd and All
     - ✧ 11-13/1489r5, "Airport Capacity Analysis", Graham Smith (DSP Group)
     - ✧ 11-14/0026r1, "thoughts on hew par", Yong Liu (Apple)
     - ✧ 11-14/0045r2, "E-Education Analysis", Graham Smith (DSP Group)
     - ✧ 11-14/0058r1, "Pico Cell Use Case Analysis ", Graham Smith (DSP Group)
     - ✧ 11-14/0061r0, "Some findings from real world measurement", Katsuo Yunoki (KDDI Labs)

- 11-14/0065r1, “Comments on Draft HEW PAR”, Bill Carney (SONY)
- 11-14/0101r2, “Comments on 802.11 HEW Draft PAR & 5C”, Rakesh Taori (Samsung Electronics)
- 11-14/0106r0, “Discussion on HEW PAR”, Kiseon Ryu (LG Electronics)
- 11-14/0119r2, “Suggested PAR Changes”, James Yee (MediaTek)
- 11-14/0163r1, “Raising the PAR”, Mat Fischer (Broadcom)

- **Best Effort submissions**
  - 11-14/0043r2, “PHY abstraction in system level simulation for HEW study”, Fei Tong (Samsung)
  - 11-14/0051r0, “Wireless Office with Interference”, David Xun Yang (Huawei)
  - 11-14/0053r0, “Further Considerations on Calibration of System Level Simulation”, Jiayin Zhang (Huawei)
  - 11-14/0056r1, “Traffic Model on Virtual Desktop Infrastructure”, Yingpei Lin (Huawei)
  - 11-14/0059r1, “Integrated System Level Simulation”, Jun Luo (Huawei)
  - 11-14/0063r0, “Design Challenges for 802.11 HEW Radios”, Yu Cai (Huawei)
  - 11-14/0070r0, “Joint MAC/PHY Evaluation Methodology”, Kaushik Josiam (Samsung)
  - 11-14/0082r0, “Improved Spatial Reuse Feasibility – Part I”, Ron Porat (Broadcom)
  - 11-14/0083r0, “Improved Spatial Reuse Feasibility – Part II”, Ron Porat (Broadcom)
  - 11-14/0086r2, “Outdoor AP Measurement in Tokyo”, Tsugu Aoki (Toshiba)
  - 11-14/0088r0, “Intra-Vehicular Channel Model”, Igal Kotzer (General Motors)
  - 11-14/0095r0, “OFDM-IDMA Uplink Communication”, Leonardo Lanante (Kyushu Inst. Of Tech)
  - 11-14/0107r0, “HEW Evaluation Metrics”, Yonggang Fang (ZTETX)
  - 11-14/0116r1, “Long-Term SINR Calibration for System Level Simulation”, Yakun Sun (Marvell)
  - 11-14/0117r0, “PHY Abstraction for HEW System Level Simulation”, Yakun Sun (Marvell)
  - 11-14/0118r0, “Consideration on System Level Simulation”, Jinsoo Chio (LG Electronics)

4. **The group passed motions to approve PAR and CSD.**
   - PAR: 11-14/0165r0, IEEE 802.11 HEW SG Proposed PAR
   - CSD: 11-14/0169r0, IEEE 802.11 HEW SG Proposed CSD

Goals for the March 2014 Meeting

- Resolve comments expected from EC members and other IEEE 802 WGs
- Continue with presentations relevant to the SG topics.
  - Simulation scenarios
  - Evaluation Methodologies
  - Channel Models
  - Technology
  - etc.

Teleconferences

The group agreed to have four teleconferences before the March 2014 meeting.

- Thursday, February 6th, 2014: 20:00 – 22:00 (ET)
- Thursday, February 13th, 2014: 10:00 – 12:00 (ET)
- Thursday, February 20th, 2014: 10:00 – 12:00 (ET)
- Thursday, February 27th, 2014: 20:00 – 22:00 (ET)

November 2013 – Dallas, TX

HEW study group had ten sessions during the week.

	Monday	Tuesday	Wednesday	Thursday
AM1			**HEW**	**HEW**
AM2		**HEW**		
PM1		**HEW**	**HEW**	**HEW**
PM2	**HEW**	**HEW**	**HEW**	**HEW**

Main documents

- Agenda: 11-13/1263r5, HEW SG November 2013 Meeting Agenda
- Closing report: 11-13/1476r1, HEW SG November 2013 Closing Report
- Draft minutes: 11-13/1465r1, November 2013 Dallas Meeting Minutes

Achievements

1. **The group approved minutes from the September 2013 Nanjing meeting and teleconferences on October 3rd and October 30th, 2013.**
   - 11-13/1117r1, September 2013 Nanjing Meeting Minutes
   - 11-13/1275r1, Minutes from the teleconference on October 3rd , 2013
   - 11-13/1303r0, Minutes from the teleconference on October 30th, 2013

2. **The group received more than 40 submissions that were categorized into three categories, i.e., (1) Channel Mode/Simulation Scenarios and Evaluation Methodologies, (2) MAC/PHY technologies and (3) PAR proposals. Following submissions were presented during the week.**
   - **Channel Models, Simulation Scenarios and Evaluation Methodologies**
     - 11-13/1001r5, "HEW SG Simulation Scenarios", Simone Merlin (Qualcomm)
     - 11-13/1305r0, "Simplification on HEW traffic models", Bill Carney (Sony)
     - 11-13/1334r5, 11-13/1335r4, "Video Traffic Modeling", Guiqing Li (Intel)
     - 11-13/1359r0, "HEW Evaluation Methodology", Ron Porat (Broadcom)
     - 11-13/1370r0, "LTE OOB Interference to 2.4 GHz Band", Yonggang Fang (ZTE TX)
     - 11-13/1376r3, "Discussions on Penetration Loss", Jianhan Liu (MediaTek)
     - 11-13/1380r0, "Outdoor Channel Model Simulation Follow-up", Hongyuan Zhang (Marvell)
     - 11-13/1383r0, "System Level Simulation Parameters", Wookbong Lee (LG Electronics)
     -
     - 11-13/1387r1, "HEW channel modeling for system level simulation", Yan Zhang (Marvell)
     - 11-13/1390r0, "PHY Abstraction for HEW System Level Simulations", Yakun Sun (Marvell)
     - 11-13/1391r0, "About SINR conversion for PHY Abstraction", Yakun Sun (Marvell)
     - 11-13/1392r0, "Methodology of Calibrating System Level Simulation Results", Yakun Sun (Marvell)
     - 11-13/1401r0, "System Level Assessments for Outdoor HEW Deployments", Kaushik Josiam (Samsung)
     - 11-13/1406r0, "Traffic Modeling for HEW Simulations", Huai-Rong Shao (Samsung)
     - 11-13/1407r0, "Simulation based study of QoE", Chao-Chun Wang (MediaTek)
     - 11-13/1412r0, "How to use simulation scenarios in HEW", Minho Cheong (ETIR)
     - 11-13/1419r1, "Modifications to ITU Channel Model to Support 160MHz bandwidth of operation", Shahrnaz Azizi (Intel)
     - 11-13/1420r1, "HEW Considerations for the Vehicular Environment", Igal Kotzer (General Motors)
     - 11-13/1438r0, "Traffic Observation and Study on Virtual Desktop Infrastructure", Phillip Barber (Huawei Technologies)
     - 11-13/1456r1, "Considerations on WFA feedback", Simone Merlin (Qualcomm)

- **MAC/PHY Technologies**
  - 11-13/1325r5, "IEEE 802.11ai overview", Hiroshi Mano (ATRD), chair of TGai
  - 11-13/1349r0, "Access Control Enhancement", Katsuo Yunoki (KDDI)
  - 11-13/1375r1, "Summary and Discussions of Proposals on Potential PHY Technologies in HEW", Jianhan Liu (MediaTek)
  - 11-13/1377r0, "DL efficiency enhancement in high density network", Kiseon Ryu (LG Electronics)
  - 11-13/1382r0, "Discussion on OFDMA in HEW", Jinsoo Choi (LG Electronics)
  - 11-13/1386r2, "Improving WLAN Efficiency and QoE – A Top Down Approach", Veli-Pekka Kentonen (7 Signals)
  - 11-13/1388r0, "UL MU-MIMO transmission", Jinyoung Chun (LG)
  - 11-13/1395r2, "Simultaneous Transmission Technologies for HEW", Koichi Ishihara (NTT)
  - 11-13/1409r0, "Dual Wi-Fi: Dual Channel Wi-Fi for Congested WLANs with Asymmetric Traffic Loads", Adriana Flores (Rice University)
  - 11-13/1421r1, "STR Radios and STR Media Access", Phillip Levis (Stanford University)
  - 11-13/1440r0, "Argos | Practical Masive-MIMO", Clayton Shepard (Rice University)

- **PAR proposals**
  - 11-13/1331r2, "Proposed direction and priorities for HEW", Guido R. Hiertz (Ericsson)
  - 11-13/1333r0, "Power Efficiency PAR Requirements", Chris Hansen (Covariant)
  - 11-13/1366r3, "Some propositions to progress towards the PAR definition", Laurent Cariou (Orange)
  - 11-13/1361r0, "Discussion to derive HEW Functional Requirements", Yasunao Misawa (KDDI)
  - 11-13/1389r1, "Discussion on HEW PAR", HanGyu Cho (LG Electronics)
  - 11-13/1397r0, "Renewing 2.4 GHz", Brian Hart (Cisco Systems)
  - 11-13/1398r0, "Requirements for HEW", Akira Yamada (NTT DOCOMO)
  - 11-13/1404r0, "Some Thoughts on PAR", and 11-13/1405r0, "HEW PAR", Eldad Perahia (Intel)
  - 11-13/1450r0, "Summary of PAR Discussions", Osama Aboul-Magd (HEW SG chair)
  - 11-13/1470r1 and 11-13/1471r1, "802.11 HEW proposed basis for PAR discussion", Laurent Cariou (Orange)

3. **Discussed the WFA feedback on prioritization of the usage cases and approved a liaison letter back to WFA.**
   - Feedback from Wi-Fi Alliance:
     - 11-13/1443r0, Liaison from Wi-Fi Alliance - HEW Use Cases
   - Approved a liaison document to Wi-Fi Alliance:
     - 11-13/1446r0, IEEE 802.11 Liaison to WFA on Prioritization of High Efficiency WLAN (HEW) Usage Scenarios

4. **Started the discussion on the PAR.**
5. **The group passed a motion to extend the study group by 136/0/2.**

Goals for the January 2014

- Progress the work on the PAR and 5C.

Teleconferences

The group agreed to have three teleconferences before the January 2014 meeting.

- Wednesday, December 4th, 2013: 10:00 – 12:00 (ET)
- Wednesday, December 18th, 2013: 20:00 – 22:00 (ET)
- Wednesday, January 8th, 2014: 10:00 – 12:00 (ET)

September 2013 – Nanjing, China

HEW study group had nine sessions during the week.

	Monday	Tuesday	Wednesday	Thursday
AM1				**HEW**
AM2		**HEW**		
PM1			**HEW**	**HEW**
PM2	**HEW**	**HEW**	**HEW**	
Evening	**HEW**	**HEW**		

Main documents

- Agenda: 11-13/0951r7
- Closing report: 11-13/1231r1
- Draft minutes: 11-13/1117r1

Achievements

1. **The group approved minutes from the Geneva meeting and teleconference on August 28th, 2013.**
   - 11-13/0861r1, Minutes from face-to-face meeting in Geneva, July 2013
   - 11-13/1003r0, Minutes from the teleconference on August 28th, 2013
2. **50 submissions in the following categories were received and presented during the week.**
   - **Channel Models (CM)**
     - 11-13/0996r2, "Outdoor Channel Model Candidates for HEW", Kaushik Josiam (Samsung)
     - 11-13/1113r0, "Channel Modeling for Dense Wi-Fi Environments", Minho Cheong (ETRI)
     - 11-13/1125r3, "HEW Outdoor Channel Model Discussions", Hongyuan Zhang (Marvell)
     - 11-13/1135r4, "Summary of HEW Channel Models", Jianhan Liu (MediaTek)
     - 11-13/1146r1, "Update on HEW Channel Model", Shahrnaz Azizi (Intel Corp)
   - **Simulation Scenarios/Simulation Methodologies (SS/SM)**
     - 11-13/1000r2, "Simulation Scenarios", Simone Merlin (Qualcomm)
     - 11-13/1001r2, "Simulation Scenarios Document Template", Simone Merlin (Qualcomm)
     - 11-13/1079r0, "Outdoor Stadium Simulation Details Discussion", Joseph Levy (InterDigital)
     - 11-13/1080r0, "Markov Modeling of the Channel for HEW System Level Simulations", Joseph Levy (InterDigital)
     - 11-13/1081r0, "HEW Simulation Methodology", Sayantan Choudhury (Nokia).
     - 11-13/1083r0, "HEW SG Unified Simulation Scenarios", David Xun Yang (Huawei)
     - 11-13/1114r1, "Simulation Scenario for unplanned Wi-Fi Network", Jae Seung Lee (ETRI)
     - 11-13/1123r1, "Capacity Simulation of High Density Indoor WLAN Systems", Filip Mestanov (Ericsson AB)
     - 11-13/1133r0, "Virtual Desktop Infrastructure (VDI)", Yingpei Lin (Huawei Technologies)
     - 11-13/1153r0, "Simulation Scenario Proposal", Laurent Cariou (Orange)
     - 11-13/1159r1, "Video Performance Requirements and Simulation Parameters", Guoqing Li (Intel)
     - 11-13/1162r1, "Video Application Categories and Characteristics", Guoqing Li (Intel)
     - 11-13/1176r0, "Some Simulation Scenarios for HEW", Reza Hedayat (Cisco)
   - **Evaluation Methodologies (EM)**
     - 11-13/1051r1, "Evaluation Methodology", Ron Porat (Broadcom)
     - 11-13-1054r1, "HEW Evaluation Metrics Suggestions", Yonggang Fang (ZTETX)

- ✧ 11-13/1059r0, “PHY Abstraction for HEW Evaluation Methodology”, Dongguk Lim (LG Electronics)
- ✧ 11-13/1131r0, “PHY Abstraction for HEW System Level Simulation”, Jiayin Zhang (Huawei Technologies)
- ✧ 11-13/1137r2, “The Definition of Performance Metrics for HEW”, Haui-Rong Shao (Samsung)
- ✧ 11-13/1144r1, “Simplified Traffic Model Based on Aggregated Network Statistics”, William Carney (Sony)
- ✧ 11-13/1158r0, “Video Traffic and Applications for HEW”, William Carney (Sony)

- **Functional Requirements (FR)**
  - ✧ 11-13/1097r0, “Functional Requirements for HEW PAR”, Minho Cheong (ETRI)
  - ✧ 11-13/1116r0, “Discussion on HEW Functional Requirements”, Jinsoo Choi (LG Electronics)

- **MAC/PHY Technologies (TECH)**
  - ✧ 11-13/1046r2, “Discussion for Massive MIMO for HEW”, Zhigang Wen (BUPT)
  - ✧ 11-13/1056r1, “Enhancement on resource utilization in OBSS environment”, Giwon Park (LG Electronics)
  - ✧ 11-13/1058r0, “Efficient wider bandwidth operation”, Kiseon Ryu (LG Electronics)
  - ✧ 11-13/1061r0, “Multicast Transmission for HEW”, Jeongki Kim (LG electronics)
  - ✧ 11-13/1073r1, “Access Control Enhancement“, Katsuo Yunoki (KDDI Labs)
  - ✧ 11-13/1074r0, “Occupied air time calculation for doc.1073r0”, Katsuo Yunoki (KDDI R&D Laboratories)
  - ✧ 11-13/1077r1, “EDCA Enhancements for HEW”, Hui Zhao (BUPT)
  - ✧ 11-13/1089r1, “D2D Technology for HEW”, Xiang Gao (BUPT)
  - ✧ 11-13/1090r2, “Non-linear pre-coding MIMO Scheme for next generation WLAN”, Xiang Gao (BUPT)
  - ✧ 11-13/1105r0, “Discussion on Access Mechanism for HEW”, Meng Yang (CATR)
  - ✧ 11-13/1122r1, “Considerations for In-Band Simultaneous Transmit and Receive (STR) feature in HEW”, Rakesh Taori (Samsung Electronics)
  - ✧ 11-13/1126r0, “Beamforming under OBSS Interference”, Hongyuan Zhang (Marvell)
  - ✧ 11-13/1168r0, “Requirements on WLAN Ad Push”, Hui Tian (BUPT)
  - ✧ 11-13/1169r0, “WLAN Cellular Offload in High Speed Moving Environment”, Hui Tian (BUPT)
  - ✧ 11-13/1154r0, “DL-MU-MIMO Transmission with Unequal Bandwidth”, Yongming Huang (Southeast University)
  - ✧ 11-13/1155r0, “Space Division Multiplex for OBSS Interference Suppression”, Yongming Huang (Southeast University)
  - ✧ 11-13/1156r0, “TXOP Redundancy NAV Clear”, Yongming Huang (Southeast University)
  - ✧ 11-13/1157r3, “Feasibility of Coordination Transmission for HEW”, Yunzhou Li (Tsunghua University)

- **General (GEN)**
  - ✧ 11-13/1057r0, “Legacy support on HEW frame structure”, Wookbong Lee (LG electronics)
  - ✧ 11-13/1100r0, “HEW SG Progress Review”, Osama Aboul-Magd (HEW SG)
  - ✧ 11-13/1115r0, “Possible vision of the HEW-driven Wi-Fi 2020”, Minho Cheong (ETRI)
  - ✧ 11-13/1163r0, “PAR and 5C: Comments based on 11n”, Sean Coffey (RealTek)
  - ✧ 11-13/1164r1, “Some PAR and 5C Requirements”, Paul Lambert (Marvell)

3. Straw Polls

Several straw polls were conducted to sense the group consensus on topics related to simulation scenarios, evaluation methodologies and channel models.

4. Timeline

The group reviewed the timeline. No changes.

5. Teleconferences

The HEW SG agreed to have three teleconferences before the November 2013 session.

- Wednesday, October 9th, 2013: 10:00 – 12:00 (ET)
- Wednesday, October 17th, 2013: 00:01 – 02:00 (ET)
- Wednesday, October 30th, 2013: 10:00 – 12:00 (ET)

Goals for the November 2013

- Hear presentations addressing SS/SM/EM/FR/CM/TECH
  - Attempt to consolidate documents related to the above areas of discussion.
  - Priority will be given to presentations with consolidated views
- Start discussion on PAR related issues
- Motion for SG extension
- WFA feedback on the usage cases

July 2013 – Geneva, Switzerland

HEW study group had nine sessions during the week.

Main documents

- Agenda: 11-13/0664r5
- Closing report: 11-13/0922r0
- Draft minutes: 11-13/0861r0

Achievements

1. **The group approved minutes from the face-to-face meeting in Waikoloa, HI and teleconferences held on June 5th and June 19th.**
   - 11-13/0560r2, May 2013 Waikoloa meeting minutes
   - 11-13/0663r1, Teleconference minutes 20130605
   - 11-13/0704r0, Teleconference minutes 20130619
2. **The group received over 35 submissions in areas of (1) Usage Models/Use Cases, (2) Functional Requirements, (3) Simulation Scenarios and Evaluation Methodology, (4) MAC/PHY techniques as listed below.**
   - **Usage Models/Use Cases**
     - 11-13/0657r3, "HEW SG usage models and requirements - Liaison with WFA" Laurent Cariou (Orange)
     - 11-13/0795r0, "HEW Usage Scenarios Categorization", Eldad Perahia (Intel)
     - 11-13/0802r1, "Proposed re-categorization of the HEW usage models", Yasuhiko Inoue (NTT)
     - 11-13/0761r0, "Interference Control Use Case for HEW", Fang Xie (CMCC)
     - 11-13/0836r0, "HEW Usage Models for Backhauls and Floor Automation", Minho Cheong (ETRI)
   - **Functional Requirements**
     - 11-13/0787r0, "Follow up requirements", Wu Tianyu (Huawei)
     - 11-13/0850r0, "Quantitative QoE Requirements for HEW", Huai-Rong Shao (Samsung)
     - 11-13/0798r1, "Functional Requirements in HEW", Jinsoo Choi (LG Electronics)
     - 11-13/0840r1, "HEW Functional Requirements Follow-up (Preliminary Version for Study Group discussions)", Minho Cheong (ETRI)
   - **Simulation Scenarios and Evaluation Methodology**
     - 11-13/0723r1, "HEW SG Evaluation Methodology Overview", Minyoung Park (Intel)

- 11-13/0756r1, “HEW Channel Model”, Vinko Erceg (Broadcom)
- 11-13/0858r0, “Enhanced Channel Model for HEW”, Shahrnaz Azizi (Intel)
- 11-13/0728r1, “Network Optimization for Expected HEW Traffic Patterns”, Bill Carney (Sony)
- 11-13/0869r0, “Simulation scenarios and metrics for HEW”, Thomas Derham (Orange)
- 11-13/0872r1, “Clarifications on outdoor deployments”, Laurent Cariou (Orange)
- 11-13/0847r1, “Evaluation Criteria and Simulation Scenarios” Klaus Doppler (Nokia)
- 11-13/0786r0, “Discussion on System Level Simulation Methodology” Wu Tianyu (Huawei)
- 11-13/0757r1, “Evaluation Methodology and Simulation Scenarios” Nihar Jindal (Broadcom)
- 11-13/0805r2, “On Definition of Dense Networks and Performance Metric”, Jianhan Liu (MediaTek)
- 11-13/0800r1, “HEW Study Group Documentation”, Hemanth Sampath (Qualcomm)
- 11-13/0837r0, “Consideration for HEW Evaluation Methodology”, Minho Cheong (ETRI)

- **MAC/PHY techniques**
  - 11-13/0768r0, “TD-*u*CSMA”, Riccard Scopigno (ISMB)
  - 11-13/0843r0, “Further Evaluation on outdoor Wi-Fi”, Wookbong Lee (LG Electronics)
  - 11-13/0852r0, “Potential approach to improve WLAN BSS edge performance”, Juho Pirskanen (Renesas Mobile)
  - 11-13/0871r0, “Discussion on Potential Techniques for HEW”, Timo Koskela (Renesas Mobile)
  - 11-13/0877r0, “HEW Beamforming Enhancements”, James Wang (MediaTek)
  - 11-13/0764r1, “Full-duplex Technology for HEW”, Andre Bourdoux (IMEC)
  - 11-13/0765r2, “Full-duplex is an emerging radio paradigm that has the potential to improve the efficiency of future WLANs”, Hongliang Bian (China Telecom)
  - 11-13/0712r1, “A Brief Time of History”, Larry Taylor (DTC)
  - 11-13/0801r1, “Issues of Low Rate Transmissions”, Akira Kishida (NTT)
  - 11-13/0758r0, “Possible Approaches for HEW”, Katsuo Yunoki (KDDI Labs)
  - 11-13/0849r1, “New Techniques: Enabling Real World Improvement By Exposing Internal MAC state”, Brian Hart (Cisco)
  - 11-13/0854r1, “Consideration on Efficiency Enhancement”, SangHyun Chang (Samsung)
  - 11-13/0865r2, “Video Data Rate for HEW”, Huai-Rong Shao (Samsung)
  - 11-13/0878r0, “Efficiency enhancement for dense WLAN environment”, Jeongki Kim (LG Electronics)

3. **The group approved document 11-13/0657r6 as HEW SG initial draft of Usage Models and to send it to Wi-Fi Alliance asking for prioritization of the use cases and additional feedbacks.**

4. **The group also approved a liaison letter to the Wi-Fi Alliance contained in the document 11-13/902r1.**

5. **The group passed motion to extend the SG.**

6. **The group discusses the timeline.**
   - May 2013: Initial meeting
   - July 2013: Presentations, SG extension
   - September 2013: Presentations
   - November 2013: Presentations, Initial PAR & 5C, SG extension
   - January 2014: Presentations, Final version of PAR and 5C, WG approval
   - March 2014: Presentations, EC approval of PAR and 5C
   - May – June 2014: NesCom approval
   - July 2014: TG starts

7. **Teleconferences**

The group agreed to have two teleconferences before the September 2013 meeting.

- Wednesday, August 7th, 2013: 10:00 – 12:00 (ET)
- Wednesday, August 28th, 2013: 20:00 – 22:00 (ET)

Next steps

During the September 2013 meeting, the HEW SG continues discussions on issues related to:

- Usage Models/Use Cases
- Functional Requirements
- Feasibility
- Scope and Process

May 2013 – Waikoloa, HI

Main documents

- Agenda: 11-13/0400r4
- Closing report: 11-13/0624r0
- Draft minutes: 11-13/0560r2

Achievements

1. **The group decided leadership structure to have one chairperson and one secretary.**
   - Osama Aboul-Magd (Huawei Technologies) was elected as the chair of the HEW SG.
   - Yasuhiko Inoue (NTT) was elected as the recording secretary of the HEW SG.

2. **The group received 22 submissions as listed below.**
   - **Usage Models/Use Cases:**
     - 11-13/0514r0, “HEW Usage Scenarios and Applications”, Eldad Perahia (Intel)
     - 11-13/0538r0, “Dense apartment building use case for HEW”, Klaus Doppler (Nokia)
     - 11-13/0554r0, “Use Cases”, Minho Cheong (ETRI)
     - 11-13/0567r0, “Proposed HEW Usage Models”, Yasuhiko Inoue (NTT)
     - 11-13/0527r2, “Usage Models for Next Generation”, David Xun Yang (Huawei) and James Wang (MediaTek)
     - 11-13/0534r1, “Direction and Use Cases for HEW”, HanGyu Cho (LG Electronics)
     - 11-13/0563r0, “D2D Technology for HEW”, Zhanji Wu (BUPT) – not presented
   - **Problem Statements:**
     - 11-13/0505r0, “MAC Efficiency Analysis for HEW SG”, Minyoung Park (Intel)
     - 11-13/0545r1, “WLAN QoE, End User Perspective Opportunities to Improve”, Veli-Pekka Ketonen (7 signals)
     - 11-13/0523r2, “Understanding Current Situation of Public Wi-Fi Usage – Possible Requirements for HEW –“, Katsuo Yunoki (KDDI Labs)
     - 11-13/0539r0, “Efficient Frequency Spectrum Utilization”, Yongho Seok (LG Electronics)
     - 11-13/0544r3, “Discussions on 11ac PHY efficiency”, Jianhan Liu (MediaTek)
     - 11-13/0536r0, “HEW SG PHY Considerations For Outdoor Environment”, Wookbong Lee (LG Electronics)
     - 11-13/0576r3, “Performance Evaluation for 11ac”, Wu Tianyu (Huawei Technologies)
     - 11-13/0556r1, “Wi-Fi interference measurements in Korea – Part 1”, Minho Cheong (ETRI)
     - 11-13/0549r0, “A perspective on what any High Efficiency Wireless TG should and should not do”, Brian Hart (Cisco Systems)
   - **Requirements:**
     - 11-13/0524r2, “HEW Finctional Requirements”, Wu Tianyu (Huawei Technologies)

- ✧ 11-13/0555r2, “Considerations on Functional Requirements for HEW”, Minho Cheoung (ETRI)

Ÿ **Scenarios and Metrics**
- ✧ 11-13/0503r0, “Discussion on Basic Technical Aspects for HEW”, Juho Pirskanen (Renesas Mobile)
- ✧ 11-13/0542r0, “HEW Scenarios and Goals”, Simone Merlin (Qualcomm)
- ✧ 11-13/0486r1, “HEW – Metrics, Targets and Simulation Scenarios”, Ron Porat (Broadcom)
- ✧ 11-13/0520r1, “HEW scenarios and evaluation metrics”, Thomas Derham (Orange)

Ÿ **Technical Feasibility**
- ✧ 11-13/0558r1, “Coexistence and Optimization of Wireless LAN: Time, Frequency, Space, Power, and Load”, Jim Lansford (CSR)

3. Liaison to the Wi-Fi Alliance

Ÿ The group agreed to ask the Wi-Fi Alliance for input about priority of the use cases.

Ÿ Laurent Cariou (Orange) volunteers to develop the use case document.

4. Project planning

Ÿ The group discussed about the project plan based on the submission 11-13/0616r2 by Phil Barber (Huawei)

Ÿ Discussion to be continued in the July meeting.

5. Teleconferences

Ÿ The group agreed to have two teleconferences before the July 2013 Plenary to develop a use case document to be shared with the Wi-Fi Alliance.
- ✧ June 5th: 10:00 – 12:00 (ET)
- ✧ June 19th: 20:00 – 22:00 (ET)

Next Steps

- During July 2013 session, the HEW SG will continue discussions on:
  - ➢ Usage Cases
  - ➢ Functional Requirements
  - ➢ Feasibility
  - ➢ Scope and Process

Related documents

Documents referenced in the motion that led to the creation of the study group
- https://mentor.ieee.org/802.11/dcn/13/11-13-0339-10-0wng-high-efficiency-wlan-straw-poll.ppt

Press release document
- https://mentor.ieee.org/802.11/dcn/13/11-13-0418-02-0000-proposed-edits-to-hew-press-release.doc

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USEFUL LINKS TO OTHER SITES:

IEEE P802.11 WLANs RELATED

- Home
- IEEE 802.11 WiKi

- E-mail Reflectors Archives (Members Only)

OTHER SITES

- IEEE P802 LAN/MAN Standards Committee (LMSC)

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Appendix BF

TGax July 2016 Meeting Agenda

Date: 2016-06-15

Authors:

Name	Company	Address	Phone	email
Osama Aboul-Magd	Huawei Technologies	303 Terry Fox Drive Kanata, ONT, Canada K2K-3J1	613-287-1405	Osama.aboulmagd@Huawei.com

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IEEE 802.11 TGax: High Efficiency WLAN Task Group

San Diego, USA

July 24-29, 2016

Chair: Osama Aboul-Magd (Huawei Technologies)
Vice Chair: Simone Merlin (Qualcomm)
Vice Chair: Ron Porat (Broadcom)
Secretary: Yasuhiko Inoue (NTT)
Technical Editor: Robert Stacey (Intel)

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Meeting Protocol

- **Please announce your affiliation when you first address the group during a meeting slot**

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Attendance

- http://newton.meeting.verilan.com

1. Register
2. Indicate attendance

Attendance, Voting & Document Status

- **Make sure your badges are correct**
- **If you plan to make a submission be sure it does not contain company logos or advertising**
- **Questions on Voting status, Ballot pool, Access to Reflector, Documentation, member's area**
  - see Jon Rosdahl – jrosdahl@ieee.org
- **Cell Phones Silent or Off**

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Patent Policy

- **Following 5 slides**

Instructions for the WG Chair

The IEEE-SA strongly recommends that at each WG meeting the chair or a designee:

- **Show slides #1 through #4 of this presentation**
- **Advise the WG attendees that:**
  - The IEEE's patent policy is described in Clause 6 of the *IEEE-SA Standards Board Bylaws*;
  - Early identification of patent claims which July be essential for the use of standards under development is strongly encouraged;
  - There July be Essential Patent Claims of which the IEEE is not aware. Additionally, neither the IEEE, the WG, nor the WG chair can ensure the accuracy or completeness of any assurance or whether any such assurance is, in fact, of a Patent Claim that is essential for the use of the standard under development.
- **Instruct the WG Secretary to record in the minutes of the relevant WG meeting:**
  - That the foregoing information was provided and that slides 1 through 4 (and this slide 0, if applicable) were shown;
  - That the chair or designee provided an opportunity for participants to identify patent claim(s)/patent application claim(s) and/or the holder of patent claim(s)/patent application claim(s) of which the participant is personally aware and that July be essential for the use of that standard
  - Any responses that were given, specifically the patent claim(s)/patent application claim(s) and/or the holder of the patent claim(s)/patent application claim(s) that were identified (if any) and by whom.
- The WG Chair shall ensure that a request is made to any identified holders of potential essential patent claim(s) to complete and submit a Letter of Assurance.
- It is recommended that the WG chair review the guidance in *IEEE-SA Standards Board Operations Manual* 6.3.5 and in FAQs 14 and 15 on inclusion of potential Essential Patent Claims by incorporation or by reference.

Note: **WG** includes Working Groups, Task Groups, and other standards-developing committees with a PAR approved by the IEEE-SA Standards Board.

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Participants, Patents, and Duty to Inform

All participants in this meeting have certain obligations under the IEEE-SA Patent Policy.

- **Participants [Note: Quoted text excerpted from IEEE-SA Standards Board Bylaws subclause 6.2]:**
  - **"Shall inform the IEEE (or cause the IEEE to be informed)" of the identity of each "holder of any potential Essential Patent Claims of which they are personally aware" if the claims are owned or controlled by the participant or the entity the participant is from, employed by, or otherwise represents**
  - **"Should inform the IEEE (or cause the IEEE to be informed)" of the identity of "any other holders of potential Essential Patent Claims" (that is, third parties that are not affiliated with the participant, with the participant's employer, or with anyone else that the participant is from or otherwise represents)**
- **The above does not apply if the patent claim is already the subject of an Accepted Letter of Assurance that applies to the proposed standard(s) under consideration by this group**
- **Early identification of holders of potential Essential Patent Claims is strongly encouraged**
- **No duty to perform a patent search**

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Slide #1

Patent Related Links

All participants should be familiar with their obligations under the IEEE-SA Policies & Procedures for standards development.

Patent Policy is stated in these sources:

IEEE-SA Standards Boards Bylaws

http://standards.ieee.org/develop/policies/bylaws/sect6-7.html#6

IEEE-SA Standards Board Operations Manual

http://standards.ieee.org/develop/policies/opman/sect6.html#6.3

Material about the patent policy is available at

http://standards.ieee.org/about/sasb/patcom/materials.html

If you have questions, contact the IEEE-SA Standards Board Patent Committee Administrator at patcom@ieee.org or visit http://standards.ieee.org/about/sasb/patcom/index.html

This slide set is available at https://development.standards.ieee.org/myproject/Public/mytools/mob/slideset.ppt

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Slide #2

Call for Potentially Essential Patents

- **If anyone in this meeting is personally aware of the holder of any patent claims that are potentially essential to implementation of the proposed standard(s) under consideration by this group and that are not already the subject of an Accepted Letter of Assurance:**
  - Either speak up now or
  - Provide the chair of this group with the identity of the holder(s) of any and all such claims as soon as possible or
  - Cause an LOA to be submitted

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Slide #3

Other Guidelines for IEEE WG Meetings

- **All IEEE-SA standards meetings shall be conducted in compliance with all applicable laws, including antitrust and competition laws.**
  - **Don't discuss the interpretation, validity, or essentiality of patents/patent claims.**
  - **Don't discuss specific license rates, terms, or conditions.**
    - Relative costs, including licensing costs of essential patent claims, of different technical approaches July be discussed in standards development meetings.
      - Technical considerations remain primary focus
  - **Don't discuss or engage in the fixing of product prices, allocation of customers, or division of sales markets.**
  - **Don't discuss the status or substance of ongoing or threatened litigation.**
  - **Don't be silent if inappropriate topics are discussed … do formally object.**

See *IEEE-SA Standards Board Operations Manual*, clause 5.3.10 and "Promoting Competition and Innovation: What You Need to Know about the IEEE Standards Association's Antitrust and Competition Policy" for more details.

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Slide #4

Agenda Items for the Week

- **Approve TG and Telecons minutes since May meeting.**
- **Resolution of comments received on draft D0.1**
- **Ad Hoc group meetings**
- **Technical Presentations and related straw polls and/or motions**
- **Schedule Telecon times.**

General Flow of the Meeting

- **Monday July25, 08:00 – 10:00**
  - Call Ad Hoc Meeting to order
  - IEEE 802 and 802.11 IPR Policy and procedure.
  - AD hoc meeting Agenda setting
  - Approval of ad hoc meeting agenda
  - Call for submissions
  - Presentations
  - Adjourn
- **Monday July 25, 16:00 – 18:00**
  - Call Meeting to order
  - IEEE 802 and 802.11 IPR Policy and procedure.
  - Review from November 2014 meeting
  - Call for submissions
  - Agenda setting and approval
  - TG Motions
  - Presentations
  - Recess
- **Tuesday July 26, 10:30 – 12:30**
  - Ad Hoc Group Meetings
- **Tuesday July 26, 16:00 – 18:00**
  - Ad Hoc Group Meetings
- **Tuesday July 26, 19:30 – 21:30**
  - Ad Hoc Group Meetings
- **Wednesday July 27, 08:00 – 10:00**
  - Call Meeting to order
  - IEEE 802 and 802.11 IPR Policy and procedure.
  - Progress Review
  - Presentations
- **Wednesday July 27, 13:30 – 15:30**
  - Ad Hoc Group Meetings
- **Wednesday July 27, 16:00 – 18:00**
  - Call Meeting to order
  - IEEE 802 and 802.11 IPR Policy and procedure.
  - Presentations
  - TG Motions
  - Recess
- **Thursday July 28, 10:30 – 12:30**
  - Call Meeting to order
  - IEEE 802 and 802.11 IPR Policy and procedure.
  - Presentations
  - TG Motions
  - Recess
- **Thursday July 28, 13:30 – 15:30**
  - Call Meeting to order
  - IEEE 802 and 802.11 IPR Policy and procedure.
  - Presentations
  - TG Motions
  - Goals for March 2016
  - Telecon Schedule
  - Adjourn

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TGax Schedule in a Glance

	Monday	Tuesday		Wednesday		Thursday
AM1	**TGax**			**TGax**		
AM2		PHY	MAC			**TGax**
PM1				PHY	MAC	**TGax**
PM2	**TGax**	SR	MU	**TGax**		
EVE		PHY	MAC			

*** Ad Hoc group is tbd**

Submissions (PHY)

DCN	Title	Author	ad hoc
11-16/0816	Comment Resolution for CID 2183	Daewon Lee	PHY
11-16/0872	CR HE-SIG-A Part II	Ross Jian Yu	PHY
11-16/0873	CR HE-SIG-B Part I	Ross Jian Yu	PHY
11-16/0891	LDPC for 1024QAM	Hongyuan Zhang	PHY
11-16/0892	Spec Text on LDPC for 1024QAM	Hongyuan Zhang	PHY
11-16/0893	11ax Extended Range PPDU	Bin Tian	PHY
11-16/0894	HE-LTF Capabilities	Hongyuan Zhang	PHY
11-16/0895	Spec Text for HE-LTF Capabilities	Hongyuan Zhang	PHY
11-16/0896	11ax Beamformee Capabilities	Hongyuan Zhang	PHY
11-16/0897	Spec Text for Beamformee Capabilities	Hongyuan Zhang	PHY
11-16/0898	BW Field in HE-MU Format	Hongyuan Zhang	PHY
11-16/0899	Spec Text for BW Field in HE-MU Format	Hongyuan Zhang	PHY
11-16/0900	PHY Comment Resolution for CID 1052 and 2519	Bin Tian	PHY
11-16/0903	Gamma phase rotation for HE PPDU	Yujin Noh	PHY
11-16/0904	proposed text for gamma phase rotation for HE PPDU	Yujin Noh	PHY
11-16/0906	RU restriction on 20MHz operating STAs	Joonsuk Kim	PHY
11-16/0908	CR - proposed text on RU restriction of 20MHz STAs	Joonsuk Kim	PHY
11-16/0910	Minimum Occupied Bandwidth	Ron Porat	PHY
11-16/0914	Bit field finalization of HE-SIG-A	Lochan Verma	PHY
11-16/0915	Text for bit field finalization of HE-SIG-A	Lochan Verma	PHY
11-16/0920	PHY comment resolution for CID 1659,493,494	Xiaogang Chen	PHY
11-16/0922	PHY CR 1024 QAM	Sriram Venkateswaran	PHY
11-16/0923	PHY CR DCM Constellation Mapping	Sriram Venkateswaran	PHY
11-16/0928	CR on Section 26.3.9.8 - HE-SIG-B	Kaushik Josiam	PHY
11-16/0937	11ax Comment Resolutions for Clauses 26.3.2-26.3.9.3-26.3.9.4-26.3.9.5-26.3.10.2- 26.3.10.13	Rui Cao	PHY
11-16/0964	Considerations on MAC-PHY interactions during SR operations	Jing Ma	PHY

26 submissions

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Submissions (MAC)

34 submissions

DCN	Title	Author	ad hoc
11-16/0828	HE Fragmentation - part 1	Alfred Asterjadhi	MAC
11-16/0829	Comment Resolution for Section 10.24.10 Block Ack/GCR block ack	Reza Hedayat	MAC
11-16/0844	CC0-Intra_PPDU_PS	Alfred Asterjadhi	MAC
11-16/0856	Issue of Buffer Status reporting	Stephane Baron	MAC
11-16/0860	comment resolution on A-MPDU format	Yongho Seok	MAC
11-16/0861	comment resolution on mu acknowledgment procedure	Yongho Seok	MAC
11-16/0862	comment resolution on subclause 25.11	Yongho Seok	MAC
11-16/0864	d0.1 comment resolution on clause 6	Yasuhiko Inoue	MAC
11-16/0867	CIDs for CIDs: Section 9.3.1.9.3 Compressed BA format	George Cherian	MAC
11-16/0868	CIDs for Section 9.3.1.9.7 Multi STA BAs	George Cherian	MAC
11-16/0869	Comment resolution section 9.3 TWT	Zhou Lan	MAC
11-16/0871	Trigger Frame Per User Info Order	Zhou Lan	MAC
11-16/0877	Comment resolution on CID 783 (TXOP Duration field format)	Jeongki Kim	MAC
11-16/0878	Comment resolution on CID 782 (Intra-PPDU PS)	Jeongki Kim	MAC
11-16/0881	Comment resolution on ROMI	Jayh Park	MAC
11-16/0882	Comment resolution on TOMI	Jayh Park	MAC
11-16/0883	Comment resolution for CID152	Jayh Park	MAC
11-16/0884	Spec. Text for HE Operation element and AID Assign Rule	Jianhan Liu	MAC
11-16/0890	Comment Resolution on NAV Setting of Single and Multiple Protection and Control Response	Po-Kai Huang	MAC
11-16/0913	SU Multi-TID Rules	Jarkko Kneckt	MAC
11-16/0916	TID value of ALL ACK signaling	Woojin Ahn	MAC
11-16/0917	Text for TID value of ALL ACK signaling	Woojin Ahn	MAC
11-16/0918	Discussions on Partial BSS Color	Geonjung Ko	MAC
11-16/0924	NAV resetting with RTS/MU-RTS	Weimin Xing	MAC
11-16/0925	Spex text on NAV resetting with RTS/MU-RTS	Weimin Xing	MAC
11-16/0941	CR HE Fragmentation - part 2	Ming Gan	MAC
11-16/0942	CR Service Field	Ming Gan	MAC
11-16/0951	Setting for TXOP Duration Field	Po-Kai Huang	MAC
11-16/0952	Spec text trigger frame per user info order	Zhou Lan	MAC
11-16/0953	Comment Resoluaton and Spec Text for Setting for TXOP Duration field	Po-Kai Huang	MAC
11-16/0960	AP access procedure for UL MU operation	Jinsoo Ahn	MAC
11-16/0961	Consideration on Multi-STA BlockAck Optimization	Hanseul Hong	MAC
11-16/0962	EDCA rules-follow up 1	Jing Ma	MAC
11-16/0963	EDCA rules-follow up 2	Jing Ma	MAC
11-16/0966	CID71 and CID190 Resolutions	Jarkko Kneckt	MAC

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11-16/998 Laurent cariou

Submissions (MU)

DCN	Title	Author	ad hoc
11-16/0866	Comment Resolution of Section 26.3.13 MU-MIMO	Kome Oteri	MU
11-16/0875	CR for the section 10.3.2.8a CS Condition to Respond CTS	Kiseon Ryu	MU
11-16/0876	CR for the section 25.5.2.4 UL MU CS CCA and CS Required Bit	Kiseon Ryu	MU
11-16/0880	UL MU Transmission Rules - EDCA backoff	Jayh Park	MU
11-16/0885	Comment Resolution on UL MU CS NAV Considerstion	Po-Kai Huang	MU
11-16/0886	Comment Resolution for some UL MU CS TBD	Po-Kai Huang	MU
11-16/0887	Spec Text for MU-RTS restriction on HE MU PPDU	Po-Kai Huang	MU
11-16/0926	Soliciting UL_MU_ACK	Raja Banerjea	MU
11-16/0929	CR - UL MU Operation	Simone Merlin	MU
11-16/0930	CD - DL MU Operation	Simone Merlin	MU
11-16/0938	Comment Resolution for Sub-clause 25.10.4	Chittabrata Ghosh	MU
11-16/0958	UL OFDMA for Unassociated STAs	Leonardo Lanante	MU

12 submissions

Submissions (SR)

DCN	Title	Author	ad hoc
11-16/0879	Comment resolution on SR for VHT PPDUs	Jeongki Kim	SR
11-16/0889	comment-resolution-SR-Intra-BSS-detection	Young Hpoon Kown	SR
11-16/0901	Clarification of SR Fields in HE Trigger Based PPDU	Daewon Lee	SR
11-16/0902	Proposed Text Changes for SR Fields in HE Trigger-Based PPDU	Daewon Lee	SR
11-16/0905	SR Fields Clarification	Ron Porat	SR
11-16/0919	Discussions on SR Fields in HE Trigger-based PPDU	Geonjung Ko	SR
11-16/0310	DSC Proposal Text	Graham Smith	SR
11-16/0945	Clarifications for OBSS_PD-based SR parameters	Laurent Cariou	SR
11-16/0946	Proposed text changes for OBSS_PD-based SR parameters	Laurent Cariou	SR
11-16/0957	Comment Resolutions on OBSS_PD Conditions in 25.9.3	James Wang	SR

10 submissions

Submissions (TG)

DCN	Title	Author	ad hoc
11-16/0835	EIFS	Alfred Asterjadhi	TG
11-15/1095	OFDMA Performance in 11ax	Suhwook Kim	TG
11-16/0870	Conclusing MAC Trigger Padding	Zhou Lan	T G
11-16/0907	20MHz HE devices	Joonsuk Kim	TG
11-16/0909	CR - proposed text on 20MHz devices	Joonsuk Kim	TG
11-16/0949	MAC trigger frame padding follow up	Zhou Lan	TG
11-16/0965	On High Efficiency WLAN (HEW) TG PAR Scope	Osama Aboul-Magd	TG

9 submissions adding Ke Yao comment resolution

Agenda for Monday July 25, 08:00 – 10:00

- Call meeting to order
- Patent policy, etc.
- Ad Hoc meeting (No motions)
- Call for submissions.
- Set up agenda for the ad hoc meeting.
- Presentations
- Adjourn

Agenda for Monday July 25, 16:00 – 18:00

- **Call meeting to order**
- **Patent policy, etc.**
- **Call for submissions**
- **Set Ad Hoc Groups schedule and approve agenda**
- **Comment Resolution Tutorial – Adrian Stephens**
- **Summary from May 2016 meeting**
- **TG motions**
  - Approve TG meeting and Telecon minutes since May meeting.
  - Approve resolutions of comments, if needed.
- **Comment Resolution Status – Robert Stacey**
- **Timeline**
- **Presentations and Comment Resolution**
  - TXOP Duration Issues (Jeongki Kim and Bo Sun)
  - 11-16/0965; On HEW TG PAR Scope
  - 11-15/1095; OFDMA Performance in 11ax
  - …..
- **Recess**

Summary from May 2016 Meeting

- **Received about 70 submissions. Majority of the submission were requesting changes to the TG Specification Framework document. Few submissions were addressing comment resolution mainly ofor the PHY clause.**
- **Agreed to terminate the Specification Framework process. The frame of reference is Draft D0.1.**
  - Future submissions shall bring text to continue developing the TG draft
- **Approved the resolutions of about 200 comments, most of them addressing the PHY clause**
- **Revisited the timeline and accepted a new modified timeline – next slide.**
- **The TG had a series of telecons where resolutions of about 227 comments were discussed.**

Submissions Covered During Telecons

- https://mentor.ieee.org/802.11/dcn/16/11-16-0725-03-00ax-comment-resolution-on-9-3-1-23.docx (6 CIDs)
- https://mentor.ieee.org/802.11/dcn/16/11-16-0773-02-00ax-comment-resolution-section-25-6-he-sounding.docx (15 CIDs)
- https://mentor.ieee.org/802.11/dcn/16/11-16-0774-01-00ax-comment-resolution-on-9-3-1-23-ruallocation.docx (14 CIDs)
- https://mentor.ieee.org/802.11/dcn/16/11-16-0780-01-00ax-comment-resolution-on-9-3-1-23-phy-tbd.docx (31 CIDs)
- https://mentor.ieee.org/802.11/dcn/16/11-16-0775-01-00ax-comment-resolution-on-section-26-3-12-4-phy-mu-mimo-power-pre-correction.docx (7 CIDs)
- https://mentor.ieee.org/802.11/dcn/16/11-16-0766-00-00ax-he-variant-ht-control-ul-mu-response.docx (28 CIDs)
- https://mentor.ieee.org/802.11/dcn/16/11-16-0798-00-00ax-he-variant-ht-control-general.docx (33 CIDs)
- https://mentor.ieee.org/802.11/dcn/16/11-16-0815-02-00ax-comment-resolution-mu-rts-scrambler-seed.docx (5 CIDs)
- https://mentor.ieee.org/802.11/dcn/16/11-16-0819-01-00ax-cids-for-section-9-3-1-9-blockack-frame-format.docx (9 CIDs)
- https://mentor.ieee.org/802.11/dcn/16/11-16-0806-00-00ax-he-variant-ht-control-buffer-status-report.docx (24 CIDs)
- https://mentor.ieee.org/802.11/dcn/16/11-16-0807-00-00ax-comment-resolution-on-mu-rts-cts-procedure.docx (27 CIDs)
- Note: A new revision is expected to accommodate Mark's comments
- https://mentor.ieee.org/802.11/dcn/16/11-16-0808-00-00ax-comment-resolution-on-trigger-frame-format-mu-rts-variant.docx (14 CIDs)
- Note: A new revision is expected to accommodate Mark's comments
- https://mentor.ieee.org/802.11/dcn/16/11-16-0813-00-00ax-cr-on-secition-26-2-2-txrxvector-parameters.doc (4 CIDs)
- Note: We need to revisit this document again to try to cose a couple of TBDs
- https://mentor.ieee.org/802.11/dcn/16/11-16-0836-00-00ax-comment-resolution-on-section-9-4-1-phy-mu-mimo-compressed-beamforming-report.docx (10 CIDs)
- Note: Adds significant amount of text and introduces new frame.

1356

Approval of TG Minutes (March 2016 Meeting and Telecon Minutes)

- **Approve TGax minutes of meetings and teleconferences from May 2016 interim meeting to today:**
  - https://mentor.ieee.org/802.11/dcn/16/11-16-0686-00-00ax-tgax-may-2016-waikoloa-meeting-minutes.docx
  - https://mentor.ieee.org/802.11/dcn/16/11-16-0768-05-00ax-tgax-teleconference-minutes-from-june-to-july-2016.docx
  - https://mentor.ieee.org/802.11/dcn/16/11-16-0755-00-00ax-tgax-may-2016-waikoloa-phy-ad-hoc-meeting-minutes.docx
  - https://mentor.ieee.org/802.11/dcn/16/11-16-0716-00-00ax-mu-ad-hoc-meeting-minutes-may-2016.docx
  - https://mentor.ieee.org/802.11/dcn/16/11-16-0701-00-00ax-combined-spatial-reuse-mac-ad-hoc-group-meeting-minutes.docx

- **Move: Bo Sun** **Second: Robert Stacey**
- **Approved with no objection**

1357

Comment Resolution Status (Editor Report)

- **Robert Stacey (Technical Editor)**

From IEEE 802.11 Operation Manual

- https://mentor.ieee.org/802.11/dcn/14/11-14-0629-14-0000-802-11-operations-manual.docx

Motions modifying drafts may be made at appropriate times during meetings.
Complex technical changes to a draft shall be in a submission that has been accepted by document control according to document formats specified in section 3.7 of this document and has been made available electronically for a **period of not less than four active 802.11 WG session hours**. The TG chair determines if a technical change is sufficiently complex to require a submission.

When a CRC is following the "Accelerated process" for completion of a WG letter ballot, and is not meeting during an 802.11 WG session, any submission containing changes to the draft shall be on the server and announced to the appropriate TG reflector no less than 72 hours before any motion is made related to that submission.
NOTE – when a CRC is meeting coincident with an 802.11 session, it is subject to the four hour rule described in the previous paragraph.

Timeline

- May 2014: start of the TG
- Nov. 2014: First draft of the TG SFD was approved
- Jan. 2016: proposed TG draft
- March 2016: Draft D0.1 was approved and CC started
- September 2016: Draft 1.0 and WG letter ballot
- March 2017: Draft 2.0 and recirculation
- July 2017: MDR (Mandatory Document Review)
- November 2017: Formation of SB pool
- March 2018: Sponsor Ballot
- December 2018: RevCom

1360

Agenda for Tuesday July 26, 10:30 – 12:30

- **Ad Hoc Group Meetings**
  - PHY: Seaport DE
  - MAC: Seaport G

1361

Agenda for Tuesday July 17, 16:00 – 18:00

- **Ad Hoc Group Meetings**
  - MU : Seaport DE
  - SR: Seaport G

1362

Agenda for Tuesday July 17, 19:30 – 21:30

- **Ad Hoc Group Meetings**
  - PHY: Seaport DE
  - MAC: Harbor EF

1363

Agenda for Wednesday July 27, 08:00 – 10:00

- **TG Meeting**
- **Call Meeting to order**
- **IEEE 802 and 802.11 IPR Policy and procedure.**
- **Progress from Ad Hocs**
- **Presentations**
  - 11-16/0907: 20 MHz HE Devices – Joonsuk kim
  - 11-16/0909: Text for 20 MHz - Joonsuk Kim
  - 11-16/0870 and 11-16/0949 – Zhou Lan
  - 11-16/0971 – Graham Smith
  - 11-16/0957 – James Wang
  - 11-16/0947 – Laurent Cariou
- **Recess**

1364

Agenda for Wednesday July 27, 13:30 – 15:30

- **Ad Hoc Group Meetings**
  - PHY: Seaport DE
  - MAC: Seaport G

Agenda for Wednesday July 27, 16:00 – 18:00

- **TG Meeting**
- **Call Meeting to order**
- **IEEE 802 and 802.11 IPR Policy and procedure.**
- **Presentations**
  - 11-16/0947 – Laurent Cariou
  - 11-16/0957 – James Wang (??)
- **TG Motions**
- **Recess**

1366

SR Motion #9

- **Move to include the text in doc 11-16/0971r2 related to DSC in the next revision of the TG draft**

- **Move: Graham Smith**
- **Second: Sean Coffey**

- **Motion withdrawn**

SR Motion #10

- **Move to accept the proposed text changes in document "11-16/0947r4, for OBSS_PD-based SR parameters" and include the changes in the next revision of the TG draft**

- **Move: Laurent Cariou**
- **Second: Ron Porat**
- **Y: 59, N:20, A: 29**
- **Motion fails**

Agenda for Thursday July 28, AM2 and PM1

- **TG Meeting**
- **Call Meeting to order**
- **IEEE 802 and 802.11 IPR Policy and procedure.**
- **TG Motions**
- **Presentations (if time allows)**
  - George
  - Wojin
  - Chitto
  - Jerrko
  - Kaushik
- **Telecon**
- **adjourn**

1369

SR Motion #11

- **Move to accept the proposed text changes in document 11-16/0902r3 and include the changes in the next revision of the TG draft**

- **Move: Daewon Lee**
- **Second: Ron Porat**
- **Accepted with no objection**

PHY Motion #158

- **Move to include the spec text change as shown in doc 11/16-0892r0 to the next revision of the TG draft**

- **Move: Hongyuan Zhang**
- **Second: Bo Sun**
- **Y/N/A**
- **Accepted with no objection**

PHY Motion #159

- **Move to include the spec text changes as shown in doc 11/16-0895r0 in the next revision of the TG draft, which reflects Straw Polls 1~3 in doc 11-16/0894r0**

- **Move: Hongyuan Zhang**
- **Second: Bo Sun**
- **Accepted with no objection**

PHY Motion #160

- **Move to include the spec text changes as shown in doc 11/16-0897r1 in the next revision of the TG draft.**

- **Move: Hongyuan Zhang**
- **Second: Bo Sun**
- **Accepted with no objection**

- **Y/N/A**

PHY Motion #161

- **Move to include the spec text changes as shown in doc 11/16-0899r0 (reflects the content of SP1 in doc 11-16/0898r0) to the next revision of the TG draft**

- **Move: Hongyuan Zhang**
- **Second: Bo Sun**
- **Y/N/A**
- **Accepted with no objection**

PHY Motion #162

- Move to add the spec text changes to D0.2 on Table 26-20 – Fields in the HE-SIG-A for an HE SU PPDU and HE Extended Range SU PPDU as shown in doc 11/16-0915r0

- Move: Bin Tian
- Second:
- Y/N/A

PHY Motion #163

- **Move to include the spec text change as shown in doc 11/16-0909r2 in the next revision of the TG draft.**

- **Move: Joonsuk Kim**
- **Second: Bo Sun**
- **Y/N/A**
- **Approved with no objection**

PHY Motion #164

- **Move to include the spec text changes in doc 11-16/0915r2 in the next revision of the TG draft.**

- **Move: Brian Hart**
- **Second: Bo Sun**
- **Accepted with no objection**

PHY Motion #165

- **Move to add to the next revision of the TG draft:**
  - Add at the end of section 26.3.7.1 the following sentence:

  - In a HE MU PPDU transmission, at least Nx4x26 tones (contiguous or non-contiguous), where N is the number of 20MHz channels' legacy preambles present, shall be occupied throughout the signaled BW
- **Move: Ron Porat**
- **Second: Bo Sun**
- **Y/N/A**
- **Accepted with no objection**

MU Motion #57

- **Move to add the following to the next revision of the TG draft:**
  - *Insert the following at the end of 10.22.2.2:*
  - When an HE STA successfully receives the corresponding acknowledgement frame in response to the MPDU sent in HE trigger based PPDU, the backoff for the associated EDCAF resumes the backoff counter countdown

  - *Insert the following at the end of 10.22.2.2:*
  - When an HE STA does not receive the corresponding acknowledgement frame in response to the MPDU sent in HE trigger based PPDU, the backoff for the associated EDCAF resumes the backoff counter countdown

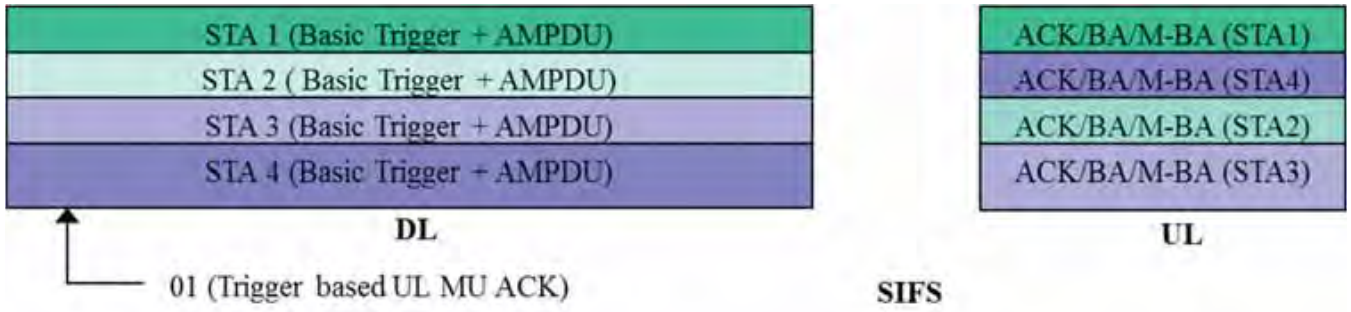
- *Insert the following at the end of 10.22.2.2:*
- If an HE STA does not successfully receive the corresponding acknowledgement frame in response to the MPDU sent in an HE trigger based PPDU, the short retry counters and long retry counters for the associated EDCAF are not changed

1380

- **Move: Kiseon Ryu**
- **Second: Simone Merlin**
- **Accepted with no objection**

MU Motion

- **Move to add the following text to the next revision of the TG draft**
- **Section 25.5.1**
  - It is mandatory at the non AP HE STA to support reception of Trigger in the DL MU PPDU aggregated with Data and respond with an ACK/BA/M-BA if the QoS ACK Policy in the DL A-MPDU is set to 01 (Trigger based UL MU ACK) and the STA has not set the UL MU Disable to 1.



- It is mandatory at the non AP HE STA to support reception of DL MU PPDU with QoS ACK Policy set to Block Ack or No ACK followed by a MU-BAR within SIFS followed by transmission of the ACK/BA/M-BA appropriately if the STA has not set the UL MU Disable to 1.

1382

- **Move: Simone Merlin**
- **Second: Alfred**
- **Ttable till PM1**

MAC Motion #85

- **Move to add the following text to the TG draft:**
  - The Queue Size subfield is an 8-bit field that indicates the amount of buffered traffic, for a given TC or TS at the STA sending this frame.
  - *An HE non-AP STA uses the Queue Size subfield to indicate the amount of buffered traffic intended for the STA identified by the receiver address of the frame containing the QoS Control field.*
- **Move: Pascal Viger Second:**
- **Y/N/A: Stephane Baron**
- **Accepted with no objection**

1383

MAC Motion #86

- **Move to add the following text to the TG draft:**
  - Add to clause #9.3.1.23
  - "Per User Info fields with AID = 0 shall be allocated only after Per User Info fields with AID not equals to 0, if any, and before the MAC padding field, if present."

  - Move: Zhou Lan
  - Second: Reza Hedayat
  - Accepted with no objection

MAC Motion #87

- **Move to include the spec text change as shown in doc 11/16-0917r1 in the TG draft**

- **Move: Woojin Ahn**
- **Second: John Son**

- **Accepted with no objection**

CR Motion #15

- Move to approve resolutions of CIDs, 9, 228
- 2219, 2422, 2691, 2900 in doc 11-16/0725r3.

- Move: Raja Banerjea
- Second: Simone Merlin
- Y/N/A
- Accepted with no objection

1386

CR Motion #16

- **Move to approve resolutions to CIDs, 55, 1000, 1221, 1915, 2234, 802,1695, 1222, 182, 971,2713, 702, 1916, 2233, 223 in doc 11-16/0773r2.**

1387

- **Move: Raja Banerjea**
- **Second: Robert Stacey**
- **Accepted with no objection**

CR Motion #17

- **Move to accept resolutions to CIDs, 262,1083, 102, 612, 660, 830, 864, 1716, 2215, 2301, 2376, 372, 719, 864 in doc 11-16/0774r1**

1388

- **Move: Raja Banerjea**
- **Second: Simone Merlin**
- **Y/N/A**
- **Accepted with no objection**

CR Motion # 18

- **Move to approve resolutions to CIDs, 101,103, 104,374,375, 377, 558, 561, 661, 662, 664, 688, 1296, 1299, 1301, 1717, 1718, 1882, 2113, 2114, 2174, 2217, 2302, 2421, 227, 720, 663,1303,1305,1306 in doc 11-16/0780r1**

- **Move: Raja Banerjea**
- **Second: Simone Merlin**
- **Accepted with no objection**
-

CR Motion #19

- **Move to approve resolutions to CIDs, 340, 341, 342, 343, 1023, 2734, and 2889 in doc 11-16/0775r2**

- **Move: Lochan Verma**
- **Second: Sameer Vermani**
- **Y/N/A**
- **Accepted with no objection**

CR Motion #20

- **Move to approve resolutions of CIDs, 855, 1064, 1, 784, 90, 94, 654, 453, 1181, 2249, 2297, 2208, 2406, 2576, 2901, 2902, 2903, 2405, 2904, 1254, 1255, 1256, 1202, 1714, 1761, 1762, 1881, 1418 in doc 11-16/766r1**

- **Move: Alfred Asterjadhi**
- Second: Young Hoon kwon
- Y/N/A
- Accepted with no objection

CR Motion #21

- **Move to approve resolutions of CIDs, 1126, 1127, 1179, 58, 89, 361, 2248, 1877, 1878, 792, 686, 687, 793, 1133, 91, 92, 362, 363, 2296, 1712, 1713, 1250, 1253, 1711, 2204, 2205, 2206, 211, 364, 1231, 134, 1750, 1244 in doc 11-16/0798r0**

- **Move: Alfred Asterjadhi**
- Second: Simone Merlin
- Y/N/A
- No objection

1392

CR Motion #22

- **Move to approve resolutions to CIDs, 14, 127, 370, 371, 2602 in doc 11-16/0815r2**

- **Move: Young Hoon Kwon**
- **Second: Yongho Seok**
- **Accepted with no objection**

CR Motion #23

- **Move to approve resolutions to CIDs, 961, 1137, 804, 212, 2212, 2412, 2413, 1136, 1493 in doc 11-16/0819r1**

- **Move: Alfred**
- **Second: Yasu**
- **Y/N/A**
- **Accepted with no objection**

CR Motion #24

- **Move to approve resolutions to CIDs, 824, 93, 1067, 2388, 45, 178, 254, 438, 680, 769, 770, 771, 817, 818, 1062, 1065, 1066, 1550, 2189, 2190, 2191, 2272, 2711, 147 in doc 11-16/0806r0**

- **Move: Alfred Asterjadhi**
- Second: Matt Fischer
- Y/N/A
- Accepted with no objection

CR Motion #25

- **Move to approve the resolutions to CIDs, 963, 128, 214, 2171, 2428, 692, 124, 2906, 2840, 2603, 2599, 1209, 2264, 15, 13, 126, 1071, 693, 1768, 401, 1727, 403, 1644, 2281, 2282, 2279, 160 in doc11-16/0807r2**

1396

- **Move: Po-Kai Huang**
- **Second: Yongho Seok**
- **Y/N/A**
- **Accepted with no objection**

CR Motion #26

- **Move to accept the resolutions of CIDs, 1311, 2223, 110, 2587, 8, 2222, 1068, 1310, 1312, 2588, 2601, 2894, 1204, 2907 in doc 11-16/0808r2**

1397

- **Move: Po-Kai Huang**
- **Second: Kiseon Ryu**
- **Y/N/A**
- **Accepted with no objection**

CR Motion #27

- **Move to approve resolutions to CIDs, 2517, 1780, 1923, and 1610 in doc 11-16/0813r5.**

1398

- **Move: Bo Sun**
- **Second: Hongyuan Zhang**
- **Y/N/A**
- **Accepted with no objection**

CR motion #28

- **Move to approve resolutions to CIDs, 112, 380, 381, 456, 539, 689, 690, 1154, 1316, 1862 in doc 11-16/0836r1**

- **Move: Lochan Verma**
- **Second: Sriram**
- **Y/N/A**
- **No objection**

CR Motion #29

- **Move to approve resolution to CID 2183 in document 11-16/0816r1**

- **Move: Daewon Lee**
- **Second: Young Hoon Kown**
- **Y/N/A**
- **Accepted with no objection**

CR Motion #30

- **Move to approve the resolutions to CIDs, 2007, 2005, 2123, 2747, 2746, 2244, 842, 846, 526, 910 in doc 11-16/0872r2**
-
- **Move: Ross Jian Yu**
- **Second: Bo Sun**
- **Accepted with no objection**

1401

CR Motion #31

- **Move to approve resolutions to CIDs, 302, 2040, 2132, 2680, 2039, 2038, 1001,479, 2150 in doc 11-16/0873r1**

- **Move: Ross Jian Yu**
- **Second: Bo Sun**
- **Accepted with no objection**

1402

CR Motion #32

- **Move to approve resolutions to CIDs, 2032, 2549, 2133, 2548, and 1009 in doc 11-16/1021r2**

- **Move: Ross Jian Yu**
- **Second: Bo Sun**
- **Accepted with no objection**

CR Motion #33

- **Move to approve the resolutions to CIDs, 1052, 2519 in doc 11-16/0900r1**

- **Move: Robert Stacey**
- **Second: Sriram**
- **Y/N/A**
- **Accepted with no objection**

CR Motion #34

- **Move to approve the resolution to CID 854 in doc 11-16/0908r1**

- **Move: Joonsuk Kim**
- **Second: Yongho Seok**
- **Accepted with no objection**

CR Motion #35

- **Move to approve the resolutions to CIDs, 1659, 493, 494 in doc 11-16/0920r3**

- **Move: Xiogang Chen**
- **Second: Bo Sun**
- **Y/N/A**
- **Accepted with no objection**

1406

CR Motion #36

- **Move to approve the resolutions to the CIDs, 1782, 2082, 2083 in doc 11-16/0922r2**

- **Move:** Sriram Venkaeswaran
- Second: Bo Sun
- Accepted with no objection

CR Motion #37

- **Move to approve the resolutions to CIDs, 836 883 884 1930 2247 292 525 904 906 908 1984 1990 1995 1988 1994 1058 1992 1991 1985 1989 1684 523 1857 271 1412 1195 1996 2532 2120 2098 293 1987 1993 2748 2749 in doc 11-16/0937r7.**

1408

- **Move: Rui Cao**
- **Second: Bo Sun**
- **Accepted with no objection**

CR Motion #38

- Move to approve resolutions to CIDs, 482, 1867, 2084, 2085 in doc 11-16/0923r1

- Need presentation can skip
- Move: Sriram Venkateswaran
- Second:
- Y/N/A

1409

CR Motion #39

- **Move to approve resolutions to CIDs, 22, 23, 24, 136, 414, 415, 587, 694, 21, 1213, 2615, 1442, 1443, 1756, 1769, 2231 in doc 11-16/0829r3**

1410

- **Move: Reza Hedayat**
- **Second: Brian Hart**
- **Accepted with no objection**

CR Motion #40

- **Move to approve resolutions to CIDs, 1275, 1270, 1269, 1139, 97, 2213, 1809, 1808, 1807, 1806 in doc 11-16/0867r2**

1411

- **Move: George Cherian**
- **Second: Brian Hart**
- **Accepted with no objection**

CR Motion #41

- **Move to approve resolutions to CIDs, 76, 194, 258, 259, 1598, 1773, 2849 in doc 11-16/0844r2**

- **Move: Alfred Asterjadhi**
- Second: Brian Hart
- Y/N/A
- Accepted with no objection

1412

CR Motion #42

- **Move to approve resolutions to CIDs, 1482, 1481, 1480, 1479, 1478, 1476, 1475, 1474, 1473, 30, 1225, 1486, 967, 750, 697, 696, 1793, 424, 167, 2629, 2628, 2627, 2626, 2269, 1484, 1485, 1794, 1662, 1487, 2197, 2464, 2465, 1470, 165, 1217 in doc 11-16/0828r0**

1413

- **Move: Alfred Asterjadhi**
- Second: Brian Hart
- Y/N/A
- Accepted with no objection

CR Motion #43

- **Move to approve resolutions to CIDs, 2484, 2483, 2482, 2481, 2430, 2429, 2489 in doc 11-16/0860r1**

- **Move: Yongho Seok**
- **Second: Brian Hart**
- **Accepted with no objection**

CR Motion #44

- **Move to approve the resolutions to CIDs, 73, 210, 192, 642, 1593, 1919, 643, 1595, 2259, 2260 in doc 11-16/0862r3**

- **Move: Yongho Seok**
- **Second: Young Hoon Kwon**
- **Accepted with no objection**

CR Motion #45

- **Move to approve resolutions to CIDs, 2608, 2607, 2606, 2488, 2487, 1399, 2841 in doc 11-16/0861r2**

- **Move: Yongho Seok**
- **Second: Brian Hart**
- **Accepted with no objection**

1416

CR Motion #46

- **Move to approve the resolution to CID 2596 in doc 11-16/0953r2 and includes the text changes in the TG draft**

- **Move: Po-Kai Huang**
- **Second: Young Hoon Kown**
- **Accepted with no objection**

1417

CR Motion # 47

- **Move to approve resolutions to CIDs, 705, 2437, 2436, 2439, 2440 in doc 11-16/0879r2**

- **Move: Jeongki Kim**
- **Second: Young Hoon Kwon**
- **Accepted with no objection**

CR Motion #48

- **Move to approve resolutions to CIDs, 62, 640, 2434, 2438, 703, 2435, 66, 257, 447, 186, 2661, 2662, 776, 2660, 1577, 2332, 2718 in doc 11-16/0889r1**

1419

- **Move: Young Hoon Kwon**
- **Second: Yongho Seok**
- **Accepted with no objection**

CR Motion #49

- **Move to approve resolutions of CIDs, 1070, 2226, 693, 125, 2650, 2651 in doc 11-16/0875r2**

- **Move: Kiseon Ryu**
- **Second: Po-Kai Huang**
- **Y/N/A**
- **accepted with no objection**

CR Motion #50

- **Move to approve the resolutions of CIDs, 768, 829, 978, 1546, 1295, 2710, 2709, 2187, 2647, 2266 in doc 11-16/0876r2**

1421

- **Move: Kiseon Ryu**
- **Second: Po-Kai Huang**
- **Accepted with no objection**

CR Motion #51

- **Move to approve the resolutions of CIDs, 2890, 2896, 1634 in doc 11-16/0870r0**
- **Move: Zhou Lan**
- **Second: Young Hoon Kwon**
- **Accepted with no objection**

1422

CR Motion #52

- **Move to approve resolution to CID 783 in doc 11-16/0877 r5**
-
- **Move: Jeongki Kim**
- **Second: Kiseon Ryu**
- **Accpted with no objection**

CR Motion #53

- **Move to approve resolutions of CIDs, 162, 2444, 2443, 2623 in doc 11-16/0835r1**

- **Move: Alfred**
- **Second: Po-Kai Huang**
- **Accepted with no objection**

CR Motion #54

- **Move to approve resolutions to CIDs 507, 949, 1005, 1785, 1862 in doc 11-16/0866r4**

- **Move: Kome Oteri**
- **Second: Xiaofei**
- **Accepted with no objection**

CR Motion #55

- **Move to approve resolutions to CIDs, 482, 1867, 2084, 2085 in doc 11-16/0923r1**
-
- **Move:** Sriram Venkateswaran
- Second: Ron Porat

- Accepted with no objection

CR Motion #56

- **Move to approve resolutions of CIDs, 9, 228**
- **2219, 2422, 2691, 2900 in doc 11-16/0725r3.**

- **Move: Alfred**
- **Second: Simone Merlin**
- **Second: Y/N/A**
- **Accepted with no objection**

CR Motion #57

- **Move to approve resolutions to CIDs, 55, 1000, 1221, 1915, 2234, 802,1695, 1222, 182, 971,2713, 702, 1916, 2233, 223 in doc 11-16/0773r2.**

1428

- **Move: Alfred**
- **Second: Simone**
- **No objection**

CR Motion #58

- **Move to accept resolutions to CIDs, 262,1083, 102, 612, 660, 830, 864, 1716, 2215, 2301, 2376, 372, 719, 864 in doc 11-16/0774r1**

1429

- **Move: Alfred**
- **Second: Simone Merlin**
- **Y/N/A**

Accepted with no objection

CR Motion #59

- **Move to approve resolutions to CIDs, 101,103, 104,374,375, 377, 558, 561, 661, 662, 664, 688, 1296, 1299, 1301, 1717, 1718, 1882, 2113, 2114, 2174, 2217, 2302, 2421, 227, 720, 663,1303,1305,1306 in doc 11-16/0780r1**

- **Move: Alfred**
- **Second: Simone Merlin**

Accepted with no objection

CR Motion #60

- **Move to accept resolutions to CIDs, 80, 1284, 1182, 1143, 1286, 962, 1287, 831, 508, 367, 100, 99, 98, 999, 1812, 2580, 2458, 2414, 2232, 2185, 2170, 1285, 1813, 2582, 1811, 1810, 1715, 1291, 1288, 1814 in doc 11-16/0868r1**

1431

- **Move: George Cherian**
- **Second: Simone Merlin**
- **Y/N/A**
- **Accepted with no objection**

CR Motion #61

- **Move to approve resolutions to CIDs, 306, 310, 311, 477, 1002, 1003, 1010, 1692, 2020, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2036, 2037, 2130, 2151, 2245, 2246, 2543, 2544, 2545, 2546, 2547, 2679, 2681 in doc 11-16/0928r2**

- **Move: Kaushik Josiam**
- **Second: Bo Sun**
- **Accepted with no objection**

CR Motion #62

- **Move to approve resolutions to CIDs, 1589, 1590, 2668, and 2669 in doc 11-16/0938r0**

- **Move: Chitto Ghosh**
- **Second: Yasu**
- **Accepted with no objection**

CR Motion #63

- **Move to approve resolutions to CIDs, 71 and 190 in doc 11-16/966r0**

- **Move: Jarkko Kneckt**
- **Second: Alfred**
- **Accepted with no objection**

CR Motion #64

- **Move to approve resolution to CID 782 in doc 11-16/0878r1**

- **Move: Jeongki Kim**
- **Second: Kiseon Ryu**
- **Approved with no objection**

Conference call times

- **August 4 20:00 – 22:00 ET is already approved**

- **August 11, 25, Sept 8 10:00 – 12:00 ET**
- **August 18, Sept 1 20:00 – 22:00 ET**

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Appendix BG

TGax September 2016 Meeting Agenda

Date: 2016-08-05

Authors:

Name	Company	Address	Phone	email
Osama Aboul-Magd	Huawei Technologies	303 Terry Fox Drive Kanata, ONT, Canada K2K-3J1	613-287-1405	Osama.aboulmagd@Huawei.com

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IEEE 802.11 TGax: High Efficiency WLAN Task Group

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Warsaw, Poland

September 11-16, 2016

Chair: Osama Aboul-Magd (Huawei Technologies)
Vice Chair: Simone Merlin (Qualcomm)
Vice Chair: Ron Porat (Broadcom)
Secretary: Yasuhiko Inoue (NTT)
Technical Editor: Robert Stacey (Intel)

Meeting Protocol

- **Please announce your affiliation when you first address the group during a meeting slot**

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Attendance

- http://newton.meeting.verilan.com

1. Register
2. Indicate attendance

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Attendance, Voting & Document Status

- **Make sure your badges are correct**
- **If you plan to make a submission be sure it does not contain company logos or advertising**
- **Questions on Voting status, Ballot pool, Access to Reflector, Documentation, member's area**
  - see Jon Rosdahl – jrosdahl@ieee.org
- **Cell Phones Silent or Off**

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Patent Policy

- **Following 5 slides**

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Instructions for the WG Chair

The IEEE-SA strongly recommends that at each WG meeting the chair or a designee:

- **Show slides #1 through #4 of this presentation**
- **Advise the WG attendees that:**
  - The IEEE's patent policy is described in Clause 6 of the *IEEE-SA Standards Board Bylaws*;
  - Early identification of patent claims which September be essential for the use of standards under development is strongly encouraged;
  - There September be Essential Patent Claims of which the IEEE is not aware. Additionally, neither the IEEE, the WG, nor the WG chair can ensure the accuracy or completeness of any assurance or whether any such assurance is, in fact, of a Patent Claim that is essential for the use of the standard under development.
- **Instruct the WG Secretary to record in the minutes of the relevant WG meeting:**
  - That the foregoing information was provided and that slides 1 through 4 (and this slide 0, if applicable) were shown;
  - That the chair or designee provided an opportunity for participants to identify patent claim(s)/patent application claim(s) and/or the holder of patent claim(s)/patent application claim(s) of which the participant is personally aware and that September be essential for the use of that standard
  - Any responses that were given, specifically the patent claim(s)/patent application claim(s) and/or the holder of the patent claim(s)/patent application claim(s) that were identified (if any) and by whom.
- The WG Chair shall ensure that a request is made to any identified holders of potential essential patent claim(s) to complete and submit a Letter of Assurance.
- It is recommended that the WG chair review the guidance in *IEEE-SA Standards Board Operations Manual* 6.3.5 and in FAQs 14 and 15 on inclusion of potential Essential Patent Claims by incorporation or by reference.

Note: **WG** includes Working Groups, Task Groups, and other standards-developing committees with a PAR approved by the IEEE-SA Standards Board.

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Participants, Patents, and Duty to Inform

All participants in this meeting have certain obligations under the IEEE-SA Patent Policy.

- **Participants [Note: Quoted text excerpted from IEEE-SA Standards Board Bylaws subclause 6.2]:**
  - **"Shall inform the IEEE (or cause the IEEE to be informed)" of the identity of each "holder of any potential Essential Patent Claims of which they are personally aware" if the claims are owned or controlled by the participant or the entity the participant is from, employed by, or otherwise represents**
  - **"Should inform the IEEE (or cause the IEEE to be informed)" of the identity of "any other holders of potential Essential Patent Claims" (that is, third parties that are not affiliated with the participant, with the participant's employer, or with anyone else that the participant is from or otherwise represents)**
- **The above does not apply if the patent claim is already the subject of an Accepted Letter of Assurance that applies to the proposed standard(s) under consideration by this group**
- **Early identification of holders of potential Essential Patent Claims is strongly encouraged**
- **No duty to perform a patent search**

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Slide #1

Patent Related Links

All participants should be familiar with their obligations under the IEEE-SA Policies & Procedures for standards development.

Patent Policy is stated in these sources:

IEEE-SA Standards Boards Bylaws

http://standards.ieee.org/develop/policies/bylaws/sect6-7.html#6

IEEE-SA Standards Board Operations Manual

http://standards.ieee.org/develop/policies/opman/sect6.html#6.3

Material about the patent policy is available at

http://standards.ieee.org/about/sasb/patcom/materials.html

If you have questions, contact the IEEE-SA Standards Board Patent Committee Administrator at patcom@ieee.org or visit http://standards.ieee.org/about/sasb/patcom/index.html

This slide set is available at https://development.standards.ieee.org/myproject/Public/mytools/mob/slideset.ppt

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Slide #2

Call for Potentially Essential Patents

- **If anyone in this meeting is personally aware of the holder of any patent claims that are potentially essential to implementation of the proposed standard(s) under consideration by this group and that are not already the subject of an Accepted Letter of Assurance:**
  - Either speak up now or
  - Provide the chair of this group with the identity of the holder(s) of any and all such claims as soon as possible or
  - Cause an LOA to be submitted

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Slide #3

Other Guidelines for IEEE WG Meetings

- **All IEEE-SA standards meetings shall be conducted in compliance with all applicable laws, including antitrust and competition laws.**
  - **Don't discuss the interpretation, validity, or essentiality of patents/patent claims.**
  - **Don't discuss specific license rates, terms, or conditions.**
    - Relative costs, including licensing costs of essential patent claims, of different technical approaches September be discussed in standards development meetings.
      - Technical considerations remain primary focus
  - **Don't discuss or engage in the fixing of product prices, allocation of customers, or division of sales markets.**
  - **Don't discuss the status or substance of ongoing or threatened litigation.**
  - **Don't be silent if inappropriate topics are discussed … do formally object.**

See *IEEE-SA Standards Board Operations Manual*, clause 5.3.10 and "Promoting Competition and Innovation: What You Need to Know about the IEEE Standards Association's Antitrust and Competition Policy" for more details.

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Slide #4

Agenda Items for the Week

- **Approve TG and Telecons minutes since May meeting.**
- **Resolution of comments received on draft D0.1**
- **Ad Hoc group meetings**
- **Technical Presentations and related straw polls and/or motions**
- **Schedule Telecon times.**

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General Flow of the Meeting

- **Monday September 12, 10:30 – 12:30**
  - Call Ad Hoc Meeting to order
  - IEEE 802 and 802.11 IPR Policy and procedure.
  - AD hoc meeting Agenda setting
  - Approval of ad hoc meeting agenda
  - Call for submissions
  - Presentations
  - Recess
- **Monday September 12, 16:00 – 18:00**
  - Ad Hoc Group Meetings
- **Monday September 12, 19:30 – 21:30**
  - Ad Hoc Group Meetings
- **Tuesday September 13, 10:30 – 12:30**
  - Ad Hoc Group Meetings
- **Tuesday September 13, 16:00 – 18:00**
  - Ad Hoc Group Meetings
- **Wednesday September 14, 08:00 – 10:00**
  - Call Meeting to order
  - IEEE 802 and 802.11 IPR Policy and procedure.
  - Progress Review
  - Presentations
  - Recess
- **Wednesday September 14, 13:30 – 15:30**
  - Ad Hoc Group Meetings
- **Wednesday September 14, 16:00 – 18:00**
  - Ad Hoc Group Meetings
- **Thursday September 15, 10:30 – 12:30**
  - Call Meeting to order
  - IEEE 802 and 802.11 IPR Policy and procedure.
  - Presentations
  - TG Motions
  - Recess
- **Thursday September 15, 13:30 – 15:30**
  - Call Meeting to order
  - IEEE 802 and 802.11 IPR Policy and procedure.
  - Presentations
  - TG Motions
  - Recess
- **Thursday September 28, 16:00 – 18:00**
  - Call Meeting to order
  - IEEE 802 and 802.11 IPR Policy and procedure.
  - Presentations
  - TG Motions
  - Goals for November 2016
  - Telecon Schedule
  - Adjourn

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TGax Schedule in a Glance

	Monday		Tuesday		Wednesday		Thursday
AM1					**TGax**		
AM2	**TGax**		MU	MAC			**TGax**
PM1					PHY	MAC	**TGax**
PM2	PHY	MAC	PHY	MAC	MU/PHY	MAC	**TGax**
EVE	PHY	SR					

*** Ad Hoc group is tbd**

Agenda for Monday September 12, 10:30 – 13:30

- **Call meeting to order**
- **Patent policy, etc.**
- **Call for submissions**
- **Set Ad Hoc Groups schedule and approve agenda**
- **Summary from July 2016 meeting**
- **TG motions**
  - Approve TG meeting and Telecon minutes since November meeting.
  - Approve resolutions of comments, if needed.
- **Comment Resolution Status – Robert Stacey**
- **Timeline**
- **Presentations and Comment Resolution**
- **Recess**

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MAC Leftover

DCN	Title	Author	
11-16/0828	HE Fragmentation - part 1	Alfred Asterjadhi	
11-16/0829	Comment Resolution for Section 10.24.10 Block Ack/GCR block ack	Reza Hedayat	
11-16/0844	CC0-Intra_PPDU_PS	Alfred Asterjadhi	
11-16/0856	Issue of Buffer Status reporting	Stephane Baron	
11-16/0860	comment resolution on A-MPDU format	Yongho Seok	
11-16/0861	comment resolution on mu acknowledgment procedure	Yongho Seok	
11-16/0862	comment resolution on subclause 25.11	Yongho Seok	
11-16/0864	d0.1 comment resolution on clause 6	Yasuhiko Inoue	
11-16/0867	CIDs for CIDs: Section 9.3.1.9.3 Compressed BA format	George Cherian	
11-16/0868	CIDs for Section 9.3.1.9.7 Multi STA BAs	George Cherian	
11-16/0869	Comment resolution section 9.3 TWT	Zhou Lan	
11-16/0871	Trigger Frame Per User Info Order	Zhou Lan	
11-16/0877	Comment resolution on CID 783 (TXOP Duration field format)	Jeongki Kim	
11-16/0878	Comment resolution on CID 782 (Intra-PPDU PS)	Jeongki Kim	
11-16/0881	Comment resolution on ROMI	Jayh Park	
11-16/0882	Comment resolution on TOMI	Alfred	
11-16/0883	Comment resolution for CID152	Jayh Park	
11-16/0884	Spec. Text for HE Operation element and AID Assign Rule	Jianhan Liu	
11-16/0890	Comment Resolution on NAV Setting of Single and Multiple Protection and Control Response	Po-Kai Huang	

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MAC Leftover (Cotinued)

DCN	Title	Author	
11-16/0913	SU Multi-TID Rules	Jarkko Kneckt	
11-16/0916	TID value of ALL ACK signaling	Woojin Ahn	
11-16/0917	Text for TID value of ALL ACK signaling	Woojin Ahn	
11-16/0918	Discussions on Partial BSS Color	Geonjung Ko	
11-16/0924	NAV resetting with RTS/MU-RTS	Weimin Xing	
11-16/0925	Spex text on NAV resetting with RTS/MU-RTS	Weimin Xing	
11-16/0941	CR HE Fragmentation - part 2	Ming Gan	
11-16/0942	CR Field	Ming Gan	
11-16/0951	Setting for TXOP Duration Field	Po-Kai Huang	
11-16/0952	Spec text trigger frame per user info order	Zhou Lan	
11-16/0953	Comment Resoluaton and Spec Text for Setting for TXOP Duration field	Po-Kai Huang	
11-16/0960	AP access procedure for UL MU operation	Jinsoo Ahn	
11-16/0961	Consideration on Multi-STA BlockAck Optimization	Hanseul Hong	
11-16/0962	EDCA rules-follow up 1	Jing Ma	
11-16/0963	EDCA rules-follow up 2	Jing Ma	
11-16/0966	CID71 and CID190 Resolutions	Jarkko Kneckt	
11-16/0998	Rules for 2 EDCA parameters	laurent cariou	

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MU Leftover

DCN	Title	Author	ad hoc
11-16/0866	Comment Resolution of Section 26.3.13 MU-MIMO	Kome Oteri	MU
11-16/0875	CR for the section 10.3.2.8a CS Condition to Respond CTS	Kiseon Ryu	MU
11-16/0876	CR for the section 25.5.2.4 UL MU CS CCA and CS Required Bit	Kiseon Ryu	MU
11-16/0880	UL MU Transmission Rules - EDCA backoff	Jayh Park	MU
11-16/0885	Comment Resolution on UL MU CS NAV Considerstion	Po-Kai Huang	MU
11-16/0886	Comment Resolution for some UL MU CS TBD	Po-Kai Huang	MU
11-16/0887	Spec Text for MU-RTS restriction on HE MU PPDU	Po-Kai Huang	MU
11-16/0926	Soliciting UL_MU_ACK	Raja Banerjea	MU
11-16/0929	CR - UL MU Operation	Simone Merlin	MU
11-16/0930	CD - DL MU Operation	Simone Merlin	MU
11-16/0938	Comment Resolution for Sub-clause 25.10.4	Chittabrata Ghosh	MU
11-16/0958	UL OFDMA for Unassociated STAs	Leonardo Lanante	MU

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PHY Leftover

DCN	Title	Author	ad hoc
11-16/0898	BW Field in HE-MU Format	Hongyuan Zhang	PHY
11-16/0899	Spec Text for BW Field in HE-MU Format	Hongyuan Zhang	PHY
11-16/0903	Gamma phase rotation for HE PPDU	Yujin Noh	PHY
11-16/0904	proposed text for gamma phase rotation for HE PPDU	Yujin Noh	PHY
11-16/0937	11ax Comment Resolutions for Clauses 26.3.2-26.3.9.3-26.3.9.4-26.3.9.5-26.3.10.2- 26.3.10.13	Rui Cao	PHY
11-16/0906	RU restriction on 20MHz operating STAs	Joonsuk Kim	PHY
11-16/0908	CR - proposed text on RU restriction of 20MHz STAs	Joonsuk Kim	PHY
11-16/0910	Minimum Occupied Bandwidth	Ron Porat	PHY
11-16/1021r1	further-change-on-the-proposed-change-of-cid-2032-2549-2133-2548-1009	Ross	PHY
11-16/0914	Bit field finalization of HE-SIG-A	Lochan Verma	PHY
11-16/0915	Text for bit field finalization of HE-SIG-A	Lochan Verma	PHY
11-16/0920	PHY comment resolution for CID 1659,493,494	Xiaogang Chen	PHY
11-16/0922	PHY CR 1024 QAM	Sriram Venkateswaran	PHY
11-16/0923	PHY CR DCM Constellation Mapping	Sriram Venkateswaran	PHY
11-16/0928	CR on Section 26.3.9.8 - HE-SIG-B	Kaushik Josiam	PHY
11-16/0964	Considerations on MAC-PHY interactions during SR operations	Jing Ma	PHY

SR Leftover

DCN	Title	Author	Order
11-16/0879r2	Comment resolution on SR for VHT PPDUs	Jeongki Kim	1
11-16/0889r1	comment-resolution-SR-Intra-BSS-detection	Young Hoon Kown	2
11-16/0901r2	Clarification of SR Fields in HE Trigger Based PPDU	Daewon Lee	3
11-16/0902r2	Proposed Text Changes for SR Fields in HE Trigger-Based PPDU	Daewon Lee	4
11-16/0905	SR Fields Clarification	Ron Porat	5
11-16/0919r0	Discussions on SR Fields in HE Trigger-based PPDU	Geonjung Ko	6
11-16/0971r2	DSC Proposal Text	Graham Smith	10
11-16/0945	Clarifications for OBSS_PD-based SR parameters	Laurent Cariou	7
11-16/0947	Proposed text changes for OBSS_PD-based SR parameters	Laurent Cariou	8
11-16/0957	Comment Resolutions on OBSS_PD Conditions in 25.9.3	James Wang	9

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Submissions

- **TBD**

MAC Submissions

DCN	Title	Author	Ad Hoc	Notes
11-16/0864	d0.1 comment resolution on clause 6	Yasuhiko Inoue	MAC	presented during a telecon.
11-16/0869	Comment resolution section 9.3 TWT	Zhou Lan	MAC	
11-16/0881	Comment resolution on ROMI	Jayh Park	MAC	
11-16/0882	Comment resolution on TOMI	Alfred	MAC	
11-16/0883	Comment resolution for CID152	Jayh Park	MAC	
11-16/0884	Spec. Text for HE Operation element and AID Assign Rule	Jianhan Liu	MAC	
11-16/0913	SU Multi-TID Rules	Jarkko Kneckt	MAC	
11-16/0917	Text for TID value of ALL ACK signaling	Woojin Ahn	MAC	
11-16/0918	Discussions on Partial BSS Color	Geonjung Ko	MAC	
11-16/0924	NAV resetting with RTS/MU-RTS	Weimin Xing	MAC	
11-16/0925	Spex text on NAV resetting with RTS/MU-RTS	Weimin Xing	MAC	
11-16/0941	CR HE Fragmentation - part 2	Ming Gan	MAC	
11-16/0942	CR Service Field	Ming Gan	MAC	
11-16/0960	AP access procedure for UL MU operation	Jinsoo Ahn	MAC	presented during telecon. waiting SP
11-16/0961	Consideration on Multi-STA BlockAck Optimization	Hanseul Hong	MAC	
11-16/0962	EDCA rules-follow up 1	Jing Ma	MAC	presented during telecon. waiting SP
11-16/0963	EDCA rules-follow up 2	Jing Ma	MAC	presented during telecon. Waiting SP
11-16/0998	Rules for 2 EDCA parameters	laurent cariou	MAC	
11-16/1110	comment resolution on subclause 10.22.2 and 10.22.4	Yongho Seok	MAC	
11-16/1131	comment resolution on mu ack policy	Yongho Seok	MAC	
11-16/1154	MAC CR for CID 966	Weimin Xing	MAC	
11-16/1157	Comment resolution on SU_MU ACK procedures	Jeongki Kim	MAC	
11-16/1173	Comment Resolution on Two NAVs - Part II	Po-Kai Huang	MAC	
11-16/1180	Proposed text changes for MU EDCA parameters	laurent cariou	MAC	
11-16/1181	CW value after UL MU procedure	Woojin Ahn	MAC	
11-16/1182	HE Sounding Feedback Segmentation	Liwen Chu	MAC	
11-16/1183	MU RTS CTS data rate comment	Liwen Chu	MAC	
11-16/1184	A-MPDU 25.10 25.10.2 comment resolution	Liwen Chu	MAC	
11-16/1185	A-MPDU 25.10.3 comment resolution	Liwen Chu	MAC	
11-16/1186	A-MPDU Content Comment Resolution	Liwen Chu	MAC	
11-16/1188	MAC Capabilities in HE Capabilities IE	Alfred Asterjadhi	MAC	
11-16/1189	CC0-TWT operation	Alfred Asterjadhi	MAC	
11-16/1195	MAC Clarifications	Alfred Asterjadhi	MAC	
11-16/1204	Intra-PPDU Power Save for a Multiple BSSID Set Case	Geonjung Ko	MAC	
11-16/1205	Text for Intra-PPDU Power Save for a Multiple BSSID Set Case	Geonjung Ko	MAC	
11-16/1210	Comment Resolution on MU acknowledgement procedure	Junichi Iwatani	MAC	
11-16/1211	CR_CID_122_576_972_2598	Huizhao Wang	MAC	
11-16/1213	CR TWT and HE element related	Matthew Fischer	MAC	
11-16/1220	MU mode EDCA control	Jinsoo Ahn	MAC	
11-16/1234	Spec Text for TWT Protectioin field	Hanseul Hong	MAC	
11-16/1236	Text for Partial BSS Color and AID Assignment Rule	Geonjung Ko	MAC	
11-16/1237	setting-quiet-time-period	Chao-Chun Wang	MAC	
11-16/1238	Setting Quiet time period - text	Chao-Chun Wang	MAC	

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PHY Submissions

DCN	Title	Author	Ad Hoc	Notes
11-16/1133	11ax sounding modes reduction	Yan Zhang	PHY	
11-16/1134	11ax spec text on sounding modes reduction	Yan Zhang	PHY	
11-16/1135	11ax comment resolutions for clause 26.3.5	Yan Zhang	PHY	
11-16/1136	11ax comment resolutions for clause 26.3.8	Yan Zhang	PHY	
11-16/1137	11ax comment resolutions for clause 26.3.9	Yan Zhang	PHY	
11-16/1138	11ax comment resolutions for clause 26.3.10	Yan Zhang	PHY	
11-16/1148	CR HE-SIG-A part III	Ross Jian Yu	PHY	
11-16/1149	CR HE-SIG-A part II	Ross Jian Yu	PHY	
11-16/1150	CR Packet Extension Part I	Ross Jian Yu	PHY	
11-16/1160	Comment Resolution for CID 355	Eunsung Park	PHY	
11-16/1167	UL MU Clarifications	Ron Porat	PHY	
11-16/1168	DCM TBDs	Sriram Venkateswaran	PHY	
11-16/1169	CR Duplicate MU MIMO	Sriram Venkateswaran	PHY	
11-16/1170	HE PHY Capabilities	Lochan Verma	PHY	
11-16/1171	PHY Miscellaneous Part-1	Lochan Verma	PHY	
11-16/1176	PHY CR Miscellaneous Part-2	Lochan Verma	PHY	
11-16/1179	PHY section editorial comments on D0.4	Sungeun Lee	PHY	maybe discuss with the Editor
11-16/1190	Tx Quality Requirements	Daewon Lee	PHY	
11-16/1191	Comment Resolution for CIDs on PHY Transmit Spec	Daewon Lee	PHY	
11-16/1192	Comment Resolution for CID 1450	Daewon Lee	PHY	
11-16/1193	HE variant HT Control - He Link Adaptation	Daewon Lee	PHY	
11-16/1194	Removal of Unnecessary PHY TBDs	Daewon Lee	PHY	
11-16/1202	CR HE-LTF	Ming Gan	PHY	
11-16/1227	cr-on-26-3-7	Shahrnaz Azizi	PHY	
11-16/1232	Text change proposal of TXTIME in 26.3.19 and 26.4.3	Daewon Lee	PHY	
11-16/1233	CR for DCM related CID 503, 504 and 2750	Daewon Lee	PHY	
11-16/1240	Packet Extension Factor calculation fix	Yan Zhang	PHY	
11-16/1242	spec text for packet extension factor calculation fix	Yan Zhang	PHY	

28 submissions

MU Submissions

DCN	Title	Author	Ad Hoc	Notes
11-16/773	Comment Resolution Section 25.6 HE Sounding	Raja Banerjea	MU	presented before July meeting. New revision
11-16/0929	CR - UL MU Operation	Simone Merlin	MU	presented during a telecon.
11-16/1152	DL OFDMA Ack rule for uplink trigger based PPDU	Ming Gan	MU	
11-16/1158	Comment resolution on OFDMA random access procedure	Jeongki Kim	MU	
11-16/1162	Comment Resolution on Retansmission of OFDMA Random Access	Yunbo Li	MU	
11-16/1163	Concluding OFDMA M-BA transmission	Zhou Lan	MU	
11-16/1177	comment-resolution-TXOP-truncation	Young-Hoon Kown	MU	
11-16/1239	Trigger Frame_MUBAR_part1	Raja Banerjea	MU	
11-16/1241	Trigger Frame_MUBAR_part2	Raja Banerjea	MU	
11-16/1199	Proposed text changes for DL OFDMA Acknowledge rule for trigger based PPDU	Ming Gan	MU	
11-16/1222	Comment Resolution on UL OFDMA Random Access	Chittabrata Ghosh	MU	
11-16/1224	Random Access Paramer Set (RAPS) element	Chittabrata Ghosh	MU	

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SR Submissions

DCN	Title	Author	Ad Hoc	Notes
11-16/0945	Clarification for OBSS_PD-based SR parameters	Matthew Fischer	SR	
11-16/0947	Proposed text changes for OBSS_PD-based SR parameters	Laurent Cariou	SR	
11-16/1064	Unified SR approach DSC, ATPC and Inter-BSS	Graham Smith	SR	
11-16/1155	SR Comment Resolution for CID994	Kaiying Lv	SR	
11-16/1161	Simulation-based evaluation of OBSS_PD-based SR default parameters	Tanguy Ropitault	SR	
11-16/1178	comment-resolution-SR-RSSI	Young-Hoon Kown	SR	
11-16/1216	SR Field SRP Table for HE-Trigger-Based PPDU	James Wang	SR	
11-16/1223	CR for Section 25.9.2 OBSS_PD Spatial reuse	laurent cariou	SR	
11-16/1225	Heads We Win, Tails We Don't Lose: Proposals for Dynamic CCA	Sean Coffey	SR	

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TG submissions

DCN	Title	Author	Ad Hoc	Notes
11-16/1095	OFDMA performance in 11ax	Suhwook Kim	TG	
11-16/1143	11ax PAR Verification	TG	TG	
11-16/1159	Summary of Mandatory or Optional Features of 802.11ax	Joonsuk Kim	TG	
11-16/1166	Meeting PAR requirements with UL OFDMA	Sriram Venkateswaran	TG	
11-16/1198	Preliminary 11ax PAR Verification	Jiyong Pang	TG	
11-16/1219	Considerations on CR for 2665 and 2715	Jing Ma	TG	

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6 submissions

Summary from July 2016 Meeting

- **Approved the resolutions of about 230 comments discussed during telecons before July meeting.**
- **Approved resolutions of almost 350 CIDs during the July meeting**
- **Approved a number of submissions proposing new text to be added to the draft.**
- **Editor generated draft D0.3 and draft D0.4.**
- **Conducted weekly telecons since July F2F meeting.**
  - Covered 17 submissions
  - Discussed resolutions of almost 250 CIDs
  - Please refer to telecon minutes
    - https://mentor.ieee.org/802.11/dcn/16/11-16-1105-03-00ax-tgax-teleconference-minutes-from-august-to-september-2016.docx

Microsoft Word Document

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Approval of TG Minutes (July 2016 Meeting and Telecon Minutes)

- **Approve TGax minutes of meetings and teleconferences from July 2016 plenary meeting to today:**
  - https://mentor.ieee.org/802.11/dcn/16/11-16-0967-00-00ax-tgax-july-2016-san-diego-meeting-minutes.docx
  - https://mentor.ieee.org/802.11/dcn/16/11-16-1105-03-00ax-tgax-teleconference-minutes-from-august-to-september-2016.docx
  - https://mentor.ieee.org/802.11/dcn/16/11-16-1040-00-00ax-tgax-july-2016-san-diego-phy-ad-hoc-meeting-minutes.docx
  - https://mentor.ieee.org/802.11/dcn/16/11-16-1000-02-00ax-july-2016-san-diego-tgax-mac-ad-hoc-meeting-minutes.docx
  - https://mentor.ieee.org/802.11/dcn/16/11-16-1027-00-00ax-mu-ad-hoc-meeting-minutes-july-2016.docx
  - https://mentor.ieee.org/802.11/dcn/16/11-16-1022-00-00ax-tgax-spatial-reuse-ad-hoc-group-meeting-minutes.docx

- **Move: Peter Loc** **Second: Yasu Inoue**
- **Approved with no objection**

Comment Resolution Status (Editor Report)

- **Robert Stacey**

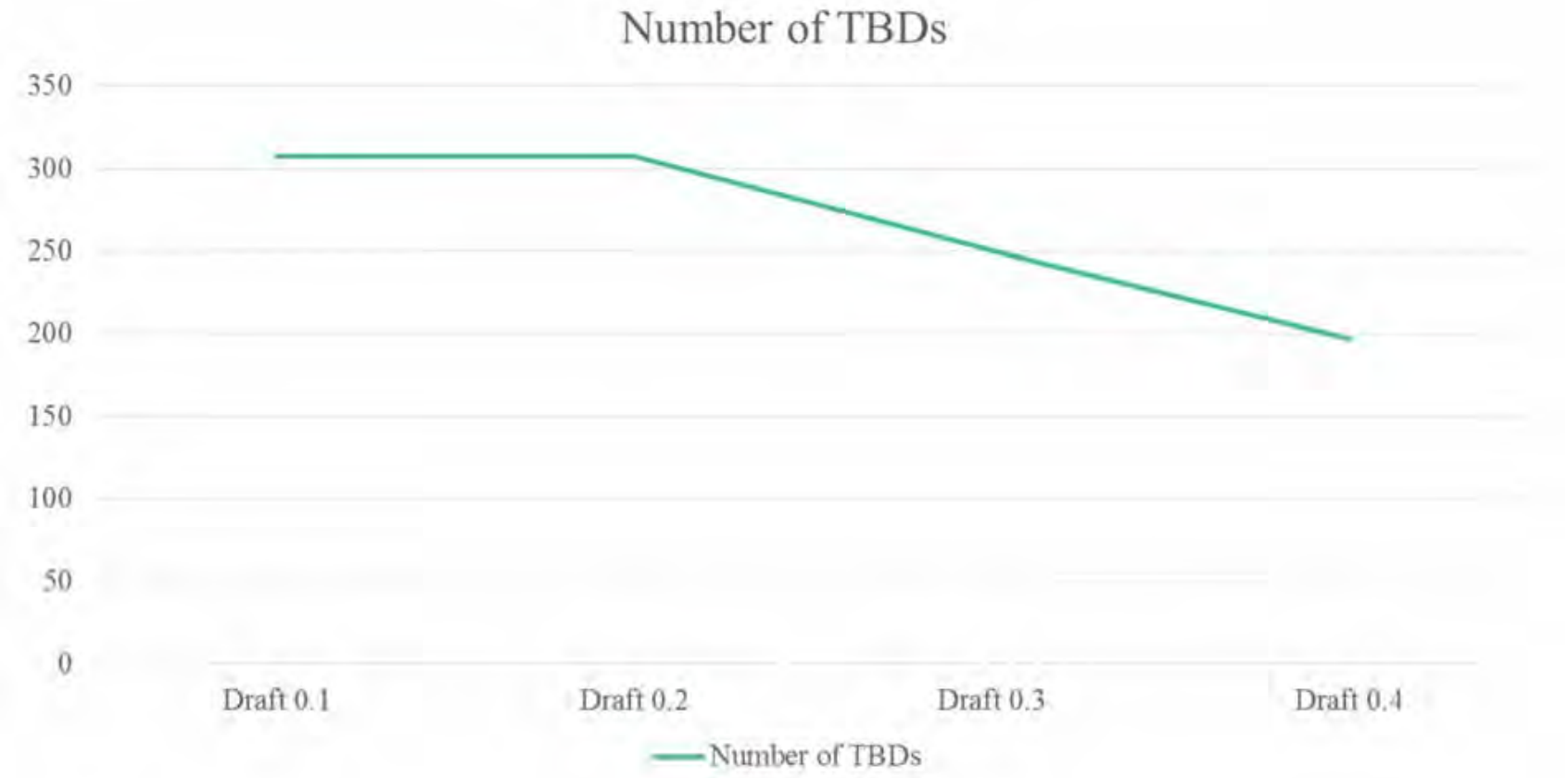
1466

Timeline

- May 2014: start of the TG
- Nov. 2014: First draft of the TG SFD was approved
- Jan. 2016: proposed TG draft
- March 2016: Draft D0.1 was approved and CC started
- September 2016: Draft 1.0 and WG letter ballot
- March 2017: Draft 2.0 and recirculation
- July 2017: MDR (Mandatory Document Review)
- November 2017: Formation of SB pool
- March 2018: Sponsor Ballot
- December 2018: RevCom

1467

Number of TBDs



1468

Agenda for Monday September 12, 16:00 – 18:00

- **Ad Hoc Meetings**
  - PHY: Ballroom C&D
  - MAC : Baltic I

1469

Agenda for Monday September 12, 19:30 – 21:30

- **Ad Hoc Meetings**
  - PHY: Ballroom C&D
  - SR: Baltic I

1470

Agenda for Tuesday September 13, 10:30 – 12:30

- **Ad Hoc Group Meetings**
  - MU: Ballroom C&D
  - MAC: Baltic I

1471

Agenda for Tuesday September 13, 16:00 – 18:00

- **Ad Hoc Group Meetings**
  - PHY: Ballroom C&D
  - MAC: Baltic I

1472

Agenda for Wednesday September 14, 08:00 – 10:00

- **TG Meeting**
- **Call Meeting to order**
- **IEEE 802 and 802.11 IPR Policy and procedure.**
- **Progress from the ad hocs**
- **Presentations**
  - 11-16/1143, “11ax PAR Verification”
  - 11-16/1159, “Summary of Mandatory or Optional Features in 11ax”
  - 11-16/1223, “CR for Section 25.9.2 OBSS_PD Spatial reuse” - SP
  - 11-16/1219, “Consideration on CR for 2665 and 2715 – Jing Ma
  - 11-16/1225, “Heads We Win, Tails We Don't Lose: Proposals for Dynamic CCA” – move to Thursday AM2
- **Recess**

1473

11-16/1223 SP

- **Do you agree with the comment resolutions in document 1223r6 for CIDs 2386, 1232, 63, 463, 2663, 67, 641, 2913, 65, 462, 2742, 2743, 777, 255, 2665, 449, 68, 706, 1018, 2723, 1017, 1582, and 2667?**

- **Accepted with no objection**

1474

Agenda for Wednesday September 14, 13:30 – 15:30

- **Ad Hoc Group Meetings**
  - PHY: Ballroom C/D
  - MAC: Baltic I

1475

Agenda for Wednesday September 14, 16:00 – 18:00

- **Ad Hoc Group Meeting**
  - MU : Ballroom C/D
  - MAC: Baltic I

1476

Agenda for Thursday September 15, 08:00 – 10:00

- **Ad Hoc Meetings**
  - PHY: Ballroom C/D
  - MAC: Baltic I

1477

Agenda for Thursday September 15, AM2, PM1, and PM2

- **TG Meeting**
- **Call Meeting to order**
- **IEEE 802 and 802.11 IPR Policy and procedure.**
- **Presentations**
  - Continuation of PHY comments assignment
  - 11-16/1225, “Heads We Win, Tails We Don't Lose: Proposals for Dynamic CCA” – move to Thursday AM2
  - 11-16/1241 from the MAC ad hoc
- **TG Motions**
- **Timeline**
- **Goals for November 2016**
- **Telecon Schedule**
- **Adjourn**

1478

Motions

- **TG Motions start here**

1479

PHY Motion #166

Move to make the following changes to the spec.

Replace the following text in Subclause 26.3.5 P82 L65

The HE extended range SU PPDU is 20 MHz and can only be transmitted with the <HE-MCS, NSS> tuples <MCS 0, 1>, <MCS 1, 1> and <MCS 2, 1>

by

The HE extended range SU PPDU only supports single 242-tone and 106-tone RU. The 242-tone RU can only be transmitted with the <HE-MCS, NSS> tuples <MCS 0, 1>, <MCS 1, 1> and <MCS 2, 1>. The 106-tone RU can only be transmitted with the <HE-MCS, NSS> tuples <MCS 0, 1>. The 106-tone RU location within the 20MHz tone plan is fixed as the right one.

Move: Bin Tian Second: VK Jones

Accepted with no objection

PHY Motion #167

- **Move to accept the spec text changes as shown in doc 11/16-1134r1 and add to the next revision of the TG draft**

- **Move: Yan Zhang**
- **Second: Daewon Lee**
- **Accepted with no objection**

PHY Motion

- **Move to adopt the following SRP values for the corresponding entries in Spatial Reuse fields (in Spatial Reuse 1, Spatial Reuse 2, Spatial Reuse 3, and Spatial Reuse 4) for HE Trigger-based PPDU**

Spatial Reuse	SRP	Spatial Reuse	SRP
0001	-80 dBm	1000	-44 dBm
0010	-74 dBm	1001	-41 dBm
0011	-68 dBm	1010	-38dBm
0100	-62 dBm	1011	-35dBm
0101	-56 dBm	1100	-32 dBm
0110	-50 dBm	1101	-29 dBm
0111	-47 dBm	1110	-26 dBm

- SRP= $TX\ PWR_{AP}$ + Acceptable Receiver Interference $level_{AP}$
- Adjustment range for parameters (referenced to the antenna port)
  - TX_PWR_{AP}: -10 dBm to 26 dBm
  - Acceptable Receiver Interference $Level_{AP}$: -82dBm to -36 dBm
- If SRP is below <-80 dBm, set to Spatial Reuse to 0001, if SRP is above -26 dBm, set Spatial reuse to 1110
- Set Spatial Reuse to 0000 for SR disallowed flag, Value 1111 is reserved
- Same table is used for AP and STA.

Doc 11-16/1216r1

Move: James Wang Second:

Motion is not run since it is included in comment resolution doc 11-16/1148r6

PHY Motion # 168

- **Move to accept the proposed spec text in doc 11-16/1170r1 and include it in the next revision of the TG draft**

1483

- **Move: Sameer Vermani**
- **Second: Bin Tian**
- **Accepted with no objection**

PHY Motion #169

- **Move to accept the proposed spec text in doc 11-16/1171r0 and include it in the next revision of the TG draft**

- **Move: Sameer Vermani**
- **Second: Bin Tian**
- **Accepted with no objection**

PHY Motion #170

- **Move to add to 11ax spec draft D0.4 page 227 line 7 the following statement:**
  - A STA that applies beamforming (BF) in the UL should take the BF gain into account when calculating the transmit power needed to meet the target RSSI.

- **Move: Sriram**
- **Second: Zhou Lan**

- **Doc 11-16/1167r1**
- **Accepted with no objection**

PHY Motion

- **Move to add to the 11ax spec draft D0.4 on page 186 line 52 (after "It is mandatory to support transmission of 1x HE-LTF in an UL MU-MIMO PPDU over the full bandwidth, for a STA declaring support for UL MU-MIMO") the following sentence:**
  - When 1xLTF is used for full BW UL MU-MIMO, no pilots (in the LTF field) or frequency domain masking are applied.

1486

- **Move: Sriram Second:**
- **Doc: 11-16/1167r1**
- **Skipped because it is already in a CR document 11-16/1202r2**

PHY Motion #171

- **Move to add the proposed spec text changes in 11-16/1168r2 and include it in the next revision of the TG draft**

1487

- **Move: Sriram Venkateswaran**
- **Second: Bin Tian**
- **Accepted with no objection**

PHY Motion #172

- **Move to add the proposed spec text changes in 11-16/1179r4 and include in the next revision of the TG draft**

1488

- **Move: Daewon Lee**
- **Second: Sai**
- **Accepted with no objection**

PHY Motion #173

- **Move to add the proposed spec text changes in 11-16/1194r1 and include it in the next revision of the TG draft**

1489

- **Move: Daewon Lee**
- **Second: Young Hoon Kwon**
- **Accepted with no objection**

PHY Motion #174

- **Move to add the proposed spec text changes in 11-16/1242r1 and include it in the next revision of the TG draft**

- **Move: Yan Zhang**
- **Second: Daewon Lee**

- **Accepted with no objection**

SR Motion #12

- **Move to accept the modifications as proposed in submission 11-16/0947r12 and include it in the next TG draft**

1491

- **Move: Matthew Fischer**
- **Second: Alfred Asterjadhi**

- **Y:27 N: 10 A;21 Motion fails**

Motion to amend (SR #12 *)

- **Move to amend the motion (2016-09 SR #12) as follows:**
  - Alter to:
    - Move to accept the modifications as proposed in submission 11-16/0947r12, with the normative text

    "In the SR subfield of the HE-SIGA field:

    - One entry disallows SRP-based SR;
    - One entry disallows both SRP-based SR and OBSS_PD-based SR."

    added in Section 25.9.2,

    and include it in the next TG draft
- **Move: Sean Coffey**
- **Second: George Cherian**
- **Y 26 N 22 A 17**
- **Simple majority required. Motion passes**

1492

Motion (2016-09 SR #12A)

Move to accept the modifications as proposed in submission 11-16/0947r12, with the normative text

"In the SR subfield of the HE-SIGA field:

- One entry disallows SRP-based SR;
- One entry disallows both SRP-based SR and OBSS_PD-based SR."

added in Section 25.9.2,

and include it in the next TG draft

1493

Motion to amend (SR #12 **)

Amend to read as:

"Move to accept the modifications as proposed in submission 11-16/0947r12, with the normative text

"In the SR subfield of the HE-SIGA field:

- One entry disallows both SRP-based SR and OBSS_PD-based SR."

added in Section 25.9.2,

and include it in the next TG draft"

Move: Matthew Fischer

Second: Bin Tian

Y 39 N 14 A 9

Simple majority required. Motion passes

1494

Motion (2016-09 SR #12B)

"Move to accept the modifications as proposed in submission 11-16/0947r12, with the normative text

"In the SR subfield of the HE-SIGA field:

- One entry disallows both SRP-based SR and OBSS_PD-based SR."

added in Section 25.9.2,

and include it in the next TG draft"

Y 44 N 21 A 4

75% majority required. Motion fails

Motin To reconsider SR Motion #12

- **Move to reconsider SR Motion #12**

- **Move: Robert Stacey**
- **Second Po-Kai Huang**

- **Y: 34 No: 5 A: 25**
- **Motion Passes**
- **Back to the original SR #12 motion.**

1496

Move to amend ST Motion #12

- **Move to amend the motion**
- **Delete the exploratory text**

1497

MU motion #58

- **Move to add the following text after the end of the first paragraph of section 10.3.2.11.3 of the draft spec:**

Specifically, when an AP transmits an immediate acknowledgement in HE MU PPDU in response to (A-)MPDU sent in HE trigger-based PPDU, the AP should send it within the 20 MHz channel(s) where the pre-HE modulated fields of the HE trigger-based PPDU sent by the STA are located. The immediate acknowledgement is either Block Ack frame (or Ack frame) or Multi-STA Block Ack frame.

1498

Move: Ming Gan

Second: David Yang

Accepted with no objection

MU Motion #59

- **Move to add the following paragraph after the first paragraph of section 25.4.1**

A HE AP should only transmit group addressed M-BA in the DL MU PPDU to HE non AP STA *n* on the (broadcast RU) RU (26/52/106/242/484/996) that includes the RU used for receiving the immediate preceding HE Trigger Based PPDU from STA *n*. There shall be no more than one M-BA that is addressed to multiple recipients carried in a broadcast RU of the DL MU PPDU.

- **Move: Zhou Lan Second: Sriram**
- **Doc: 11-16/1163r0**
- **Approved with no objection**

MU Motion #60

- **Move to add the following text to the next revision of the TG draft**

- ***TGax editor: Add the Paragraph on page 40 line 62 as the following:***
  - An MU-RTS frame shall not be carried in an HE MU PPDU.

- **Move: Po-Kai Huang**
- **Second: Robert Stacey**
- **Accepted with no objection**
- **Doc 11-16/0887r1**

MAC Motion #88

- **Move to accept the proposed text in document 16/0884r5 and include it in the next revision of the TG draft.**

1501

- **Move: Tianyu Wu**
- **Second: David Yang**
- **Accepted with no objection**

MAC Motion #89

- **Move to accept the proposed text in document 16/0925r1 and include it in the next revision of the TG draft.**

1502

- **Move: Weimin Xing**
- **Second: Kaiying**
- **Accepted with no objection**

MAC Motion #90

- **Move to add the following sentence to the section 25.5.2.2.3 AP access procedures for UL MU operation on page 92 line 31, draft D0.4**
  - An AP may send the Trigger frame using any access category and follows the rules defined in 10.22.2 (HCF contention based channel access (EDCA)) for obtaining and sharing the TXOP

1503

- **Move: Jing Ma**
- **Second: Young Hoon Kwon**

Accepted with no objection

- **Doc:11-16/0962r5**

MAC Motion #91

- **Move to accept the spec changes proposed in document 16/1180r1 and include them in the next revision of the TG draft**

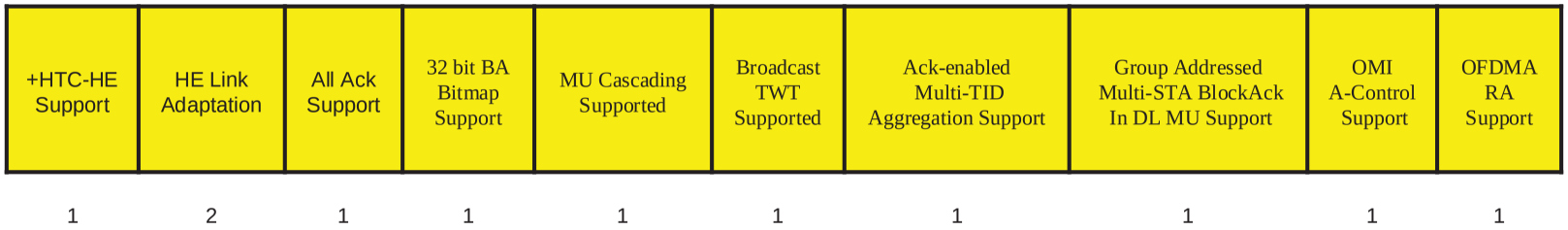
1504

- **Move: Po-Kai Huang**
- **Second: Young Hoon Kwon**

- **Accepted with no objection**

MAC Motion

- **Move to add the subfields below to the HE Capabilities IE and include it in the next revision of the TG draft**



	+HTC-HE Support	HE Link Adaptation	All Ack Support	32 bit BA Bitmap Support	MU Cascading Supported	Broadcast TWT Supported	Ack-enabled Multi-TID Aggregation Support	Group Addressed Multi-STA BlockAck In DL MU Support	OMI A-Control Support	OFDMA RA Support
Bits:	1	2	1	1	1	1	1	1	1	1

- **Move: Alfred Asterjadhi**
- **Second:**
- **Doc:11-16/1188r1**
- **Motion is not run. It is included in another CR document 11-16/1266r3**

MAC Motion

- **Do you support that:**
  - The reception of Action (ACK) frame aggregated with Data is optional.
  - The reception of acknowledgement frames (ACK, BA, M-BA) aggregated with Data is optional (indicated via MU Cascading Supported bit).
  - The reception of Basic variant Trigger frame aggregated with Data is mandatory.

- **What is the action?**

1506

MAC Motion

- **Move to accept the proposed text in document 16/0884r5 and add it to the next revision of the TG draft.**

1507

- **Move: Jianhan Liu**
- **Second:**
- **Motion is skipped. Duplication of MAC Motion #88**

MAC Motion #92

- **Move to instruct the TGax Editor to make the following changes:**
- ***TGax Editor: Change the paragraph below of 9.3.1.23.1 of D0.4 as follows:***
- **The TID Aggregation Limit subfield indicates the maximum number of TIDs ~~minus 1~~ that can be aggregated by a STA in a multi-TID A-MPDU carried in the responding HE trigger-based PPDU.**
- **NOTE– A value of 7 in the TID Aggregation Limit subfield indicates to the STA that it can aggregate QoS Data frames from any number of different TID values in the multi-TID A-MPDU.**
-
- ***TGax Editor: Change the paragraph below of 25.5.2.2.2 of D0.4 as follows:***
- **The AP shall set the value in the TID Aggregation Limit subfield in the Type dependent Per User Information field to 0 or 1 for an HE STA with STA that has indicated a zero value in the Multi-TID Aggregation Support field of the HE Capabilities element it transmits and is identified by the AID12 subfield of the User Info field of a Basic Trigger variant Trigger frame (see 9.3.1.23 (Trigger frame format)).(#2669) A value of zero indicates to the STA that it shall not solicit any immediate response for the MPDUs that the STA aggregates in the Trigger-based PPDU.**
- **Move: Alfred Asterjadhi Second: George Cherian**
- **Accepted with no objection**
- **Doc: 11-16/1195r1**

1508

MAC Motion

- **Move to accept the following NAV update rule:**
  - A STA shall update its NAV, irrespectively of whether it is the intended receiver of an MPDU contained in the received PPDU, except that it shall ignore the NAV if the PPDU solicits an immediate response from the STA

1509

- **Move: Alfred Asterjadhi**
- **Second:**
- **Skipped because it is included in CR document 11-16/1173r2**
- **Doc: 11-16/1195r1**

MAC Motion #93

- **Move to accept the proposed spec text change in document 16/1205r0 and include it in the next revision of the TG draft**

- **Move: Geonjung Ko**
- **Second: John Son**
- **Accepted with no objection**

CR Motion #65

- **Move to accept resolutions to CIDs; 1467, 635, 2648, 2708, 1544, 1545, 2649, 437, 1542, 990, 2256, 1543, 599 in doc 11-16/0885r3**

1511

- **Move: Po-Kai Huang**
- **Second: Alfred**
- **Accepted with no objection**

CR Motion #66

- **Move to accept resolutions to CIDs; 177, 2188, 1220, 206, 700 in doc 11-16/0886r3**

- **Move: Po-Kai Huang**
- **Second: Alfred**
- **Accepted with no objection**

1512

CR Motion #67

- **Move to accept resolutions to CIDs; 2579, 1203, 795, 610, 2408, 2375, 2184, 1263, 1264, 2409, 2410, 2411 in doc 11-16/0890r2**

1513

- **Move: Po-Kai Huang**
- **Second: Kiseon Ryu**
- **Accepted with no objection**

CR Motion #68

- **Move to accept resolutions to CIDs; 1218, 31, 168, 752, 1495, 1498, 1499, 1500, 1664, 1795, 1900, 2319, 813 doc 11-16/1028r3**

- **Move: Bin Tian**
- **Second: Alfred**
- **Accepted with no objection**

CR Motion #69

- **Move to accept resolutions to CID; 32, 33, 169, 221, 250, 427, 429, 753, 754, 755, 756, 1502, 1503, 1504, 1505, 1506, 1508, 1801, 1901, 1902, 1903, 2632, 2633, 2634, 2635 in doc 11-16/930r3**

1515

- **Move: Alfred Asterjadhi**
- **Second: VK Jones**

- **Accepted with no objection**

CR Motion #70

- **Move to accept resolutions to CIDs; 34, 35, 36, 39, 40, 42, 43, 44, 170, 172, 173, 174, 175, 176, 432, 436, 460, 591, 593, 594, 676, 677, 678, 698, 699, 800, 815, 816, 859, 860, 862, 968, 977, 997, 1078, 1079, 1080, 1081, 1082, 1184, 1438, 1519, 1522, 1530, 1531, 1534, 1538, 1541, ~~1646~~, 1648, 1665, 1753, 1772, 1802, 1828, 1904, 1905, 1906, 1909, 1910, 1911, 1912, 2173, 2175, 2176, 2194, 2255, 2271, 2321, 2381, 2382, 2452, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2644, 2645, 2646, 2682, 2706, 2707 in doc 11-16/0929r3**

- **Move: Alfred Asterjadhi Second: Bin Tian**
- **Accepted with no objection**

CR Motion #71

- **Move to accept resolutions to CIDs; 112, 380, 381, 456, 539, 689, 690, 1154, 1316, 1862 in doc 11-16/1097r1**

- **Move: Sameer Vermani**
- **Second: Bin Tian**
- **Accepted with no objection**

CR Motion #72

- **Move to accept resolutions to CIDs; 1743, 1775, 1638, 785, 1742, 164, 1636, 28, 163, 2317, 1463, 2625, 2702, 2703, 2704, 2705, 422, 748, 1216, 1744, 1759, 866, 788, 2739, 220, 1014, 1011, 746, 1466, 709, 27, 1469, 2473, 747, 2491, 1215, 29 in doc 11-16/1106r2**

- **Move: Po-Kai Huang**
- **Second: Kiseon Ryu**
- **Accepted with no objection**

1518

CR Motion #73

- **Move to accept resolutions to CIDs; 2207, 857, 2611, 2612, 1429, 1434, 1435, 1817 in doc 11-16/1127r0**

- **Move: Alfred Asterjadhi**
- **Second: Bin Tian**
- **Accepted with no objection**

CR Motion #74

- **Move to accept resolutions to CIDs; 995, 2597, 2584 in doc 11-16/1122r0**

- **Move: Po-Kai Huang**
- **Second: Kiseon Ryu**
- **Accepted with no objection**

CR Motion #75

- **Move to accept resolutions to CIDs; 83, 1227, 1228, 1229, 1238, 1239, 1240, 2292, 2293, 2294, 2304, 2305, 2306, 1125, 1230, 1241, 1596, 1869, 2420, 1123 in doc 11-16/0864r6**

1521

- **Move: Yasu Inoue**
- **Second: Alfred**

- **Accepted with no objection**

CR Motion #76

- **Move to accept resolutions to CIDs; 2386, 1232, 63, 463, 2663, 67, 641, 2913, 65, 462, 2742, 2743, 777, 255, 2665, 449, 68, 706, 1018, 2723, 1017, 1582, and 2667 in doc 1223r6**

1522

- **Move: Po-Kai Huang**
- **Second: Chittabrata Ghosh**
- **Accepted with no objection**

CR Motion #77

- **Move to approve resolutions of CIDs; 2664 and 2744 in doc 11-16/1178r0**

- **Move: Youn Hoon Kwon**
- **Second: Daewon Lee**
- **Accepted with no objection**

CR Motion #78

- **Move to accept resolution to CID 979 in doc 11-16/0876r2**

- **Move: Kiseon Ryu**
- **Second: Alfred Asterjadhi**

- **Accepted with no objection**

CR Motion #79

- **Move to approve resolutions to CIDs; 1927, 2521, 2522, 2523, 2107, 2108 in doc 11-16/1135r2**

- **Move: Yan Zhang**
- **Second: Bo Sun**
- **Accepted with no objection**

CR Motion #80

- **Move to approve resolutions to CIDs; 286, 290, 2137, 287, 288, 289, 528, 1676, 1980, 1982, 1983, 2417, 2418, 2419, 298, 299, 300, 1979, 2370, 901, 1847, 1967, 1968, 1970, 1971, 1973, 1974, 1976, 1977, 1978 in doc 11-16/1136r5.**

- **Move: Yan Zhang**
- **Second: Bo Sun**
- **Accepted with no objection**

CR Motion #81

- **Move to approve resolutions of CIDs; 294, 873, 1099, 1698, 1997, 1998, 1999, 2000, 2019, 2531, 2540, 2541 and 2542 in doc 11-16/1137r4**

1527

- **Move: Yan Zhang**
- **Second: Daewon Lee**
- **Accepted with no ojection**

CR Motion #82

- **Move to approve the resolutions of CIDs; 2097, 2099, 2563, 2564, 2726, 2881, 484 in doc 11-16/1138r4**

- **Move: Yan Zhang**
- **Second: Bo Sun**
- **Accepted ith no objection**

CR Motion #83

- **Move to approve the resolutions of CIDs; 1022, 2864, 2678, 2016, 2011, 2010, 2001, and 226 in doc 11-16/1148r6**

1529

- **Move: Ross Jian Yu**
- **Second: Bo Sun**
- **Accepted with no objection**

CR Motion #84

- **Move to approve the resolutions of CIDs; 304, 2035, 2033, 527, 478, 2550, 2157, 2131 in doc 11-16/1149r1**

- **Move: Ross Jian Yu**
- **Second: Bo Sun**

- **Accepted with no objection**

CR Motion #85

- **Move to accept resolutions to CIDs; 1459, 2100, 2101, 2102, 2104, 2135, 2568, 2569, 2570, 2571, 2573, 1414, 1626, 2015, and 336 in doc 11-16/1150r3**

1531

- **Move: Ross Jian Yu**
- **Second: Bo Sun**
- **Accepted with no objection**

CR Motion #86

- **Move to approve resolution of CID 355 in doc 11-16/1160r0**

- **Move: Eunsung Park**
- **Second: Jinsoo Choi**

- **Accepted with no objection**

CR Motion #87

- **Move to approve resolutions to CIDs; 834, 1030, 1604, 1861, 2242, and 2919 in doc 11-16/1176r1**

- **Move: Sameer Vermani**
- **Second: Bo Sun**
- **Accepted with no objection**

CR Motion #88

- **Move to accept resolutions to CIDs; 506, 851, 1024, 1628, 1693, 1694, 1696, 2159, 2162, 2163, 2165, 2166 in doc 11-16/1169**r1

1534

- **Move:** Sriram Venkateswaran
- **Second: Bo Sun**

- **Accepted with no objection**

CR Motion #89

- **Move to approve resolutions to CIDs; 1778, 1784, 2063, 2064, 2065, 2069, 2071, 2073, 2074, 925, 2561, 2560, 2562, 2076, 2070, 332, 2075, 328, 329, 331, 2160, 2161, 2164, 2067 in doc 11-16/1259r2**

1535

- **Move: Sriram Venkateswaran**
- **Second: Bo Sun**
- **Accepted with no objection**

CR Motion #90

- **Move to approve resolutions to CIDs; 538, 496, 497, 498, 499, 344, 501, 1026, 1115, 2351, 500 in doc 11-16/1191r2**

1536

- **Move: Daewon Lee**
- **Second: Young Hoon Kwon**
- **Accepted with no objection**

CR Motion #91

- **Move to approve the resolution of CID 1450 in doc 11-16/1192r0**

- **Move: Daewon Lee**
- **Second: Young Hoon Kwon**

- **Accepted with no objecton**

CR Motion #92

- **Move to accept resolutions to CIDs 4 and 2740 in doc 11-16/1193r1**

- **Move: Daewon Lee**
- **Second: Young Hoon Kwon**
- **Accepted with no objection**

CR Motion #93

- **Move to accept resolutions to CIDs; 503, 504 and 2750 in doc 11-16/1233r1**

- **Move: Daewon Lee**
- **Second: Young Hoon Kwon**
- **Accepted with no objection**

CR Motion #94

- **Move to accept resolutions to CIDs; 327, 2442 in doc 11-16/0942r3**

- **Move: Min Gan**
- **Second:Peter Loc**
- **Accepted with no objection**

CR Motion

- **Move to accept resolutions to CID 286 and CID 2137 to as in 11-16/1136r5**
- **Move: Yan Zhang**
- **Skipped. Covered by motion #80**

1541

CR Motion #95

- **Move to approve resolution of CIDs 55, 1000, 1221, 1915, 2234, 802, 1695, 1222, 182, 971, 2713, 702, 1916, 2233, 223 as proposed in doc 11-16/0773r4**

1542

- **Move: Sameer Vermani**
- **Second: Bin Tian**

- **Accepted with no objection**

CR Motion #96

- **Move to approve resolution of CIDs 787 and 2471 as proposed in doc 11-16/1158r3**

- **Move: Jeongki Kim**
- **Second: Kiseon Ryu**

- **Accepted with no objection**

CR Motion #97

- **Move to approve resolution of CIDs 49, 601, 442, 2385, 51, 602, 1198, 2684, 181, 440 and 2291 as proposed in doc 11-16/1162r4**

1544

- **Move: Yunbo Li**
- **Second: Ross Jian Yu**
- **Accepted with no objection**

CR Motion #98

- **Move to approve resolutions of CIDs 18, 204, 626, 673, 737, 738, 810, 1440, 1660, 2193, 2283, 2447, 2613, 2614 and 992 as proposed in doc 11-16/1177r2**

1545

- **Move: Young Hoon Kwon**
- **Second: Peter Loc**
- **Accepted with no objection**

CR Motion #99

- **Move to approve resolution of CIDs 5, 108, 512, 566, 567, 615, 665, 973, 1308, 1815, 2220, 2252, 2423, 2585 and 2586 as proposed in doc 11-16/1239r1**

1546

- **Move: George Cherian**
- **Second: Kiseon Ryu**
- **Accepted with no objection**

CR Motion #100

- **Move to approve resolution of CIDs 863, 219, 411, 2380, 2609, 671, 2115, 986 and 734 as proposed in doc 11-16/1183r3**

1547

- **Move: Liwen Chu**
- **Second: Kiseon Ryu**
- **Accepted with no objection**

CR Motion #101

- **Move to approve resolution of CIDs 47, 48, 179, 180, 450, 600, 701, 801, 820, 988, 1084, 1199, 1201, 1913, 1914 and 2384 as proposed in doc 11-16/1222r1**

1548

- **Move: Chittabrata Ghosh**
- **Second: Po-Kai Huang**
- **Accepted with no objection**

CR Motion #102

- **Move to approve resolution of CIDs 2316, 631, 811, 2905, 2257, 632, 205 and 966 as proposed in doc 11-16/1173r2**

1549

- **Move: Po-Kai Huang**
- **Second: Chittabrata Ghosh**
- **Accepted with no objection**

CR Motion #103

- **Move to accept resolutions to CIDs: 1315, 2424, 2589, 2590, 2591 in doc 11-16/0869r2**

- **Move: Zhou Lan**
- **Second: Alfred Asterjadhi**
- **Accepted with no objection**

CR Motion #104

- **Move to accept resolutions to CIDs: 2, 60, 61, 184, 185, 207, 445, 446, 655, 685, 775, 856, 1223, 1224, 1562, 1565, 1568, 1569, 1572, 1573, 1574, 2200, 2236, 2238, 2239, 2328, 2330, 2657 in doc 11-16/0881r2**

1551

- **Move: Jayh Park**
- **Second: Brian Hart**
- **Accepted with no objection**

CR Motion #105

- **Move to accept resolution for CIDs: 152 in doc 11-16/0883r1**

- **Move: Jayh Park**
- **Second: Alfred Asterjadhi**

- **Accepted with no objection**

1552

CR Motion #106

- **Move to accept resolutions to CIDs: 1477, 675, 423, 166, 1823, 2270, 2268, 2254, 2198, 1824, 1818, 1800, 1796, 1663, 1491, 1489, 1488, 2630 in doc 11-16/0941r0**

1553

- **Move: Ming Gan**
- **Second: Peter Loc**

- **Accepted with no objection**

CR Motion #107

- **Move to accept resolutions to CIDs: 2468, 2470, 2448, 2450, 2451, 809 in doc 11-16/1110r0**

- **Move: Yongho Seok**
- **Second: Young Hoon Kwon**
- **Accepted with no objection**

CR Motion #108

- **Move to accept resolutions to CIDs; 2445, 2457, 2494, 2395 in doc 11-16/1131r2**

- **Move: Yongho Seok**
- **Second: Young Hoon Kwon**
- **Accepted with no objection**

CR Motion #108

- **Move to accept resolutions to CIDs: 129, 130, 131, 132, 405, 406, 407, 408, 672 in doc 11-16/1157r0**

- **Move: Jeongki Kim**
- **Second: Young Hoon Kwon**
- **Accepted with no objection**

CR Motion #110

- **Move to accept resolutions to CIDs: 2258, 2446, 1588, 1645 in doc 11-16/1184r1**

- **Move: Liwen Chu**
- **Second: Lei Wang**
- **Accepted with no objection**

CR Motion #111

- **Move to accept resolutions for CIDs: 984, 70, 229, 191, 2670, 1379, 1380 in doc 11-16/1185r2**

- **Move: Liwen Chu**
- **Second: Lei Wang**
- **Accepted with no objection**

CR Motion #112

- **Move to accept resolutions for CIDs: 95, 365, 656, 794, 1134, 1135, 1260, 2298, 2407, 2463, 2469, 2658, 2659 in doc 11-16/0882r3**

1559

- **Move:Jayh Park**
- **Second: Alfred Asterjadhi**

- **Accepted with no objection**

CR Motion #113

- **Do you agree to add to the 11ax specification D0.1 the comment resolutions in document 16/1189r2 for CIDs: 1214, 1779, 1658, 2899, 959, 416, 1735, 740, 1445, 1639, 137, 139, 2398, 2399, 1640, 1738, 2616, 1651, 1652, 1736, 1737, 742, 25, 138, 2617, 1653, 744, 957, 26, 141, 420, 142, 2618, 1741, 1874, 2400, 2845, 1649, 1650, 1740, 1739, 695, 1641, 976, 144, 1077, 145, 146, 452, 1642, 2619, 2621, 1643, 1647, 958, 745, 586, 143, 2622, 2820, 1656, 1654, 1657, 1646, 1318, 544, 155, 153, 151 in doc 11-16/1189r2.**

- **Move: Alfred Asterjadhi**
- **Second: Reza Hedayat**
- **Accepted with no objection**

1560

CR Motion #114

- **Move to accept resolutions for CIDs: 2313, 1410, 1454, 1728, 1897, 1411, 1729, 1898, 1899, 1730, 1731, 1403, 1427, 1409, 20, 1732, 1733, 17, 133 in doc 11-16/1210r1**

1561

- **Move: Junichi Iwatani**
- **Second: Yasu Inoue**
- **Accepted with no objection**

CR Motion #115

- **Move to accept resolutions for CIDs:122, 576, 972, 2598 in doc 11-16/1211r2**

- **Move: Huizhao Wang**
- **Second: Zhou Lan**
- **Accepted with no objection**

1562

CR Motion #116

- **Move to accept resolutions to CIDs; 1865 323 481 517 537 920 319 1059 2559 2551 2552 2553 2554 2555 2556 2557 2558 923 in doc 11-16/1202r5**

1563

- **Move: Ming Gan**
- **Second: Bo Sun**
- **Accepted with no objection**

CR Motion #117

- **Move to accept resolutions to CIDs; 841,1787,1945, 1946,1949,1950,1965,2365,2366,2524,2525,2526,2918 in doc 11-16/1227r2**

1564

- **Move: Po-Kai Huang**
- **Second: Chitto Ghosh**
- **Accepted with no objection**

CR Motion #118

- **Move to accept resolutions for CIDs: 805, 1354, 1356, 1357, 1358, 1360, 1359, 668, 1792, 2475, 2477, 2478, 2479, 2480, 1527, 2263, 120, 1366, 10, 1368, 1369, 1371, 1372, 1374, 1375, 394, 11,12, 669, 1378, 1376, 2455, 2592, 1381, 1384, 2456, 1377, 1635, 1804, 2309, 1367, 670, 2593, 2594, 2595, 1386 in doc 11-16/1186r1**

1565

- **Move: Liwen Chu**
- **Second: Lei Wang**

- **Accepted with no objection**

CR Motion #119

- “Moved to add to the 11ax draft comment resolutions in document 16/1266r3 for CIDs:

113	114	115	116	117	156	196	197
	198	199	200	201	202	213	263
	264	267	387	388	389	390	391
	392	393	457	571	572	573	620
	621	666	667	682	723	724	
	1027	1152	1156	1157	1158	1159	1160
	1161	1162	1163	1164	1183	1205	1206
	1207	1314	1319	1320	1321	1322	1323
	1324	1325	1327	1332	1333	1335	1343
	1344	1346	1347	1348	1352	1415	1452
	1453	1655	1679	1680	1721	1723	1724
	1725	1764	1797	1798	1799	1803	1883
	1884	1885	1886	1887	1888	1889	1890
	1891	1892	1893	1894	1896	2253	2276
	2277	2278	2307	2308	2377	2390	2391
	2392	2393	2394	2425	2426	2427	2466
	2830	2831	2832	2836	2837	2838	2839

1566

- **Move: Brian Hart**
- **Second: Yasu Inoue**

- **Accepted with no objection**

CR Motion #120

- **Move to accept resolutions to CIDs; 567,665, 2220,2586 in doc 11-16/1241r1**

- **Move: George Cherian**
- **Second: Reza Hedayat**

- **Accepted with no objection**

CR Motion #121

- **The comment resolution to the following CIDs is "Revised" since they have been resolved in D0.4 or by approved resolutions to other CIDs?**
  - CID 2745, 1981, 1025, 502, 1666, 284, 1670, 1788, 1672, 1675, 2139, 1622, 1681, 295, 297, 2182, 309

1569

- **Move to accept the resolution of the above CIDs as "Revised"**
- **Move: Bo Sun Second: Bin Tian**
- **Accepted with no objection**

CR Motion #122

- **The comment resolution to CID 261 is “Rejected” with the reason “HE modulated field consists HE-STF, HE-LTF and HE-DATA only as defined in 26.3.2”**

- **Move to accept “Rejected” as the resolution to CID 261.**

- **Move Bo Sun Second: Bin Tian**
- **Accepted with no objection**

CR Motion #123

- **The comment resolution to CID 1458 is “Rejected” with the reason “The commenter failed to provide an applicable changes to the spec.”**

1571

- **Move to accept “Rejected” as the resolution to CID 1458**

- **Move: Bo Sun Second: Bin Tian**
- **Accepted with no objection**

CR Motion #124

- **Move to accept resolutions to CIDs, 1034, 1035, 1036, and 2138 in doc 11-16/1277r1**

- **Move: Yan Zhang**
- **Second: Bo Sun**
- **Accepted with no objectiom**

1572

Timeline

Current Timeline

- May 2014: start of the TG
- Nov. 2014: First draft of the TG SFD was approved
- Jan. 2016: proposed TG draft
- March 2016: Draft D0.1 was approved and CC started
- September 2016: Draft 1.0 and WG letter ballot
- March 2017: Draft 2.0 and recirculation
- July 2017: MDR (Mandatory Document Review)
- November 2017: Formation of SB pool
- March 2018: Sponsor Ballot
- December 2018: RevCom

Modified Timeline

- May 2014: start of the TG
- Nov. 2014: First draft of the TG SFD was approved
- Jan. 2016: proposed TG draft
- March 2016: Draft D0.1 was approved and CC started
- November 2016: Draft 1.0 and WG letter ballot
- May 2017: Draft 2.0 and recirculation
- Novemebr 2017: MDR (Mandatory Document Review)
- January 2018: Formation of SB pool
- March 2018: Sponsor Ballot
- December 2018: RevCom

1573

November 2016 Plan

- **Continue with the comment resolution**
- **Resolve as many comments as we can**
- **Prepare draft D1.0 and start a WG LB**

1574

Conference call times

- **Thursday Sept 29, Oct 20 10:00 – 12:00 ET**
- **Thursday Oct 13 20:00 -22:00 ET**
- **Thursday Oct 27 10:00 – 12:00 ET**
- **Thursday Nov 17 10:00 -12:00 ET**

1575

Appendix BH

IEEE P802.11
Wireless LANs

IEEE 802.11 TGax

November 2016 San Antonio Meeting Minutes

Date: 2016-11-29

Author(s):

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Yasuhiko Inoue	NTT	1-1 Hikari-no-oka, Yokosuka, Kanagawa 239-0847 Japan	+81 46 859 5097	inoue.yasuhiko@lab.ntt.co.jp

Abstract

TGax meeting minutes from the IEEE 802.11 November 2016 San Antonio meeting, November 7th – 11th, 2016.

Minutes/motions from the ad hoc groups are contained in the following documents:

- PHY Ad Hoc
  - Agenda: 11-16-1475, TGax PHY Ad Hoc Nov 2016 Meeting Agenda
  - Minutes: 11-16-1530, November 2016 San Antonio PHY Ad Hoc Meeting Minutes

- MAC Ad Hoc
  - Agenda: 11-16-1478, TGax MAC Ad Hoc November 2016 Meeting Agenda
  - Minutes: 11-16-1480, November 2016 San Antonio TGax MAC Ad hoc Meeting Minutes

- MU Ad Hoc
  - Agenda: 11-16-1487, TGax MU Ad-hoc Agenda November 2016
  - Minutes: 11-16-1520, IEEE 802.11 TGax, MU Ad hoc November 2016 Meeting Minutes

- SR Ad Hoc
  - Agenda: 11-16-1481, TGax Spatial Reuse Ad-hoc Agenda November 2016 Meeting
  - Minutes: 11-16-1569, TGax Spatial Reuse ad hoc group meeting minutes – San Antonio, November 2016

IEEE 802.11 Task Group AX (TGax)
November 2016 San Antonio Meeting
Grand Hyatt San Antonio, TX, U.S.A.
November 7th – 11th, 2016

TGax Chair	**Osama Aboul-Magd (Huawei Technologies)**
Vice Chair	**Simone Merlin (Qualcomm)**
Vice Chair	**Ron Porat (Broadcom)**
TGax Secretary	**Yasuhiko Inoue (NTT)**
TGax Technical Editor	**Robert Stacy (Intel)**

Monday, November 7th, 2016, AM1 TGax Ad Hoc Session (8:00 - 10:00 AM)

1. The meeting called to order by Osama Aboul-Magd (Huawei Technologies), the chair of the TGax, @08:03 AM
   1.1. Introduction of TGax chair, secretary, vice chair.

2. Announcement
- 2.1. Agenda Doc.11-16/1310r0 on the server. Rev. 1 is the working document.
- 2.2. Meeting Protocol:
  - 2.2.1. Chair asked to set the mobile devices mute.
  - 2.2.2. Chair asked to state name and affiliation when speaking for the first time.
- 2.3. Attendance reminder.
  - 2.3.1. The attendance server: https://imat.ieee.org/
- 2.4. Since this is an ad hoc meeting, no motion will be conducted.

3. Agenda Setting.
- 3.1. Proposed Agenda for Monday AM1:
  - 3.1.1. Call meeting to order
  - 3.1.2. Ad Hoc Meeting (no Motions)
  - 3.1.3. Patent policy, etc.
  - 3.1.4. Agenda Items for the week.
  - 3.1.5. Call for submissions.
  - 3.1.6. Set Ad hoc Group schedule and approve agenda.
  - 3.1.7. Comment Resolution Status – Robert Stacy (TGax editor).
  - 3.1.8. Timeline
  - 3.1.9. Presentations and Comment Resolution
    - 3.1.9.1. 11-16/1348 Coexistence assurance document
    - 3.1.9.2. 11-16/1363 11ax PAR Verification through OFDMA
    - 3.1.9.3. 11-16/1414 Verifying 11ax¡¯s PAR by UL MU-MIMO
    - 3.1.9.4. 11-16/1435 PAR Verification Simulation Followup
    - 3.1.9.5. More presentations if time allows
  - 3.1.10. Recess.
- 3.2. Chair asked if there are any other items – No items proposed. Meeting will be conducted based on this order.

4. The chair reviewed the mandatory 5 slides of P&P.
- 4.1. Instructions for the WG Chair.
- 4.2. Participants, Patents, and Duty to Inform.

4.3. Patent Related Links.
4.4. Call for potentially essential patents.
4.4.1. Chair asked if anyone is aware of potentially essential patents.
4.4.2. No potentially essential patents reported.
4.5. Other Guidelines for IEEE WG Meetings.

5. Agenda items for the week

- Approve TG and Teleconferences minutes since September meeting.
- Complete the resolution of comments received on draft D0.1
- Approve a motion to prepare draft D1.0 and start WG LB
- Ad Hoc group meetings
- Technical Presentations and related straw polls and/or motions
- Schedule Teleconference times.

6. General Flow of the meeting

6.1. Slides 13 and 14 of the 16/1310r1 contain general flow of the meeting.
6.2. There are eight meeting slots planed for TGax.

	Monday		Tuesday		Wednesday		Thursday	
AM1	TGax (full ad hoc)				TGax (full)		TGax (ad hoc)	TGax (ad hoc)
AM2			TGax (Ad Hoc)	TGax (Ad Hoc)				
PM1	TGax (full)				TGax (Ad Hoc)	TGax (Ad Hoc)	TGax (full)	
PM2	TGax (ad hoc)	TGax (ad hoc)	TGax (Ad Hoc)	TGax (Ad Hoc)	TGax (ad hoc)	TGax (ad hoc)	TGax (full)	
PM3	TGax (ad hoc)	TGax (ad hoc)						

7. Call for submissions – there are about 90 submissions

7.1. PHY – 29 submissions
7.1.1. 16/1295, “CC23 PHY CR Miscellaneous Part-1,” Yongho Seok (Newracom)
7.1.2. 16/1340, “CR HE-PHY Miscellaneous Part-3,” Lochan Verma (Qualcomm)
7.1.3. 16/1341, “CR HE-PHY-Introduction-Part-2,” Lochan Verma (Qualcomm)
7.1.4. 16/1356, “Spec text for HE NDP,” Yongho Seok (Newracom)
7.1.5. 16/1370, “Proposed Spec Text for CCA Section,” Laurent Cariou (Intel)
7.1.6. 16/1371, “CR HE-SIG-B part III,” Ross Jian Yu (Huawei)
7.1.7. 16/1372, “Some proposed changes to D0.5,” Ross Jian Yu (Huawei)
7.1.8. 16/1374, “Resolution on CID495 and Removal of Unnecessary PHY TBDs,” Yujin Noh (Newracom)
7.1.9. 16/1375, “Comment Resolution for CID2867 and Text Change Proposal of 26.3.10.8 HE-SIG-B,” Yujin Noh (Newracom)
7.1.10. 16/1377, “Comment resolution on Clauses 26.3.9 and 26.3.10,” Yusuke Asai (NTT)
7.1.11. 16/1387, “Comment resolution on CID2506 and proposed changes,” Jinsoo Chio (LG Electronics)
7.1.12. 16/1393, “EVM Definition for UL OFDMA,” Ron Porat (Broadcom)
7.1.13. 16/1398, “CR for CID 2077,” Sriram Venkateswaran (Broadcom)
7.1.14. 16/1399, “Changes to D0.5,” Sriram Venkateswaran (Broadcom)
7.1.15. 16/1402, “11ax Receiver Specification,” Bin Tian (Qualcomm)
7.1.16. 16/1406, “Spec Text for 11ax Receiver Requirements,” Bin Tian (Qualcomm)

7.1.17. 16/1407, “Changes to D0.5,” Xiaogang Chen (Intel)
7.1.18. 16/1408, “PHY CRs 26.3.3,26.3.18,26.3.19,” Xiaogang Chen (Intel)
7.1.19. 16/1410, “Clause 26 Fixes,” Hongyuan Zhang (Marvell)
7.1.20. 16/1411, “TXTIME and RXTIME Fixes,” Hongyuan Zhang (Marvell)
7.1.21. 16/1421, “Smoothness Recommendation for 4x HE-LTF,” Feng Jiang (Intel)
7.1.22. 16/1427, “Remove TBDs in PHY Transmit Spec.,” Yujin Noh (Newracom)
7.1.23. 16/1434,” Miscellaneous HE PHY corrections,” Lochan Verma (Qualcomm)
7.1.24. 16/1437, “Updated Text for DCM,” Jianhan Liu (MediaTek)
7.1.25. 16/1438, “0.8us GI with 4x HE LTF,” Jianhan Liu (MediaTek)
7.1.26. 16/1439, “Error correction to D0.5_on Beam-change text,” Jianhan Liu (MediaTek)
7.1.27. 16/1443, “Spec text: Smoothness Recommendation for HE-LTF,” Feng Jiang (Intel)
7.1.28. 16/1448, “Remaining CR on secition-26-2-2 TXRXVECTOR Parameters,” Ke Yao (ZTE)
7.1.29. 16/1449, “Proposed Text Changes to TXRXVECTOR in Clause 26.2.2,” Ke Yao (ZTE)

7.2. MAC – 36 submissions
7.2.1. 16/1238, “Setting Quiet time period – text,” Chao-Chun Wang (MediaTek)
7.2.2. 16/1352, “CC23 MAC CR Miscellaneous Part-1,” Yongho Seok (Newracom)
7.2.3. 16/1354, “CC23 CR Annex C,” Yongho Seok (Newracom)
7.2.4. 16/1355, “Spec text for 10.22.2.5 and 3.2,” Yongho Seok (Newracom)
7.2.5. 16/1358, “CC0-Remaining CIDs on BA,” Alfred Asterjadhi (Qualcomm)
7.2.6. 16/1359, “CC0-Some remaining CIDs related to TWT,” Alfred Asterjadhi (Qualcomm)
7.2.7. 16/1360, “CC0-HE variant HT control - Some Remaining CIDs,” Alfred Asterjadhi (Qualcomm)
7.2.8. 16/1362, “CC0-Complete RTS Enablement,” Alfred Asterjadhi (Qualcomm)
7.2.9. 16/1367, “NDP feedback report,” Laurent Cariou (Intel)
7.2.10. 16/1368, “Follow-up on MU EDCA parameters,” Laurent Cariou (Intel)
7.2.11. 16/1380, “Proposed text changes for TWT in congested environment,” Laurent Cariou (Intel)
7.2.12. 16/1381, “Proposed text changes for fragmentation operation,” Laurent Cariou (Intel)
7.2.13. 16/1404, “Early TWT SP Termination in TWT Operation,” Jayh Hyunhee Park (LG Electronics)
7.2.14. 16/1409, “A-MSDU Fragmentation,” Matthew Fischer (Broadcom)
7.2.15. 16/1413, “CID193 BSS Color Disabled Indication,” Abhishek Patil (Qualcomm)
7.2.16. 16/1415, “CID72 BSS Color change mechanism,” Abhishek Patil (Qualcomm)
7.2.17. 16/1416, “CC0-HE BSS operation11-16-xxxx-00-00ax-CC0-HE BSS operation,” Alfred Asterjadhi (Qualcomm)
7.2.18. 16/1417, “CC0-HE BSS operation,” Alfred Asterjadhi (Qualcomm)
7.2.19. 16/1418, “CC0-HE Multirate Support and 2G4 40MHz HE STA,” Alfred Asterjadhi (Qualcomm)
7.2.20. 16/1419, “MCS_NSS_BW_PPDU_Selection_for_11ax,” Alfred Asterjadhi (Qualcomm)
7.2.21. 16/1420, “TWT Information frames in 11ax,” Alfred Asterjadhi (Qualcomm)
7.2.22. 16/1423, “NAV Update Rule Considering UL MU Operation,” Geonjung Ko (WILUS)
7.2.23. 16/1424, “Issue on the CWmax value in MU EDCA,” Woojin Ahn (WILUS)
7.2.24. 16/1425, “Clarification on applying MU EDCA parameter set,” Woojin Ahn (WILUS)
7.2.25. 16/1431, “IEEE 802.11ax Annex G,” Osama Aboul-Magd (Huawei Technologies)
7.2.26. 16/1442, “Spec texts for section 25.4 BA,” Jeongki Kim (LG Electronics)
7.2.27. 16/1452, “Multiple BSSID and MU,” Liwen Chu (Marvell)
7.2.28. 16/1453, “A-MPDU content,” Liwen Chu (Marvell)
7.2.29. 16/1454, “Multiple BSSID and MU Discussion,” Liwen Chu (Marvell)
7.2.30. 16/1456, “A-MPDU content discussion,” Liwen Chu (Marvell)
7.2.31. 16/1458, “Comment Resolution for Sub-clause 25.13.2,” Chittabrata Ghosh (Intel)
7.2.32. 16/1459, “Considerations on Quiet Time Period,” Jinsoo Ahn (Yonsei Univ.)
7.2.33. 16/1461, “MU BAR comment resolutions,” Reza Hedayat (Newracom)
7.2.34. 16/1464, “RD Protocol,” Jarkko Kneckt (Apple)
7.2.35. 16/1468, “A-MPDU Content Capabilities,” Raja Banerjea (Qualcomm)
7.2.36. 16/1477, “CC23 Proposed Resolution (Update for) TWT Element,” Matthew Fischer (Broadcom)

7.3. SR – 9 submissions
- 7.3.1. 16/0947, “Proposed text changes for OBSS_PD-based SR parameters,” Matthew Fischer (Broadcom)
- 7.3.2. 16/1063, “Unified SR text DSC, ATPC, inter-BSS,” Graham Smith (SR Technologies)
- 7.3.3. 16/1064, “Unified SR approach DSC, ATPC and Inter-BSS,” Graham Smith (SR Technologies)
- 7.3.4. 16/1121, “Spec Texts: Spatial Reuse Indication for Trigger,” Po-Kai Huang (Intel)
- 7.3.5. 16/1337, “CR on SR CCA rules clause 25.9,” Bo Sum (ZTE)
- 7.3.6. 16/1403, “SR Backoff Procedure,” Jayh Hyunhee Park (LG Electronics)
- 7.3.7. 16/1430, “Comment Resolution for SR on BSS Color,” Junichi Iwatani (NTT)
- 7.3.8. 16/1440, “Proposed Resolutions to CID 2719,” Jing Ma (NICT)
- 7.3.9. 16/1450, “CR for CID 2492 section 25.9 spatial reuse operation,” Kaiying Lv (ZTE)

7.4. MU – 12 submissions
- 7.4.1. 16/1353, “CC23 MAC CR Miscellaneous Part-2,” Yongho Seok (Newracom)
- 7.4.2. 16/1357, “CC0 Remaining CIDs on sounding,” Alfred Asterjadhi (Qualcomm)
- 7.4.3. 16/1361, “CC0- Remaining CIDs on MU Operation,” Alfred Asterjadhi (Qualcomm)
- 7.4.4. 16/1382, “MAC support of preamble puncture,” Zhou Lan (Broadcom)
- 7.4.5. 16/1383, “Spec Text: MAC support of preamble puncture,” Zhou Lan (Broadcom)
- 7.4.6. 16/1389, “Comment Resolution for CID 807,” Po-Kai Huang (Intel)
- 7.4.7. 16/1390, “Spec Text: Revision for NAV Setting Rule under Immediate Response,” Po-Kai Huang (Intel)
- 7.4.8. 16/1391, “Comment Resolution Random Access miscellaneous,” Young Hoon Kwon (Newracom)
- 7.4.9. 16/1392, “Comment Resolution CID 2624 and 2738,” Young Hoon Kwon (Newracom)
- 7.4.10. 16/1426, “DL/UL indication in MU-RTS,” Woojin Ahn (WILUS)
- 7.4.11. 16/1441, “Consideration on Internal Contention Between Data and Trigger Frame,” Jing Ma (NICT)
- 7.4.12. 16/1457, “11ax D0.1 Comment Resolution for Clause 25.5.3,” David Xun Yang (Huawei)

7.5. TG – 4 submissions
- 7.5.1. 16/0995, “Editor's report,” Robert Stacy (Intel)
- 7.5.2. 16/1363, “11ax PAR Verification through OFDMA,” Suhwook Kim (LG Electronics)
- 7.5.3. 16/1414, “Verifying 11ax’s PAR by UL MU-MIMO,” Jason Yuchen Guo (Huawei)
- 7.5.4. 16/1435, “PAR Verification Simulation Followup, ” James Yee (MediaTek)

8. Ad Hoc meeting scheduling

8.1. Ad Hoc slot assignment
- 8.1.1. PHY … 5, MAC … 5, SR … 2, MU … 2.

	Monday		Tuesday		Wednesday		Thursday	
AM1	TGax (full ad hoc)				TGax (full)		TGax (PHY)	TGax (MAC)
AM2			TGax (PHY)	TGax (MAC)				
PM1	TGax (full)				TGax (PHY)	TGax (MAC)	TGax (full)	
PM2	TGax (PHY)	TGax (MAC)	TGax (SR)	TGax (MU)	TGax (PHY)	TGax (MAC)	TGax (full)	
PM3	TGax (SR)	TGax (MU)						

8.2. Chair asked if there are any objections to approve the TGax schedule as follow.
- 8.2.1. There are no objections. The TGax schedule is approved.

9. Presentations

9.1. Osama Aboul-Magd (Huawei Technologies), Chair of TGax, presented "Coexistence assurance document," based on the submission 11-16/1348r1, on behalf of Eldad Perahia (HP Enterprise).

9.1.1. Summary

9.1.1.1. Eldad Perahia (HP Enterprise) created the coexistence assurance document and the initial version was presented during the TGax teleconference.

9.1.1.2. The TGax chair presented the updated document.

9.1.2. Discussion

9.1.2.1. During the teleconference, some issues have been raised such as the definition of "legacy 802.11 system," and content of the section 5 New Features.

9.1.2.2. Osama asked for suggestions for the above issues.

9.1.3. Next Step

9.1.3.1. Osama will make some modification before the motion to approve the document as the official TGax CA document.

9.2. Suhwook Kim (LG Electronics) presented "11ax PAR Verification through OFDMA," based on the submission 11-16/1363r0.

9.2.1. Summary

9.2.1.1. It was verified that OFDMA can provide four times throughput enhancement in outdoor environment and DL/UL mixed traffic.

9.2.1.2. More gain in OFDMA can be obtained e.g., by adopting a better scheduler than a random scheduler.

9.2.2. Discussion

9.2.2.1. A member asked for the details of simulation conditions such as frame aggregation and MCS selection. Another member also asked for the simulation set up.

9.2.2.2. Chair asked for the importance of the simulation scenario that 37 STAs are on the same location. The answer is that it is to obtain the highest performance gain.

9.2.3. Next Step

9.2.3.1. The presenter plans to provide more simulation results.

9.3. Jason Yuchen Guo presented "Verifying 11ax's PAR by UL MU-MIMO," based on the submission 11-16/1414r2.

9.3.1. Summary

9.3.1.1. This presentation is to verify the four times throughput gain by UL MU-MIMO.

9.3.1.2. Higher throughput gain can be expected as the STA density goes higher.

9.3.1.3. Use of efficient scheduling algorithm also important for the higher throughput gain.

9.3.2. Discussion

9.3.2.1. There was a discussion on the fairness of the scheduling algorithm.

9.3.2.2. A member asked for the reason of fixed throughput performance in slide 4. → It is due to the assumed scheduling algorithm.

9.3.2.3. There was a discussion on the MCS selection/link adaptation.

9.3.2.4. There was a question on the use of buffer status report. → It is not considered in the simulations.

9.4. James Yee (MediaTek) presented "PAR Verification Simulation Follow-up ," based on the submission 11-16/1435r0.

9.4.1. Summary

9.4.1.1. In the residential scenario, increasing STA size improves DL gain and using higher UL MCS (5->8, 9) improves UL gain.

9.4.1.2. Indoor BSS scenario with more STAs and no frequency reuse does not show additional performance gain.

9.4.1.3. 4x gain with certain single BSS scenarios, but they are not the ‘dense’ STA and BSS scenarios we target in the EVM.

9.4.2. Discussion

9.4.2.1. A member commented on the throughput of MU with and without OBSS_PD that overhead introduced by the trigger frame is not so significant.

9.4.2.2. There was a discussion on the adjustment of OBSS_PD in a multiple BSS scenario.

9.4.2.3. A member asked if there are simulation results changing the packet size. The answer is yes. Additional gain can be expected in some cases.

9.4.2.4. There was a discussion on the impact of legacy STAs.

9.4.3. Straw poll

9.4.3.1. The straw poll was deferred until PM1 (due to lack of time).

10. Adjournment

10.1. TGax ad hoc session adjourned @ 10:00 AM.

Monday, November 7th, 2016, PM1 TGax Ad Hoc Session (13:30 - 15:30)

1. **The meeting called to order by Osama Aboul-Magd (Huawei Technologies), the chair of the TGax, @13:33 AM**
   1.1. Introduction of TGax chair, secretary, vice chair.

2. **Announcement**
   2.1. Agenda Doc.11-16/1310r1 on the server. Rev. 2 is the working document.
   2.2. Meeting Protocol: Chair asked to state name and affiliation when speaking for the first time.
   2.3. Attendance reminder.
      2.3.1. The attendance server: https://imat.ieee.org/

3. **Agenda for Monday, November 7th, PM1 (13:30 – 15:30).**
   3.1. Proposed Agenda for Monday PM1:
      3.1.1. Call meeting to order
      3.1.2. Patent policy, etc.
      3.1.3. Call for submissions.
      3.1.4. Set Ad hoc Group schedule and approve agenda.
      3.1.5. Summary from September 2016 meeting.
      3.1.6. TG motions
         3.1.6.1. Approve TG meeting and Telecon minutes since November meeting.
         3.1.6.2. Approve resolutions of comments, if needed
      3.1.7. Comment Resolution Status – Robert Stacy (TGax editor).
      3.1.8. Timeline
      3.1.9. Presentations and Comment Resolution
      3.1.10. Recess.
   3.2. Chair asked if there are any other items – No items proposed. Meeting will be conducted based on this order.

4. **The chair reviewed the mandatory 5 slides of P&P.**
   4.1. Instructions for the WG Chair.
   4.2. Participants, Patents, and Duty to Inform.
   4.3. Patent Related Links.
   4.4. Call for potentially essential patents.
      4.4.1. Chair asked if anyone is aware of potentially essential patents.
      4.4.2. No potentially essential patents reported.
   4.5. Other Guidelines for IEEE WG Meetings.

5. **Agenda items for the week**
   5.1. Approve TG and Telecons minutes since July meeting.
   5.2. Resolution of comments received on draft D0.1
   5.3. Ad Hoc group meetings
   5.4. Technical Presentations and related straw polls and/or motions
   5.5. Schedule Telecon times.

6. **Summary from the September 2016 Meeting – slide 23 of the agenda document.**
   - Continue with the resolution of comments received on CC-23
   - Good progress on the comment resolution
   - Adjusted the TG timeline with draft D1.0 available after November meeting.
   - Draft D0.5 was prepared by the TG Editor.

- Conducted "almost" weekly telecons since September F2F meeting.
  - **Covered 13 submissions**
  - **Discussed resolutions of almost 55 CIDs**
  - **Please refer to telecon minutes**
    - **https://mentor.ieee.org/802.11/dcn/16/11-16-1308-02-00ax-tgax-teleconference-minutes-from-september-to-october.docx**

7. TG Motions

7.1. Approve TGax minutes of meetings and teleconferences from September 2016 meeting to today:

- **https://mentor.ieee.org/802.11/dcn/16/11-16-1231-00-00ax-tgax-september-2016-warsaw-meeting-minutes.docx**
- **https://mentor.ieee.org/802.11/dcn/16/11-16-1308-02-00ax-tgax-teleconference-minutes-from-september-to-october.docx**
- **https://mentor.ieee.org/802.11/dcn/16/11-16-1300-00-00ax-september-2016-tgax-spatial-reuse-ad-hoc-group-meeting-minutes.docx**
- **https://mentor.ieee.org/802.11/dcn/16/11-16-1276-00-00ax-september-2016-warsaw-tgax-phy-ad-hoc-meeting-minutes.docx**
- **https://mentor.ieee.org/802.11/dcn/16/11-16-1252-01-00ax-september-2016-warsaw-tgax-mac-ad-hoc-meeting-minutes.docx**
- **https://mentor.ieee.org/802.11/dcn/16/11-16-1275-00-00ax-mu-ad-hoc-meeting-minutes-september-2016.docx**

7.2. Moved by Simone Merlin, Seconded by Robert Stacy
7.3. Result: Motion was accepted with no objection.

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8. Editor's Report

8.1. Robert Stacy (Intel), TGax Editor, presented "," based on the submission 11-16-0995-02.
8.2. CR Status Summary
8.3. Discussion – No discussion.

9. Timeline

- **Current Timeline**
  - **May 2014: start of the TG**
  - **Nov. 2014: First draft of the TG SFD was approved**
  - **Jan. 2016: proposed TG draft**
  - **March 2016: Draft D0.1 was approved and CC started**
  - **November 2016: Draft 1.0 and WG letter ballot**
  - **May 2017: Draft 2.0 and recirculation**
  - **November 2017: MDR (Mandatory Document Review)**
  - **January 2018: Formation of SB pool**
  - **March 2018: Sponsor Ballot**
  - **December 2018: RevCom**

9.1. The good news is that the number of TBDs in the draft is reduced as shown in slide 27.

10. Presentation and Comment Resolution

10.1. PAR Verification Discussion

10.1.1. Discussion on continuing the work on PAR verification

10.1.1.1. 4 time improvement is already shown for outdoor scenarios in 11-16/1363

10.1.1.2. 4 times for indoor scenario is observed in 11-16/1414

10.1.2. Discussion

10.1.2.1. A member commented that it is hard to show x4 improvement for indoor cases. Outdoor scenario is more appropriate.

10.1.2.2. There was a comment that some simulation results are not based on realistic scenarios. More time is needed to evaluate realistic scenario.

10.1.2.3. There was a comment that indoor scenario is very important.

10.1.2.4. A member suggested mixed environment of HE and legacy STAs.

10.1.2.5. There was a comment that single BSS is not a dense environment.

10.1.3. Straw poll by James Yee (MediaTek) re: submission 11-16-1435-00.

10.1.3.1. Straw Poll: While we continue to look for additional gain under new modes - combination of 11ax features, do we:

Option 1

Continue to use current EVM scenarios.

Option 2

Modify scenarios in the EVM. E.g.

- Adding single BSS scenarios

- New OBSS scenarios

10.1.3.2. Discussion

10.1.3.2.1. Chair commented that we need more time if we choose option 2.

10.1.3.2.2. A member asked if EVM is the right reference to discuss the simulation scenario.

10.1.3.2.3. Chair asked if there is any objection to go with option 2. → No objection. The simulation scenario will be discussed in the TGax conferences.

10.2. James Wang (MediaTek) presented "Spatial Reuse Subfield Encoding Rule Clarification," based on the submission 11-16-1473-00.

10.2.1. Summary

10.2.1.1. This is the proposed changes to the Spatial Reuse subfield encoding rule based on TGax Draft 0.5

10.2.1.2. Transmit power of AP in table 26-19 Spatial Reuse subfield encoding is changed from "TX PWRAP: -10 dBm to 26 dBm" to "TX PWRAP: ≥-10 dBm."

10.2.2. Discussion

10.2.2.1. A member commented it could mean infinite transmit power is allowed. → The upper limit of the transmit power is obviously the regulatory limit.

10.2.3. Next Step

10.2.3.1. Chair asked if there is objection to this change. → No objection heard.

10.3. Sameer Vermani (Qualcomm) presented "Comment Resolutions of Miscellaneous HE PHY comments," based on the submission 11-16-1340-03.

10.3.1. Summary

10.3.1.1. A previous version of this document was presented by Lochan Verma during the TGax conference call on October 27th and got some minor comment.
10.3.1.2. This is the update considering those comments.
10.3.2. Discussion
10.3.2.1. A member suggested further change to the document. → Sameer agreed.
10.3.3. Next Step
10.3.3.1. Chair asked if there is any objection to accept the resolution. → No objection heard.

10.4. Sameer Vermani (Qualcomm) presented "Comment Resolutions on Clause 26.1.1 Part 2," based on the submission 11-16-1341-06.

10.4.1. Summary
10.4.1.1. Previous version of this document was presented by Lochan Verma during the TGax teleconference on October 27th.
10.4.1.2. Proposed changes to the text in 26.1.1 Introduction to the HE PHY.
10.4.2. Discussion
10.4.2.1. No discussion.
10.4.3. Next Step
10.4.3.1. Chair asked if there is any objection to the resolution. → No objection heard.

10.5. Sameer Vermani (Qualcomm) presented "Miscellaneous HE PHY Corrections," based on the submission 11-16-1434-01.

10.5.1. Summary
10.5.1.1. Various fixes relevant to the HE PHY propsoed.
10.5.2. Discussion
10.5.2.1. A member suggested minor correction to the document. Sameer agreed and updated the document.
10.5.3. Next Step
10.5.3.1. Chair asked if there is any objection to this resolution. → No objection heard.

10.6. Jarkko Kneckt (Apple) presented "Resolution to CIDs 52, 2459 and 2632," based on the submission 11-16-1464-00.

10.6.1. Summary
10.6.1.1. This document contains proposed resolutions for CIDs 52, 2459 and 2632 regarding the reverse direction protocol.
10.6.1.2. Text for the RD protocol signaling and the use of Multi-TID transmissions in RD protocol were proposed.
10.6.2. Discussion
10.6.2.1. A member commented that there is duplicate on the definition of the Multi-TID Aggregation. → Jarkko to update the document.
10.6.2.2. There was a discussion on the tradeoff between the AC constraint and QoS.
10.6.3. Next Step
10.6.3.1. Chair asked if there is any objection to incorporate these changes to the draft. → No objection heard.

10.7. Ross Jian Yu (Huawei Technologies) presented "Proposed resolutions to comments on clause 26.3.10.8 in D0.5," based on the submission 11-16-1371-00.

10.7.1. Summary
10.7.1.1. The document contains the proposed resolutions for CIDs 308, 1619 and 2847.
10.7.1.2. The document contains the proposed changes to the text in clause 26.3.10.8.4 as well which clarifies the mapping of user-fields to the RU allocation signaling for 80 and 160 MHz.
10.7.2. Discussion
10.7.2.1. No discussion.

10.7.3. Next Step
10.7.3.1. Chair asked if there is any objection to the proposed resolutions. → No objection.

10.8. Ross Jian Yu (Huawei Technologies) presented "Proposed change," based on the submission 11-16-1372-01.
10.8.1. Summary
10.8.1.1. This submission contains the proposed changes to clause 26.3.10.5 L-SIG and 26.3.10.8 HE-SIG-B.
10.8.2. Discussion
10.8.2.1. Chair confirmed that this is not comment resolution.
10.8.3. Next Step
10.8.3.1. Chair asked if there is any objection to accept the proposed changes in 16/1372r1. → No objection.

11. AoB
11.1. Chair asked if we have any business that can be conducted.
11.2. Room assignment for PM2 & PM3:
11.2.1. PM2: PHY – Texas D, MAC - Texas E.
11.2.2. PM3: MU – Texas D, SR – Texas E.

12. Adjournment
12.1. TGax recessed @ 15:29 PM.

Monday, November 7th, 2016, PM2 TGax ad hoc sessions (16:00-18:00)

Ad Hoc room assignment:
- PHY ad hoc: Texas D
- MAC ad hoc: Texas E

Monday, November 7th, 2016, PM3 TGax ad hoc sessions (19:30-21:30)

Ad Hoc room assignment:
- SR ad hoc: Texas D
- MU ad hoc: Texas E

Tuesday, November 8th, 2016, AM2 TGax ad hoc sessions (10:30-12:30)

Ad Hoc room assignment:

- PHY ad hoc: Texas D
- MAC ad hoc: Texas E

Tuesday, November 8th, 2016, PM2 TGax ad hoc sessions (16:00-18:00)

Ad Hoc room assignment:

- SR ad hoc: Texas D
- MU ad hoc: Texas E

Wednesday, November 9th 2016, AM1 TGax Full Sessions (8:00-10:00)

1. The meeting called to order by Osama Aboul-Magd (Huawei Technologies), the chair of the TGax, @8:04 AM.
   1.1. Introduction of the TG leadership.
   1.2. Agenda 11-16-1310-02 is on the server.

2. Announcements/Reminder
   2.1. Chair asked participants to state name and affiliation when speaking for the first time during the session.
   2.2. Chair reminded that the meeting is conducted under IEEE 802 and 802.11 P&P.
   2.3. Chair reminded attendance.

3. Agenda Setting
   3.1. Proposed agenda for this session
      3.1.1. Call Meeting to order
      3.1.2. IEEE 802 and 802.11 IPR Policy and procedure.
      3.1.3. Progress Review
      3.1.4. Presentations
         3.1.4.1. 11-16/1472 New Amendment Style – Robert Stacey
         3.1.4.2. 11-16/1431 IEEE 802.11ax Annex G - Osama
         3.1.4.3. Presentations from ad hocs
      3.1.5. Recess
   3.2. Chair asked if there is any objection to proceed with this agenda. → No objection.
   3.3. The agenda for Wednesday AM1 was approved.

4. Progress from Ad Hoc groups
   4.1. MU and SR ad hocs – completed.
   4.2. PHY: 7 – 8 presentations left.
   4.3. MAC: 16 presentations to go.

5. Presentations
   5.1. Robert Stacy (Intel) presented "New Amendment Style," based on the submission 11-16-1472r01.
      5.1.1. Summary
         5.1.1.1. The new amendment style is not a radical departure from how we amend the 802.11 specification.
         5.1.1.2. It concentrates MAC changes into one clause which helps with a number issues.
         5.1.1.3. The requirement inheritance is clear from the structure of the document.
      5.1.2.Discussion
         5.1.2.1. A member asked if there is a plan to apply this new style to the previous amendment. → Currently there is no plan to do so.
         5.1.2.2. Chair mentioned that the issue raised during the conference call was cross reference. Not sure what is the real issue.

   5.2. Osama Aboul-Magd (Huawei Technologies) presented "IEEE 802.11ax Annex G," based on the submission 11-16-1431r01.
      5.2.1. Summary
         5.2.1.1. This document contains resolutions for CIDs 1430, 1703 and 2503.

5.2.1.2. The initial text for the G.5 HE Sequences is proposed. The plan is to put one example here and add more, or reject current text and start from the scratch after the WG LB.

5.2.2. Discussion

5.2.2.1. A member commented that people should pay more attention to this clause since Annex. G is normative. The only trigger sequence looks quiet incomplete.

5.2.2.2. Another member suggested the trigger sequence to be the placeholder.

5.3. Jeongki Kim (LG Electronics) presented "Spec text for section 25.4 Block Acknowledgment," based on the submission 11-16-1442r00.

5.3.1. Summary

5.3.1.1. This is basically a clarification to the texts in subclause 25.4 Block Acknowledgment in D0.5.

5.3.1.2. In 9.3.1.9.7 Multi-STA BlockAck variant (D0.5), ACK of all MPDUs in an A-MPDU is indicated by Ack Type = 1 and TID subfield = 14 of Multi-STA Block ACK frame. The same concept should also be used in other subclauses (25.4 Block Acknowledgement).

5.3.2. Discussion

5.3.2.1. No discussion.

5.3.3.Next Step

5.3.3.1. Chair asked if there is any objection to accept this spec text. → No objection.

5.4. Abhishek Patil (Qualcomm) presented "Proposed Resolution for CID 193 (BSS Color Disable Indication)," based on the submission 11-16-1413r06.

5.4.1. Summary

5.4.1.1. The submission contains a resolution for CID 193.

5.4.1.2. The proposed resolution is to disable BSS Color when AP determines that there is a color collision.

5.4.2. Discussion

5.4.2.1. The document is not on the server. A member asked for more time to review.

5.5. Alfred Asterjadhi (Qualcomm) presented "HE BSS Operation," based on the submission 11-16-1417r00.

5.5.1. Summary

5.5.1.1. This document contains a resolution for the CID 154.

5.5.1.2. Proposed resolution includes expansion of the Basic HE MCS and NSS Set field from 2 to 3 bits to include the new MCSs added in 11ax (1024 QAM) and the addition of the VHT Operation Information field to the HE Operation element to remove dependency from the VHT Operation element.

5.5.2. Discussion

5.5.2.1. No discussion.

5.5.3.Next Step

5.5.3.1. Chair asked if there is any objection to accept this resolution and the changes to the draft. → No objection.

5.6. Alfred Asterjadhi (Qualcomm) presented "MCS, NSS, BW and PPDU selection for 11ax," based on the submission 11-16-1419r00.

5.6.1. Summary

5.6.1.1. This submission contains a proposed clarification on the selection rules for PPDU type, BW, and <MCS, NSS> for 11ax.

5.6.1.2. Proposed to finalize all the normative behavior for the selection of these parameters for control response frames.

5.6.1.3. Related submission (11-16-1418) which contains the spec text was presented as well.

5.6.2. Discussion

5.6.2.1. There was a discussion on the applicability of each rule.

5.6.3.Next Step

5.6.3.1. Chair asked if there is any objection to this resolution for CID #203. → No objection.

6. Preview of WG Motion
   6.1. Chair showed the motion text for WG Letter Ballot:
      6.1.1.Discussion
         6.1.1.1. A member mentioned that TGax, at this point, does not need detailed description as in the motion for WG recirculation ballot. Just need to say:
            6.1.1.1.1. Instruct the editor to prepare for TGax draft 1.0, and
            6.1.1.1.2. Approve a 30-day Working Group Letter Ballot.
      6.1.2. Chair will update the motion text as suggested.
   6.2. Chair showed the motion text for approval of coexistence assurance document.

7. AOB
   7.1. Only 5 minutes left.
   7.2. No other business to conduct.

8. Recess
   8.1. TGax full session is in recess @9:55 AM, until Thursday AM2.

Wednesday, November 9th 2016, PM1 TGax Ad Hoc Sessions (13:30-15:30)

- PHY ad hoc → Texas D.
- MAC ad hoc → Texas E

Wednesday, November 9th 2016, PM2 TGax ad hoc Sessions (16:00-18:00)

- PHY ad hoc → Texas D
- MAC ad hoc → Texas E

Thursday, November 10th, 2016, AM1 TGax full Session (8:00-10:00)

1 The meeting called to order by Osama Aboul-Magd (Huawei Technologies), the chairperson of the TGax, @8:04 AM

1.1 Agenda 16/1310r3 is on the server. Rev. 4 is the working document.
1.2 Introduction of people at the front table.

2 Announcement/Reminder

2.1 Chair reminded IEEE 802 and 802.11 IPR P&P.
2.2 Chair asked people to state name and affiliation when addressing for the first time in the session.
2.3 Chair reminded people to do attendance.

3 Agenda for this session

3.1 Thursday AM1, PM1 and PM2
- 3.1.1 Call Meeting to order
- 3.1.2 Announcement/Reminder
  - 3.1.2.1 IEEE 802 and 802.11 IPR Policy and procedure.
  - 3.1.2.2 Attendance
- 3.1.3 Agenda Setting
- 3.1.4 Presentations
- 3.1.5 TG Motions
- 3.1.6 New Business:
  - 3.1.6.1 11-16-1238-04 Setting Quiet Time Period, by Chao-Chun Wang
- 3.1.7 WG LB, CA Doc Motions
- 3.1.8 11-16-1537-00, by Guido R. Hiertz.
- 3.1.9 Goals for January 2017
- 3.1.10 Teleconference schedule
- 3.1.11 AOB
- 3.1.12 Adjourn

3.2 Chair asked if there are any modifications to the agenda.
3.3 Agenda approved with no objection.

4 TG Motions

Chair asked the people to check the agenda file to make sure that the motion text is correct.

4.1 PHY Motion

4.1.1 PHY Motion #175: Move to accept the proposed changes to 11ax D0.5 spec text as in 11-16/1356r0.

4.1.1.1 Moved by Young Hoon Kwon, Seconded by Alfred Asterjadhi
4.1.1.2 Discussion – No discussion.
4.1.1.3 Result: The motion was accepted with no objection.

4.1.2 PHY Motion #176: Move to accept the proposed spec changes in doc 11-16/1387r3.

4.1.2.1 Moved by Jinsoo Choi, Seconded by Kiseon Ryu.
4.1.2.2 Discussion – No discussion.
4.1.2.3 Result: The motion was accepted with no objection

4.1.3 PHY Motion #177: Move to accept the proposed spec text changes in doc 11-16/1427r2.

4.1.3.1 Moved by Yujin Noh, Seconded by Young Hoon Kwon.
4.1.3.2 Discussion – No discussion.
4.1.3.3 Result: The motion was accepted with no objection.

4.1.4 PHY Motion #178: Do you agree the proposed spec text changes as in doc 11-16/1370r4.

4.1.4.1 Moved by Laurent Cariou, Seconded by Chittabrata Ghosh.
4.1.4.2 Discussion – No discussion.
4.1.4.3 Result: The motion was accepted with no objection.

4.1.5 PHY Motion #179: Move to accept the proposed spec text changes in doc 11-16/1399r2.

4.1.5.1 Moved by Sriram Venkateswaran, Seconded by Ron Porat.
4.1.5.2 Discussion – No discussion.
4.1.5.3 Result: The motion was accepted with no objection.

4.1.6 PHY Motion #180: Move to adopt the spec text in doc 11/16-1406r1 on 11ax Receiver Requirements.

4.1.6.1 Moved by Bin Tian, Seconded by Abhishek Patil.
4.1.6.2 Result: The motion was accepted with no objection.

4.1.7 PHY Motion #181: Move to adopt the changes to the 11ax spec text in doc 11/16-1407r4.

4.1.7.1 Moved by Xiaogang Chen, Seconded by Chittabrata Ghosh.
4.1.7.2 Discussion - No discussion.
4.1.7.3 Result: The motion was accepted with no objection.

4.1.8 PHY Motion #182: Move to adopt the spec text in doc 11/16-1443r0 into 11ax draft.

4.1.8.1 Moved by Feng Jiang, Seconded by Chittabrata Ghosh.
4.1.8.2 Discussion – No discussion.
4.1.8.3 Result: The motion was accepted with no objection.

4.1.9 PHY Motion #183: Move to adopt the spec text in doc 11/16-1410r2 into 11ax draft.

4.1.9.1 Moved by Hongyuan Zhang, Seconded by Saishankar Nandagopalan.
4.1.9.2 Discussion – No discussion.
4.1.9.3 Result: The motion was accepted with no objection.

4.1.10 PHY Motion #184: Move to adopt the spec text in doc 11/16-1411r1 into 11ax draft.

4.1.10.1 Moved by Hongyuan Zhang, Seconded by Saishankar Nandagopalan.

4.1.10.2 Discussion – No discussion.
4.1.10.3 Result: The motion was accepted with no objection.

4.1.11 PHY Motion #185: Move to adopt the spec text in doc 11/16-1437r0 into 11ax draft.

4.1.11.1 Moved by Tianyu Wu, Seconded by Hongyuan Zhang.
4.1.11.2 Discussion – No discussion.
4.1.11.3 Result: The motion was accepted with no objection.

4.1.12 PHY Motion #186: Move to adopt the spec text in doc 11/16-1438r4 into 11ax draft.

4.1.12.1 Moved by Tianyu Wu, Seconded by Hongyuan Zhang.
4.1.12.2 Discussion – No discussion.
4.1.12.3 Result: The motion was accepted with no objection.

4.1.13 PHY Motion #187: Move to adopt the spec text in doc 11/16-1439r1 into 11ax draft.

4.1.13.1 Moved by Tianyu Wu, Seconded by Hongyuan Zhang.
4.1.13.2 Discussion – No discussion.
4.1.13.3 Result: The motion was accepted with no objection.

4.1.14 PHY Motion #188: Move to adopt the spec text in doc 11/16-1449r3 into 11ax draft.

4.1.14.1 Moved by Bin Tian, Seconded by Alfred Asterjadhi.
4.1.14.2 Discussion – No discussion.
4.1.14.3 Result: The motion was accepted with no objection.

4.1.15 PHY Motion #189: Move to adopt the spec text in doc 11/16-1434r2 into 11ax draft.

4.1.15.1 Moved by Sameer Vermani, Seconded by Abhishek Patil.
4.1.15.2 Discussion – No discussion.
4.1.15.3 Result: The motion was accepted with no objection.

4.1.16 PHY Motion #190: Move to adopt the spec text in doc 11-16/1372r1 into 11ax draft.

4.1.16.1 Moved by Ross Jian Yu, Seconded by Ron Porat.
4.1.16.2 Discussion – No discussion.
4.1.16.3 Result: The motion was accepted with no objection.

4.2 MAC Motions

4.2.1 MAC Motion #94: Move to update the 11ax specification D0.5 according to the instructions in document 16/1355r0.

4.2.1.1 Moved by Young Hoon Kwon, Seconded by Eric Wong.
4.2.1.2 Discussion - No discussion.
4.2.1.3 Result: The motion was accepted with no objection.

4.2.2 MAC Motion #95: Move to update the 11ax specification D0.5 according to the instructions in document 16/1362r1.

4.2.2.1 Moved by Alfred Asterjadhi, Seconded by George Cherian.
4.2.2.2 Discussion – No discussion.
4.2.2.3 Result: The motion was accepted with no objection.

4.2.3 MAC Motion #96: Move to update the 11ax specification D0.5 according to the instructions in slide 16 of document 16/1367r0.
And append the following sentence at the end of slide 16
- This mechanism is optional for non-AP STA

4.2.3.1 Moved by Laurent Cariou, Seconded by Alfred Asterjadhi.
4.2.3.2 Discussion – No discussion.
4.2.3.3 Result: The motion was accepted with no objection.

4.2.4 MAC Motion #97: Move to update the 11ax specification D0.5 according to the instructions in document 16/1368r2.

4.2.4.1 Moved by Laurent Cariou, Seconded by Eric Wong.
4.2.4.2 Discussion – No discussion.
4.2.4.3 Result: The motion was accepted with no objection.

4.2.5 MAC Motion #98: Move to update the 11ax specification D0.5 according to the instructions in slide 16 of document 16/1404r1.

4.2.5.1 Moved by Kiseon Ryu, Seconded by Alfred Asterjadhi.
4.2.5.2 Discussion – No discussion.
4.2.5.3 Result: The motion was accepted with no objection.

4.2.6 MAC Motion #99: Move to update the 11ax specification D0.5 according to the instructions in document 16/1409r3.

4.2.6.1 Moved by Zhou Lan, Seconded by Eric Wong.
4.2.6.2 Discussion – No discussion.
4.2.6.3 Result: The motion was accepted with no objection.

4.2.7 MAC Motion #100: Move to update the 11ax specification D0.5 according to the instructions in slides 8, 9 and 10 in document 16/1420r0.

4.2.7.1 Moved by Alfred Asterjadhi, Seconded by Abhishek Patil.
4.2.7.2 Discussion – No discussion.
4.2.7.3 Result: The motion was accepted with no objection.

4.2.8 MAC Motion #101: Move to update the 11ax specification D0.5 according to the instructions in document 16/1380r3.

4.2.8.1 Moved by Laurent Cariou, Seconded by Abhishek Patil.
4.2.8.2 Discussion – No discussion.
4.2.8.3 Result: The motion was accepted with no objection.

4.2.9 MAC Motion #102: Move to update the 11ax specification D0.5 according to the instructions in slide 6 of document 16/1425r2.

4.2.9.1 Moved by Woojin Ahn, Seconded by John Son.
4.2.9.2 Discussion – No discussion.
4.2.9.3 Result: The motion was accepted with no objection.

4.2.10 MAC Motion #103: Move to update the 11ax specification D0.5 according to the instructions in document 16/1452r2.

4.2.10.1 Moved by Liwen Chu, Seconded by Abhishek Patil.
4.2.10.2 Discussion – No discussion.
4.2.10.3 Result: The motion was accepted with no objection.

4.2.11 MAC Motion #104: Move to update the 11ax specification D0.5 according to the instructions in document 16/1453r1.

4.2.11.1 Moved by Liwen Chu, Seconded by Eric Wong.
4.2.11.2 Discussion – No discussion.
4.2.11.3 Result: The motion was accepted with no objection.

4.2.12 MAC Motion #105: Move to update the 11ax specification D0.5 according to the instructions in document 16/1381r2.

4.2.12.1 Moved by Laurent Cariou, Seconded by Chittabrata Ghosh.
4.2.12.2 Discussion – No discussion.
4.2.12.3 Result: The motion was accepted with no objection.

4.2.13 MAC Motion #106: Move to instruct the TGax editor to remove the sentence below from IEEE802.11ax D0.5 in clause 9.3.1.23.
"The exact location of each 20 MHz for 80 MHz BW is TBD"

4.2.13.1 Moved by Alfred Asterjadhi, Seconded by Ron Porat.
4.2.13.2 Discussion – No discussion.
4.2.13.3 Result: The motion was accepted with no objection.

4.2.14 MAC Motion #107: Move to instruct the TGax Editor to make the following changes (related to HE Link adaptation A-Control format):

- Replace "TBD" with "16" in P17L21 of TGax D0.5
- Replace "TBD" with "Reserved" in P19L8 of TGax D0.5
- Replace "B6+X" with "B15" in P19L6 of TGax D0.5
- Replace "X" with "9" in P19L6 of TGax D0.5

4.2.14.1 Moved by Abhishek Patil, Seconded by Alfred Asterjadhi.

4.2.14.2 Discussion – No discussion.
4.2.14.3 Result: The motion was accepted with no objection.

4.2.15 MAC Motion #108: Move to instruct the TGax Editor to make the changes as shown in 16/1529r0.

4.2.15.1 Moved by Zhou Lan, Seconded by Eric Wong.
4.2.15.2 Discussion – No discussion.
4.2.15.3 Result: The motion was accepted with no objection.

4.2.16 MAC Motion #109: Move to instruct the TGax Editor to make the changes as shown in slide 6 of document 16/1424r2.

4.2.16.1 Moved by Woojin Ahn, Seconded by John Son.
4.2.16.2 Discussion – No discussion.
4.2.16.3 Result: The motion was accepted with no objection.

4.2.17 MAC Motion #110: Move to instruct the TGax Editor to make the changes as shown in 16/1442r0.

4.2.17.1 Moved by Jeongki Kim, Seconded by Kiseon Ryu.
4.2.17.2 Discussion – No discussion.
4.2.17.3 Result: The motion was accepted with no objection.

4.2.18 MAC Motion #111: Move to instruct the TGax Editor to make the changes as shown in 16/1238r4.

4.2.18.1 Moved by Chao-Chun Wang, Seconded by Dengyu Qiao.
4.2.18.2 Discussion – No discussion.
4.2.18.3 Result: The motion was accepted with no objection.

4.3 MU Motions

4.3.1 MU Motion #61: Move to update the 11ax draft specification D0.5 according to editor instruction in document 802.11-16/1383r2

- **A HE AP transmits a new trigger variant (Bandwidth Query Report Poll) to solicit bandwidth Query Report from one or multiple HE non AP STAs**
- **A HE non AP STA after receiving Bandwidth Query Report Poll from a HE AP responds with channel availability information in a new A-control field (Bandwidth Query Report)**
- **It is optional for a non AP STA to support the Bandwidth Query mechanism**

4.3.1.1 Moved by Zhou Lan, Seconded by Ron Porat.
4.3.1.2 Discussion – No discussion.
4.3.1.3 Result: The motion was accepted with no objection.

4.3.2 MU Motion #62: Move to accept the proposed changes to D0.5 in 802.11-16/1390r0.

4.3.2.1 Moved by Po-Kai Huang, Seconded by Kiseon Ryu.
4.3.2.2 Discussion – No discussion.

4.3.2.3 Result: The motion was accepted with no objection.

4.4 SR Motions

4.4.1 SR Motion #13: Move to incorporate 11-16/947r18 into the TGax draft.

4.4.1.1 Moved by Zhou Lan, Seconded by Ron Porat.
4.4.1.2 Discussion:

- A member commented that this motion should be withdrawn and whole SR related text should be reviewed.
- Another member agreed with the previous commenter and proposed a motion to table this motion.

4.4.1.3 Motion to table SR Motion #13: Move to table the SR Motion #13 till January 2017 F2F meeting.
4.4.1.3.1. Moved by Sean Coffey, Seconded by Graham Smith.
4.4.1.3.2. Result: Y/N/A = 16/42/43, motion to table the SR motion #13 fails.

- **Go back to the main motion.**
- **A member asked for a recorded vote.**

4.4.1.4 Result: Y/N/A = 45/19/51, motion fails (< 75%).

- **The vote record can be found in the Annex of this document.**

4.4.2 SR Motion #14: Move to incorporate 11-16/1121r2 into the TGax draft.

4.4.2.1 Moved by Po-Kai Huang, Seconded by Laurent Cariou.
4.4.2.2 Discussion – No discussion.
4.4.2.3 Result: The motion was accepted with no objection.

4.4.3 SR Motion #15: Move to add the following text in the 11ax spec draft (11-16/1403r1).

25.9.2.1 General

- **SR Backoff procedure for SR delayed case**

The STA may resume its backoff procedure after the end of the PPDU carrying the SR delay entry by following the procedure defined in 10.22.2 HCF contention based channel access (EDCA)

NOTE - The countdown of an existing backoff procedure is suspended until the end of the PPDU carrying the SR delay entry since the medium is busy during the duration of the PPDU carrying the SR delay entry..

4.4.3.1 Moved by Kiseon Ryu, Seconded by Po-Kai Huang.
4.4.3.2 Discussion – No discussion.
4.4.3.3 Result: The motion was accepted with no objection.

4.4.4 SR Motion #16: Move to accept the changes to the TG draft in doc 11-16/1473r0.

4.4.4.1 Moved by James Wang, Seconded by Bahar Sadeghi.
4.4.4.2 Discussion – No discussion.
4.4.4.3 Result: The motion was accepted with no objection.

Chair asked if there is any business that can be done in 6 minutes. → No response.

5 Recess

TGax Recess @9:54 until PM1 (13:30) this afternoon.

Thursday, November 10th, 2016, PM1 TGax full Session (13:30-15:30)

6 The meeting called to order by Osama Aboul-Magd (Huawei Technologies), the chairperson of the TGax @ 13:35.

6.1 The agenda file: 11-16-1310-04.

7 Announcement

7.1 Chair reminded IEEE 802 and 802.11 IPR P&P.
7.2 Chair asked people to state name and affiliation when addressing for the first time in the session.
7.3 Chair reminded people to do attendance.

8 Agenda for this sessions – as approved during AM1 session.

8.1.1 Call Meeting to order
8.1.2 Announcement/Reminder
8.1.2.1 IEEE 802 and 802.11 IPR Policy and procedure.
8.1.2.2 Attendance
8.1.3 Agenda Setting
8.1.4 Presentations
8.1.5 TG Motions
8.1.6 New Business:
8.1.6.1 11-16-1238-04 Setting Quiet Time Period, by Chao-Chun Wang
8.1.7 WG LB, CA Doc Motions
8.1.8 11-16-1537-00, by Guido R. Hiertz.
8.1.9 Goals for January 2017
8.1.10 Teleconference schedule
8.1.11 AOB
8.1.12 Adjourn

9 TG Motions (continued from AM1)

9.1 CR Motions

9.1.1 CR Motion #125 (PHY): Move to accept resolutions to CIDs

- **CID 495 as in 11-16/1374r1**
- **CID 2867 in 11-16/1375r1**
- **CID 2043, 2044, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2058, 2059, 2062 in doc 11-16/1377r6**
- **CID 2431 in 11-16/1295r0**
- **CID 2077 in doc 11-16/1398r1**
- **CID 1031, 1827, 2472, 2753 in doc 11-16/1448r0**
- **CID 1116, 2350, 2460, 2461, 1038, 2147, 275 in doc 11-16/1408r0**
- **CID 1864 and 1849 in doc 11-16/1341r6**
- **CID 2506 in doc 11-16/1387r3**
- **CID 2147 in doc 11-16/1522r2**
- **1932, 2106, 2572, 2796 in doc 11-16/1340r4**
- **CID 308, 1619, 2874 in doc 11-16/1371r0**

9.1.1.1 Moved by Bin Tian, Seconded by Jianhan Liu.
9.1.1.2 Discussion – No discussion.
9.1.1.3 Result: The motion was accepted with no objection.

9.1.2 CR Motion #126 (PHY): Move to accept the following resolution to CID 85
- Resolution: Rejected
- Reason: The comment doesn't provide an applicable change suggestion to the spec draft

9.1.2.1 Moved by Jianhan Liu, Seconded by Hongyuan Zhang.
9.1.2.2 Discussion – No discussion.
9.1.2.3 Result: The motion was accepted with no objection.

9.1.3 CR Motion #127 (MAC): Move to accept resolutions to CIDs
- CIDs: 150, 1020, 2201 in doc 11-16/1354r0
- CIDs: 135, 658, 2389 in doc 11-16/1358r0
- CIDs: 385, 419, 458, 459, 514, 630, 741, 743, 2844, 2846 in doc 11-16/1359r0
- CIDs: 93, 824, 819, 989, 1067, 2388, 147, 161 in doc 11-16/1360r1
- CID 72 in doc 11-16/1415r2
- CID 193 in doc 11-16/1413r8
- CIDs: 195, 723, 779, 780, 1087, 1088, 2179, 2387, 2672, 2673, and 2674 in doc 11-16/1458r0
- CID 6 and 7 in doc 11-16/1461r1
- CIDs: 969, 1517, 1558, 1560, 1917, 2180 in doc 11-16/1357r0

9.1.3.1 Moved by Reza Hedayat, Seconded by George Cherian.
9.1.3.2 Discussion – No discussion.
9.1.3.3 Result: The motion was accepted with no objection.

9.1.4 CR Motion #128 (MAC): Move to accept resolutions to CIDs
- CID 682 in doc 11-16/1477r2
- CID 991 in doc 11-16/1503r2
- CID 1012 in doc 11-16/1350r0
- CID: 861, 1073, 16, 1398, 1212, 1211, 1176, 964, 823, 798, 797, 781, 733, 1400, 1072, 735 in doc 11-16/1332r3
- CID: 81, 82, 710, 1226, 1235, 1236, 1351, 1707, 1776 in doc 11-16/1336r1
- CID 2186 in doc 11-16/1342 (Editor)
- CID 154 in doc 11-16/1417r0
- CID 203 in doc 11-16/1418r0
- CID 1430, 1703, and 2503 in doc 11-16/1431r1
- CID 1700 and 2504 in doc 11-16/1335r3

9.1.4.1 Moved by Yonggang Fang, Seconded by Reza Hedayat.
9.1.4.2 Note: The motion is referring to the latest revision of 1342 which is r0.
9.1.4.3 Discussion – No discussion.
9.1.4.4 Result: The motion was accepted with no objection.

9.1.5 CR Motion #129 (MAC): Move to accept resolutions to CIDs
- CID 52, 2459, and 2632 in doc 11-16/1464r1
- CID 2113 in doc 11-16/1346r1

- CIDs: 1920, 2441, 2671, 2262, 2396, 2454, 2604, 2605, 1734, 118, 691, 822, 1353 in doc 11-16/1352r1

9.1.5.1 Moved by Reza Hedayat, Seconded by George Cherian.
9.1.5.2 Discussion – No discussion.
9.1.5.3 Result: The motion was accepted with no objection.

9.1.6 CR Motion #130 (MU): Move to accept resolutions to CIDs
- CIDs 2490 and 2505 as proposed in 11-16/1353r1
- CIDs 37, 38, 171, 759, 761, 763, 764, 815, 950, 1219, 1540, 2273, 2320, 2449, 2467, 2636, 2656 and 2910 as proposed in 11-16/1361r1
- CIDs 59, 2652 and 2653 as proposed in 802.11-16/1391r0
- CIDs 2624 and 2738 as proposed in 802.11-16/1392r0
- CID 807 as proposed in 802.11-16/1389r0
- CIDs 53, 54, 56, 57, 604, 1553, 1554, 1555, 1557 and 2655 as proposed in 802.11-16/1457r3
- CID: 729, 1069, 806, 2261, 2909, 1468, 1637, 998, 730, 245, 246, 247, 248, 399, 421, 1464, 588, 256, 812, 1661 in doc 11-16/1339r1

9.1.6.1 Moved by Kiseon Ryu, Seconded by Yonggang Fang.
9.1.6.2 Discussion – No discussion.
9.1.6.3 Result: The motion was accepted with no objection.

9.1.7 CR Motion #131 (SR): Move to accept resolutions to CIDs
- CIDs 187, 224, 803, 1233, 1578, 1579, 2284, 2433, 2666, 2912, 2915, 2916, 2917 in doc 11-16/1337r0.
- CIDs 448, 833, and 1232 in doc 11-16/1430r0
- CID 2492 as provided in submission 11-16/1450r0 and to modify the 802.11ax draft amendment as shown in the submission
- CID 2719 and to modify (adding text to the end of section 25.9.2.1 on page 153 line 15) the 802.11ax draft amendment as proposed in submission 11-16/1440r4

9.1.7.1 Moved by Sameer Alfred Asterjadhi, Seconded by Po-Kai Huang.
9.1.7.2 Discussion – No discussion.
9.1.7.3 Result: The motion was accepted with no objection.

9.1.8 CR Motion #132 (SR): Move to accept resolutions to CIDs
- CID 944, 64, and 2911 in doc 11-16/1476r6 with the exeption that 11-16/1476r6 replaces 11-16/: 461476r4 in the resolution

9.1.8.2 Moved by VK Jones, Seconded by Ron Porat.
9.1.8.3 Discussion
- A member asked to table this motion since there are so many additions to the current draft.
- The presenter replied that this document contains resolutions for the CIDs 944, 64 and 2911, and proposed text discussed in SR ad hoc in the simplest way.
- The previous commenter withdraws the motion to table, but recommends to vote No on this motion.
- This motion is determined to be a recorded vote.

9.1.8.4 Result: Y/N/A = 46/29/38, motion fails.
- The vote record is available in the Annex B of this document.

9.2 Motion to reconsider

9.2.1 Move to reconsider motion SR-13 on OBSS_PD SR.

9.2.1.1 Moved by Sriram Venkateswaran, Seconded Saishankar Nandagopalan.

9.2.1.1.1. Discussion

- **A member mentioned that this is out of order. The mover mentioned that he voted "No" for the SR motion #13, however it is worth to reconsider.**

9.2.1.2. Result: Motion to reconsider passed with no objection.

9.2.1.3. Go back to the main motion

9.2.1.4. Discussion – No discussion.

9.2.1.5. Result: Y/N/A = 46/18/38, motion fails (<75%)

- The vote record is available in the Annex C of this document.

9.3 WG Motions

9.3.1 WG LB Motion:

- **Instruct the editor to prepare TGax Draft D1.0**
- **Approve a 30 day Working Group Technical Letter Ballot asking the question "Should TGax Draft 1.0 be forwarded to Sponsor Ballot?"**

9.3.1.1 Moved by Robert Stacy, Seconded by Vinko Erceg.

9.3.1.2 Discussion – No discussion.

9.3.1.3 Result: Y/N/A = 89/0/6, motion passes.

9.3.2 Coexistence Assurance Document: Move to adopt 11-16/1348r2 as coexistence assurance document for 802.11ax amendment.

9.3.2.1 Moved by Robert Stacy, Seconded by Yasuhiko Inoue.

9.3.2.2 Discussion – No discussion.

9.3.2.3 Result: Y/N/A = 82/0/7, motion passes.

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10 Presentation

10.1 Guido R. Hiertz (Ericsson) presented "TGax ad hoc meeting," based on the submission 11-16-1537-00.

10.1.1 Summary

10.1.1.1 Guido proposes an ad hoc meeting in Stockholm, Sweden, just before the IEEE 802 Wireless Session January 2017.

10.1.1.2 Ericsson will host the meeting

10.1.2 Discussion

10.1.2.1 The editor will create draft 1.0 in two or three week after the November session and a 30-day WG letter ballot starts after that. The ballot will be closed early January. We can assign comments during the teleconferences in January.

10.1.2.2 A member mentioned that it is difficult to prepare the resolution before the January 2017 meeting considering the sequence of events we will have.

10.1.3 Motion: Authorize TGax to hold an ad-hoc meeting on January 11-13/2017 in Stockholm, Sweden, for the purpose of comment resolution.

10.1.3.1 Moved by Guido R. Hiertz, Seconded by Hakan Persson

10.1.3.2 Discussion

11.1.3.2.1. A member mentioned that it is generally good to have an ad hoc meeting to accelerate the comment resolution process, however January is not the right timing.

11.1.3.2.2. There were similar comments.

10.1.3.3 Result: Y/N/A = 9/52/32, motion fails.

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11 Teleconferences

11.1 Weekly conference calls are planned after September session.

- Thursday Dec. 1st, 8th and 15th, 2016 21:00 - 23:00 (ET) – For PAR Verification
- Thursday Jan. 5th, 2017 11:00 - 13:00 (ET)
- Thursday Jan. 12th, 2017 20:00 - 22:00 (ET)

12 AOB

12.1 No other business to conduct.

13 Adjournment

13.1 TGax adjourned for the week @ 15:35.

Thursday, November 10th, 2016, PM2 TGax full Session (16:00-18:00)

Upon completion of its business, TGax Thursday PM2 session was cancelled.

Annex A. Vote record of the SR Motion #13 - Thursday, November 10th, 2016, AM1 session.

Annex B. Vote record of the CR Motion #132 (SR) - Thursday, November 10th, 2016, PM1 session.

Annex C. Vote record of the SR Motion #13 (reconsider) - Thursday, November 10th, 2016, PM1 session.

The results are contained in separate tabs the excel file below..

802.11 TGax roll call vote November

Appendix BI

IEEE P802.11
Wireless LANs

IEEE 802.11 TGax

March 2017 Vancouver Meeting Minutes

Date: 2017-04-05

Author(s):

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Abstract

TGax meeting minutes from the IEEE 802.11 Vancouver session, March 13th – 17nd, 2017.

Minutes/motions from the ad hoc groups are contained in the following documents:

- PHY Ad Hoc
  - https://mentor.ieee.org/802.11/dcn/17/11-17-0494-00-00ax-march-2017-vancouver-phy-ad-hoc-meeting-minutes.docx
- MAC Ad Hoc
  - https://mentor.ieee.org/802.11/dcn/17/11-17-0155-01-00ax-11ax-mac-ad-hoc-minutes.docx
- MU Ad Hoc
  - https://mentor.ieee.org/802.11/dcn/17/11-17-0495-00-00ax-tgax-mu-ad-hoc-minutes-march-2017.docx
- SR Ad Hoc
  - https://mentor.ieee.org/802.11/dcn/17/11-17-0504-00-00ax-spatial-reuse-ad-hoc-group-march-2017-minutes.docx

IEEE 802.11 Task Group ax
March 2017 Vancouver Meeting
Hyatt Regency Vancouver, BC, Canada
March 13th – 17th, 2017

TGax Chair	**Osama Aboul-Magd (Huawei Technologies)**
Vice Chair	**Simone Merlin (Qualcomm)**
Vice Chair	**Ron Porat (Broadcom)**
TGax Secretary	**Yasuhiko Inoue (NTT)**
TGax Technical Editor	**Robert Stacy (Intel)**

Monday, March 13th, 2017, PM1 TGax Session (13:30-15:30)

1. The meeting called to order by Osama Aboul-Magd (Huawei Technologies), the chair of the TGax, @13:35
   1.1. Introduction of front table.

2. Announcement
   2.1. Agenda Doc.11-17/0199r1 on the server. Rev. 2 is the working document.
   2.2. Meeting Protocol: Chair asked to state name and affiliation when speaking for the first time.
   2.3. Attendance reminder.
      2.3.1. The attendance server: https://imat.ieee.org/

3. The chair reviewed the mandatory 6 slides of P&P.
   3.1. Instructions for the WG Chair.
   3.2. Participants, Patents, and Duty to Inform.
   3.3. Patent Related Links.
   3.4. Call for potentially essential patents.
      3.4.1. Chair asked if anyone is aware of potentially essential patents.
      3.4.2. No potentially essential patents reported.
   3.5. Other Guidelines for IEEE WG Meetings.
   3.6. Participation in IEEE 802 Meetings

4. Agenda items for the week
   4.1. Approve meeting and teleconferences minutes since January 2017
   4.2. Continue with comment resolution on draft D1.0
   4.3. Schedule TG ad hoc meeting (possibly in Korea)
   4.4. Schedule TG teleconferences.

5. General Flow of the meeting
   5.1. Slides 14 and 15 of the 17/0199r6 contain general flow of the meeting.

5.2. There are ten meeting slots planed for TGax.

	Monday		Tuesday		Wednesday		Thursday
AM1					TGax (full session)		
AM2			TGax (Ad Hoc)	TGax (Ad Hoc)			
PM1	TGax (full session)				TGax (Ad Hoc)	TGax (Ad Hoc)	TGax (full session)
PM2	TGax (Ad Hoc)	TGax (Ad Hoc)	TGax (Ad Hoc)	TGax (Ad Hoc)	TGax (Ad Hoc)	TGax (Ad Hoc)	TGax (full session)
PM3			SR ad Hoc				

6. Call for submissions – 62 submissions

6.1. PHY – 13 submissions

6.1.1. 11-17-0044, “NDP Short Feedback Design,” Ron Porat (Broadcom)
6.1.2. 11-17-0078, “RBW of 11ax,” Xiaogang Chen (Intel)
6.1.3. 11-17-0231, “CR_clause 28.3.5,” Xiaogang Chen (Intel)
6.1.4. 11-17-0234, “CR_clause 28.3.19_28.3.20,” Xiaogang Chen (Intel)
6.1.5. 11-17-0247, “CR HE PHY Introduction Part 4,” Lochan Verma (Qualcomm)
6.1.6. 11-17-0261, “CR HE PHY Transmit Requirements HE_TRIG_PPDU Part 1,” Lochan Verma (Qualcomm)
6.1.7. 11-17-0290, “CRs on TX specification,” Yujin Noh (Newracom)
6.1.8. 11-17-0345, “LB225 CR on TXOP_DURATION (28.2.2),” Jeongki Kim (LG Electronics)
6.1.9. 11-17-0398, “11ax Comment Resolutions for HE Preamble,” Yan Zhang (Marvell)
6.1.10. 11-17-0400, “CRs for 20MHz-only STA - Part 1,” Sungeun Lee (Cypress)
6.1.11. 11-17-0404, “CR on Pre-HE preamble transmission for trigger based PPDU,” Ross Jian Yu (Huawei)
6.1.12. 11-17-0414, “CR on clause 28-3-11 HE PHY data field,” Tianyu Wu (MediaTek)
6.1.13. 11-17-0436, “LB225 Comment Resolution of CID 7517,” Jianhan Liu (MediaTek)

6.2. MAC – 25 submissions

6.2.1. 11-17-0074, “Explanations for CR on 27.5.2.7,” Laurent Cariou (Intel)
6.2.2. 11-17-0088, “Discussion for CR on 10.22.2.8 TXOP limits,” Woojin Ahn (Wilus)
6.2.3. 11-17-0239, “LB225-MAC-CR-HT Control subclause 9.2.4.6.X and 10.1 - Block 2,” Alfred Asterjadhi (Qualcomm)
6.2.4. 11-17-0240, “LB225-MAC-CR-HT Control subclause 9.2.4.6.X and 10.1 - Block 3,” Alfred Asterjadhi (Qualcomm)
6.2.5. 11-17-0283, “lb225-mac-cr-9-3-1-23,” Raja Banerjea (Qualcomm)
6.2.6. 11-17-0285, “LB225-MAC-CR-HE MCS_NSS resolutions,” Alfred Asterjadhi (Qualcomm)
6.2.7. 11-17-0308, “CR for section 9.4.2 BSS load PPT,” Frank Hsu (MediaTek)
6.2.8. 11-17-0319, ” CRs for Section 27.4,” George Cherian (Qualcomm)
6.2.9. 11-17-0341, “LB225 11ax D1.0 Comment Resolution 10.13,” Liwen Chu (Marvell)
6.2.10. 11-17-0344, “LB225 CR on EIFS and TXOP_DURATION (10.3.2.3.7 and 27.11.5),” Jeongki Kim (LG Electronics)
6.2.11. 11-17-0346, “LB225 CR on TXOP Truncation (10.22.2.9),” Jeongki Kim (LG Electronics)
6.2.12. 11-17-0347, “LB225 CR on Intra-PPDU PS (27.14.1),” Jeongki Kim (LG Electronics)
6.2.13. 11-17-0353, “LB225-CRs-on-OFDMA-based-random-access-Response,” Suhwook Kim (LG Electronics)
6.2.14. 11-17-0359, “mac-cr-CS Required-9-3-1-23,” Raja Banerjea (Qualcomm)
6.2.15. 11-17-0360, “LB225 CR for CID5917 and CID8165,” Ming Gan (Huawei)

6.2.16. 11-17-0361, “BSS Load Information in 802.11ax,” Ming Gan (Huawei)
6.2.17. 11-17-0362, “LB225 CR for Subclause 9.4.2.218.2,” Ming Gan (Huawei)
6.2.18. 11-17-0384, “LB225, Comment resolution for 10.24.10,” Reza Hedayat (Newracom)
6.2.19. 11-17-0389, “CIDs-for-27-2-1-part1,” Kaiying Lv (ZTE)
6.2.20. 11-17-0395, “LB225-CR-on-Pre-association,” Ming Gan (Huawei)
6.2.21. 11-17-0396, “Association Exchange using Contention based UL OFDMA,” Ming Gan (Huawei)
6.2.22. 11-17-0421, “cr-for-11.49-HE BSS operation,” Chao-Chun Wang (MediaTek)
6.2.23. 11-17-0443, “LB225-CRs-on-OFDMA-based-random-access-Figure,” Suhwook Kim (LG Electronics)
6.2.24. 11-17-0445, “CR on Per-TID All Ack in Multi-STA BlockAck Frame,” Geonjung Ko (Wilus)
6.2.25. 11-17-0448, “Proposed resolution for comments related to CIDs in 27.5.2,” Jing Ma (NICT)

6.3. MU – 9 submissions
6.3.1. 11-17-0271, “CR for 17.2.2.1 and 17.3.9.10,” Po-kai Huang (Intel)
6.3.2. 11-17-0282, “11-17-xxxx-0x-00ax-lb225-mac-cr-number-of-ss-9-3-1-23,” Raja Banerjea (Qualcomm)
6.3.3. 11-17-0302, “D1.0 MAC Resolution CR for 27.5.2.4,” Po-Kai Huang (Intel)
6.3.4. 11-17-0325, “CR for 27.14.3 OPS,” Laurent Cariou (Intel)
6.3.5. 11-17-0335, “CR for CID 8142 - Random Access acronym,” Rojan Chitrakar (Panasonic)
6.3.6. 11-17-0338, “CR for 27.5.2.4 - Physical CS CIDs,” Rojan Chitrakar (Panasonic)
6.3.7. 11-17-0349, “LB225 CR for 25.5.2.4 Setting of CS Required Bit,” Kiseon Ryu (LG Electronics)
6.3.8. 11-17-0403, “CR-Subclause-27-5-3-MU-Cascading,” David Xun Yang (Huawei)
6.3.9. 11-17-0442, “LB225, CR CIDs 3215, 3216,” Reza Hedayat (Newracom)

6.4. SR – 10 submissions
6.4.1. 11-16-1063, “Unified SR text DSC, ATPC, inter-BSS,” Graham Smith (SR Technologies)
6.4.2. 11-16-1476, “CR-for section-25-9-spatial-reuse-operation-for-HE-PPDU,” Matthew Fischer (Broadcom)
6.4.3. 11-17-0075, “SRP-based SR Summary and Update,” Matthew Fischer (Broadcom)
6.4.4. 11-17-0163, “DSC as OBSS_PD,” Graham Smith (SR Technologies)
6.4.5. 11-17-0267, “CR for 25.9.2.2 OBSS_PD Spatial reuse,” Laurent Cariou (Intel)
6.4.6. 11-17-0383, “Spatial Reuse Group Challenges,” Reza Hedayat (Newracom)
6.4.7. 11-17-0452, “LB225, CR for CID3222,” Reza Hedayat (Newracom)
6.4.8. 11-17-0455, “Some clarifications on current SR spec text,” Laurent Cariou (Intel)
6.4.9. 11-17-0458, “OBSS_PD: Threshold problems,” Sean Coffey (RealTek)
6.4.10. 11-17-0459, “,” Kaiying Lv (ZTE)

6.5. TG – 5 submissions
6.5.1. 11-17-0112, “Link Transmit Power,” Matthew Fischer (Broadcom)
6.5.2. 11-17-0328, “Link Adaptation Feedback for Combating Interference,” Feng Jiang ()
6.5.3. 11-17-0334, “Proposed Text for Simulation Scenarios,” Frank Hsu (MediaTek)
6.5.4. 11-17-0369, “Some CIDs related to 20MHz operation,” Guoqing Li (Apple)
6.5.5. 11-17-0370, “Some CIDs related to 20MHz operation -- text,” Guoqing Li (Apple)

6.6. Ad Hoc meeting scheduling
6.6.1. Ad Hoc slot assignment
6.6.1.1. MAC … 5, PHY … 3.5, SR … 1, MU … 1.5.
6.6.2. Chair asked if there are any objections to approve the TGax schedule as follow.
6.6.2.1. There are no objections. The TGax schedule is approved.

	Monday		Tuesday		Wednesday		Thursday
AM1					TGax (full session)		
AM2			TGax (PHY)	TGax (MAC)			TGax (full session)
PM1	TGax (full session)				TGax (MAC)	TGax (MU)	
PM2	TGax (PHY)	TGax (MAC)	TGax (PHY)	TGax (MAC)	TGax (MAC)	TGax (PHY/MU)	TGax (full session)
PM3			TGax (SR)				

7. Agenda for Monday, March 14th, PM1 (13:30 – 15:30).

7.1. Proposed Agenda for Monday PM1:

7.1.1. Call meeting to order
7.1.2. Patent policy, etc.
7.1.3. Call for submissions
7.1.4. Set Ad Hoc Groups schedule and approve agenda
7.1.5. Summary from January 2017 meeting
7.1.6. TG motions
7.1.6.1. Approve TG meeting and Telecon minutes since November meeting.
7.1.6.2. Approve resolutions of comments, if needed.
7.1.7. Editor Report – Robert Stacey
7.1.8. Timeline
7.1.9. On Comment Resolution
7.1.10. Next ad Hoc Meeting (May)
7.1.11. Presentations and Comment Resolution
7.1.12. Recess

7.2. Chair asked if there are any other items – No items proposed. Meeting will be conducted based on this order.

8. Summary from January 2017 Meeting

8.1. Continued with the resolution of comments received on draft D1.0
8.2. Discussed issues related to spatial Reuse.
8.3. Held a weekly teleconferences to advance comment resolution
8.4. Held a TG 3-day ad hoc meeting in San Diego

9. TG Motions

9.1. Motion: Approve TGax minutes of meetings and teleconferences from January 2017 interim meeting to today:

- **https://mentor.ieee.org/802.11/dcn/17/11-17-0126-00-00ax-tgax-january-2017-atlanta-meeting-minutes.docx**
- **https://mentor.ieee.org/802.11/dcn/17/11-17-0224-03-00ax-tgax-teleconference-minutes-from-jan-to-mar-2017.docx**
- **https://mentor.ieee.org/802.11/dcn/17/11-17-0155-00-00ax-11ax-mac-ad-hoc-minutes.docx**
- **https://mentor.ieee.org/802.11/dcn/17/11-17-0358-00-00ax-tgax-march-2017-ad-hoc-meeting-minutes-non-phy-ad-hoc.docx**

- https://mentor.ieee.org/802.11/dcn/17/11-17-0456-00-00ax-mar-2017-tgax-sd-phy-ad-hoc-premeeting-minutes.docx

9.1.1. Discussion:

9.1.1.1. A member requested to check the CIDs discussed during the TGax ad hoc meeting.

9.1.2. Result: The motion was postponed until Wednesday AM1.

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10. Editor's Report

10.1. Draft 1.1 is on the members' only area of the 802.11 web site.

11. Timeline

11.1. Slide 24 of the agenda document contains the current timeline.

11.1.1. May 2014: start of the TG
11.1.2. Nov. 2014: First draft of the TG SFD was approved
11.1.3. Jan. 2016: proposed TG draft
11.1.4. March 2016: Draft D0.1 was approved and CC started
11.1.5. November 2016: Draft 1.0 and WG letter ballot
11.1.6. May 2017: Draft 2.0 and recirculation
11.1.7. November 2017: MDR (Mandatory Document Review)
11.1.8. January 2018: Formation of SB pool
11.1.9. March 2018: Sponsor Ballot
11.1.10. December 2018: RevCom

11.2. Draft 2.0 is very unlikely to be available in May 2017.

11.2.1. Chair asked for comments and suggestions.

11.2.2. Timeline will be discussed during the TGax full session on Thursday session.

12. On Comment Resolutions

12.1. Number of comments were rejected with no proper reasons

12.2. Some of the reasons cited, "it is in the SFD", "the group adopted it"

12.3. Please refer to the comment resolution tutorial;
https://mentor.ieee.org/802.11/dcn/16/11-16-0230-03-000m-sb1-stephens-resolutions-part-1.doc

13. Presentations

13.1. Guoqing Li (Apple) presented "CIDs Related to 20MHz-only STAs operating on non-primary 20 MHz channels," based on the submission 11-17-0369-03.

13.1.1. Summary

13.1.1.1. The 802.11ax draft is introducing 20 MHz-only STAs which operate at 20MHz BW only, however, it is not clear on whether and how these STAs can operate on non-primary 20MHz channel, see text below.

13.1.1.2. What's defined in 11ax draft 1.0 is ready to enable the non-primary channel operation mode which enables intelligent load balancing and interference management, maximizes BSS BW utilization and reduces STA power consumption.

13.1.2. Discussion

13.1.2.1. A member mentioned that he/she likes this idea. However, he/she is concerned about the consistency with the protection mechanism, i.e. MU-RTS/CTS procedure.

13.1.2.2. Another member is concerned about the range disadvantage that a 20 MHz-only STA may have, and also the additional complexity since such a device is very likely to be a low cost device.

13.1.2.3. There is a comment that efficiency can be achieved by putting 20 MHz-only STA on the primary channel while placing other HE STAs secondary channels.

13.1.2.4. There is a comment that this proposal introduces an OBSS coexistence issue. The commenter would like to see all the mechanism for this procedure and results of evaluation.

13.1.2.5. A member mentioned that he/she generally agrees with the idea of giving a kind of flexibility. He/she would like to understand relationship between MU-RTS/CTS procedure and power efficiency.

13.1.3. Next Step

13.1.3.1. It is good to give people to review the document 17/370r2 that contains the text of this proposal.

14. AoB

14.1. PM2 session on Monday March 13th is ad hoc sessions

14.1.1. Ad Hoc #1 – PHY – Regency C.

14.1.2. Ad Hoc #2 – MAC – Regency D.

15. TGax meeting recessed @ 15:30.

The next TGax full session is AM1 on Wednesday, March 15th.

Monday, March 13th, 2017, PM2 TGax Ad Hoc Sessions (16:00-18:00)

- Ad Hoc #1: PHY – Regency C
  - Agenda: 11-17-0464
- Ad hoc #2: MAC – Regency D
  - Agenda: 11-17-0453

Tuesday, March 14th, 2017, AM2 TGax Ad Hoc Sessions (10:30-12:30)

- Ad hoc #1: PHY – Regency C
  - Agenda: 11-17-0464

- Ad hoc #2: MAC – Regency D
  - Agenda: 11-17-0453

Tuesday, March 14th, 2017, PM2 TGax Ad Hoc Sessions (16:00-18:00)

- Ad hoc #1: PHY – Regency C.
  - Agenda: 11-17-0464

- Ad hoc #2: MAC – Regency D
  - Agenda: 11-17-0453

Tuesday, March 14th 2016, PM3 TGax ad hoc Session (19:30-21:30)

- Ad hoc #1: SR – Regency C.
  - Agenda: 11-17-0482

Wednesday, March 15th 2017, AM1 TGax full Sessions (13:30-15:30)

1 The meeting called to order by Osama Aboul-Magd (Huawei Technologies), the chairperson of the TGax, @8:00 AM

1.1 Agenda 17/0199r3 is on the server.
1.2 Rev. 4 is the working document.

2 Agenda Setting

2.1 Proposed agenda for this session
- 2.1.1 Call Meeting to order
- 2.1.2 IEEE 802 and 802.11 IPR Policy and procedure.
- 2.1.3 Approval of TG Minutes
- 2.1.4 May ad hoc Meeting and motion
- 2.1.5 Timeline
- 2.1.6 Progress Review from ad hocs
- 2.1.7 Presentations
  - 2.1.7.1 SP remaining from yesterday
  - 2.1.7.2 11-17/0075 and 11-16/1476
  - 2.1.7.3 11-17/0383 and 11-17/0452
  - 2.1.7.4 11-17/0459
  - 2.1.7.5 11-17/0267 – SP
- 2.1.8 Recess

2.2 Chair asked if there any comments or suggestions on the proposed agenda. No response.
- 2.2.1 The agenda for Wednesday AM1 is approved.

3 Reminder

3.1 Chair reminded that we are still operating under IEEE 802 and 802.11 Policies and Procedures.
3.2 Chair asked to state name and affiliation when addressing for the first time in the session.
3.3 Chair asked to put cellphone mute.

4 Approval of TG minutes (January 2017 meeting and teleconferences)

4.1 Motion: Approve TGax minutes of meetings and teleconferences from January 2017 plenary meeting to today:
- **4.1.1 https://mentor.ieee.org/802.11/dcn/17/11-17-0126-00-00ax-tgax-january-2017-atlanta-meeting-minutes.docx**
- **4.1.2 https://mentor.ieee.org/802.11/dcn/17/11-17-0224-03-00ax-tgax-teleconference-minutes-from-jan-to-mar-2017.docx**
- **4.1.3 https://mentor.ieee.org/802.11/dcn/17/11-17-0155-00-00ax-11ax-mac-ad-hoc-minutes.docx**
- **4.1.4 https://mentor.ieee.org/802.11/dcn/17/11-17-0358-02-00ax-tgax-march-2017-ad-hoc-meeting-minutes-non-phy-ad-hoc.docx**
- **4.1.5 https://mentor.ieee.org/802.11/dcn/17/11-17-0456-00-00ax-mar-2017-tgax-sd-phy-ad-hoc-premeeting-minutes.docx**

4.2 Moved by Bo Sun, Seconded by Bin Tian.
4.3 Discussion: No discussion.
4.4 Result: Motion was approved with no objection.

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5 Ad Hoc Meeting in May 2017

5.1 Jinsoo Ahn (LG Electronics) volunteers to host the TGax ad hoc meeting in May 2017 before the week of the IEEE 802 Wireless Interim session.

5.2 Discussion

5.2.1 Some members prefer to have the ad hoc meeting on Saturday and Sunday.

5.2.2 PHY ad hoc does not need ad hoc meeting.

5.3 Motion

5.3.1 Authorize TGax to hold an ad-hoc meeting on May 3-5 in Seoul, Korea, for the purpose of working on comment resolution excluding PHY CIDs.

5.3.2 Moved by Robert Stacey, Seconded by Qinghua Li

5.3.3 Discussion: No discussion.

5.3.4 Result: Y/N/A = 55/0/2, motion passes.

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6 Timeline discussion

6.1 Chair showed the proposed modification to the timeline contained in the agenda file and requested for comments and suggestions.

6.1.1 There will be a motion to approve the modified timeline on Thursday.

7 Progress from ad hoc groups

7.1 Report from the ad hoc groups:

7.1.1 PHY (Bo): 4 presentations left. Need one more session.

7.1.2 MU (Sigurd): 8 submissions left. Need one more session. It can be a joint session with PHY ad hoc.

7.1.3 SR (Guido): 5 left. Want Thursday AM1 session.

7.1.4 MAC (Eric): 14 left. Need more sessions.

7.2 Chair will request additional meeting slot during the WG mid-week plenary session.

7.3 Chair also asked the members to review the motion text contained in the agenda file.

8 Presentations

8.1 Matt. Fischer (Broadcom) presented "SRP-Based SR Operation," based on the submission 11-17-0075-07.

8.1.1 Summary

8.1.1.1 This is an update of a presentation that was given in January 2017 session.

8.1.2 Discussion

8.1.2.1 Q: A member asked about the retransmission procedure when the acknowledgment is not returned. → It is not likely that the retransmission occurs within the same SRP PPDU. We may need to think about the use of Delayed Block ACK procedure.

8.1.2.2 C: Some members disagree with the concept of SRP. Although some cases are explained in the document, there seems to be many hidden assumptions. More details of this procedure have to be discussed.

8.1.2.3 C: A member commented that AP will have an advantage for SR transmissions.

8.1.2.4 Q: A member asked if we have a mechanism to completely ON/OFF this procedure. → SR_Disallow bit.

8.1.2.5 C: Another member pointed out that there are some issues such as number of STAs participating SR transmissions, collision probability in a dense wireless LAN environment, UL/DL balancing.

8.1.3 Straw Polls

8.1.3.1 Straw Poll #1: Do you support the use of SRP in the DSRP_PPDU case, i.e. Trigger followed by UL Trigger-based PPDU?

8.1.3.1.1 Y/N/A = 31/12/35

8.1.3.2 Straw Poll #2: Do you support the use of SRP in the TSRP_PPDU case, i.e. HE Trigger-based PPDU preceded by IDLE or by PPDU with color match of Trigger-based PPDU?

8.1.3.2.1 Y/N/A = 24/26/29

8.1.3.3 Straw Poll #3: Do you support the use of SRP in the ULSRP_PPDU case 1, i.e. HE UL SU PPDU or HE UL MU PPDU preceded by IDLE?

8.1.3.3.1 Y/N/A = 13/25/31

8.2 Reza Hedayat (Newracom) presented "LB225, CR for CID3222," based on the submission 11-17-0452-02.

8.2.1 Summary

8.2.1.1 As a resolution for CID #3222, OBSS_PD Rule is modified.

8.2.1.2 The proposal is to use a more relaxed OBSS-PD for response frames to protect intended recipients of data frames from potential interference/collision.

8.2.1.3 Proposed text is contained in slide 10 of 11-17-0452-02.

8.2.2 Discussion

8.2.2.1 A member commented that we should have protection for response frame.

8.2.3 Straw Poll

8.2.3.1 Do you accept the Revised resolution for CID 3222 with the proposed text in slide 10 of 17-0452r1?

8.2.3.1.1 Accepted with no objection.

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9 AoB

9.1 Guoqing Li (Apple) has straw polls from submission 11-17-0369

9.1.1 Straw Polls:

9.1.1.1 Straw Poll #1: Do you agree to accept the text described in 0370r2 for comment resolution for CID 8810 and 8811?

9.1.1.1.1 Discussion:

9.1.1.1.1.1 A member commented that this adds lots of complexity.

9.1.1.1.2 Result: Y/N/A = 39/26/17, straw poll will not be converted to a motion.

9.1.1.2 Straw Poll #2: Do you agree to allow 20 MHz-only STAs to operate on any 20 MHz channel within the BSS bandwidth as an optional mode?

9.1.1.2.1 Discussion:

9.1.1.2.2 Result: This straw poll was not conducted.

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10 Recess

10.1 There will be TGax ad hoc meetings this afternoon.

10.2 Chair will send out an email.

Wednesday, March 15th 2017, PM1 TGax Ad Hoc Sessions (13:30-15:30)

- Ad Hoc #1: MAC – Regency C
  - Agenda: 11-17-0453
- Ad Hoc #2: MU – Regency D
  - Agenda: 11-17-0485

Wednesday, March 15th 2017, PM2 TGax Ad Hoc Sessions (16:00-18:00)

- Ad Hoc #1: MU/PHY – Regency C
  - Agenda: 11-17-0485/11-17-0464
- Ad Hoc #2: MAC – Regency D
  - Agenda: 11-17-0453

Thursday, March 16th, 2017, PM1 TGax full Session (13:30-15:30)

1 The meeting called to order by Osama Aboul-Magd (Huawei Technologies), the chairperson of the TGax, @13:30.

1.1 Agenda 17/0199r5 is on the server. Rev. 6 is the working document.

2 Agenda for this session

2.1 Thursday PM1 and PM2
- 2.1.1 Call Meeting to order
- 2.1.2 Agenda Setting
- 2.1.3 Announcement/Reminder
  - 2.1.3.1 IEEE 802 and 802.11 IPR Policy and procedure.
  - 2.1.3.2 Attendance
- 2.1.4 TG Motions
- 2.1.5 Timeline update
- 2.1.6 Goals for May 2016
- 2.1.7 Teleconferences
- 2.1.8 Presentations
  - 2.1.8.1 11-17/0328
  - 2.1.8.2 11-17/0112
- 2.1.9 Adjourn

2.2 Chair asked if there are any modifications to the agenda.

2.3 Agenda approved without objections.

3 Announcement/Reminder

3.1 Chair reminded IEEE 802 and 802.11 IPR P&P.

3.2 Chair asked people to state name and affiliation when addressing for the first time in the session.

3.3 Chair reminded people to do attendance.

4 Motions – TG documents

4.1 CR Motions

4.1.1 CR Motion #152 (MAC): Move to accept resolutions to CIDs; 5164, 6974, 6975,6978, 6979, 6980, 6981, 7532, 7533, 8293, 8486, 9865, and 9866 in doc 11-17/0191r5

4.1.1.1 Moved by Reza Hedayat, Seconded by Yasu Inoue.
4.1.1.2 Discussion: No discussion.
4.1.1.3 Result: Motion was accepted with no objection.

4.1.2 CR Motion #153 (MAC): Move to accept resolutions to CIDs; 3193, 3194, 4747, 4748, 5032, 5172, 5684, 5854, 5906, 5908, 6159, 6160, 7138, 7178, 7185, 7186, 7795, 8212, 8213, 8214, 8264, 8295, 8296, 8297, 9403, 9491, 9521, 9586, 9702, 10248, 10249, 10327, 3244, 3389, 3499, 3830, 3919, 4270, 4454, 4483, 4742, 4744, 5843, 5911, 5912, 6462, 6463, 6464, 7562, 8201, 8262, 8263, 8265, 8290, 8291, 8519, 4745, 7660 in doc 11-17/0204r5.

4.1.2.1 Moved by Laurent Cariou, Seconded by Yasu Inoue.
4.1.2.2 Discussion: No discussion.
4.1.2.3 Result: Motion was accepted with no objection.

4.1.3 CR Motion #154 (MAC): Move to accept resolutions to CIDs; 6935, 3102, 7707, 8494, 4715, 6936, 4716, 6937, 5432, 4717 in doc 11-17/0223r2.

4.1.3.1 Moved by Reza Hedayat, Seconded by Yasu Inoue.
4.1.3.2 Discussion: No discussion.
4.1.3.3 Result: Motion was accepted with no objection.

4.1.4 CR Motion #155 (MAC): Move to accept resolutions to CIDs; 5931, 7528, 9748 in doc 11-17/0227r0.

4.1.4.1 Moved by Reza Hedayat, Seconded by Yasu Inoue.
4.1.4.2 Discussion: No discussion.
4.1.4.3 Result: Motion was accepted with no objection.

4.1.5 CR Motion #156 (MAC): Move to accept resolutions to CIDs; 4266, 4479, 5211, 10290 in doc 11-17/0248r3.

4.1.5.1 Moved by Reza Hedayat, Seconded by Yasu Inoue.
4.1.5.2 Discussion: No discussion.
4.1.5.3 Result: Motion was accepted with no objection.

4.1.6 CR Motion #157 (MAC): Move to accept resolutions to CIDs; 9756, 7788 in doc 11-17/0255r0.

4.1.6.1 Moved by Reza Hedayat, Seconded by Yasu Inoue.
4.1.6.2 Discussion: A member asked for a count.
4.1.6.3 Result: Y/N/A = 28/3/9, motion passes.

4.1.7 CR Motion #158 (MAC): Move to accept resolutions to CIDs; 3166, 6086, 6328, 7267, 7272, 7275, 7753, 8396, 9834, 9836, 5682, 7271, 3019, 6329, 9835, 9646, 9647, 8252, 7273, 7274, 7490, 8117, 10342 in doc 11-17/0207r6.

4.1.7.1 Moved by Po-Kai Huang, Seconded by Yasu Inoue.
4.1.7.2 Discussion: No discussion.
4.1.7.3 Result: Motion was accepted with no objection.

4.1.8 CR Motion #159 (MAC): Move to accept resolutions to CIDs; 9612, 4832 in doc 11-17/0208r2.

4.1.8.1 Moved by Reza Hedayat, Seconded by Yasu Inoue.
4.1.8.2 Discussion:
4.1.8.2.1 A member asked for deferral of CID #9612.
4.1.8.2.2 Another member objects to it.
4.1.8.3 Result: Y/N/A = 28/3/9, motion passes.

4.1.9 CR Motion #160 (MAC): Move to accept resolutions to CIDs; 7667, 9693, 6529 in doc 11-17/0209r2.

4.1.9.1 Moved by Reza Hedayat, Seconded by Yasu Inoue.

4.1.9.2 Discussion: No discussion.
4.1.9.3 Result: Motion was accepted with no objection.

4.1.10 CR Motion #161 (MU): Move to accept resolutions to CIDs; 7840, 7959, 8502, 9771, 8715, 10071 in doc 11-17/0309r1.

4.1.10.1 Moved by George Cherian, Seconded by Yasu Inoue.
4.1.10.2 Discussion: No discussion.
4.1.10.3 Result: Motion was accepted with no objection.

4.1.11 CR Motion #162 (MAC): Move to accept resolutions to CIDs; 7668, 7669, 7906, 9694, 4833, 5775, 9600, 5969, 9861, 5968, 7670, 7881, 9346, 3188 in doc 11-17/0210r2.

4.1.11.1 Moved by Reza Hedayat, Seconded by Yasu Inoue.
4.1.11.2 Discussion: No discussion.
4.1.11.3 Result: Motion was accepted with no objection.

4.1.12 CR Motion #163 (MAC): Move to accept resolutions to CIDs; 6935, 3102, 7707, 8494, 4715, 6936, 4716, 6937, 5432, 4717 in doc. 11-17/0223r2.

4.1.12.1 Moved by Reza Hedayat, Seconded by Yasu Inoue.
4.1.12.2 Discussion: This is a duplicate of a previous motion (CR Motion #154).

4.1.13 CR Motion #164 (MAC): Move to accept resolutions to CIDs; 4754, 6094, 7564, 8404, 8689, 9677, 6480, 7565, 5848, 6481, 8406, 6484, 9611 in doc 11-17/0226r3.

4.1.13.1 Moved by Reza Hedayat, Seconded by Yasu Inoue.
4.1.13.2 Discussion: No discussion.
4.1.13.3 Result: Motion was accepted with no objection.

4.1.14 CR Motion #165 (MAC): Move to accept resolutions to CIDs; 8394, 5215, 7142, 10292 in doc 11-17/0263r3.

4.1.14.1 Moved by Po-Kai Huang, Seconded by Yasu Inoue.
4.1.14.2 Discussion: No discussion.
4.1.14.3 Result: Motion was accepted with no objection.

4.1.15 CR Motion #166 (MAC): Move to accept resolutions to CIDs; 5075, 5076, 5561, 9481, 5562, 5563, 9274, 7140, 9423, 5044, 9425, 8095, 8096, 5045, 9427, 7975, 5932, 7976, 9424, 9426, 9557, 9681, 9850, 5933, 8411, 9515, 7569, 8410, 5795, 7137, 5761, 9682, 8256, 8257, 9428, 4835, 5934, 9851, 7663 in doc 11-17/0264r3.

4.1.15.1 Moved by Po-Kai Huang, Seconded by Yasu Inoue.
4.1.15.2 Discussion: No discussion.
4.1.15.3 Result: Motion was accepted with no objection.

4.1.16 CR Motion #167 (MAC): Move to accept resolutions to CIDs; 10250, 10320, 10321, 10322, 10323, 10247, 10005, 10006, 10246, 9584, 9386, 9285, 8592, 8354, 8211, 7233, 6068, 6056, 5930, 5559, 5468, 5466, 5463, 5358, 5169, 3057, 8268, 8269, 7844, 9442 in doc 11-17/0324r1.

4.1.16.1 Moved by Po-Kai Huang, Seconded by Yasu Inoue.
4.1.16.2 Discussion: No discussion.
4.1.16.3 Result: Motion was accepted with no objection.

4.1.17 CR Motion #168 (MAC): Move to accept resolutions to CIDs; 3006, 3010, 3112, 3162, 5047, 5058, 5067, 5926, 6075, 6076, 6272, 6273, 7134, 7311, 7312, 7314, 7475, 7733, 7734, 7735, 7736, 7737, 7934, 8113, 8186, 8187, 8474, 8475, 8477, 8478, 9362, 9363, 9364, 9625, 9626, 9642, 9814, 9815, 9816, 9817, 9818 in doc 11-17/306r4.

4.1.17.1 Moved by George Cherian, Seconded by Yasu Inoue.
4.1.17.2 Discussion: No discussion.
4.1.17.3 Result: Motion was accepted with no objection.

4.1.18 CR Motion #169 (MAC): Move to accept resolutions to CIDs; 3060, 3063, 3064, 3065, 3201, 3202, 3203, 3204, 3205, 3206, 3213, 5174, 5178, 5650, 5651, 5652, 5653, 5654, 5655, 5668, 5685, 5803, 5804, 5805, 5806, 6060, 6135, 6608, 6611, 6621, 6623, 6637, 6639, 6640, 6641, 7082, 7393, 7534, 7653, 7654, 7655, 7656, 7802, 7967, 8122, 8391, 8392, 8459, 8490, 8491, 9214, 9286, 9718, 9736, 9737, 9882, 10009, 10329, 10330, 10333, 8395 in doc 11-17/0319r1.

4.1.18.1 Moved by George Cherian, Seconded by Yasu Inoue.
4.1.18.2 Discussion: No discussion.
4.1.18.3 Result: Motion was accepted with no objection.

4.1.19 CR Motion #170 (MAC): Move to accept resolutions to CIDs; 3019, 9648, 9837, 10162 in doc 11-17/0359r2.

4.1.19.1 Moved by George Cherian, Seconded by Yasu Inoue.
4.1.19.2 Discussion: No discussion.
4.1.19.3 Result: Motion was accepted with no objection.

4.1.20 CR Motion #171 (MAC): Move to accept resolutions to CIDs; 3018, 8190, 3167, 3216, 5130, 8166, 8335, 8336, 8380, 8415, 8539, 8540, 9494, 9645, 6082, 7484, 9831 in doc 11-17/0283r3.

4.1.20.1 Moved by George Cherian, Seconded by Yasu Inoue.
4.1.20.2 Discussion: No discussion.
4.1.20.3 Result: Motion was accepted with no objection.

4.1.21 CR Motion #172 (MAC): Move to accept resolutions to CIDs; 6484, 9611 in document 17/0226r3.

1.1.1.1 Moved by Alfred Asterjadhi, Seconded by Yasu Inoue.
1.1.1.2 Discussion: No discussion.
1.1.1.3 Result: Motion was accepted with no objection.

4.1.22 CR Motion #173 (MAC): Move to accept resolutions to CIDs; 9428 in document 17/0264r3.

4.1.22.1 Moved by Po-Kai Huang.

4.1.22.2 Discussion: This CID is included in a previous motion (CR Motion #166).

4.1.23 CR Motion #174 (MAC): Move to accept resolutions to CIDs; 3060, 3061, 9444, 5175, 3062, 3071, 5708, 5709, 5710, 9709, 5711, 7177, 3072, 4817, 3136, 9821, 3075, 7552, 7972, 8533, 5455, 7163, 7164, 9378, 7165, 7841, 7169, 9379, 7146, 8280, 8292 in document 17/0230r1.

4.1.23.1 Moved by Abhishek Patil, Seconded by Yasu Inoue.

4.1.23.2 Discussion: No discussion.

4.1.23.3 Result: Motion was accepted with no objection.

4.1.24 CR Motion #175 (MU): Move to accept resolutions to CIDs; 7968, 8271, 4809, 4810, 4811, 5702, 5183, 5184, 9451, 5185, 5703, 7574, 9894, 4812, 5186, 5704, 9452, 8272, 9707, 5706, 5187, 6168, 5983, 8273, 8338, 9588, 6166, 10167, 4815, 4816, 7644, 7812, 9896, 6065, 7175, 9759, 9456, 9589, 7176, 10260, 9898, 8552, 3228, 9710, 4818, 8151, 8701, 8702, 4821, 9529, 4820, 8703, 4822, 4823, 4824, 4825, 6685, 7649, 5717, 3232, 7816, 5988, 9713, 4828, 6196, 3325*, 6695, 8705, 6696, 7817, 6697, 9917, 5997, 5998, 6701 in document 17/0250r2.

4.1.24.1 Moved by Abhishek Patil, Seconded by Yasu Inoue.

4.1.24.2 Discussion: No discussion.

4.1.24.3 Result: Motion was accepted with no objection.

4.1.25 CR Motion #176 (MAC): Move to accept resolutions to CIDs; 6787, 7131, 10300, 10301, 4910, 4911, 6789, 8356, 4909, 9703, 4908 in document 17/138r1.

4.1.25.1 Moved by Abhishek Patil, Seconded by Yasu Inoue.

4.1.25.2 Discussion: No discussion.

4.1.25.3 Result: Motion was accepted with no objection.

4.1.26 CR Motion #177 (MAC): Move to agree to the resolution of CID 5189 in document 17/0359r2.

4.1.26.1 Moved by George Cherian, Seconded by Yasu Inoue.

4.1.26.2 Discussion: No discussion.

4.1.26.3 Result: Motion was accepted with no objection.

4.1.27 CR Motion #178 (MAC): Move to accept the resolutions to CIDs 3015, 3016, 3165, 7487, 8660, 8661, 9262, 9263, 9633 from document 17/0282r4.

4.1.27.1 Moved by George Cherian, Seconded by Yasu Inoue.

4.1.27.2 Discussion: No discussion.

4.1.27.3 Result: Motion was accepted with no objection.

4.1.28 CR Motion #179 (MAC): Move to accept the resolutions to CIDs 4564, 4571, 4614, 7369, 8083, 8511, 8512, 9666, 9667 in document 11-17/0235r0.

4.1.28.1 Moved by Alfred Asterjadhi, Seconded by Yasu Inoue.
4.1.28.2 Discussion: No discussion.
4.1.28.3 Result: Motion was accepted with no objection.

4.1.29 CR Motion #180 (MAC): Move to accept the resolutions to CIDs 3132, 3175, 4720, 6919, 7228, 8308 in document 11-17/0236r2.

4.1.29.1 Moved by Alfred Asterjadhi, Seconded by Yasu Inoue.
4.1.29.2 Discussion: No discussion.
4.1.29.3 Result: Motion was accepted with no objection.

4.1.30 CR Motion #181 (MAC): Move to accept the resolutions to CIDs 4789, 4808, 5217, 5218, 5219, 5220, 5221, 5511, 5518, 7034, 7035, 7154, 7581, 7582, 8525, 8526, 8616, 8617, 8729, 8730, 9732, 9961, 9962, 9963, 9964 in document 11-17/0237r3.

4.1.30.1 Moved by Alfred Asterjadhi, Seconded by Yasu Inoue.
4.1.30.2 Discussion: No discussion.
4.1.30.3 Result: Motion was accepted with no objection.

4.1.31 CR Motion #182 (MAC): Move to accept the resolutions to CIDs 3084, 3085, 3086, 5387, 7166, 6786, 6779, 6777, 6781, 3088, 9458, 10299, 3087, 5476 in document 11-17/0134r10.

4.1.31.1 Moved by Abhishek Patil, Seconded by Yasu Inoue.
4.1.31.2 Discussion: No discussion.
4.1.31.3 Result: Motion was accepted with no objection.

4.1.32 CR Motion #183 (MAC): Move to accept the resolution to CID 5050 in document 11-17/0363r5.

4.1.32.1 Moved by Matt Fischer, Seconded by Yasu Inoue.
4.1.32.2 Discussion: No discussion.
4.1.32.3 Result: Motion was accepted with no objection.

4.1.33 CR Motion #184 (MAC): Move to accept the resolutions to CIDs 7809, 3074, 5999, 9121, 9122, 9123, 5018, 5019, 5020, 5021, 5022, 5023, 5066, 5714, 5986, 6167, 7648, 8156, 8279, 8554, 9100, 9591, 9904, 9975, 9708, 10168, 5364, 7814, 3097, 3229, 3230, 3301, 4819, 5035, 5094, 5190, 5370, 5713, 6195, 6677, 6999, 7097, 7845, 8276, 8299, 9528, 9711, 10169, 10010, 5810, 10012, 5365, 9916, 9258, 7745, 9827, 9630, 7329, 9997, 9998, 9826, 7041, 7141, 9897 in document 11-17/0229r2.

4.1.33.1 Moved by Abhishek Patil, Seconded by Yasu Inoue.
4.1.33.2 Discussion: No discussion.
4.1.33.3 Result: Motion was accepted with no objection.

4.1.34 CR Motion #185 (MAC): Move to accept the resolutions to CIDs 5222, 5223, 5224, 5225, 5226, 7584, 7585, 7586, 9751, 9965, 9966, 3256, 3354, 3461, 3775, 3858, 4301, 4925, 5227, 5228, 7587, 7588, 7589, 7590, 7591, 7592 in doc 11-17/0237r3.

4.1.34.1 Moved by Alfred Asterjadhi, Seconded by Yasu Inoue.
4.1.34.2 Discussion: No discussion.
4.1.34.3 Result: Motion was accepted with no objection.

4.1.35 CR Motion #186 (MAC): Move to accept the resolutions to CIDs; 3004, 4725, 5436, 7715, 8175 (5 CIDs),
3378, 3483, 3812, 3896, 4358, 4425, 4727, 5025, 5438, 7471, 7713, 7714, 8176, 8643, 8644, 9801, 9984 (17 CIDs),
3153, 3381, 3487, 3817, 3902, 4365, 4433, 4734, 5051, 5122, 5123, 5439, 8177, 8645, 8646, 10334, 10335, 10336, 10337 (19 CIDs)
in document 11-17/0238r2.

4.1.35.1 Moved by Alfred Asterjadhi, Seconded by Yasu Inoue.
4.1.35.2 Discussion: No discussion.
4.1.35.3 Result: Motion was accepted with no objection.

4.1.36 CR Motion #187 (MAC): Move to accept the resolutions to CIDs;
- 4732, 4733, 5052, 5053, 5124, 5125, 5440, 7379, 7716, 7717, 8178, 8248, 9804,
- 5335, 5441, 7888,
- 5054, 5055, 5056, 5126, 5442, 7302, 7303, 7305, 7719, 7865, 7867, 8133, 8179, 8180, 8181, 8249, 9620, 9621, 9806
in document 11-17/0239r2.

4.1.36.1 Moved by Alfred Asterjadhi, Seconded by Yasu Inoue.
4.1.36.2 Discussion: No discussion.
4.1.36.3 Result: Motion was accepted with no objection.

4.1.37 CR Motion #188 (MAC): Move to accept the resolutions to CIDs; 3155, 3382, 3489, 3819, 3905, 4368, 4436, 5443, 7887, 8162, 8647,
3005, 3147, 3157, 3158, 3159, 4738, 5013, 5014, 5127, 5444, 6191, 7015, 7016, 7017, 7018, 7019, 7380, 7472, 7570, 7720, 8182, 8183, 8184, 8250, 8334, 8374, 9397, 9807, 9808, 10339
in document 11-17/0240r2.

4.1.37.1 Moved by Alfred Asterjadhi, Seconded by Yasu Inoue.
4.1.37.2 Discussion: No discussion.
4.1.37.3 Result: Motion was accepted with no objection.

4.1.38 CR Motion #189 (PHY): Move to accept the resolutions to the following CIDs and the corresponding spec text modification as in 11-17/0243r2.
CIDs: 3795, 4854, 4855, 4856, 4902, 4930, 4931, 5232, 5234, 5242, 5746, 5747, 5750, 5754, 5755, 5791, 10355, 10356

4.1.38.1 Moved by Lochan Verma, Seconded by Ron Porat.
4.1.38.2 Discussion: No discussion.
4.1.38.3 Result: Motion was accepted with no objection.

4.1.39 CR Motion #190 (PHY): Move to accept the resolutions to the following CIDs and the corresponding spec text modification as in 11-17/0245r2.
CIDs: 4903, 4934, 4935, 5236, 5237, 5238, 5239, 5240, 5745, 6110, 6818, 6819, 7218, 8331, 8332, 8357, 8361

4.1.39.1 Moved by Lochan Verma, Seconded by Ron Porat.
4.1.39.2 Discussion: No discussion.
4.1.39.3 Result: Motion was accepted with no objection.

4.1.40 CR Motion #191 (PHY): Move to accept the resolutions to the following CIDs and the corresponding spec text modification as in 11-17/0242r5.
CIDs: 3554, 5157, 5786, 5789, 6429, 7558, 8258, 9083, 9114, 8676, 8381, 6074

4.1.40.1 Moved by Lochan Verma, Seconded by Ron Porat.
4.1.40.2 Discussion: No discussion.
4.1.40.3 Result: Motion was accepted with no objection.

4.1.41 CR Motion #192 (PHY): Move to accept the resolutions to the following CIDs and the corresponding spec text modification as in 11-17/0244r2.
CIDs: 5147, 5148, 5149, 5150, 5151, 5152, 5153, 5154, 5841, 5842, 7557, 7559, 7573, 8346, 8347

4.1.41.1 Moved by Lochan Verma, Seconded by Ron Porat.
4.1.41.2 Discussion: No discussion.
4.1.41.3 Result: Motion was accepted with no objection.

4.1.42 CR Motion #193 (PHY): Move to accept the resolutions to the following CIDs and the corresponding spec text modification as in 11-17/0246r1.
CIDs: 8623, 8624, 8635, 8637, 8638, 8639, 8640, 8733, 8734, 8736, 8738, 8740, 8741, 8742, 8743, 10404, 10355

4.1.42.1 Moved by Lochan Verma, Seconded by Ron Porat.
4.1.42.2 Discussion: No discussion.
4.1.42.3 Result: Motion was accepted with no objection.

4.1.43 CR Motion #194 (PHY): Move to accept the resolutions to the following CIDs and the corresponding spec text modification as in 11-17/0247r2.
CIDs: 7036, 7217, 7218, 7428, 7429, 7824, 8359, 8626, 8627, 8629, 8630, 8631, 8632, 8633, 8634, 8732, 8735, 8737, 8739, 9113, 9134, 9777, 7778, 9779, 9780, 10081 10082, 10196

4.1.43.1 Moved by Lochan Verma, Seconded by Ron Porat.
4.1.43.2 Discussion: No discussion.
4.1.43.3 Result: Motion was accepted with no objection.

4.1.44 CR Motion #195 (MU): Move to accept the resolutions to the following CIDs and the corresponding spec text modification as in 11-17/0303r2.
CIDs: 6341, 6339, 7355, 7354, 7349, 3425, 3539, 3440, 3439, 3436, 3434, 3431, 3430, 3428, 3427, 9265 9266, 9840, 7756, 8665, 8666, 8667, 8669, 8670

4.1.44.1 Moved by Lochan Verma, Seconded by Ron Porat.
4.1.44.2 Discussion: No discussion.
4.1.44.3 Result: Motion was accepted with no objection.

4.1.45 CR Motion #196 (PHY): Move to accept the resolutions to the following CIDs and the corresponding spec text modification as in 11-17/0330r2.
CIDs: 3293, 3343, 3579, 3660, 4009, 4096, 5112, 5113, 5114, 5115, 5306, 5539, 6921, 7694, 7695, 8306, 8307, 8498, 9217, 9220, 9222, 9227, 9228, 9229, 9230, 9231, 9498, and 9499

4.1.45.1 Moved by Jianhan Liu, Seconded by Ron Porat.
4.1.45.2 Discussion: No discussion.
4.1.45.3 Result: Motion was accepted with no objection.

4.1.46 CR Motion #197 (PHY): Move to accept the resolutions to the following CIDs and the corresponding spec text modification as in 11-17/0333r2.
CIDs: 9025 and 9658.

4.1.46.1 Moved by Jianhan Liu, Seconded by Ron Porat.
4.1.46.2 Discussion: No discussion.
4.1.46.3 Result: Motion was accepted with no objection.

4.1.47 CR Motion #198 (PHY): Move to accept the resolutions to the following CIDs and the corresponding spec text modification as in 11-17/0332r2.
CIDs: 4995, 7234, 8894 and 8895.

4.1.47.1 Moved by Jianhan Liu, Seconded by Ron Porat.
4.1.47.2 Discussion: No discussion.
4.1.47.3 Result: Motion was accepted with no objection.

4.1.48 CR Motion #199 (PHY): Move to accept the resolutions to the following CIDs and the corresponding spec text modification as in 11-17/0299r2.
CIDs: 4918, 5264, 6117, 8935, 8936, 10062.

4.1.48.1 Moved by Dongguk Lim, Seconded by Ron Porat.
4.1.48.2 Discussion: No discussion.
4.1.48.3 Result: Motion was accepted with no objection.

4.1.49 CR Motion #200 (PHY): Move to accept the resolutions to the following CIDs and the corresponding spec text modification as in 11-17/0300r2.
CIDs: 5104, 8891, 8892, 8893, 9469.

4.1.49.1 Moved by Dongguk Lim, Seconded by Ron Porat.
4.1.49.2 Discussion: No discussion.
4.1.49.3 Result: Motion was accepted with no objection.

4.1.50 CR Motion #201 (PHY): Move to accept the resolutions to the following CIDs and the corresponding spec text modification as in 11-17/0331r2.
CIDs: 4884, 5279, 7687, 9012, 9071, 10056, 10057 and 10075.

4.1.50.1 Moved by Jianhan Liu, Seconded by Ron Porat.
4.1.50.2 Discussion: No discussion.
4.1.50.3 Result: Motion was accepted with no objection.

4.1.51 CR Motion #202 (PHY): Move to accept the resolutions to the following CIDs and the corresponding spec text modification as in 11-17/0320r2.
CIDs: 5300, 6837, 6838, 7221, 7514, 8859, 8862.

4.1.51.1 Moved by Eunsung Park, Seconded by Ron Porat.
4.1.51.2 Discussion: No discussion.
4.1.51.3 Result: Motion was accepted with no objection.

4.1.52 CR Motion #203 (PHY): Move to accept the resolutions to the following CIDs and the corresponding spec text modification as in 11-17/0321r3.
CIDs: 7048, 8969, 8970, 8971, 8974, 9749, 9750.

4.1.52.1 Moved by Eunsung Park, Seconded by Ron Porat.
4.1.52.2 Discussion: No discussion.
4.1.52.3 Result: Motion was accepted with no objection.

4.1.53 CR Motion #204 (PHY): Move to accept the resolutions to the following CIDs and the corresponding spec text modification as proposed in 11-17/0317r1.
CIDs: 5284, 10315, 8329, 8330, 9032, 7833, 9033, 8330, 4873, 5878, 7834, 10307, 5875, 5876, 5877, 9035, 9036, 10308, 10309, 10310, 5875, 5876, 5877, 9035, 9036, 10309, 10310.

4.1.53.1 Moved by Bin Tian, Seconded by Ron Porat.
4.1.53.2 Discussion: No discussion.
4.1.53.3 Result: Motion was accepted with no objection.

4.1.54 CR Motion #205 (PHY): Move to accept the resolutions to the following CIDs and the corresponding spec text modification as in 11-17/0305r2.
CIDs: 8880, 8881,5255, 8883, 8884, 7515, 8885, 8887, 4866,8888, 4867, 8889, 4868, 4994, 9484, 4990, 4993.

4.1.54.1 Moved by Yan Zhang, Seconded by Ron Porat.
4.1.54.2 Discussion: No discussion.
4.1.54.3 Result: Motion was accepted with no objection.

4.1.55 CR Motion #206 (PHY): Move to accept the resolutions to the following CIDs and the corresponding spec text modification as in 11-17/0261r2.
CIDs: 5784, 5785, 5953, 5954, 7442,6869, 6870, 6871, 3606, 3609,3359, 5282, 5281, 9028, 9027, 9090, 9078, 10125, 10314, 7678, 8575, 8581, 8582, 8583, 8578.

4.1.55.1 Moved by Lochan Verma, Seconded by Ron Porat.
4.1.55.2 Discussion: No discussion.
4.1.55.3 Result: Motion was accepted with no objection.

4.1.56 CR Motion #207 (PHY): Move to accept the resolutions to the following CIDs and the corresponding spec text modification as in 11-17/0329r4.
CIDs: 3251, 3252, 3393, 3395, 3502, 3504, 3834, 3836, 3924, 3926, 4461, 4464, 5041, 5042, 5275, 5276, 5277, 5278, 6197, 7430, 7431, 7432, 7434, 7435, 7437, 7438, 7439, 7440, 7441, 7516, 8565, 8997, 8998, 8999, 9000, 9001, 9002, 9004, 9005 and 9069.

4.1.56.1 Moved by Jianhan Liu, Seconded by Ron Porat.
4.1.56.2 Discussion: No discussion.
4.1.56.3 Result: Motion was accepted with no objection.

4.1.57 CR Motion #208 (PHY): Move to accept the resolutions to the following CIDs and the corresponding spec text modification as in 11-17/0301r4.
CIDs: 5287, 5288, 8842, 5289, 3317, 3397, 3666, 3756, 4016, 4140, 4242, 4253, 5095, 5290, 8843, 8844, 10205, 3318, 3399, 3669, 3758, 4145, 4246, 5096, 5291, 8845, 5097, 5293, 5294, 8846, 9162, 5098, 5099, 5100, 5295, 5296, 8847, 9163, and 6114.

4.1.57.1 Moved by Dongguk Lim, Seconded by Ron Porat.
4.1.57.2 Discussion: No discussion.
4.1.57.3 Result: Motion was accepted with no objection.

4.1.58 CR Motion #209 (PHY): Move to accept the resolutions to the following CIDs and the corresponding spec text modification as in 11-17/0231r2.
CIDs: 4000, 4236, 4897, 5254, 8161, 8838, 8841, 10202, and 10203.

4.1.58.1 Moved by Po-Kai Huang, Seconded by Ron Porat.
4.1.58.2 Discussion: No discussion.
4.1.58.3 Result: Motion was accepted with no objection.

4.1.59 CR Motion #210 (PHY): Move to accept the resolutions to the following CIDs and the corresponding spec text modification as in 11-17/0232r2.
CIDs: 5101, 5102, 5103, 5297, 5298, 5299, 7513, 8848, 8849, 8850, 8851, 8852, 8853, 8854, 8855, 8856, 8857, 8858, 8985, 9158, 9159, 9160, 9166, 9167, and 10114.

4.1.59.1 Moved by Xiaogang Chen, Seconded by Ron Porat.
4.1.59.2 Discussion: No discussion.
4.1.59.3 Result: Motion was accepted with no objection.

4.1.60 CR Motion #211 (MAC): Move to accept the resolutions to the CIDs as in 11-17/0283r6.
CIDs: 8114, 3018, 8190, and 9494.

4.1.60.1 Moved by Alfred Asterjadhi, Seconded by Yasu Inoue.
4.1.60.2 Discussion: No discussion.
4.1.60.3 Result: Motion was accepted with no objection.

4.1.61 CR Motion #212 (SR): Move to accept "Revised" as the resolution for CID 3222 with the proposed text in slide 10 of 11-17/0452r2.

4.1.61.1 Moved by Reza Hedayat, Seconded by Yasu Inoue.
4.1.61.2 Discussion: No discussion.
4.1.61.3 Result: Motion was accepted with no objection.

4.1.62 CR Motion #213 (MAC): Move to accept resolutions to CIDs; 5054, 5055, 5056, 5126, 5442, 7302, 7303, 7305, 7719, 7865, 7867, 8133, 8179, 8180, 8181, 8249, 9620, 9621, 9806 in doc 11-17/0239r2.

4.1.62.1 Moved by Alfred Asterjadhi, Seconded by .
4.1.62.2 Discussion: This is a duplicate of the previous motion.

4.1.63 CR Motion #214 (MAC): Move to accept resolutions to CIDs; 3384, 3491, 3822, 3907, 4371, 4439, 4740, 5445, 7020, 7473, 8185, 8375, 9809, 9810, 9811, 6965 in doc 11-17/0240r2.

4.1.63.1 Moved by Alfred Asterjadhi, Seconded by Yasu Inoue.
4.1.63.2 Discussion: No discussion.
4.1.63.3 Result: Motion was accepted with no objection.

4.1.64 CR Motion #215 (MAC): Move to accept resolutions to CIDs; 6537, 9282 (2 CIDs) in doc 11-17/0346r1.

4.1.64.1 Moved by Jeongki Kim, Seconded by Yasu Inoue.
4.1.64.2 Discussion: No discussion.
4.1.64.3 Result: Motion was accepted with no objection.

4.1.65 CR Motion #216 (MAC): Move to accept resolutions to CIDs; 3089, 6057, 7527, 9599, 9385 in doc 11-17/0344r1.

4.1.65.1 Moved by Jeongki Kim, Seconded by Yasu Inoue.
4.1.65.2 Discussion: No discussion.
4.1.65.3 Result: Motion was accepted with no objection.

4.1.66 CR Motion #217 (MAC): Move to accept resolutions to CIDs; 3091, 5216, 5506, 5938, 6055, 6782, 6783, 6784, 6785, 7602, 8241, 8242, 9602 in doc 11-17/0347r2.

4.1.66.1 Moved by Jeongki Kim, Seconded by Yasu Inoue.
4.1.66.2 Discussion: No discussion.
4.1.66.3 Result: Motion was accepted with no objection.

4.1.67 CR Motion #218 (MAC): Move to accept resolutions to CIDs; 3051, 3052, 3053, 3207, 3208, 3209, 3210, 3211, 3212, 7786, 7787, 9695, 9864 in doc 11-17/0384r2.

4.1.67.1 Moved by Reza Hedayat, Seconded by Yasu Inoue.
4.1.67.2 Discussion: No discussion.
4.1.67.3 Result: Motion was accepted with no objection.

4.1.68 CR Motion #219 (MAC): Move to accept resolutions to CIDs; 3018, 8190, 9494 in doc 11-17/283r5.

4.1.68.1 Moved by Raja Banerjea.
4.1.68.2 Discussion: This is duplicate of the previous motion.

4.1.69 CR Motion #220 (MU): Move to accept resolutions to CIDs; 5397, 5712 in doc 11-17/0448r4.

4.1.69.1 Moved by Jing Ma, Seconded by Yasu Inoue.
4.1.69.2 Discussion: No discussion.
4.1.69.3 Result: Motion was accepted with no objection.

4.1.70 CR Motion #221 (MAC): Move to accept resolutions to CIDs; 5403, 6184, 7044 in doc 11-17/0306r4.

4.1.70.1 Moved by George Cherian, Seconded by Yasu Inoue.
4.1.70.2 Discussion: No discussion.
4.1.70.3 Result: Motion was accepted with no objection.

4.1.71 CR Motion #222 (MU): Move to accept resolutions to CIDs; 7103, 7106, 7412, 8152, 8221, 9103, 9533 in doc 11-17/0443r2.

4.1.71.1 Moved by Suhwook Kim, Seconded by Yasu Inoue.
4.1.71.2 Discussion: No discussion.
4.1.71.3 Result: Motion was accepted with no objection.

4.1.72 CR Motion #223 (MAC): Move to accept resolutions to CIDs; 4782, 5975, 5976, 7161, 7789, 8267, 9698, 7661, 6567 in doc 11-17/0421r1.

4.1.72.1 Moved by Chao-Chun Wang, Seconded by Yasu Inoue.
4.1.72.2 Discussion: No discussion.
4.1.72.3 Result: Motion was accepted with no objection.

4.1.73 CR Motion #224 (MAC): Move to accept resolutions to CIDs; 6189, 7040, 9412 in doc 11-17/0088r2.

4.1.73.1 Moved by Woojin Ahn, Seconded by Yasu Inoue.
4.1.73.2 Discussion: A member expressed a concern on this motion and asked for deferral of this motion.
4.1.73.3 Result: Motion was deferred.

4.1.74 CR Motion #225 (MU): Move to accept resolution to CID 8142 in doc 11-17/0335r0.

4.1.74.1 Moved by Rojan Chitrakar, Seconded by Yasu Inoue.
4.1.74.2 Discussion: No discussion.
4.1.74.3 Result: Motion was accepted with no objection.

4.1.75 CR Motion #226 (PHY): Move to accept resolutions to CIDs; 6569, 7790, 7791, 8690, 8691, 10192, 9683 (MAC) in doc 11-17/0271r4.

4.1.75.1 Moved by Po-Kai Huang, Seconded by Yasu Inoue.
4.1.75.2 Discussion: No discussion.
4.1.75.3 Result: Motion was accepted with no objection.

4.1.76 CR Motion #227 (MU): Move to accept resolutions to CIDs; 3142, 5992, 4830, 7650, 8061, 9712, 9912, 9913, 9914, 10271, 10272, 9297, 10011, 4831, 7575, 10014, 3012 (MAC) in doc 11-17/0302r2.

4.1.76.1 Moved by Po-Kai Huang, Seconded by Yasu Inoue.
4.1.76.2 Discussion: No discussion.
4.1.76.3 Result: Motion was accepted with no objection.

4.1.77 CR Motion #228 (MU): Move to accept resolutions to CIDs; 3235, 4829, 9339, 9911, 10013, 10172, 10270 in doc 11-17/0338r1.

4.1.77.1 Moved by Rojan Chitrakar, Seconded by Yasu Inoue.
4.1.77.2 Discussion: No discussion.
4.1.77.3 Result: Motion was accepted with no objection.

4.1.78 CR Motion #229 (MU): Move to accept resolutions to CIDs; 3231, 6690, 6691, 6692, 9637 in doc 11-17/0349r1.

4.1.78.1 Moved by Kiseon Ryu, Seconded by Yasu Inoue.
4.1.78.2 Discussion: No discussion.
4.1.78.3 Result: Motion was accepted with no objection.

4.1.79 CR Motion #230 (MU): Move to accept resolutions to CIDs; 4806, 4807, 5725, 5726, 5727, 6009, 6145, 6146, 6147, 6148, 6155, 6721, 6722, 8560, 9535, 9716, 9717, 9921, 9922 in doc 11-17/0403r1.

4.1.79.1 Moved by David Xun Yang, Seconded by Yasu Inoue.
4.1.79.2 Discussion: No discussion.
4.1.79.3 Result: Motion was accepted with no objection.

4.1.80 CR Motion #231 (PHY): Move to accept resolution to CID 7517 in doc 11-17/0436r0.

4.1.80.1 Moved by Bo Sun, Seconded by Ron Porat.
4.1.80.2 Discussion: No discussion.
4.1.80.3 Result: Motion was accepted with no objection.

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5 Recess @ 15:28 until 16:00.

Thursday, March 16th, 2017, PM2 TGax full Session (16:00-18:00)

6 The meeting called to order by Osama Aboul-Magd (Huawei Technologies), the chairperson of the TGax, @16:00.

6.1 Agenda 17/0199r5 is on the server. Rev. 6 is the working document.

7 Agenda for today has been approved during the PM1 session.

8 Announcement/Reminder

8.1 Chair reminded IEEE 802 and 802.11 IPR P&P.
8.2 Chair asked people to state name and affiliation when addressing for the first time in the session.
8.3 Chair reminded people to do attendance.

9 Continue with Motions – TG documents

9.1 CR Motions

9.1.1 CR Motion #232 (PHY): Move to accept resolutions to CIDs; 9549, 10204 in doc 11-17/0231r2.

9.1.1.1 Moved by Robert Stacy, Seconded by Ron Porat.
9.1.1.2 Discussion: No discussion.
9.1.1.3 Result: Motion was accepted with no objection.

9.1.2 CR Motion #233 (PHY): Move to accept resolution to CID 7547 in doc 11-17/0471r1.

9.1.2.1 Moved by Xiaogang Chen, Seconded by Ron Porat.
9.1.2.2 Discussion: A member asked for deferral. Another member objected.
9.1.2.3 Result: Y/N/A = 28/5/12, motion passes.

9.1.3 CR Motion #234 (PHY): Move to accept resolutions to CIDs; 5381, 5383, 5783, 6880, 6881, 6883, 6884, 6886, 6887, 6889, 6890, 6891, 9041, 9042, 9043, 9044, 9045, 9046, 9047, 9049, 9051, 9089, 9609, 9610, 9733, 10134, 10135, 10228, 10231, 10232 in doc 11-17/0234r3.

9.1.3.1 Moved by Robert Stacy, Seconded by Ron Porat.
9.1.3.2 Discussion: No discussion.
9.1.3.3 Result: Motion was accepted with no objection.

9.1.4 CR Motion #235 (PHY): Move to accept resolution to CID 8136 in doc 11-17/0247r3.

9.1.4.1 Moved by Lochan Verma, Seconded by Ron Porat.
9.1.4.2 Discussion: No discussion.
9.1.4.3 Result: Motion was accepted with no objection.

9.1.5 CR Motion #236 (PHY): Move to accept resolution to CID 8839 in doc 11-17/0261r2.

9.1.5.1 Moved by Lochan Verma, Seconded by Ron Porat.
9.1.5.2 Discussion: No discussion.
9.1.5.3 Result: Motion was accepted with no objection.

9.1.6 CR Motion #237 (PHY): Move to accept resolutions to CIDs; 8897, 8898, 9064, 4870, 4907, 5256, 5265, 9487, 10405, 8899, 5105, 8900, 5257, 8901, 10403, 8902, 10401, 10402, 5258, 4898, 4915, 8927, 8928, 8933, 8934, 10214, 5106, 8929, 8930, 8931, 5263, 6116, 8932, 10215, 8944, 8945, 8946, 8947, 5270, 8169, 8948, 8949 in doc 11-17/0398r1.

9.1.6.1 Moved by Hongyuan Zhang, Seconded by Bin Tian.
9.1.6.2 Discussion: No discussion.
9.1.6.3 Result: Motion was accepted with no objection.

9.1.7 CR Motion #238 (PHY): Move to accept resolutions to CIDs; 8809, 9154, 8360, 8813, 9795, 8614, 7506, 9796, 7508, 8615, 9799, 9800, 8798, 9766, 8799, 8800, 8801, 8802, 8803, 8804, 8805, 5250, 8807, 10089, 9797, 9798, 4973, 10090, 9151, 10091, 10092, 9152, 6826, 6827, 8812, 9767, 9768, 6828, 6829, 6830 in doc 11-17/0400r3.

9.1.7.1 Moved by Sungeun Lee, Seconded by Ron Porat.
9.1.7.2 Discussion: No discussion.
9.1.7.3 Result: Motion was accepted with no objection.

9.1.8 CR Motion #239 (PHY): Move to accept resolutions to CIDs; 8774, 9142, 9143 in doc 11-17/0345r2.

9.1.8.1 Moved by Suhwook Kim, Seconded by Ron Porat.
9.1.8.2 Discussion: No discussion.
9.1.8.3 Result: Motion was accepted with no objection.

9.1.9 CR Motion #240 (PHY): Move to accept resolutions to CIDs; 10360, 8840 in doc 11-17/0404r1.

9.1.9.1 Moved by Ross Jian Yu, Seconded by Ron Porat.
9.1.9.2 Discussion: No discussion.
9.1.9.3 Result: Motion was accepted with no objection.

9.1.10 CR Motion #241 (PHY): Move to accept resolutions to CIDs; 8863, 4983, 8864, 8865, 8866, 8867, 8868, 8869, 8870, 8871, 8872, 8874, 9550, 10036, 4985, 4989, 8875, 8877, 8878, 8879, 10037, 10209, 4986, 4987, 7500, 7501,9321, 10234, 7244, 7245, 7246, 7502 in doc 11-17/0316r4.

9.1.10.1 Moved by Bin Tian, Seconded by Ron Porat.
9.1.10.2 Discussion: No discussion.
9.1.10.3 Result: Motion was accepted with no objection.

9.1.11 CR Motion #242 (PHY): Move to accept resolution to CID 3441 in doc 11-17/0465r5.

9.1.11.1 Moved by Bin Tian, Seconded by Ron Porat.
9.1.11.2 Discussion: No discussion.
9.1.11.3 Result: Motion was accepted with no objection.

9.1.12 CR Motion #243 (PHY): Move to accept resolutions to CIDs; 4347, 4883, 5304, 5379, 9074, 9014, 9073, 9011, 9010, 9009, 9008, 9007, 9006, 8991, 10224, 10055, 9754 in doc 11-17/0414r1.

9.1.12.1 Moved by Bo Sun, Seconded by Ron Porat.
9.1.12.2 Discussion: No discussion.
9.1.12.3 Result: Motion was accepted with no objection.

9.1.13 CR Motion #244 (SR): Move to accept resolutions to CIDs; 3198, 3199, 3200, 5204, 5205, 5207, 5208, 5484, 5489, 5494, 5496, 5497, 5499, 5500, 5502, 5503, 5690, 5691, 5870, 7122, 7123, 7129, 7406, 7612, 8073, 8104, 8232, 8239, 9315,9540, 9944, 9946, 9947, 10031, 10032, 7125, 3197, 5689, 9541, 3196, 6025, 7823, 8233 in doc 11-17/0267r5.

9.1.13.1 Moved by Laurent Cariou, Seconded by Alfred Asterjadhi.
9.1.13.2 Discussion: A member asked for a deferral of this motion since the power restriction is not clear.
Another member objects.
9.1.13.3 Result: Y/N/A = 23/9/24, motion failed.

9.1.14 CR Motion #245: Move to accept resolutions to CIDs; 3056, 3189, 3190, 5167, 5168, 5394, 5454, 5456, 5686, 5779, 5799, 6058, 6051,6152,6176, 6574,6575,6576,6579,6580,6581,6582,6583,7022,7071,7232,7659,8358,8693,9380,9585,9727,~~9739~~, 9747,9872,10007,10171,10241,10242,10243,10244,~~10319~~ in doc 11-17/389r3.

9.1.14.1 Moved by Kaiying Lv.
9.1.14.2 Discussion: Kaiying asked for deferral of this motion.
9.1.14.3 Result: This motion was deferred.

9.1.15 CR Motion #246: Move to accept resolutions to CIDs; 5402, 6183, 5403, 6184, 7044 in doc 11-17/0445r1.

9.1.15.1 Moved by Geonjung Ko.
9.1.15.2 Discussion: Those CIDs are covered by another motion.
9.1.15.3 Result: This motion was not conducted.

9.1.16 CR Motion #247: Move to accept resolutions to CIDs; 3241, 3350, 3454, 3762, 3848, 4284, 4753, 5404, 5571, 6967, 6968, 6969, 6970, 6971, 6972, 6973 in doc 11-17/0341r2.

9.1.16.1 Moved by Hongyuan Zhang, Seconded by Yasu Inoue.
9.1.16.2 Discussion: No discussion.
9.1.16.3 Result: Motion was accepted with no objection.

9.1.17 CR Motion #248: Move to accept resolutions to CIDs; 5036, 7254, 7546, 8140, 8520, 8157, 9332, 9119, 9120 in doc 11-17/0395r8.

9.1.17.1 Moved by Ming Gan, Seconded by Chittabrata Ghosh.
9.1.17.2 Discussion: No discussion.
9.1.17.3 Result: Motion was accepted with no objection.

9.1.18 CR Motion #249 (SR): Move to accept resolutions to CIDs;
6178, 5043, 5873, 5940, 7117, 7174, 5385, 9508, 10040, 10039, 10080, 8094
5941, 7611, 5485, 5504, 8069, 8234, 7908, 8118
6760, 6020, 7116, 3195, 5482, 5680, 10194, 9760, 8068, 8231, 9730

8087, 8091, 8092,

6115, 6127, 6143, 6142, 6842, 5872, 5871, 6845, 5942, 6843, 6844, 3600, 4997, 5259, 5260, 5261, 9462, 9180, 9181, 9183, 9208, 9209, 9210, 10043, 10041, 10415, 10414, 10413, 10412, 10409, 10407, 10406, 10306, 10305, 8568, 8920, 8907, 8908, 8914, 8909

by adopting the proposed resolutions in 11-16-1476r21.

9.1.18.1 Moved by Matthew Fischer, Seconded by Sean Coffey.
9.1.18.2 A member requested vote count.
9.1.18.3 Result: Y/N/A = 31/4/21, motion passes.

9.1.19 CR Motion #250: Move to accept resolution to CID; 6768 by adopting the proposed resolutions in 11-17-0500r0.

9.1.19.1 Moved by Sean Coffey, Seconded by George Cherian.
9.1.19.2 A member requested vote count.
9.1.19.3 Result: Y/N/A = 33/4/17, motion passes.

9.2 TG Motions
9.2.1 A member mentioned 17/292r2 (Re: CR Motion #210) is a wrong document.
9.2.2 WG vice chair suggested motion to reconsider CR Motion #210.

9.2.3 Motion to reconsider CR Motion #210
9.2.3.1 Moved by Jon Rosdahl, Seconded by Al Petrick.
9.2.3.2 Result: Motion to reconsider CR Motion #210 passes with no objection.
9.2.3.3 Back to the CR Motion #210.

9.2.4 CR Motion #210: Move to accept resolutions to the following CIDs and the corresponding spec text modification as in 11-17/0232r3.
CIDs: 5101, 5102, 5103, 5297, 5298, 5299, 7513, 8848, 8849, 8850, 8851, 8852, 8853, 8854, 8855, 8856, 8857, 8858, 8985, 9158, 9159, 9160, 9166, 9167, and 10114.

9.2.4.1 Moved by Jon Rosdahl, Seconded by Al Petrick.
9.2.4.2 Discussion:

9.2.4.3 Motion to table this motion
9.2.4.3.1 Moved by Jon Rosdahl, Seconded by Al Petrick.
9.2.4.3.2 Discussion:
9.2.4.3.2.1 Q: Table to when? → Conference call.
9.2.4.3.3 Result: Motion to table passes with no objection.

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10 Timeline update

10.1 Proposed modification to the current timeline.

10.1.1 May 2014: start of the TG

10.1.2 Nov. 2014: First draft of the TG SFD was approved

10.1.3 Jan. 2016: proposed TG draft

10.1.4 March 2016: Draft D0.1 was approved and CC started

10.1.5 November 2016: Draft 1.0 and WG letter ballot

10.1.6 September 2017: Draft 2.0 and recirculation

10.1.7 May 2018: MDR (Mandatory Document Review)

10.1.8 May 2018: Formation of SB pool

10.1.9 November 2018: Sponsor Ballot

10.1.10 July 2019: RevCom

11 Goals for the May 2017

11.1 Continue with the comment resolution and development of the TG draft.

12 Ad Hoc Meeting

12.1 After some discussions, PHY ad hoc decided to have a 1-day ad hoc meeting on Friday.

12.2 Motion: Authorize TGax to hold an ad-hoc meeting on May 3-5 in Seoul, Korea, for the purpose of working on comment resolution.

12.2.1 Moved by Hongyuan Zhang, Seconded by Bo Sun.

12.2.2 Result: Y/N/A = 20/2/9, motion passes.

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13 Conference Calls

13.1 Already approved.

13.1.1 Thursday, March 30th, 2017: 10:00-12:00 (ET)

13.1.2 Thursday, March 23rd, April 6th, 2017: 20:00-22:00 (ET)

13.2 New calls:

13.2.1 Thursday, April 13th, 27th, May 25th, 2017: 10:00 – 12:00 (ET)

13.2.2 Thursday, April 20th, May 18th, 2017: 20:00 – 22:00 (ET)

13.3 Chair asked if there is any objection to this plan. → No objection.

13.4 The above plan will be approved during the WG closing plenary tomorrow.

14 Motion from the floor

14.1 A member proposed a motion to adjourn.

14.2 Move to adjourn TGax Meeting for the week.

14.2.1 Moved by Bin Tian, Seconded by David Xun Yang.

14.2.2 Result: Y/N/A = 47/3/1, motion passes.

15 Adjournment

15.1 TGax adjourned for the week @ 16:42.

Appendix BJ

[STDS-802-11-TGAX] Draft 1.0

- *To*: STDS-802-11-TGAX@xxxxxxxxxxxxxxxx
- *Subject*: [STDS-802-11-TGAX] Draft 1.0
- *From*: Osama AboulMagd <Osama.AboulMagd@xxxxxxxxxx>
- *Date*: Thu, 1 Dec 2016 18:41:48 +0000

Hello All,

Draft D1.0 is available in the member area. The WG Chair will announce the start of the 30-day WG letter ballot shortly.

Regards;

Osama.

_____

If you wish to be removed from this reflector, do not send your request to this reflector - it will have no effect.

Instead, go to http://listserv.ieee.org/cgi-bin/wa?SUBED1=STDS-802-11-TGAX and then press the LEAVE button.

Further information can be found at: http://www.ieee802.org/11/Email_Subscribe.html

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- Prev by Date: **[STDS-802-11-TGAX] TGax Telecon 20161208 is Cancelled**
- Next by Date: **[STDS-802-11-TGAX] TGax Telecon on Dec. 1st Cancelled**
- Previous by thread: **[STDS-802-11-TGAX] TGax Telecon on Dec. 1st Cancelled**
- Next by thread: **[STDS-802-11-TGAX] TGax Telecon 20161208 is Cancelled**
- Index(es):
  - **Date**
  - **Thread**

Appendix BK

[STDS-802-11] IEEE 802.11 Mandatory Technical Letter Ballot 225 for P802.11ax Draft 1.0 Starts Today

- *To*: STDS-802-11@xxxxxxxxxxxxxxxxx
- *Subject*: [STDS-802-11] IEEE 802.11 Mandatory Technical Letter Ballot 225 for P802.11ax Draft 1.0 Starts Today
- *From*: Adrian Stephens <adrian.p.stephens@xxxxxxxx>
- *Date*: Thu, 1 Dec 2016 19:16:52 +0000

--- This message came from the IEEE 802.11 Working Group Reflector ---

IEEE 802.11(TM) Letter Ballot 225

To: IEEE 802.11 Voters,

With this email, the 802.11 Working Group is officially beginning WG Technical Letter Ballot 225 (LB225), which is a Letter Ballot on the question "Should P802.11ax D1.0 be forwarded to Sponsor Ballot?".

This Letter Ballot opens Thu Dec 01, 2016 at 23:59 Eastern Time USA (11:59PM) and will close 30 days later on Sat Dec 31, 2016 at 23:59 Eastern Time USA (11:59pm). All necessary documents are available in the instructions that can be found on the IEEE 802.11 web site at
http://www.ieee802.org/11/LetterBallots/LB225ax/LB225_instructions.html.

Important:
o This is a 30-day Technical letter ballot and the ballot group (i.e., those that may vote) for this ballot is all IEEE 802.11 voter members as of the start of this letter ballot. o All current voter members of 802.11 are required to vote on this ballot series. o If you cast a "Do not approve" vote on this ballot, it must be accompanied by comments for your vote to be valid. o You must follow these instructions to vote. Do not send an email to vote. Voting by any method other than the web-based process described here will invalidate your vote. o Failure to follow these instructions will result in your vote being discarded as an invalid vote. o Not voting on a letter ballot series or sending an invalid vote can affect your voting privileges. o The draft is password protected in accordance with IEEE 802 Policies and Procedures. To obtain the draft, use the username and the password supplied to active members for the 802.11 WG private area.

(The attached file contains a reminder set for 4 days before the close of the ballot. You may find it helpful to import this into or open this with your calendar client in order to get an automated reminder.)

Thank you for participating in Letter Ballot 225.

Adrian Stephens, IEEE 802.11   Working Group Chair
E-mail: Adrian.P.Stephens@xxxxxxxx

Osama Aboul-Magd, IEEE 802.11 TGax Chair
E-mail: Osama.AboulMagd@xxxxxxxxxx

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If you wish to be removed from this reflector, do not send your request to this reflector - it will have no effect.

Instead, go to http://listserv.ieee.org/cgi-bin/wa?SUBED1=STDS-802-11 and then press the LEAVE button.

If there is no LEAVE button here, try http://listserv.ieee.org/cgi-bin/wa?SUBED1=STDS-802-11-RO.

Further information can be found at: http://www.ieee802.org/11/Email_Subscribe.html

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BEGIN:VCALENDAR
VERSION:2.0
METHOD:PUBLISH

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BEGIN:VEVENT
DTSTART:20161227T000000Z
DTEND:20161227T235959Z
LOCATION:http://www.ieee802.org/11/LetterBallots/LB225ax/LB225_instructions.html
TRANSP:TRANSPARENT
SEQUENCE:0
UID:225@802.11
DTSTAMP:20161201
SUMMARY;ENCODING=QUOTED-PRINTABLE:Reminder - IEEE 802.11 LB225 for TGax finishes on Sat Dec 31, 2016
CLASS:PUBLIC
BEGIN:VALARM
TRIGGER:-PT0M
ACTION:DISPLAY
DESCRIPTION:Reminder
END:VALARM
END:VEVENT
END:VCALENDAR
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- **Follow-Ups**:
  - **Re: [STDS-802-11] IEEE 802.11 Mandatory Technical Letter Ballot 225 for P802.11ax Draft 1.0 Starts Today**
    - *From:* Sigurd Schelstraete
  - **Re: [STDS-802-11] IEEE 802.11 Mandatory Technical Letter Ballot 225 for P802.11ax Draft 1.0 Starts Today**
    - *From:* Adrian Stephens

- Prev by Date: **Re: [STDS-802-11] IEEE 802.11 Mandatory Technical Letter Ballot 225 for P802.11ax Draft 1.0 Starts Today**
- Next by Date: **[STDS-802-11] TGax special measures declaration doc**
- Previous by thread: **[STDS-802-11] TGax special measures declaration doc**
- Next by thread: **Re: [STDS-802-11] IEEE 802.11 Mandatory Technical Letter Ballot 225 for P802.11ax Draft 1.0 Starts Today**
- Index(es):
  - **Date**
  - **Thread**

Appendix BL

IEEE 802.11™ TGax Technical Letter Ballot 225 Instructions

Motion: " Should P802.11ax D1.0 be forwarded to Sponsor Ballot? "

(Type of Motion: Technical)

Cast your vote here

This Letter Ballot opens on: Thu Dec 01, 2016 at 23:59 Eastern Time USA and closes 38 days later on Sun Jan 08, 2017 at 23:59 Eastern Time USA. (Add reminder to calendar).

Show detailed instructions Show detailed description of how to provide comments

The draft and the supporting documentation:

Document	Hyperlink
Draft	Draft P802.11ax_D1.0.pdf
Redlined Doc	n/a
Resolution Doc	n/a
Comment Template	.xls format or .csv format NOTE - you must be already signed into Mentor for these links to work.
Ballot Group	LB225 Voters
CA Document	11-16-1348-02-00ax-coexistence-assurance.docx
CSD Document	11-14-0169-01-0hew-ieee-802-11-hew-sg-proposed-csd.docx

Notes

- This is a 38-day Technical letter ballot and the ballot group (i.e., those that may vote) for this ballot is all IEEE 802.11 voters as of the start of this letter ballot.
  All current voter members of 802.11 are required to vote on this letter ballot series, even if they are subject to TGax "special measures".
- If you cast a "Do not approve" vote on this ballot, it must be accompanied by "must be satisfied = yes" comments for your vote to be valid.
- You must follow these instructions to vote. Do not send an email to vote. Voting by any method other than the web-based process described here will invalidate your vote. Failure to follow these instructions will result in your vote being discarded as an invalid vote. Not voting on letter ballots or sending an invalid vote can affect your voting privileges.
- The draft is password protected in accordance with IEEE 802 Policies and Procedures. To obtain the draft, use the username and the password supplied to active members for the 802.11 WG private area.
- You need an IEEE-SA web account to vote. Instructions for getting an account, changing the registered email address and affiliation are here. If you get a new IEEE-SA web account, you will need to record an interest in C/LM/WG802.11, and let the WG chair know your new SA pin before you can vote using this account.

Adrian Stephens

IEEE 802.11 Working Group Chair
E-mail: adrian.p.stephens@ieee.org

Osama Aboul-Magd
IEEE 802.11 TGax Chair
E-mail: Osama.AboulMagd@huawei.com

Thu Dec 01, 2016 - Updated 2016-12-09

Appendix BM

The Wayback Machine - https://web.archive.org/web/20170521192427/http://www.ieee802.org:80/11/LetterBallots.shtml

IEEE 802.11, The Working Group for Wireless LANs Standards

This page is maintained by Adrian Stephens . Comments are welcome.

IEEE 802.11 WG LETTER BALLOTS

Note - percentage results are rounded to the nearest integer

Note - Links to documents in the voting members' private area (such as drafts) will stop functioning once the project is complete, e.g., whe its output document has been published by the IEEE-SA.

ONGOING BALLOTS/COMMENT COLLECTIONS

CC	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
25	TGmd	Comments TGmd Draft 0.1	CC25	Draft	Draft P802.11REVmd_D0.1.pdf	Wed May 10, 2017	Wed Jun 14, 2017	35	Ballot Group	N/A
				Redlined Doc	n/a				Approve	n/a
				Resolution Doc	n/a				Abstain	n/a
				Comments Templates	.xls format .csv format NOTE - you must be already signed into Mentor for these links to work.				Return%	n/a
				Ballot Group	n/a				Approve%	n/a
				CA Document	n/a					
				CSD Document	n/a					
26	LC_TIG	Comments LC_TIG Draft 8	CC26	Draft	11-17/23r08	Wed May 17, 2017	Fri Jun 09, 2017	23	Ballot Group	N/A
				Redlined Doc	n/a				Approve	n/a
				Resolution Doc	n/a				Abstain	n/a
				Comments Templates	.xls format .csv format NOTE - you must be already signed into Mentor for these links to work.				Return%	n/a
				Ballot Group	n/a				Approve%	n/a
				CA Document	n/a					
				CSD Document	n/a					

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
229	TGak	Recirculation TGak Draft 4.00	LB# 229	Draft	Draft P802.11ak_D4.0.pdf	2017-03-15	2017-03-30	15	Pool	359
									Approve	202
				Redlined Doc	Draft P802.11ak_D4.0 Redline.pdf				Disapprove	10
				Resolution Doc	11-17-0025-09-00ak-11ak-wg-lb-comments.xlsx				Abstain	41
				Comment	Template				Return%	70
				Pool	LB# 229 Voters				Approve%	95
228	TGaj	Recirculation TGaj Draft 5.00	LB# 228	Draft	Draft P802.11aj_D5.0.pdf	2017-02-17	2017-03-04	15	Pool	377
									Approve	247
				Redlined Doc	Draft P802.11aj_D5.0 Redline.pdf				Disapprove	14
				Resolution Doc	11-16-1639-02-00aj-lb226-comments-database.xlsx				Abstain	51
				Comment	Template				Return%	83
				Pool	LB# 228 Voters				Approve%	95
227	TGak	Recirculation TGak Draft 3.00	LB# 227	Draft	Draft P802.11ak_D3.0.pdf	2016-12-21	2017-01-10	20	Pool	359
									Approve	198
				Redlined Doc	Draft P802.11ak_D3.0 Redline.pdf				Disapprove	12
				Resolution Doc	11-15-0556-34-00ak-lb212-working-group-ballot-comments.xlsx				Abstain	43
				Comment	Template				Return%	70
				Pool	LB# 227 Voters				Approve%	94
226	TGaj	Recirculation TGaj Draft 4.00	LB# 226	Draft	Draft P802.11aj_D4.0.pdf	2016-12-06	2016-12-21	15	Pool	377
									Approve	234
				Redlined Doc	Draft P802.11aj_D4.0 Redline.pdf				Disapprove	21
				Resolution Doc	11-16-1129-02-00aj-lb223-comments-database.xlsx				Abstain	55
				Comment	Template				Return%	82
				Pool	LB# 226 Voters				Approve%	92
225	TGax	Technical TGax Draft 1.00	LB# 225	Draft	Draft P802.11ax_D1.0.pdf	2016-12-01	2017-01-08	38	Pool	371
									Approve	145
				Redlined Doc	N/A				Disapprove	106
				Resolution Doc	N/A				Abstain	25
									Return%	74

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
				Comment	Template				Approve%	58
				Pool	LB# 225 Voters					
224	TGaq	Recirculation TGaq Draft 7.00	LB# 224	Draft	Draft P802.11aq_D7.0.pdf	2016-09-10	2016-09-25	15	Pool	357
									Approve	226
				Redlined Doc	Draft P802.11aq_D7.0 Redline.pdf				Disapprove	7
				Resolution Doc	11-16-1108-03-00aq-lb222-wg-comments-for-11aq-draft-6-0.xlsx				Abstain	47
									Return%	78
				Comment	Template				Approve%	97
				Pool	LB# 224 Voters					
223	TGaj	Recirculation TGaj Draft 3.00	LB# 223	Draft	Draft P802.11aj_D3.0.pdf	2016-08-15	2016-08-30	15	Pool	377
									Approve	221
				Redlined Doc	Draft P802.11aj_D3.0 Redline.pdf				Disapprove	27
				Resolution Doc	11-16-0811-02-00aj-lb220-comments-database.xlsx				Abstain	57
									Return%	81
				Comment	Template				Approve%	89
				Pool	LB# 223 Voters					
222	TGaq	Recirculation TGaq Draft 6.00	LB# 222	Draft	Draft P802.11aq_D6.0.pdf	2016-08-04	2016-08-19	15	Pool	357
									Approve	223
				Redlined Doc	Draft P802.11aq_D6.0 Redline.pdf				Disapprove	10
				Resolution Doc	11-16-0982-04-00aq-lb221-wg-comments-for-11aq-draft-5-0.xlsx				Abstain	47
									Return%	78
				Comment	Template				Approve%	96
				Pool	LB# 222 Voters					
221	TGaq	Recirculation TGaq Draft 5.00	LB# 221	Draft	Draft P802.11aq_D5.0.pdf	2016-07-04	2016-07-19	15	Pool	357
									Approve	218
				Redlined Doc	Draft P802.11aq_D5.0 Redline.pdf				Disapprove	16
				Resolution Doc	11-16-0553-04-00aq-lb219-wg-comments-for-11aq-draft-4-0.xlsx				Abstain	46
									Return%	78
				Comment	Template				Approve%	93
				Pool	LB# 221 Voters					
220	TGaj	Recirculation TGaj Draft 2.00	LB# 220	Draft	Draft P802.11aj_D2.0.pdf	2016-06-15	2016-06-30	15	Pool	377
									Approve	218
				Redlined Doc	Draft P802.11aj_D2.0 Redline.pdf				Disapprove	28
				Resolution Doc	11-16-0193-04-00aj-lb217-comments-database.xlsx				Abstain	53
									Return%	79
				Comment	Template				Approve%	89
				Pool	LB# 220 Voters					
219	TGaq	Recirculation TGaq Draft 4.00	LB# 219	Draft	Draft P802.11aq_D4.0.pdf	2016-04-06	2016-04-21	15	Pool	357
									Approve	213
				Redlined Doc	Draft P802.11aq_D4.0 Redline.pdf				Disapprove	17
				Resolution Doc	11-15-1377-17-00aq-lb216-wg-ballot-comments-for-11aq-draft-3-0.xlsx				Abstain	45
									Return%	77
				Comment	Template				Approve%	93
				Pool	LB# 219 Voters					
218	TGak	Recirculation TGak Draft 2.00	LB# 218	Draft	Draft P802.11ak_D2.0.pdf	2016-02-24	2016-03-10	15	Pool	361
									Approve	174
				Redlined Doc	Draft P802.11ak_D2.0 Redline.pdf				Disapprove	17
				Resolution Doc	11-15-0556-19-00ak-lb212-working-group-ballot-comments.xlsx				Abstain	33
									Return%	62
				Comment	Template				Approve%	91
				Pool	LB# 218 Voters					
217	TGaj	Technical TGaj Draft 1.00	LB# 217	Draft	Draft P802.11aj_D1.0.pdf	2015-12-21	2016-01-20	30	Pool	368
									Approve	221
				Redlined Doc	N/A				Disapprove	30
				Resolution Doc	N/A				Abstain	31
									Return%	77
				Comment	Template				Approve%	88
				Pool	LB# 217 Voters					
216	TGaq	Technical TGaq Draft 3.00	LB# 216	Draft	Draft P802.11aq_D3.0.pdf	2015-10-08	2015-11-07	30	Pool	358
									Approve	202
				Redlined Doc	N/A				Disapprove	16
				Resolution Doc	N/A				Abstain	39
									Return%	72
				Comment	Template				Approve%	93
				Pool	LB# 216 Voters					
215	TGah	Recirculation TGah Draft 5.00	LB# 215	Draft	Draft P802.11ah_D5.0.pdf	2015-09-18	2015-10-03	15	Pool	330
									Approve	262
				Redlined Doc	N/A				Disapprove	6
				Resolution Doc	11-15-0525-02-00ah-tgah-lb211-comments-on-d5-0.xlsx				Abstain	15
									Return%	86
				Comment	Template				Approve%	98
				Pool	LB# 215 Voters					
214	TGai	Recirculation TGai Draft 6.00	LB# 214	Draft	Draft P802.11ai_D6.0.pdf	2015-07-16	2015-07-31	15	Pool	336
									Approve	252
				Redlined Doc	Draft P802.11ai_D6.0 Redline.pdf				Disapprove	7
				Resolution Doc	11-15-0772-08-00ai-lb213comments-for-draft-5-0.xlsx				Abstain	21
									Return%	83

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
				Comment	Template				Approve%	97
				Pool	LB# 214 Voters					
213	TGai	Recirculation TGai Draft 5.00	LB# 213	Draft	Draft P802.11ai_D5.0.pdf	2015-06-11	2015-06-26	15	Pool	336
									Approve	238
				Redlined Doc	Draft P802.11ai_D5.0 Redline.pdf				Disapprove	20
				Resolution Doc	11-15-0281-20-00ai-tbai-lb209-comments-on-draft-d4-0.xlsx				Abstain	21
									Return%	83
				Comment	Template				Approve%	92
				Pool	LB# 213 Voters					
212	TGak	Technical TGak Draft 1.00	LB# 212	Draft	Draft P802.11ak_D1.0.pdf	2015-04-06	2015-05-06	30	Pool	361
									Approve	134
				Redlined Doc	N/A				Disapprove	24
				Resolution Doc	N/A				Abstain	27
									Return%	51
				Comment	Template				Approve%	85
				Pool	LB# 212 Voters					
211	TGah	Recirculation TGah Draft 5.00	LB# 211	Draft	Draft P802.11ah_D5.0.pdf	2015-04-01	2015-04-16	15	Pool	330
									Approve	248
				Redlined Doc	Draft P802.11ah_D5.0 Redline.pdf				Disapprove	19
				Resolution Doc	11-15-0261-07-00ah-tgah-lb207-comments-on-d4-0.xlsx				Abstain	16
									Return%	86
				Comment	Template				Approve%	93
				Pool	LB# 211 Voters					
210	TGmc	Recirculation TGmc Draft 4.00	LB# 210	Draft	Draft P802.11REVmc_D4.0.pdf	2015-03-11	2015-03-26	15	Pool	325
									Approve	241
				Redlined Doc	N/A				Disapprove	10
				Resolution Doc	11-13-0233-56-0000-revmc-wg-ballot-comments.xls				Abstain	18
									Return%	83
				Comment	Template				Approve%	96
				Pool	LB# 210 Voters					
209	TGai	Recirculation TGai Draft 4.00	LB# 209	Draft	Draft P802.11ai_D4.0.pdf	2015-02-09	2015-02-24	15	Pool	336
									Approve	230
				Redlined Doc	Draft P802.11ai_D4.0 Redline.pdf				Disapprove	25
				Resolution Doc	11-14-1351-30-00ai-tgai-lb204-comments-for-draft-3-0.xlsx				Abstain	22
									Return%	82
				Comment	Template				Approve%	90
				Pool	LB# 209 Voters					
208	TGaq	Technical TGaq Draft 1.00	LB# 208	Draft	Draft P802.11aq_D1.0.pdf	2015-02-02	2015-03-04	30	Pool	363
									Approve	139
				Redlined Doc	N/A				Disapprove	52
				Resolution Doc	N/A				Abstain	42
									Return%	64
				Comment	Template				Approve%	73
				Pool	LB# 208 Voters					
207	TGah	Recirculation TGah Draft 4.00	LB# 207	Draft	Draft P802.11ah_D4.0.pdf	2015-01-30	2015-02-14	15	Pool	330
									Approve	245
				Redlined Doc	Draft P802.11ah_D4.0 Redline.pdf				Disapprove	19
				Resolution Doc	11-14-1372-09-00ah-tgah-lb205-comments-on-d3-0.xlsx				Abstain	18
									Return%	85
				Comment	Template				Approve%	93
				Pool	LB# 207 Voters					
206	TGmc	Recirculation TGmc Draft 4.00	LB# 206	Draft	Draft P802.11REVmc_D4.0.pdf	2015-01-28	2015-02-17	20	Pool	325
									Approve	237
				Redlined Doc	Draft P802.11REVmc_D4.0 Redline.pdf				Disapprove	14
				Resolution Doc	11-13-0233-51-0000-revmc-wg-ballot-comments.xls				Abstain	18
									Return%	83
				Comment	Template				Approve%	94
				Pool	LB# 206 Voters					
205	TGah	Recirculation TGah Draft 3.00	LB# 205	Draft	Draft P802.11ah_D3.0.pdf	2014-10-10	2014-10-25	15	Pool	330
									Approve	234
				Redlined Doc	Draft P802.11ah_D3.0_Redline.pdf				Disapprove	27
				Resolution Doc	11-14-0796-11-00ah-tgah-lb203-comments-on-d2-0.xlsx				Abstain	17
									Return%	84
				Comment	Template				Approve%	90
				Pool	LB# 205 Voters					
204	TGai	Recirculation TGai Draft 3.00	LB# 204	Draft	Draft P802.11ai_D3.0.pdf	2014-09-29	2014-10-14	15	Pool	336
									Approve	214
				Redlined Doc	Draft P802.11ai_D3.0 Redline.pdf				Disapprove	28
				Resolution Doc	11-14-0565-24-00ai-tgai-lb201-comments-for-draft-2-0.xlsx				Abstain	28
									Return%	80
				Comment	Template				Approve%	88
				Pool	LB# 204 Voters					
203	TGah	Technical TGah Draft 2.00	LB# 203	Draft	Draft P802.11ah_D2.0.pdf	2014-06-05	2014-07-05	30	Pool	330
									Approve	204
				Redlined Doc	N/A				Disapprove	43
				Resolution Doc	11-13-1336-16-00ah-tgah-lb200-comments-on-d1-0.xlsx				Abstain	24
									Return%	82

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
				Comment	Template				Approve%	83
				Pool	LB# 203 Voters					
202	TGmc	Recirculation TGmc Draft 3.00	LB# 202	Draft	Draft P802.11REVmc_D3.0.pdf	2014-06-03	2014-06-23	20	Pool	325
									Approve	219
				Redlined Doc	Draft P802.11REVmc_D3.0 Redline.pdf				Disapprove	24
				Resolution Doc	11-13-0233-32-0000-revmc-wg-ballot-comments.xls				Abstain	19
									Return%	81
				Comment	Template				Approve%	90
				Pool	LB# 202 Voters					
201	TGai	Technical TGai Draft 2.00	LB# 201	Draft	Draft P802.11ai_D2.0.pdf	2014-04-07	2014-05-07	30	Pool	336
									Approve	195
				Redlined Doc	Draft P802.11ai_D2.0 Redline.pdf				Disapprove	34
				Resolution Doc	11-13-1076-34-00ai-tgai-lb-198-comments-for-d1-0.xlsx				Abstain	28
									Return%	76
				Comment	Template				Approve%	85
				Pool	LB# 201 Voters					
200	TGah	Technical TGah Draft 1.00	LB# 200	Draft	Draft P802.11ah_D1.0.pdf	2013-10-05	2013-11-04	30	Pool	323
									Approve	144
				Redlined Doc	N/A				Disapprove	54
				Resolution Doc	N/A				Abstain	18
									Return%	67
				Comment	Template				Approve%	73
				Pool	LB# 200 Voters					
199	TGmc	Recirculation TGmc Draft 2.00	LB# 199	Draft	Draft P802.11REVmc_D2.0.pdf	2013-10-03	2013-10-23	20	Pool	325
									Approve	207
				Redlined Doc	Draft P802.11REVmc_D2.0 Redline.pdf				Disapprove	23
				Resolution Doc	11-13-0233-18-0000-revmc-wg-ballot-comments.xls				Abstain	22
									Return%	78
				Comment	Template				Approve%	90
				Pool	LB# 199 Voters					
198	TGai	Technical TGai Draft 1.00	LB# 198	Draft	Draft P802.11ai_D1.0.pdf	2013-08-13	2013-09-12	30	Pool	334
									Approve	147
				Redlined Doc	N/A				Disapprove	51
				Resolution Doc	N/A				Abstain	22
									Return%	66
				Comment	Template				Approve%	74
				Pool	LB# 198 Voters					
197	TGaf	Recirculation TGaf Draft 5.00	LB# 197	Draft	Draft P802.11af_D5.0.pdf	2013-07-17	2013-08-01	15	Pool	300
									Approve	228
				Redlined Doc	N/A				Disapprove	3
				Resolution Doc	11-12-1017-50-00af-tgaf-wg-lb-comment-resolutions.xlsx				Abstain	7
									Return%	79
				Comment	Template				Approve%	99
				Pool	LB# 197 Voters					
196	TGaf	Recirculation TGaf Draft 5.00	LB# 196	Draft	Draft P802.11af_D5.0.pdf	2013-05-30	2013-06-14	15	Pool	300
									Approve	215
				Redlined Doc	Draft P802.11af_D5.0 Redline.pdf				Disapprove	14
				Resolution Doc	11-12-1017-46-00af-tgaf-wg-lb-comment-resolutions.xlsx				Abstain	8
									Return%	79
				Comment	Template				Approve%	94
				Pool	LB# 196 Voters					
195	TGaf	Recirculation TGaf Draft 4.00	LB# 195	Draft	Draft P802.11af_D4.0.pdf	2013-04-02	2013-04-17	15	Pool	300
									Approve	211
				Redlined Doc	Draft P802.11af_D4.0 Redline.pdf				Disapprove	19
				Resolution Doc	11-12-1017-38-00af-tgaf-wg-lb-comment-resolutions.xlsx				Abstain	7
									Return%	79
				Comment	Template				Approve%	92
				Pool	LB# 195 Voters					
194	TGac	Recirculation TGac Draft 5.00	LB# 194	Draft	Draft P802.11ac_D5.0.pdf	2013-03-20	2013-04-04	15	Pool	300
									Approve	252
				Redlined Doc	N/A				Disapprove	10
				Resolution Doc	11-13-0199-03-00ac-lb191-comments-tgac-d5-0.xls				Abstain	10
									Return%	91
				Comment	Template				Approve%	96
				Pool	LB# 194 Voters					
193	TGmc	Technical TGmc Draft 1.00	LB# 193	Draft	Draft P802.11REVmc_D1.0.pdf	2013-01-31	2013-03-02	30	Pool	325
									Approve	197
				Redlined Doc	N/A				Disapprove	26
				Resolution Doc	N/A				Abstain	22
									Return%	75
				Comment	Template				Approve%	88
				Pool	LB# 193 Voters					
192	TGaf	Recirculation TGaf Draft 3.00	LB# 192	Draft	Draft P802.11af_D3.0.pdf	2013-01-24	2013-02-08	15	Pool	300
									Approve	194
				Redlined Doc	Draft P802.11af_D3.0 Redline.pdf				Disapprove	30
				Resolution Doc	11-12-1017-30-00af-tgaf-wg-lb-comment-resolutions.xlsx				Abstain	8
									Return%	77

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
				Comment	Template				Approve%	87
				Pool	LB# 192 Voters					
191	TGac	Recirculation TGac Draft 5.00	LB# 191	Draft	Draft P802.11ac_D5.0.pdf	2013-01-17	2013-02-01	15	Pool	300
									Approve	249
				Redlined Doc	Draft P802.11ac_D5.0 Redline.pdf				Disapprove	12
				Resolution Doc	11-12-1277-10-00ac-lb190-comments-tgac-d4-0.xls				Abstain	10
									Return%	90
				Comment	Template				Approve%	95
				Pool	LB# 191 Voters					
190	TGac	Recirculation TGac Draft 4.00	LB# 190	Draft	Draft P802.11ac_D4.0.pdf	2012-10-17	2012-11-01	15	Pool	300
									Approve	242
				Redlined Doc	Draft P802.11ac_D4.0 Redline.pdf				Disapprove	15
				Resolution Doc	11-12-0752-17-00ac-lb188-comments-tgac-d3-0.xls				Abstain	14
									Return%	90
				Comment	Template				Approve%	94
				Pool	LB# 190 Voters					
189	TGaf	Technical TGaf Draft 2.00	LB# 189	Draft	Draft P802.11af_D2.0.pdf	2012-07-20	2012-08-19	30	Pool	300
									Approve	163
				Redlined Doc	N/A				Disapprove	43
				Resolution Doc	N/A				Abstain	14
									Return%	73
				Comment	Template				Approve%	79
				Pool	LB# 189 Voters					
188	TGac	Recirculation TGac Draft 3.00	LB# 188	Draft	Draft P802.11ac_D3.0.pdf	2012-06-05	2012-06-25	20	Pool	300
									Approve	233
				Redlined Doc	Draft P802.11ac_D3.0 Redline.pdf				Disapprove	24
				Resolution Doc	11-12-0223-24-00ac-lb187-comment-tgac-d2-0.xls				Abstain	14
									Return%	90
				Comment	Template				Approve%	91
				Pool	LB# 188 Voters					
187	TGac	Technical TGac Draft 2.00	LB# 187	Draft	Draft P802.11ac_D2.0.pdf	2012-01-19	2012-02-18	30	Pool	300
									Approve	223
				Redlined Doc	N/A				Disapprove	28
				Resolution Doc	N/A				Abstain	19
									Return%	90
				Comment	Template				Approve%	89
				Pool	LB# 187 Voters					
186	TGad	Recirculation TGad Draft 5.00	LB# 186	Draft	Draft P802.11ad_D5.0.pdf	2011-11-09	2011-11-24	15	Pool	278
									Approve	197
				Redlined Doc	N/A				Disapprove	11
				Resolution Doc	11-11-1374-02-00ad-lb185-comment-database.xlsx				Abstain	21
									Return%	82
				Comment	Template				Approve%	95
				Pool	LB# 186 Voters					
185	TGad	Recirculation TGad Draft 5.00	LB# 185	Draft	Draft P802.11ad_D5.0.pdf	2011-09-21	2011-10-06	15	Pool	278
									Approve	196
				Redlined Doc	Draft P802.11ad_D5.0 Redline.pdf				Disapprove	13
				Resolution Doc	11-11-1113-05-00ad-lb183-comment-database.xlsx				Abstain	19
									Return%	82
				Comment	Template				Approve%	94
				Pool	LB# 185 Voters					
184	TGaa	Recirculation TGaa Draft 6.00	LB# 184	Draft	Draft P802.11aa_D6.0.pdf	2011-08-16	2011-08-31	15	Pool	257
									Approve	151
				Redlined Doc	N/A				Disapprove	8
				Resolution Doc	11-11-1118-01-00aa-proposed-resolutions-to-lb182-comments.xls				Abstain	38
									Return%	77
				Comment	Template				Approve%	95
				Pool	LB# 184 Voters					
183	TGad	Recirculation TGad Draft 4.00	LB# 183	Draft	Draft P802.11ad_D4.0.pdf	2011-07-25	2011-08-09	15	Pool	278
									Approve	195
				Redlined Doc	Draft P802.11ad_D4.0 Redline.pdf				Disapprove	11
				Resolution Doc	11-11-0850-06-00ad-lb177-comment-database.xlsx				Abstain	22
									Return%	82
				Comment	Template				Approve%	95
				Pool	LB# 183 Voters					
182	TGaa	Recirculation TGaa Draft 6.00	LB# 182	Draft	Draft P802.11aa_D6.0.pdf	2011-07-25	2011-08-09	15	Pool	257
									Approve	149
				Redlined Doc	Draft P802.11aa_D6.0 Redline.pdf				Disapprove	9
				Resolution Doc	11-11-0876-07-00aa-lb179-comments.xlsx				Abstain	38
									Return%	76
				Comment	Template				Approve%	94
				Pool	LB# 182 Voters					
181	TGae	Recirculation TGae Draft 5.00	LB# 181	Draft	Draft P802.11ae_D5.0.pdf	2011-07-20	2011-08-04	15	Pool	278
									Approve	182
				Redlined Doc	Draft P802.11ae_D5.0 Redline.pdf				Disapprove	7
				Resolution Doc	11-11-0888-08-00ae-lb-180-comment-resolutions.xls				Abstain	35
									Return%	81

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
				Comment	Template				Approve%	96
				Pool	LB# 181 Voters					
180	TGae	Recirculation TGae Draft 4.00	LB# 180	Draft	Draft P802.11ae_D4.0.pdf	2011-06-03	2011-06-18	15	Pool	278
									Approve	180
				Redlined Doc	Draft P802.11ae_D4.0 Redline.pdf				Disapprove	8
				Resolution Doc	11-11-0598-07-00ae-tgae-lb-176-comment-resolutions.xls				Abstain	35
									Return%	80
				Comment	Template				Approve%	96
				Pool	LB# 180 Voters					
179	TGaa	Recirculation TGaa Draft 5.00	LB# 179	Draft	Draft P802.11aa_D5.0.pdf	2011-06-02	2011-06-17	15	Pool	257
									Approve	142
				Redlined Doc	Draft P802.11aa_D5.0 Redline.pdf				Disapprove	15
				Resolution Doc	11-11-0523-08-00aa-lb175-comments.xls				Abstain	39
									Return%	76
				Comment	Template				Approve%	90
				Pool	LB# 179 Voters					
178	TGac	Technical TGac Draft 1.00	LB# 178	Draft	Draft P802.11ac_D1.0.pdf	2011-05-26	2011-06-25	30	Pool	315
									Approve	148
				Redlined Doc	N/A				Disapprove	52
				Resolution Doc	N/A				Abstain	16
									Return%	69
				Comment	Template				Approve%	74
				Pool	LB# 178 Voters					
177	TGad	Recirculation TGad Draft 3.00	LB# 177	Draft	Draft P802.11ad_D3.0.pdf	2011-05-17	2011-06-01	15	Pool	278
									Approve	188
				Redlined Doc	Draft P802.11ad_D3.0 Redline.pdf				Disapprove	16
				Resolution Doc	11-11-0508-07-00ad-lb174-comment-database.xlsx				Abstain	24
									Return%	82
				Comment	Template				Approve%	92
				Pool	LB# 177 Voters					
176	TGae	Recirculation TGae Draft 3.00	LB# 176	Draft	Draft P802.11ae_D3.0.pdf	2011-04-11	2011-04-26	15	Pool	278
									Approve	163
				Redlined Doc	Draft P802.11ae_D3.0 Redline.pdf				Disapprove	21
				Resolution Doc	11-11-0255-03-00ae-tgae-lb-172-comment-resolutions.xls				Abstain	37
									Return%	79
				Comment	Template				Approve%	89
				Pool	LB# 176 Voters					
175	TGaa	Recirculation TGaa Draft 4.00	LB# 175	Draft	Draft P802.11aa_D4.0.pdf	2011-03-25	2011-04-09	15	Pool	257
									Approve	135
				Redlined Doc	Draft P802.11aa_D4.0 Redline.pdf				Disapprove	23
				Resolution Doc	11-11-0267-03-00aa-lb173-comments.xls				Abstain	37
									Return%	76
				Comment	Template				Approve%	85
				Pool	LB# 175 Voters					
174	TGad	Recirculation TGad Draft 2.00	LB# 174	Draft	Draft P802.11ad_D2.0.pdf	2011-03-21	2011-04-05	15	Pool	278
									Approve	175
				Redlined Doc	Draft P802.11ad_D2.0 Redline.pdf				Disapprove	25
				Resolution Doc	11-10-1220-21-00ad-lb168-comment-database.xlsx				Abstain	25
									Return%	81
				Comment	Template				Approve%	88
				Pool	LB# 174 Voters					
173	TGaa	Recirculation TGaa Draft 3.00	LB# 173	Draft	Draft P802.11aa_D3.0.pdf	2011-02-09	2011-02-24	15	Pool	257
									Approve	127
				Redlined Doc	Draft P802.11aa_D3.0 Redline.pdf				Disapprove	30
				Resolution Doc	11-10-1441-10-00aa-lb170-comments.xls				Abstain	37
									Return%	75
				Comment	Template				Approve%	81
				Pool	LB# 173 Voters					
172	TGae	Recirculation TGae Draft 2.00	LB# 172	Draft	Draft P802.11ae_D2.0.pdf	2011-02-03	2011-02-18	15	Pool	278
									Approve	155
				Redlined Doc	Draft P802.11ae_D2.0 Redline.pdf				Disapprove	26
				Resolution Doc	11-10-1221-24-00ae-tgae-lb169-comment-resolutions.xls				Abstain	38
									Return%	79
				Comment	Template				Approve%	86
				Pool	LB# 172 Voters					
171	TGaf	Technical TGaf Draft 1.00	LB# 171	Draft	Draft P802.11af_D1.0.pdf	2011-01-25	2011-02-24	30	Pool	300
									Approve	125
				Redlined Doc	N/A				Disapprove	76
				Resolution Doc	N/A				Abstain	35
									Return%	79
				Comment	Template				Approve%	62
				Pool	LB# 171 Voters					
170	TGaa	Recirculation TGaa Draft 2.00	LB# 170	Draft	Draft P802.11aa_D2.0.pdf	2010-11-23	2010-12-08	15	Pool	257
									Approve	117
				Redlined Doc	Draft P802.11aa_D2.0 Redline.pdf				Disapprove	32
				Resolution Doc	11-10-1395-02-00aa-lb164-consolidated-comments-editorial-notes.xls				Abstain	36
									Return%	72

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
				Comment	Template				Approve%	79
				Pool	LB# 170 Voters					
169	TGae	Technical TGae Draft 1.00	LB# 169	Draft	Draft P802.11ae_D1.0.pdf	2010-09-27	2010-10-27	30	Pool	278
									Approve	134
				Redlined Doc	N/A				Disapprove	32
				Resolution Doc	N/A				Abstain	40
									Return%	74
				Comment	Template				Approve%	81
				Pool	LB# 169 Voters					
168	TGad	Technical TGad Draft 1.00	LB# 168	Draft	Draft P802.11ad_D1.0.pdf	2010-09-24	2010-10-24	30	Pool	278
									Approve	163
				Redlined Doc	N/A				Disapprove	24
				Resolution Doc	N/A				Abstain	26
									Return%	77
				Comment	Template				Approve%	87
				Pool	LB# 168 Voters					
167	TGmb	Recirculation TGmb Draft 5.00	LB# 167	Draft	Draft P802.11REVmb_D5.0.pdf	2010-08-04	2010-08-19	15	Pool	246
									Approve	172
				Redlined Doc	Draft P802.11REVmb_D5.0 Redline.pdf				Disapprove	15
				Resolution Doc	11-09-0706-15-000m-revmb-wg-ballot-comments.xls				Abstain	25
									Return%	86
				Comment	Template				Approve%	92
				Pool	LB# 167 Voters					
166	TGs	Recirculation TGs Draft 7.00	LB# 166	Draft	Draft P802.11s_D7.0.pdf	2010-07-29	2010-08-13	15	Pool	248
									Approve	167
				Redlined Doc	Draft P802.11s_D7.0 Redline.pdf				Disapprove	9
				Resolution Doc	11-10-0725-09-000s-lb-165-comment-resolutions.xls				Abstain	34
									Return%	85
				Comment	Template				Approve%	95
				Pool	LB# 166 Voters					
165	TGs	Recirculation TGs Draft 6.00	LB# 165	Draft	Draft P802.11s_D6.0.pdf	2010-06-13	2010-06-28	15	Pool	248
									Approve	157
				Redlined Doc	Draft P802.11s_D6.0 Redline Compared to P802.11s_D5.0.pdf				Disapprove	20
				Resolution Doc	11-10-0478-09-000s-lb-161-comment-resolutions.xls				Abstain	33
									Return%	85
				Comment	Template				Approve%	89
				Pool	LB# 165 Voters					
164	TGaa	Technical TGaa Draft 1.00	LB# 164	Draft	Draft P802.11aa_D1.0.pdf	2010-06-10	2010-07-10	30	Pool	257
									Approve	112
				Redlined Doc	N/A				Disapprove	31
				Resolution Doc	N/A				Abstain	37
									Return%	70
				Comment	Template				Approve%	78
				Pool	LB# 164 Voters					
163	TGmb	Recirculation TGmb Draft 4.00	LB# 163	Draft	Draft P802.11REVmb_D4.0.pdf	2010-06-10	2010-06-25	15	Pool	246
									Approve	164
				Redlined Doc	Draft P802.11REVmb_D4.0 Redline.pdf				Disapprove	20
				Resolution Doc	11-09-0706-12-000m-revmb-wg-ballot-comments.xls				Abstain	28
									Return%	86
				Comment	Template				Approve%	89
				Pool	LB# 163 Voters					
162	TGmb	Recirculation TGmb Draft 3.00	LB# 162	Draft	Draft P802.11REVmb_D3.0.pdf	2010-03-31	2010-04-25	25	Pool	246
									Approve	167
				Redlined Doc	Draft P802.11REVmb_D3.0 Redline.pdf				Disapprove	20
				Resolution Doc	11-09-0706-10-000m-revmb-wg-ballot-comments.xls				Abstain	25
									Return%	86
				Comment	Template				Approve%	89
				Pool	LB# 162 Voters					
161	TGs	Recirculation TGs Draft 5.00	LB# 161	Draft	Draft P802.11s_D5.0.pdf	2010-03-31	2010-04-15	15	Pool	248
									Approve	159
				Redlined Doc	Draft P802.11s_D5.0 Redline Compared to P802.11s_D4.0.pdf				Disapprove	19
				Resolution Doc	11-10-0032-13-000s-lb-159-comment-resolutions.xls				Abstain	32
									Return%	85
				Comment	Template				Approve%	89
				Pool	LB# 161 Voters					
160	TGmb	Recirculation TGmb Draft 2.00	LB# 160	Draft	Draft P802.11REVmb_D2.0.pdf	2009-12-11	2010-01-08	28	Pool	246
									Approve	166
				Redlined Doc	Draft P802.11REVmb_D2.0 Redline.pdf				Disapprove	20
				Resolution Doc	11-09-0706-06-000m-revmb-wg-ballot-comments.xls				Abstain	25
									Return%	86
				Comment	Template				Approve%	89
				Pool	LB# 160 Voters					
159	TGs	Recirculation TGs Draft 4.00	LB# 159	Draft	Draft P802.11s_D4.0.pdf	2009-12-09	2010-01-08	30	Pool	248
									Approve	150
				Redlined Doc	Draft P802.11s_D4.0 Redline.pdf				Disapprove	27
				Resolution Doc	11-09-0471-24-000s-lb-147-comment-resolutions.xls				Abstain	33
									Return%	85

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
				Comment	Template				Approve%	85
				Pool	LB# 159 Voters					
158	TGp	Recirculation TGp Draft 9.00	LB# 158	Draft	Draft P802.11p_D9.0.pdf	2009-09-25	2009-10-10	15	Pool	232
									Approve	171
				Redlined Doc	Draft P802.11p_D9.0 Redline.pdf				Disapprove	12
				Resolution Doc	11-09-0927-03-000p-lb154-tgp-comment-resolution-master.xls				Abstain	29
									Return%	91
				Comment	Template				Approve%	93
				Pool	LB# 158 Voters					
157	TGz	Recirculation TGz Draft 6.00	LB# 157	Draft	Draft P802.11z_D6.0.pdf	2009-08-11	2009-08-26	15	Pool	254
									Approve	187
				Redlined Doc	Draft P802.11z_D6.0 Redline.pdf				Disapprove	8
				Resolution Doc	11-09-0739-04-000z-tgz-lb153-comment-spreadsheet.xls				Abstain	38
									Return%	92
				Comment	Template				Approve%	96
				Pool	LB# 157 Voters					
156	TGu	Recirculation TGu Draft 8.00	LB# 156	Draft	Draft P802.11u_D8.0.pdf	2009-08-03	2009-08-18	15	Pool	213
									Approve	148
				Redlined Doc	Draft P802.11u_D8.0 Redline.pdf				Disapprove	11
				Resolution Doc	11-09-0692-14-000u-lb152-comment-spreadsheet.xls				Abstain	35
									Return%	91
				Comment	Template				Approve%	93
				Pool	LB# 156 Voters					
155	TGv	Recirculation TGv Draft 7.00	LB# 155	Draft	Draft P802.11v_D7.0.pdf	2009-07-23	2009-08-07	15	Pool	254
									Approve	176
				Redlined Doc	Draft P802.11v_D7.0 Redline.pdf				Disapprove	16
				Resolution Doc	11-09-0676-07-000v-lb-150-comments.xls				Abstain	38
									Return%	91
				Comment	Template				Approve%	92
				Pool	LB# 155 Voters					
154	TGp	Recirculation TGp Draft 8.00	LB# 154	Draft	Draft P802.11p_D8.0.pdf	2009-07-21	2009-08-05	15	Pool	232
									Approve	163
				Redlined Doc	Draft P802.11p_D8.0 Redline.pdf				Disapprove	20
				Resolution Doc	11-09-0688-03-000p-LB151-TGp Comment Resolution Master2.xls				Abstain	28
									Return%	91
				Comment	Template				Approve%	89
				Pool	LB# 154 Voters					
153	TGz	Recirculation TGz Draft 5.00	LB# 153	Draft	Draft P802.11z_D5.0.pdf	2009-06-08	2009-06-23	15	Pool	254
									Approve	183
				Redlined Doc	Draft P802.11z_D5.0 Redline.pdf				Disapprove	15
				Resolution Doc	11-09-0313-03-000z-tgz-lb143-comment-spreadsheet.xls				Abstain	34
									Return%	91
				Comment	Template				Approve%	92
				Pool	LB# 153 Voters					
152	TGu	Recirculation TGu Draft 7.00	LB# 152	Draft	Draft P802.11u_D7.0.pdf	2009-06-04	2009-06-19	15	Pool	213
									Approve	142
				Redlined Doc	Draft P802.11u_D7.0 Redline.pdf				Disapprove	19
				Resolution Doc	11-09-0489-13-000u-lb148-comment-spreadsheet.xls				Abstain	33
									Return%	91
				Comment	Template				Approve%	88
				Pool	LB# 152 Voters					
151	TGp	Recirculation TGp Draft 7.00	LB# 151	Draft	Draft P802.11p_D7.0.pdf	2009-05-29	2009-06-13	15	Pool	232
									Approve	158
				Redlined Doc	Draft P802.11p_D7.0 Redline.pdf				Disapprove	27
				Resolution Doc	11-09-0432-05-000p-lb144-tgp-comment-resolution-master.xls				Abstain	26
									Return%	91
				Comment	Template				Approve%	85
				Pool	LB# 151 Voters					
150	TGv	Recirculation TGv Draft 6.00	LB# 150	Draft	Draft P802.11v_D6.0.pdf	2009-05-28	2009-06-12	15	Pool	254
									Approve	172
				Redlined Doc	Draft P802.11v_D6.0 Redline Compared to P802.11v_D5.0.pdf				Disapprove	20
				Resolution Doc	11-09-0434-04-000v-lb146.xls				Abstain	38
									Return%	91
				Comment	Template				Approve%	90
				Pool	LB# 150 Voters					
149	TGmb	Technical TGmb Draft 1.00	LB# 149	Draft	Draft P802.11REVmb_D1.0.pdf	2009-05-18	2009-06-27	40	Pool	246
									Approve	155
				Redlined Doc	N/A				Disapprove	23
				Resolution Doc	N/A				Abstain	29
									Return%	84
				Comment	Template				Approve%	87
				Pool	LB# 149 Voters					
148	TGu	Recirculation TGu Draft 6.00	LB# 148	Draft	Draft P802.11u_D6.0.pdf	2009-04-09	2009-04-24	15	Pool	213
									Approve	142
				Redlined Doc	Draft P802.11u_D6.0 Redline.pdf				Disapprove	15
				Resolution Doc	11-09-0245-10-000u-lb142-comment-spreadsheet.xls				Abstain	35
									Return%	90

COMPLETED BALLOTS, from LB101 onwards

Letter ballot results up to LB100 can be found here. Ballot results can also be found in this spreadsheet.

LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
				Comment	Template				Approve%	90
				Pool	LB# 148 Voters					
147	TGs	Technical TGs Draft 3.00	LB# 147	Draft	Draft P802.11s_D3.0.pdf	2009-04-04	2009-05-04	30	Pool	248
									Approve	132
				Redlined Doc	N/A				Disapprove	35
				Resolution Doc	N/A				Abstain	34
									Return%	81
				Comment	Template				Approve%	79
				Pool	LB# 147 Voters					
146	TGv	Recirculation TGv Draft 5.00	LB# 146	Draft	Draft P802.11v_D5.0.pdf	2009-03-20	2009-04-04	15	Pool	254
									Approve	155
				Redlined Doc	Draft P802.11v_D5.0 Redline Compared to P802.11v_D4.0.pdf				Disapprove	32
				Resolution Doc	11-08-1467-04-000v-lb140-comments.xls				Abstain	41
									Return%	90
				Comment	Template				Approve%	83
				Pool	LB# 146 Voters					
145	TGs	Procedural TGs Draft 3.00	LB# 145	Draft	Draft P802.11s_D3.0.pdf	2009-03-19	2009-04-03	15	Pool	247
									Approve	166
				Redlined Doc	N/A				Disapprove	6
				Resolution Doc	N/A				Abstain	24
									Return%	79
				Comment	Template				Approve%	97
				Pool	LB# 145 Voters					
144	TGp	Recirculation TGp Draft 6.00	LB# 144	Draft	Draft P802.11p_D6.0.pdf	2009-03-16	2009-03-31	15	Pool	232
									Approve	161
				Redlined Doc	Draft P802.11p_6.0 Redline.pdf				Disapprove	20
				Resolution Doc	11-08-1452-06-000p-lb141-tgp-comment-resolution-master.xls				Abstain	29
									Return%	91
				Comment	Template				Approve%	89
				Pool	LB# 144 Voters					
143	TGz	Recirculation TGz Draft 4.00	LB# 143	Draft	Draft P802.11z_D4.0.pdf	2009-02-18	2009-03-05	15	Pool	254
									Approve	170
				Redlined Doc	Draft P802.11z_D4.0 Redline.pdf				Disapprove	23
				Resolution Doc	11-09-0097-02-000z-lb139-comment-resolution.xls				Abstain	37
									Return%	91
				Comment	Template				Approve%	88
				Pool	LB# 143 Voters					
142	TGu	Recirculation TGu Draft 5.00	LB# 142	Draft	Draft P802.11u_D5.0.pdf	2009-02-05	2009-02-20	15	Pool	213
									Approve	125
				Redlined Doc	Draft P802.11u_D5.0 Redline.pdf				Disapprove	27
				Resolution Doc	11-08-1225-25-000u-lb137-comment-spreadsheet.xls				Abstain	39
									Return%	90
				Comment	Template				Approve%	82
				Pool	LB# 142 Voters					
141	TGp	Recirculation TGp Draft 5.00	LB# 141	Draft	Draft P802.11p_D5.0.pdf	2008-11-20	2008-12-05	15	Pool	232
									Approve	149
				Redlined Doc	Draft P802.11p_D5.0 Redline Compared to P802.11p_D4.0.pdf				Disapprove	26
				Resolution Doc	11-08-0514-06-000p-lb125-tgp-comment-resolution-master.xls				Abstain	35
									Return%	91
				Comment	Template				Approve%	85
				Pool	LB# 141 Voters					
140	TGv	Technical TGv Draft 4.00	LB# 140	Draft	Draft P802.11v_D4.0.pdf	2008-11-19	2008-12-19	30	Pool	254
									Approve	149
				Redlined Doc	Draft P802.11v_D4.0 Redline.pdf				Disapprove	36
				Resolution Doc	11-08-0801-05-000v-lb133-comments.xls				Abstain	40
									Return%	89
				Comment	Template				Approve%	81
				Pool	LB# 140 Voters					
139	TGz	Technical TGz Draft 3.00	LB# 139	Draft	Draft P802.11z_D3.0.pdf	2008-11-18	2008-12-18	30	Pool	254
									Approve	155
				Redlined Doc	N/A				Disapprove	29
				Resolution Doc	N/A				Abstain	41
									Return%	89
				Comment	Template				Approve%	84
				Pool	LB# 139 Voters					
138	TGn	Recirculation TGn Draft 7.00	LB# 138	Draft	Draft P802.11n_D7.0.pdf	2008-11-17	2008-12-02	15	Pool	325
									Approve	281
				Redlined Doc	N/A				Disapprove	14
				Resolution Doc	11-08-1417-00-000n-p802-11n-wg-ballot-unsatisfied-comments.xls				Abstain	20
									Return%	97
				Comment	Template				Approve%	95
				Pool	LB# 138 Voters					
137	TGu	Recirculation TGu Draft 4.00	LB# 137	Draft	Draft P802.11u_D4.0.pdf	2008-09-23	2008-10-08	15	Pool	213
									Approve	118
				Redlined Doc	Draft P802.11u_D4.0 Redline.pdf				Disapprove	34
				Resolution Doc	11-08-0722-27-000u-lb-132-comment-spreadsheet.xls				Abstain	37
									Return%	89

COMPLETED BALLOTS, from LB101 onwards

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LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
				Comment	Template				Approve%	78
				Pool	LB# 137 Voters					
136	TGn	Recirculation TGn Draft 7.00	LB# 136	Draft	Draft P802.11n_D7.0.pdf	2008-09-15	2008-09-30	15	Pool	325
									Approve	276
				Redlined Doc	Draft P802.11n_D7.0 Redline.pdf				Disapprove	17
				Resolution Doc	11-08-0958-02-000n-tgn-lb134-composite-comments.xls				Abstain	21
									Return%	97
				Comment	Template				Approve%	94
				Pool	LB# 136 Voters					
135	TGz	Technical TGz Draft 2.00	LB# 135	Draft	Draft P802.11z_D2.0.pdf	2008-07-21	2008-08-20	30	Pool	242
									Approve	99
				Redlined Doc	N/A				Disapprove	51
				Resolution Doc	N/A				Abstain	48
									Return%	82
				Comment	Template				Approve%	66
				Pool	LB# 135 Voters					
134	TGn	Recirculation TGn Draft 6.00	LB# 134	Draft	Draft P802.11n_D6.0.pdf	2008-07-21	2008-08-05	15	Pool	325
									Approve	266
				Redlined Doc	Draft P802.11n_D6.0 Redline.pdf				Disapprove	27
				Resolution Doc	11-08-0713-02-000n-tgn-lb129-composite-comments.xls				Abstain	21
									Return%	97
				Comment	Template				Approve%	91
				Pool	LB# 134 Voters					
133	TGv	Technical TGv Draft 3.00	LB# 133	Draft	Draft P802.11v_D3.0.pdf	2008-06-13	2008-07-13	30	Pool	213
									Approve	106
				Redlined Doc	Draft P802.11v_D3.0 Redline.pdf				Disapprove	47
				Resolution Doc	11-08-0265-04-000v-lb123-comments.xls				Abstain	28
									Return%	85
				Comment	Template				Approve%	69
				Pool	LB# 133 Voters					
132	TGu	Technical TGu Draft 3.00	LB# 132	Draft	Draft P802.11u_D3.0.pdf	2008-06-12	2008-07-12	30	Pool	213
									Approve	113
				Redlined Doc	Draft P802.11u_D3.0 Redline.pdf				Disapprove	34
				Resolution Doc	N/A				Abstain	35
									Return%	85
				Comment	Template				Approve%	77
				Pool	LB# 132 Voters					
131	TGv	Procedural TGv Draft 2.02	LB# 131	Draft	Draft P802.11v_D2.02.pdf	2008-05-28	2008-06-12	15	Pool	213
									Approve	175
				Redlined Doc	Draft P802.11v_D2.02 Redline.pdf				Disapprove	14
				Resolution Doc	11-08-0265-04-000v-lb123-comments.xls				Abstain	18
									Return%	97
				Comment	Template				Approve%	93
				Pool	LB# 131 Voters					
130	TGu	Procedural TGu Draft 3.00	LB# 130	Draft	Draft P802.11u_D3.0.pdf	2008-05-27	2008-06-11	15	Pool	212
									Approve	159
				Redlined Doc	Draft P802.11u_D3.0 Redline.pdf				Disapprove	8
				Resolution Doc	N/A				Abstain	19
									Return%	88
				Comment	Template				Approve%	95
				Pool	LB# 130 Voters					
129	TGn	Recirculation TGn Draft 5.00	LB# 129	Draft	Draft P802.11n_D5.0.pdf	2008-05-23	2008-06-12	20	Pool	325
									Approve	261
				Redlined Doc	Draft P802.11n_D5.0 Redline.pdf				Disapprove	29
				Resolution Doc	11-08-0460-02-000n-tgn-lb124-composite-comments.xls				Abstain	23
									Return%	96
				Comment	Template				Approve%	90
				Pool	LB# 129 Voters					
128	TGw	Recirculation TGw Draft 6.00	LB# 128	Draft	Draft P802.11w_D6.0.pdf	2008-04-03	2008-04-18	15	Pool	427
									Approve	266
				Redlined Doc	11-08-0448-00-000w-Redlined Draft P802.11w_D6.0 Compared To Draft P802.11w_5.0.pdf				Disapprove	8
				Resolution Doc	11-08-0261-05-000w-lb121-comment-resolution.xls				Abstain	54
									Return%	77
				Comment	Template				Approve%	97
				Pool	LB# 128 Voters					
127	TGz	Technical TGz Draft 1.00	LB# 127	Draft	Draft P802.11z_D1.0.pdf	2008-04-03	2008-05-03	30	Pool	233
									Approve	103
				Redlined Doc	N/A				Disapprove	59
				Resolution Doc	N/A				Abstain	47
									Return%	90
				Comment	Template				Approve%	64
				Pool	LB# 127 Voters					
126	TGs	Technical TGs Draft 2.00	LB# 126	Draft	Draft P802.11s_D2.0.pdf	2008-04-03	2008-05-03	30	Pool	233
									Approve	103
				Redlined Doc	N/A				Disapprove	67
				Resolution Doc	N/A				Abstain	36
									Return%	88

COMPLETED BALLOTS, from LB101 onwards

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LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
				Comment	Template				Approve%	61
				Pool	LB# 126 Voters					
125	TGp	Technical TGp Draft 4.00	LB# 125	Draft	Draft P802.11p D4.0.pdf	2008-04-03	2008-05-03	30	Pool	233
									Approve	136
				Redlined Doc	index.html				Disapprove	37
				Resolution Doc	index.html				Abstain	32
									Return%	88
				Comment	Template				Approve%	79
				Pool	LB# 125 Voters					
124	TGn	Recirculation TGn Draft 4.00	LB# 124	Draft	index.html	2008-03-28	2008-04-12	15	Pool	325
									Approve	253
				Redlined Doc	index.html				Disapprove	34
				Resolution Doc	11-07-2783-08-000n-tgn-lb115-editor-comments.xls				Abstain	25
									Return%	96
				Comment	Template				Approve%	88
				Pool	LB# 124 Voters					
123	TGv	Technical TGv Draft 2.00	LB# 123	Draft	Draft P802.11v_D2.0.pdf	2008-02-14	2008-03-15	30	Pool	261
									Approve	126
				Redlined Doc	index.html				Disapprove	62
				Resolution Doc	index.html				Abstain	34
									Return%	85
				Comment	Template				Approve%	67
				Pool	LB# 123 Voters					
122	TGu	Technical TGu Draft 2.00	LB# 122	Draft	Draft P802.11u_D2.0.pdf	2008-02-14	2008-03-15	30	Pool	261
									Approve	125
				Redlined Doc	index.html				Disapprove	53
				Resolution Doc	index.html				Abstain	37
									Return%	82
				Comment	Template				Approve%	70
				Pool	LB# 122 Voters					
121	TGw	Recirculation TGw Draft 5.00	LB# 121	Draft	P802.11w_D5.0.pdf	2008-02-05	2008-02-20	15	Pool	427
									Approve	259
				Redlined Doc	index.html				Disapprove	14
				Resolution Doc	index.html				Abstain	55
									Return%	77
				Comment	Template				Approve%	95
				Pool	LB# 121 Voters					
120	TGv	Procedural TGv Draft 1.04	LB# 120	Draft	Draft P802.11v_D1.04.pdf	2008-01-29	2008-02-13	15	Pool	297
									Approve	213
				Redlined Doc	index.html				Disapprove	13
				Resolution Doc	index.html				Abstain	27
									Return%	85
				Comment	Template				Approve%	94
				Pool	LB# 120 Voters					
119	TGu	Procedural TGu Draft 2.00	LB# 119	Draft	Draft P802.11u_D2.0.pdf	2008-01-27	2008-02-11	15	Pool	297
									Approve	203
				Redlined Doc	index.html				Disapprove	16
				Resolution Doc	index.html				Abstain	33
									Return%	85
				Comment	Template				Approve%	93
				Pool	LB# 119 Voters					
118	TGk	Technical TGk	LB# 118	Draft	11-07-2959-02-000k-11k-sponsor-ballot-recirc-2-comment-resolutions(1).xls	2007-12-13	2008-01-05	23	Pool	299
									Approve	175
				Redlined Doc	N/A				Disapprove	0
				Resolution Doc	N/A				Abstain	20
									Return%	65
				Comment	Template				Approve%	100
				Pool	LB# 118 Voters					
117	TGw	Recirculation TGw Draft 4.00	LB# 117	Draft	Draft P802.11w_D4.0.pdf	2007-12-12	2008-01-05	24	Pool	427
									Approve	245
				Redlined Doc	11-07-2943-00-000w-Redlined document D4.0-vs-3.0.pdf				Disapprove	21
				Resolution Doc	11-07-2697-07-000w-lb114-comment-resolutions.xls				Abstain	60
									Return%	76
				Comment	Template				Approve%	92
				Pool	LB# 117 Voters					
116	TGy	Recirculation TGy Draft 6.00	LB# 116	Draft	Draft P802.11y_D6.0.pdf	2007-11-23	2007-12-08	15	Pool	347
									Approve	271
				Redlined Doc	11-07-2902-00-000y Redlined Draft P802.11y_D6.0 Compared To Draft P802.11y_D5.0.pdf				Disapprove	2
				Resolution Doc	11-07-2623-05-000y-d5-comments.xls				Abstain	54
									Return%	94
				Comment	Template				Approve%	99
				Pool	LB# 116 Voters					
115	TGn	Recirculation TGn Draft 3.00	LB# 115	Draft	Draft P802.11n_D3.0.pdf	2007-10-07	2007-10-27	20	Pool	325
									Approve	240
				Redlined Doc	index.html				Disapprove	43
				Resolution Doc	index.html				Abstain	27
									Return%	95

COMPLETED BALLOTS, from LB101 onwards

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LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
				Comment	Template				Approve%	85
				Pool	LB# 115 Voters					
114	TGw	Recirculation TGw Draft 3.00	LB# 114	Draft	Draft P802.11w_D3.0.pdf	2007-10-04	2007-10-19	15	Pool	427
									Approve	245
				Redlined Doc	11-07-2562-00-000w-D3.0-v-2.0-redline.pdf				Disapprove	21
				Resolution Doc	11-07-0714-13-000w-lb-102-comment-resolution-spreadsheet.xls				Abstain	59
									Return%	76
				Comment	Template				Approve%	92
				Pool	LB# 114 Voters					
112	TGy	Recirculation TGy Draft 5.00	LB# 112	Draft	Draft P802.11y_D5.0.pdf	2007-09-28	2007-10-13	15	Pool	347
									Approve	257
				Redlined Doc	11-07-2607-00-000y-tgy-redline-between-Draft-5.0-and-4.0.pdf				Disapprove	11
				Resolution Doc	11-07-2333-07-000y-d4-comments.xls				Abstain	59
									Return%	94
				Comment	Template				Approve%	96
				Pool	LB# 112 Voters					
111	TGk	Technical TGk	LB# 111	Draft	11-07-2289-05-000k-tgk-sponsor-ballot-comment-resolutions.xls	2007-08-27	2007-09-11	15	Pool	278
									Approve	196
				Redlined Doc	N/A				Disapprove	22
				Resolution Doc	N/A				Abstain	35
									Return%	91
				Comment	Template				Approve%	90
				Pool	LB# 111 Voters					
110	TGp	Technical TGp Draft 3.00	LB# 110	Draft	Draft P802.11p_D3.0.pdf	2007-08-13	2007-09-12	30	Pool	278
									Approve	143
				Redlined Doc	N/A				Disapprove	50
				Resolution Doc	N/A				Abstain	58
									Return%	90
				Comment	Template				Approve%	74
				Pool	LB# 110 Voters					
109	TGy	Recirculation TGy Draft 4.00	LB# 109	Draft	Draft P802.11y_D4.0.pdf	2007-08-06	2007-08-21	15	Pool	347
									Approve	250
				Redlined Doc	11-07-2268-00-000y-tgy-redline-between Draft 4.0 and 3.0.pdf				Disapprove	17
				Resolution Doc	11-07-2019-06-000y-d3-comments.xls				Abstain	60
									Return%	94
				Comment	Template				Approve%	94
				Pool	LB# 109 Voters					
108	TGv	Technical TGv Draft 1.00	LB# 108	Draft	Draft P802.11v_D1.0.pdf	2007-07-31	2007-08-30	30	Pool	278
									Approve	132
				Redlined Doc	N/A				Disapprove	77
				Resolution Doc	N/A				Abstain	38
									Return%	89
				Comment	Template				Approve%	63
				Pool	LB# 108 Voters					
107	TGu	Technical TGu Draft 1.00	LB# 107	Draft	Draft P802.11u_D1.0.pdf	2007-06-08	2007-07-08	30	Pool	299
									Approve	111
				Redlined Doc	index.html				Disapprove	62
				Resolution Doc	index.html				Abstain	48
									Return%	74
				Comment	Template				Approve%	64
				Pool	LB# 107 Voters					
106	TGy	Recirculation TGy Draft 3.00	LB# 106	Draft	Draft P802.11y_D3.0.pdf	2007-06-05	2007-06-20	15	Pool	347
									Approve	242
				Redlined Doc	index.html				Disapprove	24
				Resolution Doc	index.html				Abstain	60
									Return%	94
				Comment	Template				Approve%	91
				Pool	LB# 106 Voters					
105	TGr	Recirculation TGr Draft 6.00	LB# 105	Draft	Draft P802.11r_D6.0.pdf	2007-05-28	2007-06-13	16	Pool	518
									Approve	360
				Redlined Doc	index.html				Disapprove	11
				Resolution Doc	index.html				Abstain	65
									Return%	84
				Comment	Template				Approve%	97
				Pool	LB# 105 Voters					
104	TGy	Recirculation TGy Draft 2.00	LB# 104	Draft	Draft P802.11y_D2.0.pdf	2007-04-19	2007-05-05	16	Pool	347
									Approve	221
				Redlined Doc	index.html				Disapprove	41
				Resolution Doc	index.html				Abstain	62
									Return%	93
				Comment	Template				Approve%	84
				Pool	LB# 104 Voters					
103	TGk	Recirculation TGk Draft 7.00	LB# 103	Draft	Draft P802.11k_D7.0.pdf	2007-04-18	2007-05-05	17	Pool	514
									Approve	363
				Redlined Doc	index.html				Disapprove	29
				Resolution Doc	index.html				Abstain	39
									Return%	84

COMPLETED BALLOTS, from LB101 onwards

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LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
				Comment	Template				Approve%	93
				Pool	LB# 103 Voters					
102	TGw	Recirculation TGw Draft 2.00	LB# 102	Draft	Draft P802.11w_D2.0.pdf	2007-04-07	2007-05-02	25	Pool	427
									Approve	227
				Redlined Doc	index.html				Disapprove	29
				Resolution Doc	index.html				Abstain	61
									Return%	74
				Comment	Template				Approve%	89
				Pool	LB# 102 Voters					
101	TGt	Technical TGt Draft 1.00	LB# 101	Draft	Draft-P802.11.2_D1.0.pdf	2007-04-16	2007-05-16	30	Pool	307
									Approve	163
				Redlined Doc	N/A				Disapprove	52
				Resolution Doc	N/A				Abstain	57
									Return%	89
				Comment	Template				Approve%	76
				Pool	LB# 101 Voters					
99	TGt	Procedural TGt Draft 0.14	LB# 99	Draft	Draft P802.11.2_D0.14.pdf	2007-03-28	2007-04-12	15	Pool	323
									Approve	244
				Redlined Doc	N/A				Disapprove	16
				Resolution Doc	N/A				Abstain	38
									Return%	92
				Comment	Template				Approve%	94
				Pool	LB# 99 Voters					
98	TGr	Recirculation TGr Draft 5.00	LB# 98	Draft	Draft P802.11r_D5.0.pdf	2007-03-20	2007-04-04	15	Pool	518
									Approve	350
				Redlined Doc	11-07-0471-00-000r-P802-11r-D5-0-redline.pdf				Disapprove	19
				Resolution Doc	11-06-1895-18-000r-d4-comments.xls				Abstain	67
									Return%	84
				Comment	Template				Approve%	95
				Pool	LB# 98 Voters					
97	TGn	Technical TGn Draft 2.00	LB# 97	Draft	Draft-P802.11n_D2.0.pdf	2007-02-07	2007-03-09	30	Pool	325
									Approve	231
				Redlined Doc	index.html				Disapprove	46
				Resolution Doc	N/A				Abstain	28
									Return%	94
				Comment	Template				Approve%	83
				Pool	LB# 97 Voters					
96	TGk	Recirculation TGk Draft 7.00	LB# 96	Draft	Draft P802.11k_D7.0.pdf	2007-01-29	2007-02-13	15	Pool	514
									Approve	361
				Redlined Doc	11-07-0119-00-000k-D7.0-Redlined-Changes-from-D6.0.pdf				Disapprove	30
				Resolution Doc	11-06-1739-18-000k-lb-90-EDITOR-comment-resolution-worksheet.xls				Abstain	38
									Return%	83
				Comment	Template				Approve%	92
				Pool	LB# 96 Voters					
95	TGn	Procedural TGn Draft 2.00	LB# 95	Draft	Draft P802.11n_D1.10.pdf	2007-01-22	2007-02-06	15	Pool	332
									Approve	293
				Redlined Doc	N/A				Disapprove	6
				Resolution Doc	N/A				Abstain	14
									Return%	94
				Comment	Template				Approve%	98
				Pool	LB# 95 Voters					
94	TGy	Technical TGy Draft 1.00	LB# 94	Draft	Draft P802.11y_D1.0.pdf	2006-12-08	2007-01-07	30	Pool	347
									Approve	182
				Redlined Doc	N/A				Disapprove	59
				Resolution Doc	N/A				Abstain	71
									Return%	90
				Comment	Template				Approve%	76
				Pool	LB# 94 Voters					
93	TGs	Technical TGs Draft 1.00	LB# 93	Draft	Draft P802.11s_D1.0.pdf	2006-12-07	2007-01-06	30	Pool	347
									Approve	128
				Redlined Doc	N/A				Disapprove	138
				Resolution Doc	N/A				Abstain	36
									Return%	87
				Comment	Template				Approve%	48
				Pool	LB# 93 Voters					
92	TGp	Technical TGp Draft 2.00	LB# 92	Draft	Draft P802.11p_D2.0.pdf	2006-12-06	2007-01-05	30	Pool	347
									Approve	166
				Redlined Doc	11-06-1885-00-000p-Draft P802.11p_D2.0-Redline.pdf				Disapprove	83
				Resolution Doc	11-06-0553-07-000p-lb81-11p-d1-0-comment-resolutions.xls				Abstain	62
									Return%	90
				Comment	Template				Approve%	67
				Pool	LB# 92 Voters					
91	TGr	Recirculation TGr Draft 4.00	LB# 91	Draft	Draft P802.11r_D4.0.pdf	2006-11-20	2006-12-04	14	Pool	518
									Approve	335
				Redlined Doc	11-06-1850-00-000r-P802.11r-D4.0-redline.pdf				Disapprove	30
				Resolution Doc	11-06-1576-11-000r-d3-comments.xls				Abstain	70
									Return%	84

COMPLETED BALLOTS, from LB101 onwards

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LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
				Comment	Template				Approve%	92
				Pool	LB# 91 Voters					
90	TGk	Recirculation TGk Draft 6.00	LB# 90	Draft	P802.11k-D6.0.pdf	2006-11-01	2006-11-16	15	Pool	514
									Approve	354
				Redlined Doc	11-06-1583-00-000k-redlined-version-draft-d6.0.pdf				Disapprove	36
				Resolution Doc	11-06-1366-08-000k-tgk-lb86-comment-resolution-spreadsheet.xls				Abstain	39
									Return%	83
				Comment	Template				Approve%	91
				Pool	LB# 90 Voters					
89	TGk	Procedural TGk Draft 6.00	LB# 89	Draft	P802.11k-D6.0.pdf	2006-10-13	2006-10-30	17	Pool	424
									Approve	236
				Redlined Doc	11-06-1583-00-000k-redlined-version-draft-d6.0.pdf				Disapprove	14
				Resolution Doc	11-06-1366-08-000k-tgk-lb86-comment-resolution-spreadsheet.xls				Abstain	25
									Return%	65
				Comment	Template				Approve%	94
				Pool	LB# 89 Voters					
88	TGw	Technical TGw Draft 1.00	LB# 88	Draft	P802.11w-D1.0.pdf	2006-10-10	2006-11-19	40	Pool	427
									Approve	202
				Redlined Doc	N/A				Disapprove	34
				Resolution Doc	N/A				Abstain	59
									Return%	69
				Comment	Template				Approve%	86
				Pool	LB# 88 Voters					
87	TGr	Recirculation TGr Draft 3.00	LB# 87	Draft	11-06-1540-00-000r-P802-11r-D3-0-redline.pdf	2006-09-29	2006-10-14	15	Pool	518
									Approve	318
				Redlined Doc	N/A				Disapprove	50
				Resolution Doc	11-06-0537-34-000r-d2-comments.xls				Abstain	65
									Return%	84
				Comment	Template				Approve%	86
				Pool	LB# 87 Voters					
86	TGk	Recirculation TGk Draft 5.00	LB# 86	Draft	P802.11k_D5.0.pdf	2006-09-01	2006-09-16	15	Pool	514
									Approve	325
				Redlined Doc	11-06-1311-00-0000-redlined-document-11k-draft-d5.0.doc				Disapprove	59
				Resolution Doc	11-06-0891-18-000k-LB83-may-to-jun-com-merge.xls				Abstain	44
									Return%	83
				Comment	Template				Approve%	85
				Pool	LB# 86 Voters					
85	TGk	Procedural TGk Draft 5.00	LB# 85	Draft	P802.11k_D5.0.pdf	2006-08-10	2006-08-26	16	Pool	452
									Approve	246
				Redlined Doc	11-06-1311-00-0000-redlined-document-11k-draft-d5.0.pdf				Disapprove	65
				Resolution Doc	11-06-0891-18-000k-LB83-may-to-jun-com-merge.xls				Abstain	46
									Return%	79
				Comment	Template				Approve%	79
				Pool	LB# 85 Voters					
84	TGn	Technical TGn Draft 1.00	LB# 84	Draft	P802.11n-D1.0.pdf	2006-03-19	2006-04-29	41	Pool	435
									Approve	149
				Redlined Doc	N/A				Disapprove	171
				Resolution Doc	N/A				Abstain	32
									Return%	81
				Comment	Template				Approve%	47
				Pool	LB# 84 Voters					
83	TGk	Recirculation TGk Draft 4.00	LB# 83	Draft	P802.11k-D4.0-changes.doc	2006-03-16	2006-03-31	15	Pool	514
									Approve	308
				Redlined Doc	N/A				Disapprove	73
				Resolution Doc	11-05-1049-69-000k-11k-lb78-comment-resolution-spreadsheet.xls				Abstain	44
									Return%	83
				Comment	Template				Approve%	81
				Pool	LB# 83 Voters					
82	TGr	Recirculation TGr Draft 2.00	LB# 82	Draft	P802.11r-D2.0-changes.pdf	2006-03-15	2006-04-04	20	Pool	518
									Approve	316
				Redlined Doc	N/A				Disapprove	44
				Resolution Doc	11-06-1284-29-000r-lb79-11r-d1-0-comment-resolutions.xls				Abstain	69
									Return%	83
				Comment	Template				Approve%	88
				Pool	LB# 82 Voters					
81	TGp	Technical TGp Draft 1.00	LB# 81	Draft	P802.11p_D1.0.pdf	2006-03-02	2006-04-11	40	Pool	486
									Approve	167
				Redlined Doc	N/A				Disapprove	117
				Resolution Doc	N/A				Abstain	63
									Return%	71
				Comment	Template				Approve%	59
				Pool	LB# 81 Voters					
80	TGp	Procedural TGp Draft 0.26	LB# 80	Draft	P802.11p_D0.26.pdf	2006-02-03	2006-02-18	15	Pool	486
									Approve	217
				Redlined Doc	N/A				Disapprove	72
				Resolution Doc	N/A				Abstain	56
									Return%	71

COMPLETED BALLOTS, from LB101 onwards

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LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
				Comment	Template				Approve%	75
				Pool	LB# 80 Voters					
79	TGr	Technical TGr Draft 1.00	LB# 79	Draft	P802.11r-D1.0.pdf	2005-11-25	2006-01-04	40	Pool	518
									Approve	268
				Redlined Doc	N/A				Disapprove	64
				Resolution Doc	N/A				Abstain	72
									Return%	78
				Comment	Template				Approve%	81
				Pool	LB# 79 Voters					
78	TGk	Technical TGk Draft 3.00	LB# 78	Draft	P802.11k-D3.0.pdf	2005-10-03	2005-11-12	40	Pool	514
									Approve	295
				Redlined Doc	N/A				Disapprove	75
				Resolution Doc	N/A				Abstain	33
									Return%	78
				Comment	Template				Approve%	80
				Pool	LB# 78 Voters					
77	TGma	Technical TGma Draft 4.00	LB# 77	Draft	P802.11-REVma-D4.0.pdf	2005-09-09	2005-09-19	10	Pool	542
									Approve	411
				Redlined Doc	N/A				Disapprove	15
				Resolution Doc	N/A				Abstain	19
									Return%	82
				Comment	Template				Approve%	96
				Pool	LB# 77 Voters					
76	TGma	Technical TGma Draft 3.00	LB# 76	Draft	P802.11-REVma-D3.0.pdf	2005-08-08	2005-08-19	11	Pool	542
									Approve	397
				Redlined Doc	N/A				Disapprove	20
				Resolution Doc	N/A				Abstain	21
									Return%	81
				Comment	Template				Approve%	95
				Pool	LB# 76 Voters					
75	TGma	Technical TGma Draft 2.00	LB# 75	Draft	P802.11REV-ma-D2.0.pdf	2005-07-07	2005-07-17	10	Pool	542
									Approve	387
				Redlined Doc	N/A				Disapprove	26
				Resolution Doc	N/A				Abstain	19
									Return%	80
				Comment	Template				Approve%	94
				Pool	LB# 75 Voters					
74	TGma	Technical TGma Draft 1.00	LB# 74	Draft	P802.11REV-ma-D1.0.pdf	2005-03-29	2005-05-08	40	Pool	542
									Approve	348
				Redlined Doc	N/A				Disapprove	36
				Resolution Doc	N/A				Abstain	23
									Return%	75
				Comment	Template				Approve%	91
				Pool	LB# 74 Voters					
73	TGk	Technical TGk Draft 2.00	LB# 73	Draft	P802.11k-D2.0.pdf	2005-02-03	2005-03-15	40	Pool	493
									Approve	253
				Redlined Doc	N/A				Disapprove	42
				Resolution Doc	11-04-0964-37-000k-lb71-comment-spreadsheet.xls				Abstain	25
									Return%	65
				Comment	Template				Approve%	86
				Pool	LB# 73 Voters					
71	TGk	Technical TGk Draft 1.00	LB# 71	Draft	P802.11k-D1.0.pdf	2004-08-02	2004-09-11	40	Pool	412
									Approve	329
				Redlined Doc	N/A				Disapprove	18
				Resolution Doc	N/A				Abstain	27
									Return%	91
				Comment	Template				Approve%	95
				Pool	LB# 71 Voters					
68	TGj	Recirculation TGj Draft 1.40	LB# 68	Draft	P802_11j-D1.4-redlined.pdf	2004-04-05	2004-04-20	15	Pool	464
									Approve	273
				Redlined Doc	N/A				Disapprove	13
				Resolution Doc	11-04-0411-02-000j-tgj-comment-resolution-lb66.xls				Abstain	24
									Return%	67
				Comment	Template				Approve%	95
				Pool	LB# 68 Voters					
67	TGe	Recirculation TGe Draft 8.00	LB# 67	Draft	P802_11E-D8.0-redlined.pdf	2004-02-24	2004-03-10	15	Pool	321
									Approve	262
				Redlined Doc	N/A				Disapprove	16
				Resolution Doc	11-04-0181-05-000e-letter-ballot-65-comments.xls				Abstain	23
									Return%	94
				Comment	Template				Approve%	94
				Pool	LB# 67 Voters					
66	TGj	Recirculation TGj Draft 1.30	LB# 66	Draft	P802_11j-D1.3redlined.pdf	2004-02-04	2004-03-11	36	Pool	464
									Approve	258
				Redlined Doc	N/A				Disapprove	17
				Resolution Doc	11-04-0042-05-000j-tgj-comment-resolution-lb64.xls				Abstain	27
									Return%	65

COMPLETED BALLOTS, from LB101 onwards

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LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
				Comment	Template				Approve%	94
				Pool	LB# 66 Voters					
65	TGe	Recirculation TGe Draft 7.00	LB# 65	Draft	P802_11E-D7.0-redlined.pdf	2004-01-31	2004-02-15	15	Pool	321
									Approve	258
				Redlined Doc	N/A				Disapprove	19
				Resolution Doc	11-04-1001-06-000e-letter-ballot-63-comments.xls				Abstain	24
									Return%	94
				Comment	Template				Approve%	93
				Pool	LB# 65 Voters					
64	TGj	Technical TGj Draft 1.20	LB# 64	Draft	P802_11j-D1.2.doc	2003-12-05	2004-01-14	40	Pool	463
									Approve	212
				Redlined Doc	N/A				Disapprove	27
				Resolution Doc	11-03-337r6-W-TGj_Letter_Ballot_Comment_Resolution_May_2003.xls				Abstain	24
									Return%	57
				Comment	Template				Approve%	89
				Pool	LB# 64 Voters					
63	TGe	Recirculation TGe Draft 6.00	LB# 63	Draft	P802_11E-D6.0-redlined.pdf	2003-12-04	2003-12-20	16	Pool	321
									Approve	248
				Redlined Doc	N/A				Disapprove	30
				Resolution Doc	11-03-0658-17-000e-letter-ballot-59-comments.xls				Abstain	23
									Return%	94
				Comment	Template				Approve%	89
				Pool	LB# 63 Voters					
62	TGi	Recirculation TGi Draft 7.00	LB# 62	Draft	802_11i-D7.0-redlined.doc	2003-10-20	2003-11-04	15	Pool	321
									Approve	264
				Redlined Doc	N/A				Disapprove	14
				Resolution Doc	11-03-0808-00-000i-LB61Comments.xls				Abstain	21
									Return%	93
				Comment	Template				Approve%	95
				Pool	LB# 62 Voters					
61	TGi	Recirculation TGi Draft 6.00	LB# 61	Draft	802.11i-D6.0-redlined.doc	2003-09-24	2003-10-09	15	Pool	321
									Approve	257
				Redlined Doc	N/A				Disapprove	21
				Resolution Doc	11-03-0659-04-000i-LB60-Comments.xls				Abstain	21
									Return%	93
				Comment	Template				Approve%	92
				Pool	LB# 61 Voters					
60	TGi	Recirculation TGi Draft 5.00	LB# 60	Draft	802.11i-D5.0-redlined.doc	2003-08-04	2003-08-19	15	Pool	321
									Approve	243
				Redlined Doc	N/A				Disapprove	36
				Resolution Doc	11-03-452r6-I-LB57-Comments.xls				Abstain	20
									Return%	93
				Comment	Template				Approve%	87
				Pool	LB# 60 Voters					
59	TGe	Recirculation TGe Draft 5.00	LB# 59	Draft	P802_11E-D5.0-changes-with-4.0-marked.pdf	2003-08-01	2003-08-22	21	Pool	321
									Approve	248
				Redlined Doc	N/A				Disapprove	7
				Resolution Doc	11-03-020r13-E-Merged_Letter_Ballot_51_Comments.xls				Abstain	8
									Return%	82
				Comment	Template				Approve%	97
				Pool	LB# 59 Voters					
57	TGi	Recirculation TGi Draft 4.00	LB# 57	Draft	802_11i-D4_0-redlined.doc	2003-05-22	2003-06-06	15	Pool	321
									Approve	218
				Redlined Doc	N/A				Disapprove	61
				Resolution Doc	11-03-033r10-I-LB52-Comments.xls				Abstain	19
									Return%	93
				Comment	Template				Approve%	78
				Pool	LB# 57 Voters					
56	TGj	Technical TGj Draft 1.00	LB# 56	Draft	P802_11j-D1_0.doc	2003-04-01	2003-05-12	41	Pool	394
									Approve	196
				Redlined Doc	N/A				Disapprove	93
				Resolution Doc	N/A				Abstain	5
									Return%	75
				Comment	Template				Approve%	68
				Pool	LB# 56 Voters					
54	TGg	Recirculation TGg Draft 6.10	LB# 54	Draft	802.11g-D6.1-tracking.doc	2003-01-20	2003-02-04	15	Pool	321
									Approve	184
				Redlined Doc	N/A				Disapprove	22
				Resolution Doc	11-03-068r12-G-LB50_Comment_Resolution.xls				Abstain	58
									Return%	82
				Comment	Template				Approve%	89
				Pool	LB# 54 Voters					
52	TGi	Technical TGi Draft 3.00	LB# 52	Draft	802.11i-D3.0.pdf	2002-12-02	2003-01-12	41	Pool	321
									Approve	209
				Redlined Doc	N/A				Disapprove	65
				Resolution Doc	N/A				Abstain	21
									Return%	92

COMPLETED BALLOTS, from LB101 onwards

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LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
				Comment	Template				Approve%	76
				Pool	LB# 52 Voters					
51	TGe	Technical TGe Draft 4.00	LB# 51	Draft	P802_11E-D4_0.pdf	2002-11-28	2003-01-08	41	Pool	321
									Approve	228
				Redlined Doc	N/A				Disapprove	47
				Resolution Doc	N/A				Abstain	21
									Return%	92
				Comment	Template				Approve%	83
				Pool	LB# 51 Voters					
50	TGg	Technical TGg Draft 5.00	LB# 50	Draft	802.11g-D5.0.doc	2002-11-27	2003-01-08	42	Pool	321
									Approve	256
				Redlined Doc	N/A				Disapprove	34
				Resolution Doc	N/A				Abstain	18
									Return%	96
				Comment	Template				Approve%	88
				Pool	LB# 50 Voters					
49	TGg	Recirculation TGg Draft 4.00	LB# 49	Draft	802.11g-D4.0.pdf	2002-10-17	2002-11-01	15	Pool	382
									Approve	217
				Redlined Doc	N/A				Disapprove	33
				Resolution Doc	2-535.zip				Abstain	25
									Return%	72
				Comment	Template				Approve%	87
				Pool	LB# 49 Voters					
48	TGh	Recirculation TGh Draft 2.20	LB# 48	Draft	802-11-h-D2.2.pdf	2002-10-17	2002-11-01	15	Pool	356
									Approve	241
				Redlined Doc	N/A				Disapprove	7
				Resolution Doc	11-02-515r7-H-Comments_form_LB42.xls				Abstain	17
									Return%	74
				Comment	Template				Approve%	97
				Pool	LB# 48 Voters					
42	TGh	Recirculation TGh	LB# 42	Draft	index.html	2002-07-23	2002-09-01	40	Pool	360
									Approve	208
				Redlined Doc	N/A				Disapprove	24
				Resolution Doc	N/A				Abstain	39
									Return%	75
				Comment	Template				Approve%	90
				Pool	LB# 42 Voters					
41	TGg	Technical TGg	LB# 41	Draft	index.html	2002-07-23	2002-09-01	40	Pool	382
									Approve	194
				Redlined Doc	N/A				Disapprove	40
				Resolution Doc	N/A				Abstain	15
									Return%	65
				Comment	Template				Approve%	83
				Pool						
39	TGe	Technical TGe	LB# 39	Draft	P802_11E-D3_0.pdf	2002-05-23	2002-07-02	40	Pool	365
									Approve	106
				Redlined Doc	N/A				Disapprove	110
				Resolution Doc	N/A				Abstain	44
									Return%	71
				Comment					Approve%	49
				Pool						
38	TGf	Recirculation TGf	LB# 38	Draft	802.11f-D3.1.pdf	2002-05-08	2002-06-16	39	Pool	291
									Approve	221
				Redlined Doc	N/A				Disapprove	9
				Resolution Doc	N/A				Abstain	25
									Return%	88
				Comment	Template				Approve%	96
				Pool	LB# 38 Voters					
36	TGh	Technical TGh	LB# 36	Draft	P802_11H-D2_0.pdf	2002-03-26	2002-05-05	40	Pool	330
									Approve	165
				Redlined Doc	N/A				Disapprove	52
				Resolution Doc	N/A				Abstain	53
									Return%	82
				Comment					Approve%	76
				Pool						
35	TGi	Technical TGi	LB# 35	Draft	P802_11i-D2_0.pdf	2002-03-25	2002-05-04	40	Pool	338
									Approve	143
				Redlined Doc	N/A				Disapprove	43
				Resolution Doc	N/A				Abstain	78
									Return%	78
				Comment					Approve%	77
				Pool						
33	TGg	Technical TGg	LB# 33	Draft		2002-01-31	2002-03-11	39	Pool	286
									Approve	86
				Redlined Doc	N/A				Disapprove	104
				Resolution Doc	N/A				Abstain	41
									Return%	81

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LB	Group(s)	Comment(s)	Instructions	Document(s)		Opened	Closed	Days	Ballot Results	
				Comment					Approve%	45
				Pool						
32	TGf	Technical TGf	LB# 32	Draft		2002-01-29	2002-03-10	40	Pool	290
									Approve	145
				Redlined Doc	N/A				Disapprove	31
				Resolution Doc	N/A				Abstain	19
									Return%	67
				Comment					Approve%	82
				Pool						
30	TGe	Technical TGe	LB# 30	Draft		2001-12-05	2002-01-16	42	Pool	266
									Approve	101
				Redlined Doc	N/A				Disapprove	84
				Resolution Doc	N/A				Abstain	33
									Return%	82
				Comment					Approve%	55
				Pool						
29	TGh	Technical TGh	LB# 29	Draft		2001-07-25	2001-09-03	40	Pool	None
									Approve	None
				Redlined Doc	N/A				Disapprove	None
				Resolution Doc	N/A				Abstain	None
									Return%	0
				Comment					Approve%	None
				Pool						
28	TGf	Technical TGf	LB# 28	Draft		2001-07-25	2001-09-03	40	Pool	None
									Approve	None
				Redlined Doc	N/A				Disapprove	None
				Resolution Doc	N/A				Abstain	None
									Return%	0
				Comment					Approve%	None
				Pool						
27	TGe	Technical TGe	LB# 27	Draft		2001-04-05	2001-05-15	40	Pool	None
									Approve	None
				Redlined Doc	N/A				Disapprove	None
				Resolution Doc	N/A				Abstain	None
									Return%	0
				Comment					Approve%	None
				Pool						
26	TGf	Technical TGf	LB# 26	Draft		2001-04-05	2001-05-15	40	Pool	None
									Approve	None
				Redlined Doc	N/A				Disapprove	None
				Resolution Doc	N/A				Abstain	None
									Return%	0
				Comment					Approve%	None
				Pool						
22	TGd	Recirculation TGd	LB# 22	Draft		2000-06-12	2000-06-26	14	Pool	None
									Approve	None
				Redlined Doc	N/A				Disapprove	None
				Resolution Doc	N/A				Abstain	None
									Return%	0
				Comment					Approve%	None
				Pool						
21	TGd	Recirculation TGd	LB# 21	Draft		2000-03-27	2000-04-04	8	Pool	None
									Approve	None
				Redlined Doc	N/A				Disapprove	None
				Resolution Doc	N/A				Abstain	None
									Return%	0
				Comment					Approve%	None
				Pool						
15	TGb	Technical TGb	LB# 15	Draft		1998-09-30	1998-11-09	40	Pool	None
									Approve	None
				Redlined Doc	N/A				Disapprove	None
				Resolution Doc	N/A				Abstain	None
									Return%	0
				Comment					Approve%	None
				Pool						

IEEE Networking the World search email ieee sa ieee corporate IEEE 802

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Appendix BN

The Wayback Machine - https://web.archive.org/web/20160113115407/http://www.ieee802.org/11/Me…

IEEE 802.11 FUTURE SESSION PLANS

IEEE 802.11 WLAN WORKING GROUP SESSIONS

All interested parties are welcome to attend our open Public meetings of the IEEE 802.11 Working Group, you do not have to be an IEEE member to attend. There is a registration fee, to defray the cost of the session. At Plenary sessions these are administered by the IEEE 802 LMSC organization. Interim sessions are administered by the IEEE 802.11/15 Working Groups. This is in-addition to your individual hotel accommodation, and travel expenses. Click here to view an Example Plenary and Interim Session Agenda, or review the latest Combined Tentative Agenda for the next IEEE 802.11 WG Session below.

For Year 2016		Session	Type
January 17-22	Hyatt Regency Atlanta, Atlanta, GA, USA Session Information Registration Hotel Room Reservation	155	Interim*

Registration Fees & Deadlines

Early: Before 6:00 PM Pacific Time, Friday, December 4, 2015
* $US 375.00 for attendees staying at the Hyatt Regency Atlanta
* $US 575.00 for all others (including local attendees not staying at the group hotel)

Standard: After Early Registration and before 6:00 PM Pacific Time, Friday January 8, 2016
* $US 575.00 for attendees staying at the Hyatt Regency Atlanta
* $US 775.00 for all others (including local attendees not staying at the group hotel)

Late/On-site: After 6:00 PM Pacific Time Friday January 8, 2016
* $US 775.00 for attendees staying at the Hyatt Regency Atlanta
* $US 975.00 for all others (including local attendees not staying at the group hotel)

Student Registration: $US 150 (college students at the bachelor or post-graduate level)
* The Student meeting fee is available only one time per person.
* The person using the Student meeting fee will not be able to use meeting attendance to gain or maintain voting rights.
* A valid current student ID must be shown when picking up the meeting badge.

Hotel Room Rates

EARLY RATE: $US 179.00/Night (plus applicable taxes)*
Rate applies to first 50% of Room Block or until November 30, 2015 which ever comes first.
Single/Double Occupancy Run of House Rooms, Internet access included.

IEEE 802 RATE: $US 189.00/Night (plus applicable taxes)*
Rate applies to last 50% of Room Block or until January 4, 2016 which ever comes first.
Single/Double Occupancy Run of House Rooms, Internet access included.

EXTRA ADULTS: $US 10.00/Night (plus applicable taxes)
Rate applies to Extra Adults (>2).
Per Person,Per Night.

EXTENDED DATES:
Subject to availability the IEEE 802 Group Rate is available January 8th to 29th, 2016.

SUBJECT TO AVAILABILITY:
Rates subject to the deadline and availability of rooms in the IEEE 802 Group Room Block.

ROOM BLOCK DEADLINE:
January 4, 2016. If the block is sold out before the January 4, 2016 rates may no longer be available.

HOTEL CANCELLATION POLICY:
No penalty if reservation is cancelled prior to 6:00 PM Central Time on anticipated date of arrival.

Harbin, China

Hotel Details:
Hotel Name: Heilongjiang Trade Union Business Hotel (http://www.hljghds.com/h-index.html)
Hotel address: No. 333, Guogeli Street, Nan Gang, 150001 Harbin, China
Hotel contact: Mr. Shoudu SUN , shoudu263@263.net, +86-18686840022
Conference contact: Ms. Sha WEI, weisha@cesi.cn , +86-13810785724
Hotel Price: Business Queen Room:780RMB, Business Twin Room:880 RMB
For hotel reservation, please email to Mr. Shoudu SUN, and cc to Ms. Sha WEI

January 27-28 155.5 China Interim

Meeting Registration Details
Meeting registration fee :1800 RMB
Pay upon hotel check-in

Invitation Letter for Visa Application
Contact person: Ms. Meng ZHAO, meng.zhao@ieee.org , +86-15801384410
If you need an invitation letter for Visa application, please send your request to Ms. Meng ZHAO.

March 13-18 156 Plenary

Sands Venetian Hotel, Macau, PRC
Register for the sesion
Hotel Reservations
Session Information

Registration Fees & Deadlines

Standard Registration: Before 6:00 PM Pacific Time, Friday January 29, 2016
* $US 600.00 for attendees staying at the Sands Venetian Macao Hotel
* $US 1050.00 for all others (including local attendees not staying at the group hotel)

Late/On-site Registration: After 6:00 PM Pacific Time Friday January 29, 2016
* $US 800.00 for attendees staying at the Sands Venetian Macao Hotel
* $US 1250.00 for all others (including local attendees not staying at the group hotel)

Student Registration: $US 150 (college students at the bachelor or post-graduate level)
* The Student meeting fee is available only one time per person.
* The person using the Student meeting fee will not be able to use meeting attendance to gain or maintain voting rights.
* A valid current student ID must be shown when picking up the meeting badge.

Terms and conditions can be found on the information page.

IEEE 802 GROUP HOTEL ROOM RATE:

Single/Double Occupancy Royal Suite Rooms, Internet access included.

Friday March 11, 2016
* 1,700.00 HKD/MOP

Saturday March 12, 2016
* 2,300.00 HKD/MOP

Sunday March 13 - Thursday March 17, 2016
* 1,550.00 HKD/MOP

Friday March 18, 2016
* 1,700.00 HKD/MOP

Saturday March 19, 2016
* 2,300.00 HKD/MOP

Sunday March 20, 2016
* 1,550.00 HKD/MOP

These rates do not include any applicable service charges, Macau room tax, tourism tax and/or other taxes with similar application at the rate applicable at time of occupancy. Hotel will charge a 10% service charge and 5% Government Tax.

ROOM BLOCK DEADLINE:
If the block is sold out before February 12, 2016 IEEE 802 Group rates may no longer be available.

HOTEL CANCELLATION/CHANGE POLICY:
* Individual Guest Room Reservations may be changed or cancelled without charge up until 6:00 PM Pacific Time Friday February 12, 2016.
* A charge equivalent to full nights' accommodation, plus service charge and government tax, will be imposed on guest's guaranteed credit card for no show, amendments or cancellations received after 12 February 2016. No Refunds after February 12, 2016.

EXTENDED DATES:
Delegates request to extend their stay outside the agreed room block (Friday March 11th through Sunday March 20th), based upon hotel availability.

SUBJECT TO AVAILABILITY: *Rates are subject to the deadline and availability of rooms in the IEEE 802 Group Room Block.

How to Make a Room Reservation at Sands Venetian Macao Hotel

Reserve room online

Reserve a room by phone or email:
Phone# 853 2882 8852 Email: group.reservations@sands.com.mo
Ask for reservations and then ask for IEEE 802 Plenary Session Group Rate, code = "IEEE 802"

Do you Need A VISA to enter Macau?
A Visa is not required for most participants traveling to Macau. However we recommend visiting the following Macau government sites to determine if you need to obtain such a visa.
* Entrance Visa Required Countries List (http://www.fsm.gov.mo/psp/eng/AfMV.html)
* Exempt Countries List (http://www.fsm.gov.mo/psp/eng/EDoN.html#EDoN_VII)

May 15-20	Hilton Waikoloa Village, HI, USA	157	Interim*
May 25-26	Beijing, China	157.7	China Interim
July 24-29	Manchester Grand Hyatt, San Diego, CA, USA	158	Plenary
September 11-16	Marriott Warsaw	159	Interim*
September 28-29	Chongqing, China	159.5	China Interim
November 6-11	Grand Hyatt San Antonio, San Antonio, TX, USA	160	Plenary

For Year 2017		Session	Type
January 15-20	Hyatt Regency, Atlanta, GA, USA	161	Interim*
March 12-17	Hyatt Regency, Vancouver, BC, Canada	162	Plenary
May 14-19	Daejeon Convention Center, Daejeon, Korea (TBC)	163	Interim*
July 9-14	Estrel Hotel and Convention Center, Berlin, Germany	164	Plenary
September 10-15	Hilton Waikoloa Village, Kona, HI, USA	165	Interim*
November 5-10	Caribe Hotel and Convention Center, Orlando, FL, USA	166	Plenary

For Year 2018		Session	Type
January		167	Interim*
March 4-9 (TBC)	Hyatt Regency O'Hare, Rosemont, Illinois, USA	168	Plenary
May		169	Interim*
July	Manchester Grand Hyatt, San Diego, CA, USA	170	Plenary
September 9-14	Hilton Waikoloa Village, Kona, HI, USA	171	Interim*
November 11-16		172	Plenary

NOTES

China Interm - denotes an interim meeting of the IEEE 802.11 Working Group held in China, at which the only task group meeting is TGaj (China Millimetre Wave).

* *Denotes* - The IEEE 802.11 Working Group for Wireless Area Networks (WLANs) session is co-located with the IEEE 802.15 Working Group for Wireless Personal Area Networks (WPANs), IEEE 802.18 Technical Advisory Group for Radio Regulatory (R-REG), IEEE 802.19 Technical Advisory Group for Wireless Coexistence (COEX), IEEE 802.20 Working Group for Mobile Broadband Wireless Access (MBWA), IEEE 802.21 Working Group for Media Independent Handover Interoperability (MIHI), and IEEE 802.22 Working Group for Wireless Regional Area Networks (WRAN) sessions. A joint opening session with the five Working Groups and both the Technical Advisory Groups is normally carried out, at all Interim sessions.

GENERAL SESSION INFORMATION

- New attendees should check the agenda file for any new members orientation session. This session typically takes place on Sunday afternoon or Monday morning, and is intended to bring new attendees rapidly up to speed with how to operate effectively within the group.
- The Online Tentative Session Agenda displayed is always subject to change, after review at the start of the Full Working Group session for each meeting, and may be revised during the week to incorporate any necessary work.
- All Working Group sessions start promptly on time, as detailed in the session agenda.
- Attendees should bring a Laptop computer (or other small form factor computing device) equipped with 802.11 connectivity for use at the meetings. This is needed to access meeting documents and draft standards and to record meeting attendance.
- The Working Group operates under a hierarchy of IEEE, IEEE-SA, IEEE LMSC and 802.11 policies and procedures as described in http://www.ieee802.org/11/Rules/rules.shtml. You are deemed to be aware of and compliant to these rules by your participation in an 802.11 meeting.

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Appendix BO

SUMMARY REPORTS & MINUTES OF 802.11 WG SESSIONS

IEEE 802.11 WLAN WORKING GROUP SESSIONS

As our sessions are open to the public, all interested parties are welcome to attend IEEE P802.11 Working Group sessions, for which there is a registration fee, to defray the cost of the session. At Plenary sessions this is administered by the IEEE P802 LMSC organization. Whereas, the Interim sessions are normally managed by our sponsoring host. This is in-addition to your individual hotel accommodation, and travel expenses. Click here to view Example Plenary and Interim Session Agenda.

Session	Date	Month	File URL or Doc# Report	Minutes	Location	Place	Type
For Year 2025							
210	8th - 14th	March	Report		Hilton Atlanta	Atlanta GA USA	Plenary
209	12th - 17th	January	Report	Minutes	Kobe Convention Center	Kobe Japan	Interim
For Year 2024							
208	10th - 15th	November	Report	Minutes	Hyatt Regency	Vancouver BC Canada	Plenary
207	8th - 13th	September	Report	Minutes	Hilton Waikoloa Village	Waikoloa HI USA	Interim
206	14th - 19th	July	Report	Minutes	Sheraton Le Centre	Montreal QC Canada	Plenary
205	12th - 17th	May	Report	Minutes	Warsaw Marriott	Warsaw Poland	Interim
204	10th - 15th	March	Report	Minutes	Hyatt Regency	Denver CO USA	Plenary
203	14th - 19th	January	Report	Minutes	Hilton Panama	Panama City Panama	Interim
For Year 2023							
202	12th - 17th	November	Report	Minutes	Hilton Hawaiian Village Waikiki	Honolulu HI USA	Plenary
201	10th - 15th	September	Report	Minutes	Grand Hyatt	Atlanta GA USA	Interim
200	9th - 14th	July	Report	Minutes	Estrel	Berlin Germany	Plenary
199	14th - 19th	May	Report	Minutes	Hilton Orlando Lake Buena Vista	Orlando FL USA	Interim
198	12th - 17th	March	Report	Minutes	Hilton Atlanta	Atlanta GA USA	Plenary
197	15th - 20th	January	Report	Minutes	Hilton Inner Harbor	Baltimore MD USA	Interim
For Year 2022							
196	13th - 18th	November	Report	Minutes	Marriott Marquis Queen's Park	Bangkok Thailand	Plenary
195	11th - 16th	September	Report	Minutes	Hilton Waikoloa Village	Waikoloa HI USA	Interim
194	10th - 15th	July	Report	Minutes	Marriott	Montreal QC Canada	Plenary
193	8th - 13th	May	Report	Minutes	Online	Online	Interim
192	7th - 15th	March	Report	Minutes	Online	Online	Plenary
191	17th - 25th	January	Report	Minutes	Online	Online	Interim
For Year 2021							
190	8th - 16th	November	Report	Minutes	Online	Online	Plenary
189	13th - 21st	September	Report	Minutes	Online	Online	Interim
188	12th - 20th	July	Report	Minutes	Online	Online	Plenary
187	10th - 18th	May	Report	Minutes	Online	Online	Interim
186	8th - 16th	March	Report	Minutes	Online	Online	Plenary
185	11th - 15th	January	Report	Minutes	Online	Online	Interim
For Year 2020							
184	2nd - 10th	November	Report	Minutes	Online	Online	Plenary
183	13th - 17th	September	Report	Minutes	Online	Online	Interim
182	13th - 16th	July	Report	Minutes	Online	Online	Plenary
181	10th - 15th	May	Cancelled Session		Marriott	Warsaw Poland	Interim
180	15th - 20th	March	Cancelled Session		Hilton Atlanta	Atlanta GA USA	Plenary
179	12th - 17th	January	Report	Minutes	Hotel Irvine	Irvine CA USA	Interim
For Year 2019							
178	11th - 15th	November	Report	Minutes	Hilton Waikoloa Village	Waikoloa HI USA	Plenary
177	16th - 20th	September	Report	Minutes	JW Marriott	Hanoi Vietnam	Interim
176	15th - 19th	July	Report	Minutes	Austria Center Vienna	Vienna Austria	Plenary
175	13th - 17th	May	Report	Minutes	Grand Hyatt	Atlanta GA USA	Interim

n/a Denotes - Not Applicable.

IEEE 802.11 WLAN WORKING GROUP SESSIONS

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Session	Date	Month	File URL or Doc# Report	Minutes	Location	Place	Type
174	11th - 15th	March	Report	Minutes	Hyatt Regency	Vancouver BC Canada	Plenary
173	14th - 18th	January	Report	Minutes	Hilton at the ball park	St Louis MO USA	Interim
For Year 2018							
172	12th - 16th	November	Report	Minutes	Marriott Marquis Queen's Park	Bangkok Thailand	Plenary
171	10th - 14th	September	Report	Minutes	Hilton Waikoloa Village	Waikoloa HI USA	Interim
170	9th - 13th	July	Report	Minutes	Manchester Grand Hyatt	San Diego CA USA	Plenary
169	7th - 11th	May	Report	Minutes	Marriott	Warsaw Poland	Interim
168	5th - 9th	March	Report	Minutes	Hyatt Regency O'Hare	Rosemont IL USA	Plenary
167	15th - 19th	January	Report	Minutes	Hotel Irvine	Irvine CA USA	Interim
For Year 2017							
166	6th - 10th	November	Report	Minutes	Caribe Royale	Orlando FL USA	Plenary
165	11th - 15th	September	Report	Minutes	Hilton Waikoloa Village	Waikoloa HI USA	Interim
164	9th - 14th	July	Report	Minutes	Estrel	Berlin Germany	Plenary
163	8th - 12th	May	Report	Minutes	Lotte	Daejeon South Korea	Interim
162	13th - 17th	March	Report	Minutes	Hyatt Regency	Vancouver BC Canada	Plenary
161	16th - 20th	January	Report	Minutes	Grand Hyatt	Atlanta GA USA	Interim
For Year 2016							
160	7th - 11th	November	Report	Minutes	Grand Hyatt	San Antonio TX USA	Plenary
159	12th - 16th	September	Report	Minutes	Marriott	Warsaw Poland	Interim
158	25th - 29th	July	Report	Minutes	Manchester Grand Hyatt	San Diego CA USA	Plenary
157	16th - 20th	May	Report	Minutes	Hilton Waikoloa Village	Waikoloa HI USA	Interim
156	14th - 18th	March	Report	Minutes	Venetian	Macau	Plenary
155.5	27th - 27th	January	Report	Minutes	Heilongjiang Trade Union Hotel	Harbin China	Interim
155	18th - 22nd	January	Report	Minutes	Hyatt Regency	Atlanta GA USA	Interim
For Year 2015							
154	9th - 13th	November	Report	Minutes	Hyatt Regency	Dallas TX USA	Plenary
153	14th - 18th	September	Report	Minutes	Centara Grand	Bangkok Thailand	Interim
152	13th - 17th	July	Report	Minutes	Hilton Waikoloa Village	Waikoloa HI USA	Plenary
151.5	19th - 20th	May	Report	Minutes	Zhuhai Dehan	Zhuhai China	Interim
151	11th - 15th	May	Report	Minutes	Hyatt Regency	Vancouver BC Canada	Interim
150	9th - 13th	March	Report	Minutes	Estrel	Berlin Germany	Plenary
149.5	21st - 22nd	January	Report	Minutes	Kempinski	Xiamen China	Interim
149	11th - 16th	January	Report	Minutes	Hyatt Regency	Atlanta GA USA	Interim
For Year 2014							
148	2nd - 7th	November	Report	Minutes	Grand Hyatt	San Antonio TX USA	Plenary
147	14th - 19th	September	Report	Minutes	Hilton Athens	Athens Greece	Interim
146.5	9th - 10th	September	Report	Minutes	Sofitel Luxury	Chengdu China	Interim
146	13th - 18th	July	Report	Minutes	Manchester Hyatt	San Diego CA USA	Plenary
145.5	21st - 22nd	May	Report	Minutes	New Century	Beijing China	Interim
145	11th - 16th	May	Report	Minutes	Hilton Waikoloa Village	Waikoloa HI USA	Interim
144	16th - 21st	March	Report	Minutes	China World	Beijing China	Plenary
143.5	8th - 9th	January	Report	Minutes	Howard Johnson Resort	Sanya China	Interim
143	19th - 24th	January	Report	Minutes	Hyatt Century Plaza	Los Angeles CA USA	Interim
For Year 2013							
142	10th - 15th	November	Report	Minutes	Hyatt Regency	Dallas TX USA	Plenary
141	15th - 20th	September	Report	Minutes	Zhong Shan	Nanjing China	Interim

n/a Denotes - Not Applicable.

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Session	Date	Month	File URL or Doc# Report	Minutes	Location	Place	Type
140	14th - 19th	July	Report	Minutes	ITU Headquarters	Geneva Switzerland	Plenary
139	11th - 17th	May	Report	Minutes	Hilton Waikoloa Village	Waikoloa HI USA	Interim
138.5	24th - 25th	April	Report	Minutes	Nikko New Century	Beijing China	Interim
138	17th - 22nd	March	Report	Minutes	Caribe Royale	Orlando FL USA	Plenary
137.5	23rd - 24th	January	Report	Minutes	Grand Mercure Oriental Ginza	Shenzhen China	Interim
137	12th - 18th	January	Report	Minutes	Hyatt Regency	Vancouver BC Canada	Interim
For Year 2012							
136	12th - 16th	November	Report	Minutes	Grand Hyatt	San Antonio TX USA	Plenary
135.5	26th - 27th	September	Report	Minutes	Nikko New Century	Beijing China	Interim
135	16th - 21st	September	Report	Minutes	Hyatt Regency	Indian Wells CA USA	Interim
134	14th - 20th	July	Report	Minutes	Manchester Grand Hyatt	San Diego CA USA	Plenary
133	13th - 18th	May	Report	Minutes	Hyatt Regency	Atlanta GA USA	Interim
132	11th - 16th	March	Report	Minutes	Hilton Waikoloa Village	Waikoloa HI USA	Plenary
131	15th - 20th	January	Report	Minutes	Hyatt Regency	Jacksonville FL USA	Interim
For Year 2011							
130	6th - 11th	November	Report	Minutes	Hyatt Regency	Atlanta GA USA	Plenary
129	18th - 23rd	September	Report	Minutes	Okinawa Convention Center	Okinawa Japan	Interim
128	17th - 22nd	July	Report	Minutes	Hyatt Regency	San Francisco CA USA	Plenary
127	8th - 13th	May	Report	Minutes	Hyatt Grand Champion	Indian Wells CA USA	Interim
126	13th - 18th	March	Report	Minutes	Marina Bay Sands	Singapore	Plenary
125	16th - 21st	January	Report	Minutes	Hyatt Century Plaza	Los Angeles CA USA	Interim
For Year 2010							
124	7th - 12th	November	Report	Minutes	Hyatt Regency	Dallas TX USA	Plenary
123	12th - 17th	September	Report	Minutes	Hilton Waikoloa Village	Waikoloa HI USA	Interim
122	11th - 16th	July	Report	Minutes	Manchester Grand Hyatt	San Diego CA USA	Plenary
121	16th - 21st	May	Report	Minutes	China World	Beijing PRC	Interim
120	14th - 19th	March	Report	Minutes	Caribe Royale	Orlando FL USA	Plenary
119	17th - 22nd	January	Report	Minutes	Hyatt Century Plaza	Los Angeles CA USA	Interim
For Year 2009							
118	15th - 20th	November	Report	Minutes	Hyatt Regency	Atlanta GA USA	Plenary
117	20th - 25th	September	Report	Minutes	Hilton Waikoloa Village	Waikoloa HI USA	Interim
116	12th - 17th	July	Report	Minutes	Hyatt Regency	San Francisco CA USA	Plenary
115	10th - 15th	May	Report	Minutes	Fairmont The Queen Elizabeth	Montreal PQ Canada	Interim
114	8th - 13th	March	Report	Minutes	Hyatt Regency	Vancouver BC Canada	Plenary
113	18th - 23rd	January	Report	Minutes	Hyatt Century Plaza	Los Angeles CA USA	Interim
For Year 2008							
112	9th - 14th	November	Report	Minutes	Hyatt Regency	Dallas TX USA	Plenary
111	7th - 12th	September	Report	Minutes	Hilton Waikoloa Village	Waikoloa HI USA	Interim
110	13th - 18th	July	Report	Minutes	Hyatt Regency	Denver CO USA	Plenary
109	11th - 16th	May	Report	Minutes	Hyatt Regency	Jacksonville FL USA	Interim
108	16th - 21st	March	Report	Minutes	Caribe Royale	Orlando FL USA	Plenary
107	13th - 18th	January	Report	Minutes	Howard Plaza	Taipei Taiwan ROC	Interim
For Year 2007							
106	11th - 16th	November	Report	Minutes	Hyatt Regency	Atlanta GA USA	Plenary
105	16th - 21st	September	Report	Minutes	Hilton Waikoloa Village	Waikoloa HI USA	Interim
104	15th - 20th	July	Report	Minutes	Hyatt Regency	San Francisco CA USA	Plenary

n/a Denotes - Not Applicable.

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Session	Date	Month	File URL or Doc# Report	Minutes	Location	Place	Type
103	13th - 18th	May	Report	Minutes	Fairmont The Queen Elizabeth	Montreal PQ Canada	Interim
102	11th - 16th	March	Report	Minutes	Caribe Royale	Orlando FL USA	Plenary
101	14th - 19th	January	Report	Minutes	Hilton London Metropole	London United Kingdom	Interim
For Year 2006							
100	13th - 17th	November	Report	Minutes	Hyatt Regency	Dallas TX USA	Plenary
99	17th - 22nd	September	Report	Minutes	Exhibition Convention Centre	Melbourne Victoria Australia	Interim
98	16th - 21st	July	Report	Minutes	Manchester Grand Hyatt	San Diego CA USA	Plenary
97	15th - 19th	May	Report	Minutes	Hyatt Regency	Jacksonville FL USA	Interim
96	6th - 10th	March	Report	Minutes	Hyatt Regency	Denver CO USA	Plenary
95	15th - 20th	January	Report	Minutes	Hilton Waikoloa Village	Waikoloa HI USA	Interim
For Year 2005							
94	13th - 18th	November	Report	Minutes	Hyatt Regency	Vancouver BC Canada	Plenary
93	18th - 23rd	September	Report	Minutes	Hyatt Regency	Garden Grove CA USA	Interim
92	17th - 22nd	July	Report	Minutes	Hyatt Regency	San Francisco CA USA	Plenary
91	15th - 20th	May	Report	Minutes	Cairns Convention Centre	Cairns Queensland Australia	Interim
90	13th - 18th	March	Report	Minutes	Hyatt Regency	Atlanta GA USA	Plenary
89	16th - 21st	January	Report	Minutes	Hyatt Regency	Monterey CA USA	Interim
For Year 2004							
88	15th - 19th	November	Report	Minutes	Hyatt Regency	San Antonio TX USA	Plenary
87	12th - 17th	September	Report	Minutes	Estrel Hotel Berlin	Berlin Germany	Interim
86	12th - 16th	July	Report	Minutes	Portland Hilton	Portland OR USA	Plenary
85	9th - 14th	May	Report	Minutes	Hyatt Regency	Garden Grove CA USA	Interim
84	14th - 19th	March	Report	Minutes	Hilton in Walt Disney World	Lake Buena Vista FL USA	Plenary
83	11th - 16th	January	Report	Minutes	Hyatt Regency	Vancouver BC Canada	Interim
For Year 2003							
82	10th - 14th	November	Report	Minutes	Hyatt Regency	Albuquerque NM USA	Plenary
81	15th - 19th	September	Report	Minutes	Swisstel The Stamford	Singapore	Interim
80	20th - 25th	July	Report	Minutes	Hyatt Regency	San Francisco CA USA	Plenary
79	12th - 16th	May	Report	Minutes	Hyatt Regency	Dallas/Ft Worth Airport TX USA	Interim
78	10th - 14th	March	Report	Minutes	Hyatt Regency	Dallas/Ft Worth Airport TX USA	Plenary
77	13th - 17th	January	Report	Minutes	Fort Lauderdale Marina Marriott	Fort Lauderdale FL USA	Interim
For Year 2002							
76	11th - 15th	November	Report	Minutes	Hyatt Regency	Kauai HI USA	Plenary
75	9th - 13th	September	Report	Minutes	Hyatt Regency	Monterey CA USA	Interim
74	8th - 12th	July	Report	Minutes	Hyatt Regency	Vancouver BC Canada	Plenary
73	13th - 17th	May	Report	Minutes	Wentworth Sydney Hotel	Sydney NSW Australia	Interim
72	11th - 15th	March	Report	Minutes	Hyatt Regency	St. Louis MO USA	Plenary
71	21st - 25th	January	Report	Minutes	Wyndham Anatole Hotel	Dallas TX USA	Interim
For Year 2001							
70	11th - 16th	November	Report	Minutes	Hyatt Regency	Austin TX USA	Plenary
69	17th - 21st	September	Cancelled Session		Hyatt Regency	Bellevue WA USA	Interim
68	9th - 13th	July	Report	Minutes	Portland Marriott Downtown	Portland OR USA	Plenary
67	14th - 18th	May	Report	Minutes	Radisson at Universal Orlando	Orlando FL USA	Interim
66	12th - 16th	March	Report	Minutes	Marriott Resort	Hilton Head SC USA	Plenary
65	15th - 19th	January	Report	Minutes	Hyatt Regency Resort	Monterey CA USA	Interim
For Year 2000							

n/a Denotes - Not Applicable.

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Session	Date	Month	File URL or Doc# Report	Minutes	Location	Place	Type
64	13th - 17th	November	Report	Minutes	Hyatt Regency	Tampa FL USA	Plenary
63	18th - 22nd	September	Report	Minutes	Radisson Resort Spa	Scottsdale AZ USA	Interim
62	10th - 14th	July	Report	Minutes	Hyatt Regency	La Jolla CA USA	Plenary
61	8th - 12th	May	Report	Minutes	Renaissance Madison Hotel	Seattle WA USA	Interim
60	6th - 10th	March	Report	Minutes	Hyatt Regency	Albuquerque NM USA	Plenary
59	10th - 14th	January	Report	Minutes	David Intercontinental Hotel	Tel Aviv Israel	Interim
For Year 1999							
58	8th - 12th	November	Report	Minutes	Hyatt Regency	Kauai HI USA	Plenary
57	13th - 17th	September	Report	Minutes	Hilton Sonoma County	Santa Rosa CA USA	Interim
56	5th - 9th	July	Report	Minutes	Queen Elizabeth	Montreal PQ Canada	Plenary
55	3rd - 7th	May	Report	Minutes	Makuhari Prince Hotel	Chiba Japan	Interim
54	8th - 12th	March	Report	Minutes	Hyatt Regency	Austin TX USA	Plenary
53	11th - 15th	January	Report	Minutes	Grosvenor	Lake Buena Vista FL USA	Interim
For Year 1998							
52	9th - 13th	November	n/a	Minutes	Hyatt Regency	Albuquerque NM USA	Plenary
51	1st - 1st	October	n/a	Minutes	Hyatt Regency	Atlanta GA USA	Special
50	14th - 18th	September	n/a	Minutes	Westford Regency Inn	Westford MA USA	Interim
49	6th - 11th	July	n/a	Minutes	Hyatt Regency	La Jolla CA USA	Plenary
48	19th - 21st	May	n/a	Minutes	Sheraton Grand	Irving TX USA	Special
47	8th - 9th	April	n/a	Minutes	Boston Marriott	Cambridge MA USA	Special
46	4th - 8th	May	n/a	Minutes	Holiday Inn	Utrecht Nederlands	Interim
45	9th - 13th	March	n/a	Minutes	Hyatt Regency	Irvine CA USA	Plenary
44	19th - 23rd	January	n/a	Minutes	Embassy Suites	Lynnwood WA USA	Interim
For Year 1997							
43	10th - 14th	November	n/a	Minutes	Queen Elizabeth	Montreal PQ Canada	Plenary
42	8th - 12th	September	n/a	Minutes	Grafton Radisson Edwardian	London United Kingdom	Interim
41	6th - 11th	July	n/a	Minutes	Hyatt Regency	Maui HI USA	Plenary
40	7th - 9th	May	n/a	Minutes	AMD Facility	Sunnyvale CA USA	Interim
39	10th - 14th	March	n/a	Minutes	Marriott	Irvine CA USA	Plenary
38	13th - 17th	January	n/a	Minutes	Harris Facility	Palm Bay FL USA	Interim
For Year 1996							
37	11th - 14th	November	n/a	Minutes	Hotel Vancouver	Vancouver BC Canada	Plenary
36	8th - 12th	July	n/a	Minutes	Various Campus Locations	Twente University Nederlands	Plenary
35	6th - 9th	May	n/a	Minutes	Westin	Waltham MA USA	Interim
34	11th - 15th	March	n/a	Minutes	Hyatt Regency	La Jolla CA USA	Plenary
33	8th - 12th	January	n/a	Minutes	Westgate Hotel	San Diego CA USA	Interim
For Year 1995							
32	6th - 9th	November	n/a	Minutes	Queen Elizabeth	Montreal PQ Canada	Plenary
31	28th - 31st	August	n/a	Minutes	Marriott	Schaumburg IL USA	Interim
30	10th - 13th	July	n/a	Minutes	Hyatt Regency	Maui HI USA	Plenary
29	8th - 11th	May	n/a	Minutes	Hilton Inn	Salt Lake City UT USA	Interim
28	6th - 10th	March	n/a	Minutes	Ramada Resort	West Palm Beach FL USA	Plenary
27	9th - 12th	January	n/a	Minutes	LeBaron	San Jose CA USA	Interim
For Year 1994							
26	7th - 11th	November	n/a	Minutes	Hyatt Regency	Incline Village NV USA	Plenary
25	29th - 1st	Aug / Sep	n/a	Minutes	Marriott Rivercenter	San Antonio TX USA	Interim

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Session	Date	Month	File URL or Doc# Report	Minutes	Location	Place	Type
24	11th - 15th	July	n/a	Minutes	Walt Disney World Swan	Orlando FL USA	Plenary
23	9th - 12th	May	n/a	Minutes	Holiday Inn	Oshawa ON Canada	Interim
22	7th - 11th	March	n/a	Minutes	Hotel Vancouver	Vancouver BC Canada	Plenary
21	10th - 13th	January	n/a	Minutes	LeBaron	San Jose CA USA	Interim
For Year 1993							
20	8th - 12th	November	n/a	Minutes	Ramada	West Palm Beach FL USA	Plenary
19	20th - 23rd	September	n/a	Minutes	Wyndham Garden	Atlanta GA USA	Interim
18	12th - 15th	July	n/a	Minutes	Sheraton	Denver CO USA	Plenary
17	10th - 13th	May	n/a	Minutes	Holiday Inn	Wilmington DE USA	Interim
16	8th - 12th	March	n/a	Minutes	Omni Inner Harbor	Baltimore MD USA	Plenary
15	11th - 14th	January	n/a	Minutes	Ramada	Agoura Hills CA USA	Interim
For Year 1992							
14	9th - 12th	November	n/a	.doc .pdf	Hyatt Regency	La Jolla CA USA	Plenary
13	14th - 17th	September	n/a	.doc .pdf	Hilton	Dayton OH USA	Interim
12	6th - 9th	July	n/a	.doc .pdf	Radisson	Minneapolis MN USA	Plenary
11	11th - 14th	May	n/a	.doc .pdf	Holiday Inn	Leiden Nederlands	Interim
10	9th - 12th	March	n/a	.doc .pdf	Marriott	Irvine CA USA	Plenary
9	13th - 16th	January	n/a	.doc .pdf	Omni Europe	Chapel Hill NC USA	Interim
For Year 1991							
8	11th - 15th	November	n/a	.doc .pdf	Crown Sterling Suites	Ft. Lauderdale FL USA	Plenary
7	8th - 12th	September	n/a	.doc .pdf	Hyatt Regency	Palo Alto CA USA	Interim
6	8th - 11th	July	n/a	.doc .pdf	Hyatt Regency	Kauai HI USA	Plenary
5	6th - 9th	May	n/a	.doc .pdf	Marriott	Worcester MA USA	Interim
4	11th - 14th	March	n/a	.doc .pdf	Westin Resort	Hilton Head SC USA	Plenary
3	7th - 10th	January	n/a	.doc .pdf	Compri hotel	Gaithersburg MD USA	Interim
For Year 1990							
2	12th - 16th	November	n/a	.doc .pdf	Hyatt Regency	La Jolla CA USA	Plenary
1	10th - 14th	September	n/a	.doc .pdf	Holiday Inn	Oshawa ON Canada	Interim

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Appendix BP

Explanations for CR on 27.5.2.7 NDP feedback report

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1679

Background (1)

- **It is well accepted that being able to get a very short simultaneous feedback from a high number of STAs (all STAs) improve the 11ax system and power efficiencies [1], [3]**
  - Many feedbacks require 1 bit: PS-Poll (power efficiency), Channel Availability (collisions avoidance)
  - Other feedbacks could be 2 bit. For example: “How many buffered Bytes for transmission: 0, 1 to 1000, 1000 to 5000, > 5000 ?”
  - A short simultaneous resource request feedback (1 or several bits) capable of supporting a high number of STAs is needed for an efficient UL MU simultaneous scheduling in addition to the existing (or enhanced) piggybacked buffer information
  - Less overhead for resource request feedback than polling method
  - Low and stable latency for resource request feedback, compared to possibly high and unpredictable latency with CSMA-CA in dense environments

1680

Background (2)

- In Nov. 2016, added subclause 25.5.2.7 to the spec:

25.5.2.7 NDP feedback report procedure

The NDP feedback report is a mechanism for an HE AP to collect short feedbacks from a very high number of HE STAs, in an efficient manner. The feedbacks (e.g. resource requests) are sent without data payloads in response to a Trigger frame. The feedbacks are not for channel sounding. This mechanism is optional for non-AP STA.

1681

- But details of the NDP feedback mechanism are TBD

- Contribution 44r1 proposes a signaling technique for the NDP feedback mechanism that can handle a high number of STAs and is power and air time efficient
- This contribution proposes to define a new trigger type for NDP feedback report and the procedure for an HE non-AP STA to know, based on the trigger frame, if it can respond and what parameters to use to respond

Trigger frame proposal

- We propose to define a new trigger type for NDP feedback report
  - This is the cleanest solution, as specific common info field parameters are needed for this mechanism and as this mechanism should be generic and work for multiple types of feedbacks

1682

- We propose that this trigger type contains all the information so that:
  - STAs can know if they are scheduled
  - STAs can know on which allocation they can transmit their response, that allocation being unique
  - STAs can know what is the type of feedback that is requested and how many bits for the feedback

Proposed design for the trigger frame

- Use information in common info field and trigger dependent common info field.

1683

	Feedback type	Feedback size	Scheduling Type	GroupID	Starting STA	Probe request option	Target RSSI	Number of users per set of tones	Duplicate	Ressource request buffer threshold
Bits:	4	8		6	11	1	7	2	1	4

Trigger dependent common info field

Feedback types

- We propose to define types of feedback, and a field to identify the type
  - We define the resource request type
  - We can then easily define others

- For each feedback type, we can define and limit the modes of operation:
  - number of bits of feedback
    - For instance, if feedback type is resource request, it has to be a 1-bit feedback and the mapping is the following
    - For a 1-bit feedback, PHY design allows to have 3 states
      - a state with no-response
      - A state with a bit received with a value of 0
        - Defines a resource request for a small payload
      - A state with a bit received with a value of 1
        - Defines a resource request for a larger payload
  - Mode for selecting the scheduled users
    - Range of AIDs
    - GroupID

b0 Value	Description
0	Resource request with buffered bytes for transmission between 1 and "resource_request_buffer_threshold"
1	Resource request with buffered bytes for transmission above "resource_request_buffer_threshold"

Feedback types

- With this solution, it is also possible to define multiple feedbacks
  - Some feedback type indexes are associated with a single pre-defined feedback
  - Some feedback type indexes can be associated with multiple pre-defined feedbacks
- For each index, there is a clear spec sub-section that describes how the bits are assigned to each feedback (including the number of bits) and how to encode them

1685

Scheduling the STAs with range of AID

- *If Scheduling type field is set to zero, the STAs are scheduled with a range of AIDs*
- The trigger frame identifies the group of STAs that can respond:
- This is done by defining a range of consecutive AIDs, by using:
  - Starting STA field in the trigger frame
  - And the parameters to know how many AIDs are scheduled (NAIDs)
- The STAs whose AID is between Starting STA and Starting STA + NAIDs are scheduled
  - The index of the STA AID compared to Starting STA is used to know the allocation
- This allows:
  - Unique allocation per AID
  - No need for assigning the allocation in a static manner with any other frame exchanges
  - Starting STA field allows to define different groups of STAs and target the AID range that associated STAs are using

1686

Scheduling the STAs with groupID

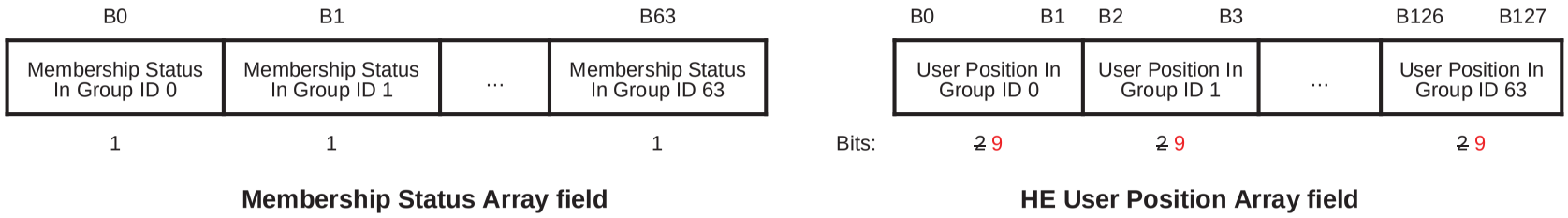
- *If Scheduling type field is set to 1, the STAs are scheduled with groupID*
- The trigger frame identifies the group of STAs that can respond:
  - The groupID field is set to a predefined group ID
  - The Starting STA field indicates at which index in the group the range of STAs are scheduled
  - STAs that belong to the group and whose index is between Starting STA and Starting STA + NAIDs are scheduled
  - The index of the STA in the groupID compared to Starting STA is used to know the allocation

1687

GroupID management

- We propose to enable group management as in 11ac
  - Frame unicasted to a STA to indicate to which group it is a member and the position of that STA in these groups.
  - 9 bits to indicate groups positions (instead of 2 with 11ac)

- For this, we propose to define a new HE Group ID Management frame (HE action frame)
  - It replicates 11ax groupID management
  - It includes Membership status array field already defined in 9.4.1.54
  - It includes a new HE user Position Array field (see below with the changes compared to User Position Array field used in 11ac)



1688

Deriving parameters for transmission of the response (allocation)

- The response follows the UL MU operation
- The parameters of the trigger-based PPDU are derived from the trigger frame, and each AID has a unique combination of:
  - 242 RU allocation
  - Tone sets allocations within each RU
  - NUM_STS

1689

- These are calculated based on:
  - AID range option: index “AID-AID start” and parameters from trigger frame: feedback size, BW, number of users per set of tones
  - Group ID: index “STA position in the group – Index start” and parameters from trigger frame: feedback size, BW, number of users per set of tones

Deriving parameters for transmission of the response (allocation)

- STAs are assigned in order depending on their AID or GroupID index, starting from Starting STA:
  - Assign all frequency allocations on the whole bandwidth using SS1 first
    - 18 first STAs for a 20MHz BW
    - 36 first STAs for a 40MHz BW (if duplicate =0)
  - Then assign the following STAs using incremented SSs.
    - Next 18 STAs are assigned the same allocations but with SS2

- For BW > 20MHz:
  - If duplicate field is equal to 0, allocations in frequency are done in order on the whole bandwidth
    - 18 first STAs in the first 20MHz, 18 following STAs in the second 20MHz…
  - If duplicate field is equal to 1, the same set of users are assigned the same allocation in each 20MHz

Example of user mapping

		Pm-c1	Pm-c2
242 RU1	TS0	0	36
	TS1	1	37
	...	...	...
	TS18	17	53
242 RU2	TS0	18	54
	TS1	19	55
	...	...	...
	TS18	35	71

40MHz – 2 P-matrix codes

		Pm-c1	Pm-c2
RU1	TS0	0	72
	TS1	1	73
	...	...	...
	TS18	17	89
RU2	TS0	18	90
	TS1	19	91
	...	...	...
	TS18	35	107
RU3	TS0	36	108
	TS1	37	109
	...	...	...
	TS18	53	125
RU4	TS0	54	126
	TS1	55	127
	...	...	...
	TS18	71	143

80MHz – 2 P-matrix codes

1691

Power control

- TargetRSSI is included in the trigger dependent common info field
- This enables power control with the same target for all STAs

1692

Specific mode for request for probe response

- *groupID* field set to the value of a groupID
- Associated STAs belonging to the signaled group ID shall respond as explained in previous slides.
- If the field “probe request option” is set to 1, it indicates that the last available allocation is assigned for non-associated STAs to **send single bit indicating probe request**.
  - This may be useful in HD/VHD deployments, such as stadiums or malls.
- The AP shall make sure that there is one allocation at the end of the bitmap not assigned to the STAs belonging to the groupID
- Non-zero value of the allocation assigned for probe requests in the received NDP feedback indicates that at least one STA requested a Probe Response frame.
- A single Probe Response shall be transmitted by the AP with the Addr1 set to Broadcast Address allowing all the non-associated STAs that transmitted the single-bit probe request to receive the probe response, preventing multiple APs from transmitting a probe-response.

1693

Summary

- We propose to progress on the definition of the NDP feedback report procedure
  - New trigger type
  - Parameters to identify the scheduled STAs
  - Parameters for scheduled STAs to derive the parameters for the response
  - Resource request type

1694

Straw Poll 2bis

- Which option do you prefer?
  - STAs scheduled by a NDP feedback report trigger frame variant with a feedback type set to “resource request” are identified by:
    - Option 1: a single mode: a range of AIDs
    - Option 2: 2 modes: a mode with a range of AIDs and a mode with groupID

1695

Straw Poll 2

- Do you agree to define a new NDP feedback report trigger frame variant

1696

Strawpoll #3

- Do you agree to define that the STAs scheduled by a NDP feedback report trigger frame variant with a feedback type set to “resource request” are identified by
  - Option 1: one range of AIDs
  - Option 2: one or multiple ranges of AIDs

  Note: A range of AIDs is defined to be between AID start and AID start + NAIDs - 1. The trigger frame includes the AID start parameter and the needed parameters to calculate NAIDs

1697

1698

Straw Poll #3

- Do you agree that the RU allocation, RU tone set allocation and starting_STS_num for the NDP feedback response from an HE non-AP STA are calculated based on common parameters in the new NDP feedback report trigger frame variant. A “duplicate” field is defined in the new NDP feedback report trigger frame variant to indicate that STAs allocation are calculated on with a 20MHz bandwidth and are duplicated on the other 20MHz channels

1699

Straw Poll #4

- Do you agree that, for resource request feedback type:
  - The feedback size is set to “1 bit” only
  - The NDP feedback report trigger frame variant has a field called “resource request buffer threshold”
  - Scheduled STAs send a 0 for the NDP feedback report to indicate a resource request with buffer size below the “resource request buffer threshold”
  - Scheduled STAs send a 1 for the NDP feedback report to indicate a resource request with buffer size above the “resource request buffer threshold”

1700

Straw Poll #5

- Do you agree with the mode defined in slide 20 to allocate one allocation to all unassociated STAs to make a request for a transmission by the AP of a probe response.

1701

References

[1] IEEE 802.11-16/1367r0: NDP feedback report

[2] IEEE 802.11-15/1334r1: HE-LTF sequence design

[3] IEEE 11-17-0044-00-00ax-NDP short feedback design

1702

Straw Poll #4bis

- Which option do you prefer:
- The “resource request buffer threshold” allows to make 2 levels of resource requests, one for a payload smaller than the threshold, one for a payload higher than the threshold
  - Option 1: The “resource request buffer threshold” is indicated in the eliciting NDP feedback report poll trigger frame
  - Option 2: The “resource request buffer threshold” is indicated in an IE sent by the AP

1703

Annex – PHY design currently proposed

How to define the NDP feedback mechanism?

- UL MU transmission in response to a trigger frame
- Use frequency dimension for many small orthogonal allocations
- To avoid collisions, assign orthogonal allocations to users
- No data payload (NDP), STAs transmit energy on one orthogonal allocation for feedback
  - with spreading gain in time domain for PHY robustness
- For minimal changes to the current PHY, we propose
  - to use UL MU NDP simultaneous transmissions in response to a trigger frame
  - and to define orthogonal allocations (resource block RBs) to multiplex different STAs' feedbacks
  - These orthogonal allocations (RBs) are defined by using different frequency tone sets

1705

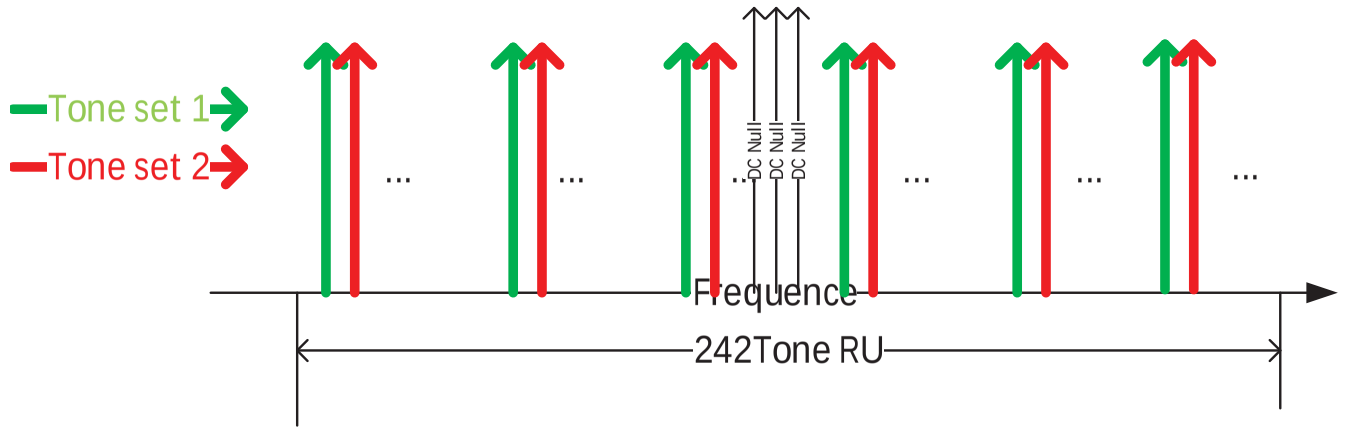
Overview of proposed signaling for Short Feedback

- For each 20MHz, the 242 tones RU are divided into 18 tones sets. Each tone set is made of 12 tones that are equally distributed over the RU (2 tones adjacent to each other)
- 1 allocation is made of 1 tone sets and a SS
  - 1 or multiple allocations can be uniquely assigned to one STA
  - 1 bit can be transmitted using 1 allocation (1 tone sets, made of 2 subsets of 6 tones)
    - 1 is sent by modulating to first tone subset and not the second one
    - 0 is sent by modumation the second subtone set and not the first one

- Channel estimation is not needed for detection
- AP and STAs must have a prior agreement on allocation assignement

1706

Proposed distribution of tones over 242 tones



1707

Tone set indices for each 20 MHz: I_{ULf}

P-Matrix 1x1	P-Matrix 2x2	P-Matrix 4x4	2 bit or 1 bit high power			
			1 bit			
Tone sets	Tone sets	Tone sets	b0 = 1	b0 = 0	b1 = 1	b1 = 0
1	1,2	1,2,3,4	-113,-77,-41,6,42,78	-112,-76,-40,7,43,79	-95,-59,-23,24,60,96	-94,-58,-22,25,61,97
2	:	:	-111,-75,-39,8,44,80	-110,-74,-38,9,45,81	-93,-57,-21,26,62,98	-92,-56,-20,27,63,99
3	:	:	-109,-73,-37,10,46,82	-108,-72,-36,11,47,83	-91,-55,-19,28,64,100	-90,-54,-18,29,65,101
4	:	:	-107,-71,-35,12,48,84	-106,-70,-34,13,49,85	-89,-53,-17,30,66,102	-88,-52,-16,31,67,103
5	:	:	-105,-69,-33,14,50,86	-104,-68,-32,15,51,87	-87,-51,-15,32,68,104	-86,-50,-14,33,69,105
6	:	:	-103,-67,-31,16,52,88	-102,-66,-30,17,53,89	-85,-49,-13,34,70,106	-84,-48,-12,35,71,107
7	:	:	-101,-65,-29,18,54,90	-100,-64,-28,19,55,91	-83,-47,-11,36,72,108	-82,-46,-10,37,73,109
8	:	:	-99,-63,-27,20,56,92	-98,-62,-26,21,57,93	-81,-45,-9,38,74,110	-80,-44,-8,39,75,111
9	17,18	33,34,35,36	-97,-61,-25,22,58,94	-96,-60,-24,23,59,95	-79,-43,-7,40,76,112	-78,-42,-6,41,77,113
10	19,20	37,38,39,40	-95,-59,-23,24,60,96	-94,-58,-22,25,61,97		
11	:	:	-93,-57,-21,26,62,98	-92,-56,-20,27,63,99		
12	:	:	-91,-55,-19,28,64,100	-90,-54,-18,29,65,101		
13	:	:	-89,-53,-17,30,66,102	-88,-52,-16,31,67,103		
14	:	:	-87,-51,-15,32,68,104	-86,-50,-14,33,69,105		
15	:	:	-85,-49,-13,34,70,106	-84,-48,-12,35,71,107		
16	:	:	-83,-47,-11,36,72,108	-82,-46,-10,37,73,109		
17	:	:	-81,-45,-9,38,74,110	-80,-44,-8,39,75,111		
18	35,36	69,70,71,72	-79,-43,-7,40,76,112	-78,-42,-6,41,77,113		

1708

Max # of STAs that can simultaneously send the UL Short Feedback

BW	Response = 1 bit			Response = 2 bit		
	$N_{ss} = 1$	$N_{ss} = 2$	$N_{ss} = 4$	$N_{ss} = 1$	$N_{ss} = 2$	$N_{ss} = 4$
20 MHz	18	36	72	9	18	36
40 MHz	36	72	144	18	36	72
80 MHz	72	144	288	36	72	144
160 MHz	144	288	576	72	144	288

1709

Straw Poll 1

- Do you agree to modify the spec following the comment resolutions in document 17-073r1?

1710

Appendix BQ

The Wayback Machine - https://web.archive.org/web/20161121130640/http://www.ieee802.org/11/Voters/voti…

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The fields in the membership list have the following meaning

Column	Description
Status	The Status column has the following meaning: • Voter - the member can vote • Potential voter - the member will have a voting token at the next face-to-face meeting and will become a voter after that meeting • Aspirant - the member has recorded attendance at one qualifying meeting • Ex Officio - the member is a voter by virtue of their membership of the IEEE 802 executive committee (EC) • Ex Voter - the member was previously a voter member of 802.11. If you wish to be recognized as an Ex Voter, and are not recorded below, please furnish evidence of former voter status to the WG officers. Members of all these status are entitled to join 802.11 email reflectors and submit documents to the 802.11 document server.
Expires	This column shows the meeting number (which is necessarily a Plenary meeting) and approximate starting date of the meeting after which a voting member's voting status expires, if member does not attend any qualifying meetings between now and the end of that meeting. For "potential voter" members, this shows the meeting after which their status reverts to "aspirant". For "aspirant" members, this shows the meeting after which they lose "aspirant" status (and disappear from this listing). An asterisk after a meeting number (e.g., "142* (2013-11-07)") indicates that a voting member needs to attend one additional meeting before the cited meeting, or they will lose their voting membership at the cited meeting, regardless of whether they attend it or not. This occurs when the last two meetings attended by the member were a plenary and the interim following it. NOTE--the "Expires" entry for some voting members is blank. This signifies that the chair has granted them voting membership without an attendance requirement.
Expired	The Expired column indicates the date when the member became an Ex Voter, if that is known.
Last Invalid Ballot	This column indicates the ballot number any last invalid or missed ballot (see http://www.ieee802.org/11/LetterBallots.shtml for the list of working group ballots). It is present only for Voter members. An invalid ballot is a failure to return a vote in a Working Group letter ballot series (i.e., the initial ballot and all recirculations for a particular project), or returning an invalid vote (voting "no" with

	no "must be satisfied" comments, or voting abstain for a reason other than "lack of expertise"). Invalid ballots are counted over up to the last three letter ballot series since the member gained Voter status. Transition arrangements: For ballots starting before August 2016, a voter's response to a letter ballot series is determined by their response to the initial ballot. After then, a voter's resonse will be determined when the letter ballot series is known to have terminated (i.e., when the project is approved by the EC, or meets the terms of conditional approval by the EC, to proceed to sponsor ballot). Voters who failed to meet the updated OM were granted a waiver of the most recent ballot they missed so that the change in the application of the rules resulted in no loss of voting membership. According to the 802.11 operations manual, a Voter must return a valid vote in 2 of the last 3 letter ballot series to maintain their status. This means the voter can miss or return an invalid vote at most 1 such ballot series. A Voter that has missed a ballot series and fails to return a valid vote by the end of the next letter ballot series loses their Voter status and becomes an Ex Voter.

Please verify your affiliation.

There is a specific requirement in the IEEE-SA policies and procedures that attendees at its meetings disclose their affiliation. Attendees failing properly to do so risk losing the privileges of membership (i.e., voting rights).

For information from the IEEE-SA on affiliations please click here**.**

Affiliation is not shown for Ex-Voters. For other membership statuses, if there is no affiliation beside your name or if the affiliation is incorrect please follow these instructions.

If you have any related questions, please contact Adrian P Stephens at adrian.p.stephens@ieee.org.

Member Status	Count
Aspirant	115
ExOfficio	12
Ex Voter	785
Potential Voter	32
Voter	359

Detail

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Abdallah	Ramy		Sony Corporation	Aspirant	162 (2017-	Hyatt Regency, Vancouver, BC,		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
					03-12)	Canada		
Aboba	Bernard			Ex Voter				
Aboulmagd	Osama	S	Huawei Technologies Co. Ltd	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Abraham	Santosh	P	Qualcomm Technologies Incorporated	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Abu Surra	Shadi	A	SAMSUNG	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Adachi	Tomoko		TOSHIBA Corporation	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Agardh	Kare		Sony Mobile Communications	Voter	164* (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Aggarwal	Alok			Ex Voter			2009-07-20	
Agre	Jonathan	R		Ex Voter				
Ahn	Jaehyun			Ex Voter			2016-01-21	
Ahn	Jinsoo		Yonsei University	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Ahn	Seung Hyeok		Newracom Inc.	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Ahn	Woojin		WILUS	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		217
Aiello	Roberto			Ex Voter			2015-07-28	
Aio	Kosuke		Sony Corporation	Potential Voter	166* (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Akhmetov	Dmitry		Intel Corporation	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Aldana	Carlos	H	Intel Corporation	Voter	166* (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Alexander	Thomas			Ex Voter			2015-03-13	
Alimian	Areg			Ex Voter				
Alpert	Yaron		Intel Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Al-Taleb	Sajaa		telekom research and development/malaysia	Aspirant	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Amann	Keith			Ex Voter			2008-11-17	
Amini	Peiman			Ex Voter			2013-07-19	
An	Song-Haur		INDEPENDENT	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Andrade	Merwyn	B		Ex Voter				
Andren	Carl	F		Ex Voter				
Andrus	David	C		Ex Voter			2011-11-11	
Ansley	Carol		ARRIS Group	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		212
Anton	Butch			Ex Voter				
Anwyl	Gary			Ex Voter			2010-03-22	
Aoki	Tsuguhide		TOSHIBA Corporation	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		217
Aramaki	Takashi			Ex Voter				

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Arita	Takashi			Ex Voter			2008-05-05	
Ariyavisitakul	Sirikiat Lek	L		Ex Voter			2014-11-07	
Armstrong	Lee	R	US Department of Transportation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Arndt	Manfred		Hewlett Packard Enterprise	Potential Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Arnett	Larry			Ex Voter				
Arnold	James		US Department of Transportation	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Asai	Yusuke		NTT	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Ashley	Alex			Ex Voter			2013-07-19	
Asterjadhi	Alfred		Qualcomm Incorporated	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Atcitty	Torrey			Ex Voter			2012-05-01	
Au	Kwok Shum	S	Huawei Technologies Co. Ltd	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Audeh	Malik			Ex Voter			2009-11-23	
Auluck	Vijay		Intel Corporation	Voter	164* (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Aust	Stefan			Ex Voter			2015-11-13	
Avera	Drayton		Ratrix Technologies	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Awater	Geert	A	Qualcomm Incorporated	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Azizi	Shahrnaz		Intel Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Babaei	Alireza			Ex Voter			2016-01-21	
Backes	Floyd			Ex Voter			2008-03-25	
Bagby	David		Calypso Ventures, Inc.	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Bahr	Michael			Ex Voter			2012-07-20	
Bai	Fan			Ex Voter			2009-11-23	
Baik	Eugene		Qualcomm Incorporated	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Bain	David		TM Technologies	Potential Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Bajko	Gabor			Ex Voter			2016-03-18	
Baker	Dennis	J		Ex Voter			2008-12-21	
Banerjea	Raja			Ex Voter			2013-11-15	
Banerjee	Kaberi			Ex Voter			2011-03-18	
bang	saehee		LG ELECTRONICS	Voter	166* (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		217
Bansal	Amit			Ex Voter			2009-03-16	
Barber	Phillip			Ex Voter			2015-11-13	
Barber	Simon			Ex Voter				

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
baron	stephane		Canon Research Centre France	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Barr	David		Intel Corporation	Potential Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Barr	John	R		Ex Voter			2012-05-01	
Barriac	gwendolyn		Qualcomm Incorporated	Voter	162* (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Barry	Kevin	M		Ex Voter				
Bartel	Charles	R		Ex Voter				
Basson	Gal			Ex Voter			2011-07-22	
Batra	Anuj		Apple, Inc.	Aspirant	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Bavafa	Moussa			Ex Voter			2009-05-05	
Baykas	Tuncer			Ex Voter			2013-03-04	
Baysal	Burak	H		Ex Voter				
Bei	Jianwei		Marvell Semiconductor, Inc.	Potential Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Benko	John	L		Ex Voter			2010-07-11	
Ben-Tovim	Erez			Ex Voter			2013-11-15	
Benveniste	Mathilde			Ex Voter			2009-11-23	
Berens	Friedbert		FBConsulting Sarl	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Berger	Christian		Marvell Semiconductor, Inc.	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Berkema	Alan			Ex Voter			2014-07-18	
Berry	Don			Ex Voter				

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Bhandaru	Nehru		Broadcom Corporation	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		212
Bharadwaj	Arjun		Qualcomm Incorporated	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		217
Bhatt	Anirudh			Ex Voter			2012-05-01	
Bhukania	Bijoy			Ex Voter			2012-11-16	
Bims	Harry		Bims Laboratories, Inc.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		217
Bjerke	Bjorn	A		Ex Voter			2009-03-16	
Black	Simon			Ex Voter				
Blanchard	Colin			Ex Voter			2008-05-05	
Blue	Scott			Ex Voter				
Bocus	Mohammud		Toshiba of Europe Ltd.	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		217
Boer	Jan			Ex Voter				
Booth	Ted			Ex Voter			2012-05-01	
Borges	Daniel			Ex Voter			2011-06-27	
Boucachard	Philippe			Ex Voter			2013-07-19	
Bourdoux	Andre		IMEC	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Brandt	David		Rockwell Automation	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Brasier	William	M		Ex Voter				
Braskich	Anthony			Ex Voter			2010-03-22	
Bray	Jennifer			Ex Voter				
Breit	Gregory			Ex Voter			2011-11-11	

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Brennan	Joseph			Ex Voter			2010-03-22	
Britz	David			Ex Voter			2008-12-21	
Buffington	John		Itron Inc.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		212
Buga	Walter			Ex Voter			2010-07-16	
Bumiller	G			Ex Voter			2012-07-20	
Buttar	Alistair	G		Ex Voter			2008-02-13	
Bynum	Ann			Ex Voter			2016-03-18	
Cai	Lin			Ex Voter			2015-07-28	
CAI	YU			Ex Voter			2015-07-28	
Caillerie	Alain		Canon Research Centre France	Potential Voter	166* (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Calcev	George		Huawei R&D USA	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Calvert	Chris		Landis Gyr Group Worldwide	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Camps Mur	Daniel	C		Ex Voter			2012-05-01	
Cam-Winget	Nancy			Ex Voter			2010-07-16	
Canchi	Radhakrishna		Kyocera International, Inc.	ExOfficio	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Canpolat	Necati			Ex Voter			2011-07-22	
cao	fengming		Toshiba of Europe Ltd.	Aspirant	162 (2017-	Hyatt Regency, Vancouver, BC,		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
					03-12)	Canada		
Cao	Rui		Marvell Semiconductor, Inc.	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		212
Capar	Cagatay		Ericsson	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Cardona	Javier			Ex Voter			2010-03-22	
Cariou	Laurent		Intel Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		217
Carlo	James			Ex Voter			2008-03-25	
Carney	William		Sony Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Carson	Pat			Ex Voter				
Centonza	Angelo			Ex Voter			2008-03-25	
Cha	Jaesun			Ex Voter			2013-07-19	
Chair	Ricky		Airgain	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Challans	Romana			Ex Voter			2013-03-22	
CHAMBELIN	Philippe			Ex Voter			2012-10-31	
Chan	Douglas	S		Ex Voter			2009-11-23	
Chang	Kapseok			Ex Voter			2011-07-22	
Chang	Kuor-Hsin			Ex Voter			2015-03-13	
CHANG	SANGHYUN		SAMSUNG ELECTRONICS	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Chang	Soo-Young		California State University, Sacramento (CSUS)	Voter	166* (2017-	Caribe Hotel and Convention		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
					11-05)	Center, Orlando, FL, USA		
Chang	Xin			Ex Voter			2014-07-08	
Chaplin	Clint	F	Imagicon	ExOfficio				
Chen	Bin			Ex Voter			2013-07-19	
Chen	Jiamin		HUAWEI	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Chen	Jiunn-Tsair			Ex Voter			2010-03-22	
Chen	Jixin			Ex Voter			2014-05-09	
CHEN	KWANG-CHENG		National Taiwan University	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Chen	Lidong		NIST	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Chen	Qian			Ex Voter			2014-11-07	
CHEN	Rory			Ex Voter			2008-02-13	
Chen	Spark		ARRIS Group	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Chen	Teyan		Huawei Technologies Co. Ltd	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
CHEN	Xi			Ex Voter			2014-03-21	
Chen	Xiaogang		Intel Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Chen	Ye			Ex Voter				
Chen	Yi-Ming			Ex Voter				
Cheng	Hong			Ex Voter			2008-05-05	
Cheng	Paul		MediaTek Inc.	Voter	164 (2017-	Estrel Hotel and Convention		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
					07-09)	Center, Berlin, Germany		
Cheong	Minho		Newracom Inc.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
CHERIAN	GEORGE		Qualcomm Incorporated	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		217
Cherniavsky	Dmitry		SiBEAM, Inc.	Voter	166* (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		212
Chesson	Greg			Ex Voter				
Chi	Zhipei			Ex Voter			2015-07-28	
Chia	Meng	W		Ex Voter			2011-07-22	
Chin	Francois			Ex Voter			2014-11-07	
Chin	Woon Hau			Ex Voter			2016-07-29	
Chindapol	Aik			Ex Voter				
Chitrakar	Rojan		Panasonic Asia Pacific Pte Ltd.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Cho	Hangyu		lg electronics	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Cho	Joongwon			Ex Voter			2016-11-11	
Cho	Woong			Ex Voter			2010-11-12	
Choi	Chang-Soon			Ex Voter			2010-11-12	
Choi	Hyeyoung			Ex Voter			2016-07-29	
Choi	Inhwan			Ex Voter			2012-02-19	

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Choi	In-Kyeong		Newracom Inc.	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Choi	Jee-Yon			Ex Voter			2015-03-13	
Choi	Jinsoo		LG ELECTRONICS	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		212
Choi	Nakjung			Ex Voter			2010-03-22	
Choi	Sangsung		Electronics and Telecommunications Research Institute (ETRI)	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Choi	Seyeong			Ex Voter			2010-03-22	
Choi	Sunghyun			Ex Voter				
Choi	Won-Joon			Ex Voter				
Choo	Li Chia	C		Ex Voter			2014-07-18	
Choudhury	Abhijit	K		Ex Voter			2008-07-19	
Choudhury	Sayantan		Nokia	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		212
CHRISTIN	Philippe			Ex Voter			2011-07-22	
Chu	Liwen		Marvell Semiconductor, Inc.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Chu	Wenjing			Ex Voter			2014-03-21	
CHUN	JINYOUNG			Ex Voter			2016-01-21	
Ciochina	Dana		Sony Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Ciotti	Frank			Ex Voter				
Clements	Ken			Ex Voter				

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Coffey	John		Realtek Semiconductor Corp.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Cole	Terry	L		Ex Voter			2010-03-14	
Coleman	Ryon	K		Ex Voter			2008-12-21	
Congdon	Paul			Ex Voter				
Conner	W	S		Ex Voter			2008-02-13	
Cook	Charles	I		Ex Voter			2010-11-12	
Cook	Kenneth			Ex Voter				
Cooklev	Todor			Ex Voter			2009-03-16	
Coop	Kenneth			Ex Voter			2015-11-08	
Cordeiro	Carlos		Intel Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Correal	Neiyer			Ex Voter			2014-07-18	
Crowley	Steven			Ex Voter			2008-03-25	
Cypher	David	E		Ex Voter			2009-11-23	
da Silva	Claudio		Intel Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
DANG	Meimei		China Academy of Telecommunication Research (CATR)	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Das	Subir		Applied Communication Sciences	ExOfficio				
Dauphinee	Leonard		MaxLinear Corp	Potential Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
De Courville	Marc			Ex Voter			2009-11-23	
De Ruijter	Hendricus			Ex Voter			2013-11-10	
de Vegt	Rolf	J	Qualcomm Incorporated	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		217
Debergh	Pierre		Orange	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Dehghan	Hossein			Ex Voter			2012-05-01	
Demessie	Yohannes			Ex Voter			2013-03-22	
Deng	Der-Jiunn		National Changhua University of Education	Potential Voter	166* (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
denson	michael			Ex Voter			2014-07-18	
Denteneer	Theodorus			Ex Voter			2012-05-01	
Derham	Thomas			Ex Voter			2015-07-28	
Deshmukh	Nikhil		National Instruments Corporation	Aspirant	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
deVries	Jeremy			Ex Voter			2010-03-22	
Dickey	Susan			Ex Voter			2010-11-12	
Ding	Gang			Ex Voter			2010-09-18	
DING	ZHIMING			Ex Voter			2008-12-21	
Doi	Yoshiharu			Ex Voter			2009-07-20	
Donapati	Rakesh		Anritsu Company	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center,		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
						Orlando, FL, USA		
Dong	Ting			Ex Voter			2014-05-09	
Dong	Xiandong			Ex Voter			2014-07-18	
Doppler	Klaus			Ex Voter			2015-05-07	
Dorsey	John			Ex Voter			2011-03-18	
Douglas	Brett	L		Ex Voter				
Dowse	Malcolm			Ex Voter			2016-01-21	
Drennan	Offie			Ex Voter			2012-07-20	
DU	JiaDong			Ex Voter			2015-11-13	
Du	Lei			Ex Voter			2008-03-25	
Dua	Praveen			Ex Voter			2016-11-11	
Duan	Chunjie			Ex Voter			2011-11-11	
Dundar	Baris	B		Ex Voter				
Durand	Roger	P		Ex Voter			2014-11-07	
duvvuri	srinivasa			Ex Voter			2009-11-23	
Eastlake 3rd	Donald	E	Huawei Technologies Co. Ltd	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		216
Ecclesine	Peter		Self	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		216
Edgar	Richard		Imagination Technologies Ltd.	Voter	166* (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Edney	Jonathan	P		Ex Voter				
Edwards	Bryan			Ex Voter			2008-03-25	

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Eitan	Alecsander		Qualcomm Incorporated	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Ekbal	Amal			Ex Voter			2014-03-21	
Elbakoury	Hesham	M		Ex Voter			2008-03-25	
Ellis	Jason			Ex Voter				
Ellis	Michael			Ex Voter			2009-06-30	
ElSherif	Ahmed		Qualcomm Incorporated	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Emeott	Stephen	P		Ex Voter			2009-11-23	
Emmelmann	Marc		Self Employed	Voter	166* (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Engwer	Darwin			Ex Voter			2010-03-22	
Eo	Iksoo			Ex Voter			2015-05-07	
Epstein	Joseph			Ex Voter			2009-03-16	
Epstein	Leonid		Celeno Communications	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Erceg	Vinko		Broadcom Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		216
Eriksson	Patrik			Ex Voter				
Escalera	Natalia		Buffalo Inc.	Aspirant	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Estevez	Leonardo			Ex Voter			2011-02-25	
Estrada	Andrew			Ex Voter				

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Euscher	Christoph			Ex Voter				
Faccin	Stefano	M		Ex Voter				
Falk	Lars	P		Ex Voter			2009-03-16	
Fan	Zhong			Ex Voter			2016-07-29	
Fanfelle	Robert			Ex Voter			2009-07-20	
Fang	Ping		Huawei Device Co. Ltd	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Fang	Yonggang		ZTE TX Inc	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Fechtel	Stefan			Ex Voter			2009-11-23	
Fei	QIN			Ex Voter			2014-07-08	
Feinberg	Paul	H		Ex Voter			2008-12-21	
Feldman	Alex			Ex Voter				
Feng	Xiang		Keysight Technologies	Aspirant	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Ferdowsi	Vida		Newracom Inc.	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Filin	Stanislav			Ex Voter			2014-07-08	
Filo	Marcin		University of Surrey	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Finn	Norman		Self Employed	Voter				
Fischer	Matthew	J	Broadcom Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		212
Fischer	Michael		NXP Semiconductors	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		

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Fisher	Wayne	K		Ex Voter			2010-11-12	
Flammer	George			Ex Voter			2014-03-21	
FLYNN	P			Ex Voter			2014-07-18	
Fracchia	Roberta			Ex Voter			2008-12-21	
Frank	Colin			Ex Voter			2011-11-11	
Fujimoto	Atsushi			Ex Voter			2010-07-16	
Fujinami	Makoto			Ex Voter			2008-03-25	
Fujio	Shunsuke		FUJITSU LABORATORIES LIMITED	Potential Voter	166* (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Fukatsu	Noriyasu			Ex Voter			2012-05-01	
Fuller	Richard		OmniTrail Technologies	Potential Voter	162* (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Funada	Ryuhei			Ex Voter			2009-07-20	
Fung	Patrick			Ex Voter			2012-05-01	
Furuichi	Sho		Sony Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Gagiev	Yaroslav		Intel Corporation	Potential Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Gal	Dan			Ex Voter			2015-05-07	
Gallizio	Edoardo			Ex Voter			2008-05-05	
Gan	Ming		Huawei Technologies Co. Ltd	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		

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Gao	Wen			Ex Voter			2011-02-25	
Garcia Villegas	Eduard		Universitat Politecnica de Catalyuna (UPC)	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Gardner	James			Ex Voter				
Gast	Matthew			Ex Voter			2011-03-18	
Ghamri-Doudane	Mohamed			Ex Voter			2011-11-11	
Ghanbarinejad	Majid		Huawei R&D USA	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Ghasemi	Amir			Ex Voter			2011-02-25	
Ghazi	Vafa			Ex Voter				
Ghosh	Chittabrata		Intel Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Ghosh	Monisha			Ex Voter			2016-07-29	
Gilb	James	P	Gilb Consulting, Inc.	ExOfficio	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Gilbert	Jeffrey			Ex Voter			2011-07-22	
Gillmore	Matthew			Ex Voter			2015-03-05	
GIRAUD	Claude			Ex Voter			2011-11-11	
Glibbery	Ronald			Ex Voter			2010-11-12	
Gloger	Reinhard			Ex Voter			2013-03-22	
Godfrey	Tim		Electric Power Research Institute, Inc. (EPRI)	Voter	164* (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		212
GONG	DANING			Ex Voter			2013-11-10	
Gong	Michelle			Ex Voter			2012-05-01	
Goodall	David			Ex Voter			2014-07-18	

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Gossain	Hrishikesh			Ex Voter			2008-03-25	
Gosteau	Jeremy			Ex Voter			2008-07-18	
GOTO	Fumihide		Self	Aspirant	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Gottlib	Elad			Ex Voter			2014-03-21	
Grandhe	Niranjan		Marvell Semiconductor, Inc.	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Grandhi	Sudheer	A		Ex Voter			2013-11-10	
Grass	Eckhard		Humboldt-University in Berlin	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Grau	Stephen			Ex Voter			2014-07-18	
Gray	Gordon	P		Ex Voter				
Green	Evan	R		Ex Voter				
Green	Larry			Ex Voter				
Grigat	Michael		Deutsche Telekom AG	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Grodzinsky	Mark			Ex Voter			2011-03-18	
Gu	Daqing			Ex Voter				
Guener	Tugrul			Ex Voter			2008-12-21	
Guo	Jianlin			Ex Voter			2010-03-22	
Guo	Qiang		Huawei R&D USA	Aspirant	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Guo	Yuchen		Huawei Technologies Co. Ltd	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		

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Gupta	Pratibha			Ex Voter			2008-09-16	
Gupta	Vivek	G		Ex Voter			2010-03-22	
Hadad	Zion		Runcom Technologies LTD.	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		217
Hailemariam	Meareg		IEEE	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Haines	Russell			Ex Voter			2015-07-28	
Haisch	Fred			Ex Voter				
Halasz	David			Ex Voter			2014-11-07	
Hall	Robert		Johnson Controls Inc	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Halls	David		Toshiba of Europe Ltd.	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		217
Hamady	Neil			Ex Voter				
Hamilton	Mark		Ruckus Wireless	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		217
HAN	Xiao		Huawei Technologies Co. Ltd	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Han	Yunbo		HUAWEI	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Hanatani	Yoshikazu			Ex Voter			2016-03-18	
Handte	Thomas		Sony Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		

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Hansen	Christopher	J	Covariant Corporation	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Hao	Peng			Ex Voter			2015-05-07	
Har Zion	Yuval		Celeno Communications	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Hara	Yukihito		Buffalo Inc.	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Harada	Hiroshi			Ex Voter			2013-11-15	
Hardison	Nathaniel			Ex Voter			2015-11-13	
Harkins	Daniel	N	Aruba Networks, Inc.	Voter	166* (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Hart	Brian	D	Cisco Systems, Inc.	Voter	166* (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Hartman	Chris		Apple, Inc.	Voter	166* (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		212
Haslestad	Thomas			Ex Voter				
Hassan	Amer	A		Ex Voter			2010-07-11	
Hassel	Vegard			Ex Voter			2010-03-22	
Hattig	Myron			Ex Voter			2008-03-25	
Hauser	James	P		Ex Voter				
Hayakawa	Yutaka			Ex Voter				
Hayase	Shigenori			Ex Voter			2008-11-17	
Hayes	Kevin	V		Ex Voter			2008-11-17	
Hayes	Victor		CONSULTANT	Voter				

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He	Haixiang			Ex Voter				
He	Linhai		Qualcomm Incorporated	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
he	shiwen		Southeast University, China	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		216
Heberling	Allen			Ex Voter			2015-11-08	
Hedayat	Ahmadreza		Newracom Inc.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		216
Hedberg	David	J		Ex Voter				
Heide	Carolyn			Ex Voter			2015-11-13	
Heile	Robert	F	Wi-SUN Alliance	ExOfficio				
Henry	Jerome		Cisco Systems, Inc.	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Hepworth	Eleanor			Ex Voter				
Hermodsson	Frans			Ex Voter				
Hiertz	Guido	R	Ericsson AB	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Hillman	Garth	D		Ex Voter			2014-03-21	
Hinsz	Christopher	S		Ex Voter			2008-02-13	
Hiraga	Ken			Ex Voter			2012-11-16	
Hirano	Jun			Ex Voter				
Ho	Chin	K		Ex Voter			2013-07-19	
Ho	Duncan		Qualcomm Incorporated	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Ho	Jin-Meng			Ex Voter				

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Hoang	Anh Tuan	T		Ex Voter			2013-11-15	
Hoang	Dien			Ex Voter			2013-07-19	
Hoghooghi	Michael	M		Ex Voter				
Holt	Keith			Ex Voter				
Hong	Hanseul		Yonsei University	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Hong	Seung-Eun			Ex Voter			2011-07-22	
Hong	Song-Nam			Ex Voter			2016-03-18	
Hong	Sungjin		WILUS Institute	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Hong	Wei			Ex Voter			2014-03-21	
Hong	Wei			Ex Voter			2014-07-18	
Hong	Yong-Geun			Ex Voter			2008-05-05	
Honma	Naoki			Ex Voter			2010-03-22	
Horisaki	Koji		Toshiba	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		216
Horne	Kenneth		Keysight Technologies	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Horne	William			Ex Voter				
Hosur	Srinath			Ex Voter				
Hou	Victor		Broadcom Corporation	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Housley	Russell	D		Ex Voter				
Howard	David			Ex Voter			2012-05-01	
hsiao	ying-chuan			Ex Voter			2013-11-10	
Hsieh	Jing-Rong			Ex Voter			2016-07-29	

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Hsu	Chien-Fang		MediaTek Inc.	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Hsu	Jen-Yuan			Ex Voter			2014-05-09	
Hsu	Ju-Lan			Ex Voter			2012-02-19	
Hsu	Yungping			Ex Voter				
Hu	Chunyu		Broadcom Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Hu	Junling			Ex Voter			2008-12-21	
hu	wendong			Ex Voter			2010-11-12	
Hua	Rui		ZTE Corporation	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Huang	He		ZTE Corporation	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Huang	Lei		Huawei Technologies Co. Ltd	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Huang	Lei		Panasonic Asia Pacific Pte Ltd.	Voter	166* (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Huang	Po-Kai		Intel Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Huang	Robert	Y		Ex Voter			2010-03-22	
Huang	Rongsheng		MediaTek Inc.	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Huang	Tian-Wei			Ex Voter			2011-07-22	

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
huang	wenyuan		Toshiba Electronics China	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
HUANG	YUN-LIANG		MediaTek Inc.	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Huang	Zhiyong		LitePoint Corporation/Teradyne	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
HUH	JIYOUNG			Ex Voter			2008-02-13	
Humbert	John			Ex Voter			2015-11-08	
Hunter	David		WireFi Networks Inc.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		217
Hurtarte	Jeorge		Teradyne, Inc.	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Hwang	Sung Hyun	H	ETRI	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Ibrahim	Azmi		TM Research & Development	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Ibrahim	Brima		Broadcom Corporation	Voter	162* (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Ikram	Muhammad	Z		Ex Voter				
Imamura	Daichi			Ex Voter				
Inoue	Yasuhiko		Nippon Telegraph and Telephone Corporation (NTT)	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Ishihara	Koichi		Nippon Telegraph and Telephone Corporation	Aspirant	164 (2017-	Estrel Hotel and Convention		

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			(NTT)		07-09)	Center, Berlin, Germany		
Ishizu	Kentaro		National Institute of Information and Communications Technology (NICT)	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Iso	Akio			Ex Voter			2012-05-01	
ITO	Takumi			Ex Voter				
Ivry	Raanan		Optima Labs	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Iwaoka	Mitsuru			Ex Voter			2016-03-18	
Iwatani	Junichi		Nippon Telegraph and Telephone Corporation (NTT)	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Jacobs	Wynona			Ex Voter			2011-11-11	
Jacobsen	Eric	A		Ex Voter				
Jacobson	Scott		Cadence Design Systems, Inc.	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
jafarian	amin			Ex Voter			2015-07-28	
Jain	Avinash			Ex Voter			2011-06-27	
Jalfon	Marc			Ex Voter			2008-05-05	
Jang	KyungHun			Ex Voter				
Jauh	Alan			Ex Voter			2016-07-29	
Jee	Junghoon			Ex Voter			2009-07-20	
Jeffries	Timothy		Huawei R&D USA	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Jeon	Ho-In J	J		Ex Voter			2008-02-13	

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Jeon	Hongseok			Ex Voter			2009-11-23	
Jeon	Taehyun			Ex Voter				
Jeong	ByungJang	J		Ex Voter			2012-07-20	
Jeong	Chanyong		SAMSUNG ELECTRO-MECHANICS	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
JEONG	MIN SEOP		SAMSUNG ELECTRONICS	Aspirant	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Jeong	Moo Ryong	R		Ex Voter				
Jeong	Wuncheol			Ex Voter			2013-11-15	
Jeong	Yangseok			Ex Voter			2015-03-05	
Jeong	Yeonkwon			Ex Voter			2009-11-23	
Jetcheva	Jorjeta	G		Ex Voter			2012-07-20	
Ji	Lusheng			Ex Voter			2011-07-22	
Ji	Mingyue		Broadcom Corporation	Potential Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Jia	Jia		Huawei Technologies Co., Ltd	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Jiang	Daniel			Ex Voter			2010-03-22	
jiang	feng		Intel Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Jiang	Jinjing		Marvell Semiconductor, Inc.	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Jiang	Robert			Ex Voter			2015-11-08	
Jin	Liang		Spirent Communications	Voter	166 (2017-	Caribe Hotel and Convention		212

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					11-05)	Center, Orlando, FL, USA		
Jin	Sunggeun			Ex Voter			2013-09-16	
Jin	ZhongYi			Ex Voter			2013-03-22	
Jindal	Nihar			Ex Voter			2015-11-08	
jo	junho			Ex Voter			2011-11-11	
Jo	Kyungtae		LG ELECTRONICS	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Johnsson	Kerstin		Intel Corporation	Voter	166* (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Johnston	David			Ex Voter				
Jokela	Jari	E		Ex Voter			2016-07-29	
Jones	Allan		Activision	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
JONES	JEFFRUM		Qorvo, Inc.	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Jones	Vincent Knowles IV		Qualcomm Incorporated	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
JOO	SEONG-SOON			Ex Voter			2015-03-05	
Jose	Bobby			Ex Voter				
Joshi	Avinash			Ex Voter			2012-07-20	
Josiam	Kaushik		SAMSUNG	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		

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Jun	Haeyoung			Ex Voter			2011-06-27	
Junell	Jari			Ex Voter			2014-03-21	
Kafle	Padam			Ex Voter			2013-07-19	
Kahn	Michael			Ex Voter			2008-07-19	
Kain	Carl	W	Noblis, Inc.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Kakani	Naveen	K	Qualcomm Incorporated	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Kamath	Krishnanand		Viavi Solutions	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Kandala	Srinivas			Ex Voter				
Kang	Byeongwoo			Ex Voter			2012-05-01	
Kang	Hyunduk		Electronics and Telecommunications Research Institute (ETRI)	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		212
Kang	Hyunjeong			Ex Voter			2015-11-08	
Kaniganti	Madhuri		Microsoft Corporation	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Kapetanovic	Dzevdan		Ericsson AB	Potential Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Karaoguz	Jeyhan			Ex Voter			2011-02-25	
Karcz	Kevin			Ex Voter				
Karnam	Mohan		Imagination Technologies Ltd.	Potential Voter	162* (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Karnik	Pankaj	R		Ex Voter				
Kasher	Assaf	Y	Qualcomm Incorporated	Voter	164 (2017-	Estrel Hotel and Convention		

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					07-09)	Center, Berlin, Germany		
Kasslin	Mika			Ex Voter			2014-03-21	
Katagiri	Masami			Ex Voter			2015-07-28	
Kato	Masato			Ex Voter			2009-07-20	
Kato	Shuzo			Ex Voter			2012-09-03	
Kato	Tatsuya			Ex Voter			2010-11-12	
Kavner	Douglas			Ex Voter			2010-03-22	
Kedem	Oren		Intel Corporation	Potential Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Kennedy	Richard	H	Hewlett Packard Enterprise	ExOfficio	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Kenney	John			Ex Voter			2016-03-18	
Kerry	Stuart	J	OK-Brit	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Ketchum	John	W		Ex Voter			2008-03-25	
Khakuria	Prithpal			Ex Voter			2012-07-20	
Khine	Thet	H		Ex Voter			2012-05-01	
Khorov	EVGENY		IITP RAS	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Khoryaev	Alexey			Ex Voter			2011-06-27	
Khoury	Peter		Ruckus Wireless	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
KI	SANGWON		Newracom Inc.	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Kikuma	Tomohiro			Ex Voter				
Kim	Bonghoe			Ex Voter			2012-11-16	
KIM	BYOUNG-HOON			Ex Voter			2012-11-16	
Kim	Byoung-Jo			Ex Voter				
Kim	Eun	S		Ex Voter			2012-11-16	
Kim	Eung	S		Ex Voter			2010-11-12	
Kim	Eunkyo			Ex Voter			2008-03-25	
Kim	Eunkyung			Ex Voter			2015-03-13	
Kim	Hongsoog			Ex Voter			2015-03-05	
Kim	Igor		Electronics and Telecommunications Research Institute (ETRI)	Potential Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Kim	Jaehwan			Ex Voter			2015-11-13	
Kim	Jeehoon			Ex Voter			2016-07-29	
Kim	Jeongki		LG ELECTRONICS	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		212
Kim	Jin Min		LG ELECTRONICS	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		216
Kim	Jinho			Ex Voter			2013-11-10	
Kim	Jinkyeong			Ex Voter			2014-03-21	
Kim	Joo Young			Ex Voter			2013-11-10	

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Kim	Joonsuk		Apple, Inc.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		212
Kim	Kyeongpyo		Newracom Inc.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		212
Kim	Kyeongsoo			Ex Voter			2008-03-25	
Kim	Myeong-Jin			Ex Voter			2016-03-18	
Kim	Sang Gook		LG ELECTRONICS	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
KIM	SANGKYUN			Ex Voter			2015-03-13	
kim	Seong Soo	S		Ex Voter			2008-12-21	
Kim	Suhwook		LG ELECTRONICS	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		212
Kim	Taejoon			Ex Voter			2013-07-19	
Kim	Yongho		Korea National University of Transportation	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Kim	Yongsuk			Ex Voter				
Kim	Yongsun			Ex Voter			2011-07-22	
Kim	Youhan		Qualcomm Incorporated	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Kim	Youjin			Ex Voter			2008-09-16	
Kim	Youngsoo			Ex Voter			2016-03-18	

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Kim	Youn-Kwan		The Catholic University of Korea	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		217
Kim	Yunbae		Electronics and Telecommunications Research Institute (ETRI)	Aspirant	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
kim	yunjoo			Ex Voter			2012-07-20	
Kimhi	Ziv			Ex Voter				
Kinney	Patrick			Ex Voter			2008-03-25	
Kirimis	Dimitri		Newracom Inc.	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Kiryanov	Anton		IITP RAS	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Kishida	Akira			Ex Voter			2015-11-08	
Kitazawa	Shoichi		ATR Wave Engineering Laboratories	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Kivinen	Tero			Ex Voter			2012-11-16	
Klein	Philippe		Broadcom Corporation	Aspirant				
Kleindl	Gunter			Ex Voter			2008-11-17	
Klik	Cees			Ex Voter				
Kloper	David		Cisco Systems, Inc.	Voter	162* (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
KNECKT	JARKKO		Apple, Inc.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		212
Ko	Geonjung		WILUS Institute	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		

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Ko	Gwangzeen			Ex Voter			2015-11-13	
KOBAYASHI	MARK	M		Ex Voter			2012-05-01	
Koga	Keiichiro			Ex Voter				
Koh	Benjamin			Ex Voter			2008-03-25	
Kojima	Fumihide		National Institute of Information and Communications Technology (NICT)	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Kolze	Tom		Broadcom Corporation	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Koskela	Timo			Ex Voter			2014-07-08	
Kotzer	Igal		General Motors Company	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Kountz	Dennis		Chemours	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Kowalski	John			Ex Voter				
Kraemer	Bruce	P	Marvell Semiconductor, Inc.	Voter				
Krasicki	Maciej		Poznan University of Technology	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Kruys	Johannes	P		Ex Voter			2009-07-20	
Kudo	Riichi			Ex Voter			2011-11-11	
Kuehnel	Thomas			Ex Voter			2009-06-30	
kukil	LIM		WILUS Inc.	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Kulkarni	Parag		Toshiba	Potential Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Kumagai	Tomoaki			Ex Voter				

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Kumar	G Rajendra			Ex Voter			2014-07-18	
Kumar	Manish		Marvell Semiconductor, Inc.	Aspirant	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Kumar	Rajesh		Qualcomm Incorporated	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Kumar	Rajneesh			Ex Voter			2008-03-25	
Kumari	Warren		Google	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Kunihiro	Takushi			Ex Voter				
Kurihara	Thomas	M		Ex Voter			2012-11-16	
Kuwahara	Denis			Ex Voter				
Kwak	Byung-Jae		Electronics and Telecommunications Research Institute (ETRI)	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Kwak	Jin-Sam		WILUS Institute	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		216
Kwak	Joseph			Ex Voter			2015-07-28	
KWON	EDWIN			Ex Voter			2009-06-30	
Kwon	Hyoungjin			Ex Voter			2015-11-13	
KWON	UI	K		Ex Voter			2011-06-27	
Kwon	Yong-Jin		Newracom Inc.	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Kwon	Young Hoon	H	Newracom Inc.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		

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LAGRANGE	Pascal			Ex Voter			2011-11-11	
Lakkis	Ismail			Ex Voter			2010-11-12	
Lalam	Massinissa		SAGEMCOM SAS	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Lambert	Paul		Marvell Semiconductor, Inc.	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Lan	Zhou		National Institute of Information and Communications Technology (NICT)	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		212
Lanante	Leonardo		Kyushu Institute of Technology	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		216
Landt	Jeremy	A		Ex Voter			2010-11-12	
Lansford	James		Qualcomm Incorporated	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		217
Lanzl	Colin			Ex Voter				
Lauer	Joseph	P		Ex Voter			2011-02-25	
Le Rouzic	Jean-Pierre			Ex Voter			2015-03-13	
Leach	David	J		Ex Voter				
Lee	Anseok			Ex Voter			2013-07-19	
Lee	Daewon		Newracom Inc.	Voter	166* (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Lee	Donghun			Ex Voter			2013-11-10	
Lee	Dongjun			Ex Voter				
Lee	Hongsup			Ex Voter			2015-11-08	

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lee	hoosung			Ex Voter			2011-07-22	
LEE	Ilgu			Ex Voter			2015-03-05	
Lee	Insun			Ex Voter				
Lee	Jae Seung	S	ETRI	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Lee	Jae-Ho			Ex Voter			2014-03-21	
Lee	Jehun		Newracom Inc.	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		212
Lee	JiHo		Korea University	Aspirant	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Lee	Jihyun			Ex Voter			2012-07-20	
Lee	Jin			Ex Voter			2008-09-16	
lee	jiseon		Pohang University of Science and Technology (POSTECH)	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
LEE	JOONSOO		Newracom Inc.	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Lee	Ronald		MaxLinear	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Lee	Sok-kyu			Ex Voter				
LEE	SUNGEUN		Cypress Semiconductor Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Lee	Tae	H		Ex Voter			2009-07-20	
Lee	Wookbong			Ex Voter			2016-01-21	
Lee	Wooyong			Ex Voter			2011-11-11	

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Lee	Xiaoyang		DHS/OEC	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Lee	Young Ha		Newracom Inc.	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		212
Lee	Yuro			Ex Voter			2015-11-13	
Lefkowitz	Martin			Ex Voter				
Lei	Zhongding			Ex Voter			2016-07-29	
Leicht	Suzanne		National Security Agency	Potential Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
lemberger	Uriel			Ex Voter			2008-03-25	
Lepp	James		BlackBerry	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Leung	Wai Kong	K		Ex Voter			2014-07-08	
Levy	Joseph		InterDigital, Inc.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Li	Bin			Ex Voter			2011-11-11	
Li	Bo		northwestern polytechnical university	Potential Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Li	Dejian		Huawei Technologies Co. Ltd	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Li	Feng			Ex Voter			2015-11-08	
Li	Guoqing		Apple, Inc.	Voter	162* (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		

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LI	HONGGANG			Ex Voter			2015-03-05	
Li	Huan-Bang		National Institute of Information and Communications Technology (NICT)	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Li	Jing		Huawei Technologies Co. Ltd	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Li	Liang			Ex Voter			2015-03-05	
Li	Lingjie			Ex Voter			2013-03-22	
Li	Pen			Ex Voter				
Li	Qinghua		Intel Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Li	Sheung			Ex Voter			2010-03-22	
Li	Yanchun		Huawei Technologies Co. Ltd	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Li	Yunbo		Huawei Technologies Co. Ltd	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
LI	YUNZHOU			Ex Voter			2013-03-04	
Li	Zhiqiang			Ex Voter			2015-05-07	
Liang	Haixiang		Huawei R&D USA	Aspirant	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Lim	Dong Guk		LG ELECTRONICS	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		212
Lin	Chih-Che			Ex Voter			2014-11-07	

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Lin	Huashih	A		Ex Voter				
Lin	Meilu		HUAWEI	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Lin	Paul			Ex Voter			2011-07-22	
Lin	Wei		Huawei Technologies Co. Ltd	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		217
Lin	Yingpei		Huawei Technologies Co. Ltd	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Lindskog	Erik		Qualcomm Incorporated	Aspirant	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Link	Jeremy			Ex Voter			2012-05-01	
Liru	Lu			Ex Voter			2014-11-07	
Liu	Changwen			Ex Voter				
LIU	CHENCHEN		Huawei Technologies Co. Ltd	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		217
Liu	Dapeng			Ex Voter			2014-07-18	
Liu	Der-Zheng		Realtek Semiconductor Corp.	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		212
Liu	Fulei		ZTE Corporation	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Liu	Hang			Ex Voter			2011-03-18	
Liu	I-Ru			Ex Voter			2008-05-05	
Liu	Jianhan		MediaTek Inc.	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		212

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Liu	Jinnan		HUAWEI	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Liu	Le		Huawei Technologies Co. Ltd	Voter	162* (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		217
Liu	Pei			Ex Voter			2012-10-09	
Liu	Pei		HiSilicon Technologies Co., LTD.	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		216
Liu	Siyang			Ex Voter			2012-07-20	
Liu	Yong		Apple, Inc.	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		212
Liu	Yun		Huawei Technologies Co., Ltd	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Liu	Zongru			Ex Voter			2014-03-21	
Livshitz	Michael			Ex Voter			2009-06-30	
Lo	Titus	K		Ex Voter				
Loc	Peter		Huawei Technologies Co. Ltd	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Lomayev	Artyom		Intel Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		217
Lou	Hui-Ling		Marvell Semiconductor, Inc.	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		216
Lu	Su			Ex Voter			2015-07-28	
Lubar	Daniel			Ex Voter			2009-07-20	
Lukaszewski	Chuck		Aruba Networks, Inc.	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		

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Luo	Haiyun			Ex Voter			2008-07-18	
Luo	Jun		Huawei Technologies Co. Ltd	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Luo	Long			Ex Voter			2014-03-21	
Luo	Yi		Huawei Technologies Co. Ltd	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Luo	Zhendong		China Academy of Telecommunication Research (CATR)	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Lv	Kaiying		ZTE Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		212
Lynch	Bradley			Ex Voter			2012-05-01	
Lynch	Michael		MJ Lynch & Associates, LLC.	ExOfficio				
M. Hizan	Hizamel		TM Research & Development	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Ma	Hui			Ex Voter			2008-07-19	
Ma	Jing		National Institute of Information and Communications Technology (NICT)	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Ma	Yuanye		CESI Group	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Maamari	Diana		Huawei R&D USA	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
MADHAVAN	NARENDAR		TOSHIBA Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Maeda	Shigeru		TOSHIBA Corporation	Voter	162* (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		

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Mahadevappa	Ravishankar			Ex Voter				
Maida	Anthony	F		Ex Voter			2008-12-21	
Majkowski	Jakub			Ex Voter			2009-11-23	
Malarky	Alastair			Ex Voter			2011-02-25	
Malek	Majid	m		Ex Voter				
Malik	Rahul		Qualcomm Incorporated	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Malinen	Jouni	K	Qualcomm Incorporated	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Maltsev	Alexander		Intel Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		217
Mangold	Stefan		Itron Inc.	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Mani	Mahalingam			Ex Voter			2008-02-13	
Mano	Hiroshi		Koden Techno Info K.K.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Marin	James		Self Employed	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Marker	Jeffrey		Ixia	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Marks	Roger		EthAirNet Associates	ExOfficio				
Marshall	Bill			Ex Voter			2011-11-11	
Maruhashi	Kenichi			Ex Voter			2011-11-11	
Maslennikov	Roman	M		Ex Voter			2010-07-16	
Masour	Avi			Ex Voter			2012-05-01	
Matsumoto	Yoichi			Ex Voter				

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Matsuo	Ryoko		TOSHIBA Corporation	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
MATTA	SUDHEER			Ex Voter			2008-12-21	
Maufer	Thomas	A		Ex Voter				
Mccann	Stephen		BlackBerry	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
McClellan	Kelly	P		Ex Voter				
Mcfarland	William	J		Ex Voter				
McIntosh	Bill			Ex Voter				
McNamara	Darren	P		Ex Voter			2008-07-18	
Mcnew	Justin	P		Ex Voter			2010-11-12	
Medvedev	Irina			Ex Voter			2008-03-25	
Mehta	Pratik	M		Ex Voter				
Merlin	Simone		Qualcomm Incorporated	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		217
Mese	Murat			Ex Voter			2012-07-20	
Mesecke	Sven			Ex Voter			2015-03-13	
Mestanov	Filip		Ericsson AB	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Meyer	Klaus			Ex Voter			2008-07-18	
Miao	Yannan		Huawei Technologies Co. Ltd	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Miller	James			Ex Voter			2016-07-29	
Miller	Robert	R		Ex Voter			2011-11-11	

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Miroll	Jochen			Ex Voter			2011-02-25	
Misawa	Yasunao			Ex Voter			2015-03-13	
Miyoshi	Hidekazu			Ex Voter			2008-05-05	
Mizutani	Keiichi			Ex Voter			2013-11-10	
Mlinarsky	Fanny			Ex Voter			2012-05-01	
Mobasher	Amin		SAMSUNG	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Mody	Apurva		BAE Systems	ExOfficio				
Mohanty	Bibhu		Qualcomm Incorporated	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Monajemi	Pooya		Cisco Systems, Inc.	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		212
Monnerie	Emmanuel			Ex Voter			2012-05-01	
Montemurro	Michael		Research In Motion Limited	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Montenegro	Gabriel			Ex Voter			2008-02-13	
Montreuil	Leo		Broadcom Corporation	Voter	162* (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		217
Moon	Sungho		Newracom Inc.	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Moore	Rondal			Ex Voter				
Moorti	Rajendra	T		Ex Voter			2012-05-01	
Moreton	Mike			Ex Voter				
Mori	Hiroki			Ex Voter			2016-07-29	
Mori	Kenichi		Space-Time Engineering	Voter	166 (2017-	Caribe Hotel and Convention		

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					11-05)	Center, Orlando, FL, USA		
Mori	Masahito		Sony Corporation	Voter	162* (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Morioka	Hitoshi		SRC Software	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		212
Morioka	Yuichi		Sony Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Morley	Steven	A		Ex Voter				
Morris	Roy			Ex Voter				
Moskowitz	Robert	G		Ex Voter			2008-01-05	
Motozuka	Hiroyuki		Panasonic Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Mourot	Patrick			Ex Voter				
Mueller	Robert		Ilmenau University of Technology - TU Ilmenau	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		217
Mujtaba	Syed	A		Ex Voter				
Murabito	Anthony			Ex Voter			2010-11-12	
Murakami	Yutaka		Panasonic Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Murias	Ronald			Ex Voter			2015-07-28	
Murphy	Peter			Ex Voter				
Murphy	Rick			Ex Voter			2014-07-18	
Murray	Peter			Ex Voter			2011-07-22	
Myles	Andrew		Cisco Systems, Inc.	Voter	166 (2017-	Caribe Hotel and Convention		

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					11-05)	Center, Orlando, FL, USA		
Nabar	Rohit			Ex Voter			2009-03-16	
Nabetani	Toshihisa		TOSHIBA Corporation	Voter	162* (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Nadeem	Tamer			Ex Voter			2008-05-05	
Nagai	Yukimasa		Mitsubishi Electric Corporation	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		216
Nagao	Yuhei		Radrix Co., Ltd	Voter	166* (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		216
nagata	kengo			Ex Voter			2009-11-23	
Nakano	Hiroki		Kyoto University	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Nakao	Seigo			Ex Voter				
Nakase	Hiroyuki			Ex Voter			2010-03-22	
Nanda	Sanjiv			Ex Voter			2008-03-25	
Nandagopalan	SAI SHANKAR	S	Cypress Semiconductor Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Narasimhan	Partha			Ex Voter				
Narasimhan	Ravi			Ex Voter				
Nemavat	Pradeep			Ex Voter			2012-11-16	
Nezou	Patrice		Canon Research Centre France	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Ngo	Chiu		SAMSUNG	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Ni	Qiang			Ex Voter				
Nikolich	Paul		self (YAS), Samsung, Intel, SilverSpringNetworks, HP	ExOfficio				

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Nikula	Eero			Ex Voter			2009-11-23	
Nitsche	Gunnar			Ex Voter				
Noble	Erwin			Ex Voter			2008-11-17	
Noens	Richard	H		Ex Voter			2010-03-22	
Noh	Yujin		Newracom Inc.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Nordstrom	Eric			Ex Voter			2015-11-13	
Notor	John		Notor Research; ARM, Inc.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		212
Oakes	Ivan	F		Ex Voter				
Odagiri	Hideaki			Ex Voter			2009-03-16	
Odman	Knut		Broadcom Corporation	Voter	162* (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		216
Ogawa	Hiroyo			Ex Voter			2014-11-07	
Oguma	Hiroshi			Ex Voter				
Oh	Jinhyung			Ex Voter			2015-07-28	
Oh	Jisung			Ex Voter			2009-11-23	
Oh	Jong-Ee			Ex Voter			2015-05-07	
Oh	Minseok		Kyonggi University	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		216
OH	MIN-SEOK		LG Electronics	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
O'Hara	Robert			Ex Voter			2008-05-05	
Ohtani	Yoshihiro			Ex Voter				

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Okada	Hiraku		Nagoya University	Aspirant	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Okada	Kazuyasu			Ex Voter			2011-11-11	
Olesen	Robert		InterDigital, Inc.	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		217
Olson	Chandra	S		Ex Voter			2009-07-20	
Olson	David			Ex Voter			2013-03-22	
Omori	Youko			Ex Voter			2010-07-16	
Orlik	Philip		Mitsubishi Electric Research Labs (MERL)	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Oteri	Oghenekome		InterDigital, Inc.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Oyama	Satoshi		Association of Radio Industries and Businesses (ARIB)	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Ozaki	Kazuyuki		FUJITSU LABORATORIES LIMITED	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Paine	Richard	H		Ex Voter			2010-07-16	
PALANIVELU	Arul	D		Ex Voter			2010-03-22	
Paljug	Michael	J		Ex Voter			2013-07-19	
Palm	Stephen		Broadcom Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Pandey	Santosh Ghanshyam	G	Cisco Systems, Inc.	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		216

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Pang	Jiyong		Huawei Technologies Co. Ltd	Voter	162* (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		212
Pantelidou	Anna			Ex Voter			2014-03-21	
Papadopoulos	Babis			Ex Voter			2015-11-08	
Pare	Thomas		MediaTek Inc.	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		212
Park	Changmin			Ex Voter			2009-11-23	
Park	Eunsung		LG Electronics	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		212
Park	Giwon			Ex Voter			2015-07-28	
Park	Hyungu		Newracom Inc.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		212
Park	Hyunhee		LG ELECTRONICS	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Park	Jaewoo			Ex Voter			2015-07-28	
Park	Jeonghwan		Newracom Inc.	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Park	Jonghyun			Ex Voter			2012-11-16	
Park	Jungsoo			Ex Voter			2008-12-21	
Park	Minyoung		Intel Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Park	Seung-Hoon			Ex Voter			2013-11-10	

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PARK	SEUNGKEUN		ETRI	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Park	Sung-jin		LG ELECTRONICS	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Park	Taejoon			Ex Voter			2014-05-09	
Parsons	Glenn		Ericsson AB	ExOfficio				
Patel	Vijaykumar			Ex Voter			2009-11-23	
Pathmasuntharam	Jaya	S		Ex Voter			2013-03-22	
Patil	Abhishek		Qualcomm Incorporated	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Patil	Sandhya			Ex Voter			2013-03-22	
Patkar	Raghavendra		National Instruments Corporation	Aspirant	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Peiris	Bemini	H		Ex Voter			2011-07-22	
Peleg	Yaron			Ex Voter				
Peng	Xiaoming		Institute for Infocomm Research	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		212
Perahia	Eldad			Ex Voter			2016-01-21	
Pereira	Stephanie			Ex Voter			2015-07-28	
Perez Costa	Xavier	P		Ex Voter			2014-07-08	
Persson	Hakan		Ericsson AB	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Petranovich	James	E	ViaSat, Inc.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center,		

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						Orlando, FL, USA		
petrick	Albert		Jones-Petrick and Associates, LLC.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Petro	John			Ex Voter			2014-07-08	
Petrovic	Vladan			Ex Voter			2015-03-13	
Pienciak	Walter		IEEE	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
PILLAI	KRISHNA	M		Ex Voter			2012-11-16	
Ping Ping	Xu	P		Ex Voter			2015-03-13	
Pirhonen	Riku		Self Employed	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Pirskanen	Juho			Ex Voter			2014-07-18	
Pirzada	Fahd			Ex Voter			2009-03-16	
Pitarresi	Joe			Ex Voter				
Png	Khiam Boon	B		Ex Voter			2015-03-13	
Poncini	Victoria	M		Ex Voter			2008-03-25	
Ponnampalam	Vishakan			Ex Voter			2013-09-16	
Ponnuswamy	Subburajan			Ex Voter			2008-11-17	
Popa	Daniel			Ex Voter			2012-11-16	
Pope	Steve		Self Employed	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
porat	ron		Broadcom Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		212

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Portaro	James	D		Ex Voter			2010-11-12	
Ptasinski	Henry	S		Ex Voter			2013-11-15	
Pulikkoonattu	Rethnakaran		Broadcom Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Purkovic	Aleksandar			Ex Voter				
Purnadi	Rene			Ex Voter			2011-02-25	
Pustogarov	Ivan			Ex Voter			2011-11-11	
Putta	Satish			Ex Voter			2012-07-20	
Pyo	Chang-Woo	C		Ex Voter			2014-07-18	
Qi	Emily	H	Intel Corporation	Voter	166* (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		217
Qian	Luke			Ex Voter			2009-07-20	
Qiao	Dengyu		Huawei Technologies Co. Ltd	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Qu	Huyu			Ex Voter			2013-03-22	
Qu	Shouxing		BlackBerry	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		216
Raab	Jim	E		Ex Voter			2012-05-01	
Rabarijaona	Verotiana		National Institute of Information and Communications Technology (NICT)	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Rafie	Reza		Self	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center,		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
						Orlando, FL, USA		
Rahman	Mohammad	A		Ex Voter			2010-07-16	
Rai	Vinuth			Ex Voter			2009-11-23	
Raissinia	Ali			Ex Voter			2010-03-22	
Rajagopal	Sridhar			Ex Voter			2011-07-22	
Rajakarunanayake	Yasantha		MediaTek Inc.	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Rajkumar	Ajay			Ex Voter				
Rakanovic	Demir		u-blox	Voter	166* (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Ramamurthy	Harish			Ex Voter			2014-07-18	
Ramasastry	Jayaram			Ex Voter			2013-03-04	
Rangwala	Noman			Ex Voter				
Rantala	Enrico-Henrik		Nokia	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Rayment	Stephen G	G	Ericsson AB	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		212
Razoumov	Leonid			Ex Voter			2008-12-21	
Redlich	Oded		Huawei Technologies Co. Ltd	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Reede	Ivan			Ex Voter			2015-03-13	
Reible	Stanley	A		Ex Voter				
Ren	Yazhen		Huawei Technologies Co. Ltd	Voter	166* (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Repice	Joseph	A		Ex Voter			2008-11-17	
Reuss	Edward		NO AFFILIATION	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Reznik	Alex			Ex Voter			2011-11-11	
Riegel	Maximilian		Nokia Networks	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Rios	Carlos	A		Ex Voter			2008-07-19	
Rison	Mark		Samsung Cambridge Solution Centre	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		212
roblot	sandrine			Ex Voter			2011-07-22	
Roebuck	Randal			Ex Voter			2010-07-16	
Roh	Dongwook			Ex Voter			2012-05-01	
Rong	Zhigang		Huawei Technologies Co. Ltd	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Rosdahl	Jon	W	Qualcomm Technologies, Inc.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Roy	Arnab		InterDigital, Inc.	Potential Voter	162* (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Roy	Richard			Ex Voter			2016-01-21	
Ryu	Cheol			Ex Voter			2015-11-13	

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Ryu	Kiseon		LG ELECTRONICS	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		212
Sada	Tomoki		KDDI R&D Laboratories	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Sadeghi	Bahareh		Intel Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		212
Sadot	Emek			Ex Voter				
Sadri	Ali		Intel Corporation	Potential Voter	166* (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Safonov	Alexander			Ex Voter			2012-05-01	
Sakamoto	Takenori		Panasonic Corporation	Voter	166* (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		212
Sakoda	Kazuyuki		Sony Corporation	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Salazar Cardozo	Ruben E	S		Ex Voter			2013-09-16	
Sambasivan	Sam		AT&T	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Sampath	Hemanth		Qualcomm Incorporated	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Sanwalka	Anil			Ex Voter				
Sargologos	Nicholas			Ex Voter			2008-09-16	
Sarikaya	Behcet		Huawei R&D USA	Aspirant	166 (2017-	Caribe Hotel and Convention		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
					11-05)	Center, Orlando, FL, USA		
Sarrigeorgidis	Konstantinos			Ex Voter				
Sarris	Ioannis		u-blox	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Sasaki	Shigenobu		Niigata University	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Sastry	Ambatipudi R	R		Ex Voter			2008-03-25	
SATO	KATSUYOSHI			Ex Voter			2009-07-20	
Sato	Naotaka		Sony Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Sawada	Hirokazu			Ex Voter			2011-07-22	
Scarpa	Vincenzo			Ex Voter			2008-11-17	
Schelstraete	Sigurd		Quantenna Communications, Inc.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Schlanger	Gabriel			Ex Voter			2008-05-05	
Schmidl	Timothy			Ex Voter			2012-11-16	
Schnacke	Richard			Ex Voter				
Schneider	Daniel			Ex Voter			2016-07-29	
Schultz	Donald			Ex Voter			2010-03-22	
Schwoerer	Jean			Ex Voter			2015-03-13	
Schylander	Erik			Ex Voter				
Scott	Andy		NCTA	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		216

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Segev	Jonathan		Intel Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		212
Seibert	Cristina			Ex Voter			2014-07-18	
Seminario	Max		ADVANTEST	Aspirant	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Sensendorf	Joe			Ex Voter				
Seok	Yongho		Newracom Inc.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Serafimovski	Nikola		pureLiFi	Aspirant	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Shah	Kunal		Silver Spring Networks Inc.	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Shao	Huairong			Ex Voter			2014-11-07	
SHAO	PENG		NEC Communication Systems, Ltd.	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Shao	Zhenhai			Ex Voter			2014-03-21	
Shapira	Nir			Ex Voter			2012-11-16	
Sharma	Neeraj			Ex Voter			2009-07-20	
Sharon	Ariel			Ex Voter			2008-03-25	
Shearer	Steve			Ex Voter			2012-07-20	
Shellhammer	Stephen	J	Qualcomm Incorporated	ExOfficio				
Shen	Bazhong		Broadcom Corporation	Voter	162* (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		216
Shen	Xia		China Academy of Telecommunication Research (CATR)	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention		

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						Center, Berlin, Germany		
Sherlock	Ian		Texas Instruments Incorporated	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		217
Sherman	Matthew			Ex Voter				
Shi	Kai			Ex Voter			2009-11-23	
SHI	QICAI			Ex Voter			2014-07-18	
Shi	Wei			Ex Voter			2013-07-19	
SHIBAGAKI	Nobuhiko			Ex Voter			2014-07-08	
Shilo	Shimi		Huawei Technologies Co., Ltd	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Shimada	Shusaku		Schubiquist Technologies	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Shimomura	Tsuyoshi			Ex Voter			2015-03-13	
Shin	ChangSub	S		Ex Voter			2013-11-10	
SHIN	JUNG-CHUL			Ex Voter			2016-07-29	
Shin	Wooram			Ex Voter			2014-11-07	
Shukla	Ashish			Ex Voter			2011-07-22	
Shvodian	William	M		Ex Voter				
Shyy	D.	J		Ex Voter			2008-05-05	
Siep	Thomas	M		Ex Voter			2013-11-15	
Sim	Michael		Panasonic Corporation	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Simon	Francois			Ex Voter			2010-11-12	

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Simons	John			Ex Voter			2008-03-25	
Simpson	Floyd			Ex Voter				
Singh	Harkirat			Ex Voter			2009-03-16	
Singh	Shubhranshu			Ex Voter			2010-11-12	
Siti	Massimiliano			Ex Voter			2008-03-25	
Skafidas	Efstratios (Stan)			Ex Voter				
Skidmore	Roger	R		Ex Voter				
Slater	Robert			Ex Voter			2016-07-29	
Smith	Dwight			Ex Voter			2013-11-10	
Smith	Graham	K	SR Technologies	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		216
Smith	Matt			Ex Voter			2009-11-23	
So	Tricci			Ex Voter				
Sohn	Ill	S		Ex Voter			2012-11-16	
Solomon	Yoram			Ex Voter				
Son	Ju-Hyung		WILUS Institute	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		212
Son	JungBo	B		Ex Voter			2015-11-13	
Song	Chunyi			Ex Voter			2012-05-01	
Song	Hayeong		Newracom Inc.	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Song	Jae-Hyung			Ex Voter			2011-06-27	
Song	Leilei			Ex Voter			2008-07-18	

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Song	Myung Sun	S		Ex Voter			2014-07-08	
Song	Nah-Oak		Korea Advanced Institute of Science and Technology (KAIST)	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		217
Song	Yoo-Seung			Ex Voter			2009-06-30	
Sood	Kapil			Ex Voter			2010-03-22	
Soomro	Amjad			Ex Voter				
Soranno	Robert	T		Ex Voter				
Sreemanthula	Srinivas			Ex Voter			2008-02-13	
Sridhara	Vinay			Ex Voter			2010-03-22	
Srinivasa	Sudhir		Marvell Semiconductor, Inc.	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Stacey	Robert		Intel Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Stanley	Dorothy		Hewlett Packard Enterprise	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Steck	William	K		Ex Voter				
Stefani	Lawrence			Ex Voter			2013-11-10	
Stephens	Adrian	P	Intel Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Stephenson	David	S		Ex Voter			2011-02-25	
Stevenson	Carl	R		Ex Voter			2010-03-14	
Stine	John			Ex Voter			2011-03-18	
Stott	Noel		Ixia	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center,		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
						Orlando, FL, USA		
Strickland	Stuart		Hewlett Packard Enterprise	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Struik	Rene			Ex Voter			2015-03-13	
STRUTT	GUENAEL	T		Ex Voter			2011-06-27	
SU	HONGJIA		Huawei Technologies Co. Ltd	Potential Voter	162* (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Suh	JUNG HOON	H	Huawei Technologies Co. Ltd	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Sum	Chin-Sean			Ex Voter			2014-03-21	
Sumi	Takenori		Mitsubishi Electric Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Sun	Bo		ZTE Corporation	Voter	166* (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		212
Sun	Chen		Sony Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Sun	Li-Hsiang		InterDigital, Inc.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
sun	sheng		Huawei Technologies Co. Ltd	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		212
Sun	Yakun		Marvell Semiconductor, Inc.	Voter	162* (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		212

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Sun	Yanjun		Qualcomm Incorporated	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		217
Sun	Winston			Ex Voter			2008-02-13	
Surineni	Shravan	K		Ex Voter				
Suzuki	Hideyuki			Ex Voter			2008-07-18	
Szott	Szymon		AGH University of Science and Technology	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Tabibiazar	Arash			Ex Voter			2010-03-22	
Taghavi	Mohammad	H		Ex Voter			2012-11-16	
Takagi	Eiji			Ex Voter			2009-11-23	
Takagi	Masahiro			Ex Voter				
Takahashi	Kazuaki		Panasonic Corporation	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Takahashi	Seiichiro			Ex Voter				
Takai	Mineo		Space-Time Engineering	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		217
Takatori	Yasushi		Nippon Telegraph and Telephone Corporation (NTT)	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Takeda	Daisuke			Ex Voter				
Tal	Nir			Ex Voter				
Tamaki	Tsuyoshi			Ex Voter				
Tamhane	Sagar		Marvell Semiconductor, Inc.	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Tan	Pek-Yew			Ex Voter				
Tan	Teik-Kheong			Ex Voter			2010-07-16	
Tanahashi	Masato			Ex Voter			2008-07-19	

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Tanaka	Hideki			Ex Voter				
Tanaka	Yusuke		Sony Corporation	Voter	166* (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		217
Tandai	Tomoya			Ex Voter			2016-03-18	
Taniguchi	Kentaro		TOSHIBA Corporation	Voter	162* (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		217
Tao	Wu		Huawei Technologies Co. Ltd	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Taori	Rakesh		Phazr	Voter	164* (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Tarighat	Alireza			Ex Voter			2016-01-21	
Tayamon	Soma		Ericsson AB	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Teo	Joseph			Ex Voter			2013-07-19	
Tetzlaff	Thomas			Ex Voter			2014-11-07	
Thirupathi	Durai		Broadcom Corporation	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Thompson	Geoffrey	O		Ex Voter			2011-09-23	
THOMSON	ALLAN			Ex Voter			2011-07-22	
Thrasher	Jerry			Ex Voter			2013-09-16	
Tian	Bin		Qualcomm Incorporated	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		212
tian	kaibo		ZTE	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Tian	Qingjiang		Qualcomm Incorporated	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Tian	Tao		Qualcomm Incorporated	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		217
Tian	Tong			Ex Voter			2014-07-18	
Tingleff	Jens			Ex Voter			2015-11-13	
Tinnakornsrisuphap	Peerapol		Qualcomm Incorporated	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Tokubo	Eric			Ex Voter			2011-02-25	
Tolpin	Alexander			Ex Voter			2008-12-21	
Tomcik	James	D		Ex Voter			2012-05-01	
Tong	Fei		Samsung Cambridge Solution Center	Potential Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Torab	Payam		Broadcom Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		212
Torkildson	Eric		Nokia	Aspirant	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Tosato	Filippo			Ex Voter			2016-11-11	
Toyoda	Ichihiko			Ex Voter			2012-05-01	
Trachewsky	Jason			Ex Voter			2010-11-12	
Trainin	Solomon	B	Intel Corporation	Voter	166* (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Tran	Ha Nguyen	N		Ex Voter			2014-07-18	

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Tsai	Chia-Hung		MediaTek Inc.	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Tsai	Chia-Lung			Ex Voter			2014-05-09	
Tsao	Alvin			Ex Voter			2008-05-05	
Tsao	Jean			Ex Voter			2010-11-12	
Tsodik	Genadiy		Huawei Technologies Co. Ltd	Potential Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Tsonev	Dobroslav		pureLiFi	Aspirant	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Tsoulogiannis	Tom			Ex Voter				
tsubaki	toshimitsu			Ex Voter			2016-11-11	
Tsukada	Kazuyoshi			Ex Voter			2015-11-13	
Tu	Yung-Szu			Ex Voter			2011-07-22	
Tuomaala	Esa		Nokia	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		212
Turner	Sandra	L		Ex Voter				
Tzamaloukas	Mike	E		Ex Voter				
Umehira	Masahiro			Ex Voter			2015-03-13	
Urabe	Yoshio		Panasonic Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Uyehara	Ashley			Ex Voter			2008-11-17	
Van Erven	Niels			Ex Voter				
Van Leeuwen	Richard			Ex Voter				
Van Nee	Richard	D	Qualcomm Incorporated	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
van Waes	Nico	J		Ex Voter				

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Van Zelst	Allert		Qualcomm Incorporated	Voter	164* (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Vangelista	Lorenzo		Patavina Technologies	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Vanthournout	Jerome		CEVA-DSP	Aspirant	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Varlet-Andre	Mathieu			Ex Voter			2009-06-30	
Varsanofiev	Dmitri			Ex Voter				
Varshney	Prabodh		Nokia	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		212
Venkatachalam Jayara	Venkata Ramanan		Qualcomm Incorporated	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Venkatesan	Ganesh		Intel Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Venkateswaran	Sriram		Broadcom Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Verma	Karan		Central University of Rajasthan	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Verma	Lochan		Qualcomm Incorporated	Potential Voter	166* (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Vermani	Sameer		Qualcomm Incorporated	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		212

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Victor	Dalton	T		Ex Voter			2015-03-13	
VIGER	Pascal		Canon Research Centre France	Voter	166* (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Villardi	Gabriel		National Institute of Information and Communications Technology (NICT)	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Virk	Bhupender			Ex Voter			2012-07-20	
Vlantis	George	A	STMicroelectronics	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Vogtli	Nanci			Ex Voter				
Volpano	Dennis			Ex Voter				
Wadhwa	Sanjay			Ex Voter			2012-07-20	
Walker	Jesse	R		Ex Voter			2010-07-16	
Wallace	Brad	N		Ex Voter				
Wandile	Vivek			Ex Voter				
Wang	Bo		Huawei Technologies Co., Ltd	Potential Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Wang	Chao Chun		MediaTek Inc.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Wang	Haiguang			Ex Voter			2015-07-28	
Wang	Haiming		Southeast University, China	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		212
Wang	Huaiyuan			Ex Voter				
Wang	Hui			Ex Voter			2008-03-25	
Wang	Huizhao		Quantenna Communications, Inc.	Voter	166 (2017-	Caribe Hotel and Convention		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
					11-05)	Center, Orlando, FL, USA		
Wang	James June	J	MediaTek Inc.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Wang	Junyi			Ex Voter			2012-07-20	
Wang	Lei		Huawei R&D USA	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Wang	Lin			Ex Voter			2014-03-21	
Wang	Qi		Broadcom Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		212
Wang	Stanley			Ex Voter				
Wang	Xiang			Ex Voter			2014-03-21	
Wang	Xiaofei		InterDigital, Inc.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Wang	Xuehuan		Huawei Technologies Co. Ltd	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Wang	Yi		Huawei Technologies Co. Ltd	Potential Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Want	Roy		Google	Aspirant	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Ward	Dennis			Ex Voter			2008-03-25	
Ward	Lisa		Rohde & Schwarz	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center,		212

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
						Orlando, FL, USA		
Ware	Christopher	G		Ex Voter				
Warren	Craig	D		Ex Voter			2010-07-16	
Watanabe	Fujio		NTT DoCoMo, Inc.	Voter	164* (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		212
waye	patrick			Ex Voter			2009-06-30	
Webber	Julian		Advanced Telecommunications Research Institute International (ATR)	Potential Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Wee	Gaius		Panasonic Asia Pacific Pte Ltd.	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Wei-Xia	Zou			Ex Voter			2015-11-13	
Wells	Bryan			Ex Voter				
Wen	Ericson			Ex Voter			2014-03-21	
Wen	Lei			Ex Voter			2013-07-19	
Wendt	Jim			Ex Voter				
Wentink	Menzo	M	Qualcomm Incorporated	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		212
West	Nicholas			Ex Voter			2012-11-16	
Weytjens	Filip			Ex Voter				
Whetten	Frank			Ex Voter			2010-03-22	
Whitesell	Stephen	R		Ex Voter			2008-02-13	
Wicaksana	Harya			Ex Voter			2013-11-15	
Wilhelmsson	Leif		Ericsson AB	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		212

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Williams	Christopher			Ex Voter			2014-07-08	
Williams	Kyle			Ex Voter			2009-03-16	
Wilson	James	M		Ex Voter				
Wineinger	Gerald			Ex Voter			2008-07-19	
Winters	Jack	H		Ex Voter				
WON	EUN TAE	T		Ex Voter			2015-03-05	
Wong	Eric		Apple, Inc.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Wong	Ian			Ex Voter			2012-11-16	
Wong	Timothy	G		Ex Voter			2014-03-21	
Worsham	James			Ex Voter			2012-05-01	
Worstell	Harry	R		Ex Voter			2016-03-18	
Wright	Charles	R		Ex Voter				
Wright	Michael			Ex Voter				
Wu	Fonchi			Ex Voter			2010-07-16	
Wu	Gang			Ex Voter				
Wu	Jianbing		Shenzhen iTest Technology Co.,Ltd.	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Wu	Songping			Ex Voter			2008-11-17	
Wu	Tianyu		MediaTek Inc.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		212
Wu	Ye			Ex Voter			2011-02-25	
Wu	Zhanji			Ex Voter			2013-09-16	
Xia	Pengfei			Ex Voter			2015-11-08	

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Xiao	Zhenyu			Ex Voter			2014-03-21	
Xie	Fang			Ex Voter			2013-11-15	
Xie	Zhen			Ex Voter			2008-03-25	
Xin	Yan		Huawei Technologies Co. Ltd	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Xing	Weimin		ZTE Corporation	Voter	166* (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Xu	Dongmei			Ex Voter			2014-03-21	
Xu	Mingguang			Ex Voter			2015-11-08	
XU	QUANPING			Ex Voter			2014-03-21	
Xue	Qi		Qualcomm Incorporated	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
YAGHOOBI	HASSAN		Intel Corporation	Potential Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Yagi	Akiyoshi			Ex Voter			2008-11-17	
Yamada	Akira		NTT DoCoMo, Inc.	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Yamamoto	Takeshi			Ex Voter			2009-11-23	
Yamaura	Tomoya			Ex Voter			2009-03-16	
Yang	Guang-Qi			Ex Voter			2014-07-08	
Yang	Lin			Ex Voter			2014-07-18	

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Yang	Liuyang			Ex Voter			2011-06-27	
Yang	Meng			Ex Voter			2015-03-05	
Yang	Ou		Intel Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Yang	Rongzhen			Ex Voter			2015-05-07	
YANG	RUI		InterDigital, Inc.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		217
Yang	Sihoon			Ex Voter			2008-03-25	
Yang	Xun		Huawei Technologies Co. Ltd	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		212
Yang	Xun			Ex Voter			2015-05-07	
Yang	Yang			Ex Voter			2014-03-21	
Yang	Yunsong		Huawei Technologies Co. Ltd	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Yang	Zhiyu			Ex Voter			2008-09-16	
Yano	Kazuto		Advanced Telecommunications Research Institute International (ATR)	Potential Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
YAO	KE		ZTE Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		212
Ye	Fan			Ex Voter			2014-05-09	

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Ye	Huanchun			Ex Voter			2012-07-20	
Yee	James		MediaTek Inc.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		212
Yee	Jung			Ex Voter			2012-07-20	
Yee	Peter		NSA/IAD	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Yeh	Chi-Hsiang			Ex Voter			2008-03-25	
Yeow	Wai-Leong			Ex Voter			2013-03-22	
Yin	Hujun			Ex Voter			2015-03-05	
Yokohira	Kanji			Ex Voter			2008-03-25	
Yokoo	Kaoru			Ex Voter			2014-03-21	
Yokota	Hidetoshi		Landis Gyr Group Worldwide	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		216
Yong	Su Khiong	K	Apple, Inc.	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Yonge	Larry			Ex Voter			2015-11-08	
Yoon	Chanho			Ex Voter			2012-11-16	
Yoshida	Seiji			Ex Voter			2010-03-22	
Young	Christopher		Broadcom Corporation	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Yu	Bo		Marvell Semiconductor, Inc.	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Yu	Chang Wahn			Ex Voter			2015-03-05	

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Yu	Chinghwa		Spreadtrum Comm.	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		212
Yu	Heejung		Yeungnam University	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Yu	Jian		Huawei Technologies Co. Ltd	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Yu	Mao		Marvell Semiconductor, Inc.	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Yu	Patrick			Ex Voter				
Yu	Zhan			Ex Voter			2013-03-22	
Yucek	Tevfik		Qualcomm Incorporated	Potential Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Yue	Guangrong			Ex Voter			2014-11-07	
Yun	Ji-Hoon			Ex Voter			2015-07-28	
Yun	SunWoong		LG ELECTRONICS	Potential Voter	166* (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Yung	Hon	M		Ex Voter				
Yunoki	Katsuo	D	KDDI R&D Laboratories	Voter	166* (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		212
Yurtkuran	Erol	K		Ex Voter				
Zaks	Artur			Ex Voter			2012-05-01	
Zeleznikar	Alan		ARRIS Group	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Zeng	Kun		Huawei Technologies Co. Ltd	Voter	166 (2017-	Caribe Hotel and Convention		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
					11-05)	Center, Orlando, FL, USA		
Zhang	Dezhi			Ex Voter			2012-11-16	
Zhang	Hongyuan		Marvell Semiconductor, Inc.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Zhang	Hui			Ex Voter			2014-03-21	
zhang	huimin			Ex Voter			2009-07-20	
ZHANG	JIAYIN		Huawei Technologies Co. Ltd	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Zhang	Jinyun		Mitsubishi Electric Research Labs (MERL)	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Zhang	Junjian			Ex Voter			2013-03-22	
Zhang	Nianzu			Ex Voter			2014-05-09	
Zhang	Ning			Ex Voter			2012-05-01	
Zhang	Xin			Ex Voter			2013-11-15	
Zhang	Xingxin		Huawei Technologies Co. Ltd	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		216
Zhang	Yan		Marvell Semiconductor, Inc.	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Zhao	Meiyuan			Ex Voter			2010-11-12	
Zhao	Mu			Ex Voter			2016-01-21	
Zhao	Qiang			Ex Voter			2012-05-01	
Zhao	Shiwei			Ex Voter			2011-07-22	
ZHAO	XIAOWU		ZTE Corporation	Aspirant	164 (2017-	Estrel Hotel and Convention		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
					07-09)	Center, Berlin, Germany		
Zheng	Jun			Ex Voter			2016-07-29	
ZHENG	SHOUKANG			Ex Voter			2015-03-13	
Zheng	Xiayu		Marvell Semiconductor, Inc.	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Zhou	Jingyi		Verizon Communications	Aspirant	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Zhou	Mingtuo			Ex Voter			2014-07-08	
Zhou	Xun		Huawei Technologies Co. Ltd	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Zhou	Yan		Qualcomm Incorporated	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		217
zhou	yuan			Ex Voter			2014-11-07	
Zhu	Chunhui		Huawei Technologies Co. Ltd	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		212
Zhu	Hufei			Ex Voter			2015-05-07	
Zhu	Jing			Ex Voter			2009-03-16	
Zhu	Jun		Huawei Technologies Co. Ltd	Voter	166* (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Zhuang	Yan			Ex Voter			2015-11-13	
Zhuo	Lan		CESI Group	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Zorn	Glen			Ex Voter				

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Zuckerman	Lawrence			Ex Voter			2012-11-16	
Zuniga	Juan Carlos		SIGFOX	Voter	162 (2017-03-12)	Hyatt Regency, Vancouver, BC, Canada		
Zweig	Jonathan			Ex Voter			2008-11-17	
Zyren	James			Ex Voter				

How do I specify my affiliation?

Affiliation is recorded in the IEEE myProject system at the Sponsor level, the Working Group level, and the Project level.

The affiliation shown above is updated from the IEEE-SA registration data after each session you attend.

To enter affiliation initially:

- Log onto myProject
- Click on Manage Activity Profile
- Expand the list to the Sponsor, Working Group, or Project
- Check the box to enroll in that specific group
- Follow the instructions to add your affiliation

To modify your affiliation in a committee that you already enrolled in:

- Log onto myProject
- Click on My Info on the top right hand corner
- Click on Affiliation Information

If you change your affiliation using the myProject system please also send an email to the Working Group Chair (Adrian P Stephens at adrian.p.stephens@ieee.org.).

(Any changes may also often require the changing of emails in the 802.11 email reflectors, which can be done by the Working Group 2nd Vice Chair (Dorothy Stanley) at the same time.)

How do I specify my employer?

There is no specific requirement in the IEEE-SA policies and procedures to disclose your employer.

Employer is asked for once in myProject.

To view or update your employer :

- Log onto myProject
- Click on My Info on the top right hand corner
- Here you can modify your employer

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Appendix BR

The Wayback Machine - https://web.archive.org/web/20170528155503/http://www.ieee802.org/11/Voters/voti…

IEEE P802.11 - WORKING GROUP MEMBERSHIP LISTS

This page shows information for IEEE P802.11 Voter, Potential Voter, Aspirant, Ex Officio members, and Ex Voters as of 2017-05-12.

Note that this information is updated only after each 802.11 face-to-face session or working group letter ballot series.

The fields in the membership list have the following meaning

Column	Description
Status	The Status column has the following meaning: • Voter - the member can vote • Potential voter - the member will have a voting token at the next face-to-face meeting and will become a voter after that meeting • Aspirant - the member has recorded attendance at one qualifying meeting • Ex Officio - the member is a voter by virtue of their membership of the IEEE 802 executive committee (EC) • Ex Voter - the member was previously a voter member of 802.11. If you wish to be recognized as an Ex Voter, and are not recorded below, please furnish evidence of former voter status to the WG officers. Members of all these status are entitled to join 802.11 email reflectors and submit documents to the 802.11 document server.
Expires	This column shows the meeting number (which is necessarily a Plenary meeting) and approximate starting date of the meeting after which a voting member's voting status expires, if member does not attend any qualifying meetings between now and the end of that meeting. For "potential voter" members, this shows the meeting after which their status reverts to "aspirant". For "aspirant" members, this shows the meeting after which they lose "aspirant" status (and disappear from this listing). An asterisk after a meeting number (e.g., "142* (2013-11-07)") indicates that a voting member needs to attend one additional meeting before the cited meeting, or they will lose their voting membership at the cited meeting, regardless of whether they attend it or not. This occurs when the last two meetings attended by the member were a plenary and the interim following it. NOTE--the "Expires" entry for some voting members is blank. This signifies that the chair has granted them voting membership without an attendance requirement.
Expired	The Expired column indicates the date when the member became an Ex Voter, if that is known.
Last Invalid Ballot	This column indicates the ballot number any last invalid or missed ballot (see http://www.ieee802.org/11/LetterBallots.shtml for the list of working group ballots). It is present only for Voter members. An invalid ballot is a failure to return a vote in a Working Group letter ballot series (i.e., the initial ballot and all recirculations for a particular project), or returning an invalid vote (voting "no" with

	no "must be satisfied" comments, or voting abstain for a reason other than "lack of expertise"). Invalid ballots are counted over up to the last three letter ballot series since the member gained Voter status. Transition arrangements: For ballots starting before August 2016, a voter's response to a letter ballot series is determined by their response to the initial ballot. After then, a voter's resonse will be determined when the letter ballot series is known to have terminated (i.e., when the project is approved by the EC, or meets the terms of conditional approval by the EC, to proceed to sponsor ballot). Voters who failed to meet the updated OM were granted a waiver of the most recent ballot they missed so that the change in the application of the rules resulted in no loss of voting membership. According to the 802.11 operations manual, a Voter must return a valid vote in 2 of the last 3 letter ballot series to maintain their status. This means the voter can miss or return an invalid vote at most 1 such ballot series. A Voter that has missed a ballot series and fails to return a valid vote by the end of the next letter ballot series loses their Voter status and becomes an Ex Voter.

Please verify your affiliation.

There is a specific requirement in the IEEE-SA policies and procedures that attendees at its meetings disclose their affiliation. Attendees failing properly to do so risk losing the privileges of membership (i.e., voting rights).

For information from the IEEE-SA on affiliations please click here**.**

Affiliation is not shown for Ex-Voters. For other membership statuses, if there is no affiliation beside your name or if the affiliation is incorrect please follow these instructions.

If you have any related questions, please contact Adrian P Stephens at adrian.p.stephens@ieee.org.

Summary

Member Status	Count
Aspirant	112
ExOfficio	12
Ex Voter	827
Potential Voter	29
Voter	328

Detail

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Aboba	Bernard			Ex Voter				
Aboulmagd	Osama	S	Huawei Technologies Co. Ltd	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Abraham	Santosh	P	Qualcomm Technologies Incorporated	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Abu Surra	Shadi	A		Ex Voter			2016-11-11	
Adachi	Tomoko		TOSHIBA Corporation	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Agardh	Kare		Sony Mobile Communications	Voter	164* (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Aggarwal	Alok			Ex Voter			2009-07-20	
Agre	Jonathan	R		Ex Voter				
Ahn	Jaehyun			Ex Voter			2016-01-21	
Ahn	Jinsoo		Yonsei University	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		225
Ahn	Seung Hyeok		Newracom Inc.	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Ahn	Woojin		WILUS	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		217
Aiello	Roberto			Ex Voter			2015-07-28	
Aio	Kosuke		Sony Corporation	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Akhmetov	Dmitry		Intel Corporation	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		225
Aldana	Carlos	H	Intel Corporation	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Alexander	Thomas			Ex Voter			2015-03-13	
Alimian	Areg			Ex Voter				
Alpert	Yaron		Intel Corporation	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Al-Taleb	Sajaa		telekom research and development/malaysia	Aspirant	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Amann	Keith			Ex Voter			2008-11-17	
Amini	Peiman			Ex Voter			2013-07-19	
An	Song-Haur		INDEPENDENT	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Andrade	Merwyn	B		Ex Voter				
Andren	Carl	F		Ex Voter				
Andrus	David	C		Ex Voter			2011-11-11	
Ansley	Carol		ARRIS Group	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Anton	Butch			Ex Voter				
Anwyl	Gary			Ex Voter			2010-03-22	
Aoki	Tsuguhide		TOSHIBA Corporation	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		217
Aramaki	Takashi			Ex Voter				
Arita	Takashi			Ex Voter			2008-05-05	

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Ariyavisitakul	Sirikiat Lek	L		Ex Voter			2014-11-07	
Armstrong	Lee	R	US Department of Transportation	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Arndt	Manfred		Hewlett Packard Enterprise	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Arnett	Larry			Ex Voter				
Arnold	James			Ex Voter			2016-11-11	
Asai	Yusuke		NTT	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Ashley	Alex			Ex Voter			2013-07-19	
Asterjadhi	Alfred		Qualcomm Incorporated	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Atcitty	Torrey			Ex Voter			2012-05-01	
Au	Kwok Shum	S	Huawei Technologies Co. Ltd	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Audeh	Malik			Ex Voter			2009-11-23	
Auluck	Vijay		Self	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		225
Aust	Stefan			Ex Voter			2015-11-13	
Avera	Drayton			Ex Voter			2016-03-18	
Awater	Geert	A	Qualcomm Incorporated	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Azizi	Shahrnaz		Intel Corporation	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Babaei	Alireza			Ex Voter			2016-01-21	
Backes	Floyd			Ex Voter			2008-03-25	
Bagby	David		Calypso Ventures, Inc.	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Bahr	Michael			Ex Voter			2012-07-20	
Bai	Fan			Ex Voter			2009-11-23	
Baik	Eugene		Qualcomm Incorporated	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Bain	David		TM Technologies	Potential Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Bajko	Gabor			Ex Voter			2016-03-18	
Baker	Dennis	J		Ex Voter			2008-12-21	
Banerjea	Raja			Ex Voter			2013-11-15	
Banerjee	Kaberi			Ex Voter			2011-03-18	
bang	saehee		LG ELECTRONICS	Voter	166* (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		217
Bansal	Amit			Ex Voter			2009-03-16	
Barber	Phillip			Ex Voter			2015-11-13	
Barber	Simon			Ex Voter				
baron	stephane		Canon Research Centre France	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Barr	David		Intel Corporation	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
						Center, Berlin, Germany		
Barr	John	R		Ex Voter			2012-05-01	
Barriac	gwendolyn			Ex Voter			2017-03-17	
Barry	Kevin	M		Ex Voter				
Bartel	Charles	R		Ex Voter				
Basson	Gal			Ex Voter			2011-07-22	
Batra	Anuj		Apple, Inc.	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Bavafa	Moussa			Ex Voter			2009-05-05	
Baykas	Tuncer			Ex Voter			2013-03-04	
Baysal	Burak	H		Ex Voter				
Bei	Jianwei		Marvell Semiconductor, Inc.	Aspirant	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Benko	John	L		Ex Voter			2010-07-11	
Ben-Tovim	Erez			Ex Voter			2013-11-15	
Benveniste	Mathilde			Ex Voter			2009-11-23	
Berens	Friedbert		FBConsulting Sarl	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Berger	Christian		Marvell Semiconductor, Inc.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Berkema	Alan			Ex Voter			2014-07-18	
Berry	Don			Ex Voter				
Bhandaru	Nehru		Broadcom Corporation	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Bharadwaj	Arjun			Ex Voter			2017-01-20	
Bhatt	Anirudh			Ex Voter			2012-05-01	
Bhukania	Bijoy			Ex Voter			2012-11-16	
Bims	Harry		Bims Laboratories, Inc.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		217
Bjerke	Bjorn	A		Ex Voter			2009-03-16	
Black	Simon			Ex Voter				
Blanchard	Colin			Ex Voter			2008-05-05	
Blue	Scott			Ex Voter				
Bocus	Mohammud		Toshiba of Europe Ltd.	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Boer	Jan			Ex Voter				
Booth	Ted			Ex Voter			2012-05-01	
Borges	Daniel			Ex Voter			2011-06-27	
Boucachard	Philippe			Ex Voter			2013-07-19	
Bourdoux	Andre		IMEC	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Brandt	David		Rockwell Automation	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Brasier	William	M		Ex Voter				
Braskich	Anthony			Ex Voter			2010-03-22	
Bray	Jennifer			Ex Voter				
Breit	Gregory			Ex Voter			2011-11-11	
Brennan	Joseph			Ex Voter			2010-03-22	

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Britz	David			Ex Voter			2008-12-21	
Brown	Alan	M	ADTRAN Inc.	Aspirant	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Buffington	John		Itron Inc.	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Buga	Walter			Ex Voter			2010-07-16	
Bumiller	G			Ex Voter			2012-07-20	
Buttar	Alistair	G		Ex Voter			2008-02-13	
Bynum	Ann			Ex Voter			2016-03-18	
Cai	Lin			Ex Voter			2015-07-28	
CAI	YU			Ex Voter			2015-07-28	
Caillerie	Alain		Canon Research Centre France	Potential Voter	166* (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Calcev	George		Huawei R&D USA	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Calvert	Chris		Landis Gyr Group Worldwide	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Camps Mur	Daniel	C		Ex Voter			2012-05-01	
Cam-Winget	Nancy			Ex Voter			2010-07-16	
Canchi	Radhakrishna		Kyocera International, Inc.	ExOfficio	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Canpolat	Necati			Ex Voter			2011-07-22	

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
cao	fengming			Ex Voter			2016-07-29	
Cao	Rui		Marvell Semiconductor, Inc.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Capar	Cagatay			Ex Voter			2016-11-11	
Cardona	Javier			Ex Voter			2010-03-22	
Cariou	Laurent		Intel Corporation	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		217
Carlo	James			Ex Voter			2008-03-25	
Carney	William		Sony Corporation	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Carson	Pat			Ex Voter				
Centonza	Angelo			Ex Voter			2008-03-25	
Cha	Jaesun			Ex Voter			2013-07-19	
Chair	Ricky		Airgain	Potential Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Challans	Romana			Ex Voter			2013-03-22	
CHAMBELIN	Philippe			Ex Voter			2012-10-31	
Chan	Douglas	S		Ex Voter			2009-11-23	
Chang	Kapseok			Ex Voter			2011-07-22	
Chang	Kuor-Hsin			Ex Voter			2015-03-13	
CHANG	SANGHYUN		SAMSUNG ELECTRONICS	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Chang	Soo-Young		California State University, Sacramento (CSUS)	Voter	166 (2017-	Caribe Hotel and Convention		225

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
					11-05)	Center, Orlando, FL, USA		
Chang	Xin			Ex Voter			2014-07-08	
Chaplin	Clint	F	Imagicon	ExOfficio				
Chen	Bin			Ex Voter			2013-07-19	
Chen	Cheng		Intel Corporation	Aspirant	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Chen	Jiamin		HUAWEI	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Chen	Jiunn-Tsair			Ex Voter			2010-03-22	
Chen	Jixin			Ex Voter			2014-05-09	
CHEN	KWANG-CHENG			Ex Voter			2016-07-29	
Chen	Lidong			Ex Voter			2016-11-11	
Chen	Peng		Huawei Technologies Co. Ltd	Aspirant	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Chen	Qian			Ex Voter			2014-11-07	
CHEN	Rory			Ex Voter			2008-02-13	
Chen	Spark		ARRIS Group	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Chen	Teyan			Ex Voter			2016-11-11	
CHEN	Xi			Ex Voter			2014-03-21	
Chen	Xiaogang		Intel Corporation	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Chen	Ye			Ex Voter				
Chen	Yi-Ming			Ex Voter				

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Cheng	Gary		Peraso Technologies Incorporated	Potential Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Cheng	Hong			Ex Voter			2008-05-05	
Cheng	Paul		MediaTek Inc.	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		225
Cheng	Yong		Huawei Device	Aspirant	170 (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Cheong	Minho		Newracom Inc.	Voter	168* (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
CHERIAN	GEORGE		Qualcomm Incorporated	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		217
Cherniavsky	Dmitry		SiBEAM, Inc.	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Chesson	Greg			Ex Voter				
Chi	Zhipei			Ex Voter			2015-07-28	
Chia	Meng	W		Ex Voter			2011-07-22	
Chin	Francois			Ex Voter			2014-11-07	
Chin	Woon Hau			Ex Voter			2016-07-29	
Chindapol	Aik			Ex Voter				
Chitrakar	Rojan		Panasonic Asia Pacific Pte Ltd.	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Cho	Hangyu		lg electronics	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Cho	Joongwon			Ex Voter			2016-11-11	

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Cho	Woong			Ex Voter			2010-11-12	
Choi	Chang-Soon			Ex Voter			2010-11-12	
Choi	Hyeyoung			Ex Voter			2016-07-29	
Choi	Inhwan			Ex Voter			2012-02-19	
Choi	In-Kyeong		Newracom Inc.	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Choi	Jee-Yon			Ex Voter			2015-03-13	
Choi	Jinsoo		LG ELECTRONICS	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Choi	Nakjung			Ex Voter			2010-03-22	
Choi	Sangsung		Electronics and Telecommunications Research Institute (ETRI)	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Choi	Seyeong			Ex Voter			2010-03-22	
Choi	Sunghyun			Ex Voter				
Choi	Won-Joon			Ex Voter				
Choo	Li Chia	C		Ex Voter			2014-07-18	
Choudhury	Abhijit	K		Ex Voter			2008-07-19	
Choudhury	Sayantan		Nokia	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
CHRISTIN	Philippe			Ex Voter			2011-07-22	
Chu	Liwen		Marvell Semiconductor, Inc.	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Chu	Wenjing			Ex Voter			2014-03-21	

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
CHUN	JINYOUNG			Ex Voter			2016-01-21	
Ciochina	Dana		Sony Corporation	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Ciotti	Frank			Ex Voter				
Clements	Ken			Ex Voter				
Coffey	John		Realtek Semiconductor Corp.	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Cole	Terry	L		Ex Voter			2010-03-14	
Coleman	Ryon	K		Ex Voter			2008-12-21	
Congdon	Paul			Ex Voter				
Conner	W	S		Ex Voter			2008-02-13	
Cook	Charles	I		Ex Voter			2010-11-12	
Cook	Kenneth			Ex Voter				
Cooklev	Todor			Ex Voter			2009-03-16	
Coop	Kenneth			Ex Voter			2015-11-08	
Cordeiro	Carlos		Intel Corporation	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Correal	Neiyer			Ex Voter			2014-07-18	
Crowley	Steven			Ex Voter			2008-03-25	
Cypher	David	E		Ex Voter			2009-11-23	
da Silva	Claudio		Intel Corporation	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		225
DANG	Meimei		China Academy of Telecommunication Research (CATR)	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Das	Subir		Applied Communication Sciences	ExOfficio				
Dash	Debashis		Quantenna Communications, Inc.	Aspirant	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Dauphinee	Leonard		MaxLinear Corp	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
De Courville	Marc			Ex Voter			2009-11-23	
De Ruijter	Hendricus		Silicon Laboratories	Aspirant	170 (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
de Vegt	Rolf	J	Qualcomm Incorporated	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		217
Debergh	Pierre		Orange	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Dehghan	Hossein			Ex Voter			2012-05-01	
Demessie	Yohannes			Ex Voter			2013-03-22	
Deng	Der-Jiunn		National Changhua University of Education	Potential Voter	166* (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
denson	michael			Ex Voter			2014-07-18	
Denteneer	Theodorus			Ex Voter			2012-05-01	
Derham	Thomas			Ex Voter			2015-07-28	
Deshmukh	Nikhil		National Instruments Corporation	Aspirant	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
deVries	Jeremy			Ex Voter			2010-03-22	
Dickey	Susan			Ex Voter			2010-11-12	

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Ding	Gang			Ex Voter			2010-09-18	
DING	ZHIMING			Ex Voter			2008-12-21	
Doi	Yoshiharu			Ex Voter			2009-07-20	
Donapati	Rakesh		Anritsu Company	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Dong	Ting			Ex Voter			2014-05-09	
Dong	Xiandong			Ex Voter			2014-07-18	
Doppler	Klaus			Ex Voter			2015-05-07	
Dorsey	John			Ex Voter			2011-03-18	
Douglas	Brett	L		Ex Voter				
Dowse	Malcolm			Ex Voter			2016-01-21	
Drennan	Offie			Ex Voter			2012-07-20	
DU	JiaDong			Ex Voter			2015-11-13	
Du	Lei			Ex Voter			2008-03-25	
Dua	Praveen			Ex Voter			2016-11-11	
Duan	Chunjie			Ex Voter			2011-11-11	
Dundar	Baris	B		Ex Voter				
Durand	Roger	P		Ex Voter			2014-11-07	
duvvuri	srinivasa			Ex Voter			2009-11-23	
Eastlake 3rd	Donald	E	Huawei Technologies Co. Ltd	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		216
Ecclesine	Peter		Self	Voter	168* (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		216

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Edgar	Richard		Imagination Technologies Ltd.	Voter	166* (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Edney	Jonathan	P		Ex Voter				
Edwards	Bryan			Ex Voter			2008-03-25	
Eitan	Alecsander		Qualcomm Incorporated	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Ekbal	Amal			Ex Voter			2014-03-21	
Elbakoury	Hesham	M		Ex Voter			2008-03-25	
Ellis	Jason			Ex Voter				
Ellis	Michael			Ex Voter			2009-06-30	
ElSherif	Ahmed		Qualcomm Incorporated	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		225
Emeott	Stephen	P		Ex Voter			2009-11-23	
Emmelmann	Marc		Self Employed	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Engwer	Darwin			Ex Voter			2010-03-22	
Eo	Iksoo			Ex Voter			2015-05-07	
Epstein	Joseph			Ex Voter			2009-03-16	
Epstein	Leonid		Celeno Communications	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Erceg	Vinko		Broadcom Corporation	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		216
Eriksson	Patrik			Ex Voter				

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Escalera	Natalia		Buffalo Inc.	Aspirant	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Estevez	Leonardo			Ex Voter			2011-02-25	
Estrada	Andrew		Sony Corporation	Potential Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Euscher	Christoph			Ex Voter				
Faccin	Stefano	M		Ex Voter				
Falk	Lars	P		Ex Voter			2009-03-16	
Fan	Zhong			Ex Voter			2016-07-29	
Fanfelle	Robert			Ex Voter			2009-07-20	
Fang	Ping		Huawei Device Co. Ltd	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Fang	Yonggang		ZTE TX Inc	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Fechtel	Stefan			Ex Voter			2009-11-23	
Fei	QIN			Ex Voter			2014-07-08	
Feinberg	Paul	H		Ex Voter			2008-12-21	
Feldman	Alex			Ex Voter				
Feldman	Ariel		Autotalks	Aspirant	170 (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Feng	Xiang		Keysight Technologies	Potential Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Ferdowsi	Vida			Ex Voter			2016-11-11	
Filin	Stanislav			Ex Voter			2014-07-08	
Finn	Norman		Huawei Technologies Co. Ltd	Voter				

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Fischer	Matthew	J	Broadcom Corporation	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Fischer	Michael		NXP Semiconductors	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		225
Fisher	Wayne	K		Ex Voter			2010-11-12	
Flammer	George			Ex Voter			2014-03-21	
FLYNN	P			Ex Voter			2014-07-18	
Fracchia	Roberta			Ex Voter			2008-12-21	
Frank	Colin			Ex Voter			2011-11-11	
Fujimoto	Atsushi			Ex Voter			2010-07-16	
Fujinami	Makoto			Ex Voter			2008-03-25	
Fujio	Shunsuke		FUJITSU LABORATORIES LIMITED	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Fukatsu	Noriyasu			Ex Voter			2012-05-01	
Funada	Ryuhei			Ex Voter			2009-07-20	
Fung	Patrick			Ex Voter			2012-05-01	
Furuichi	Sho		Sony Corporation	Voter	168* (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Gagiev	Yaroslav		Intel Corporation	Potential Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Gal	Dan			Ex Voter			2015-05-07	
Gallizio	Edoardo			Ex Voter			2008-05-05	
Gan	Ming		Huawei Technologies Co. Ltd	Voter	170* (2018-	Manchester Grand Hyatt,		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
					07-01)	San Diego, CA, USA		
Gao	Wen			Ex Voter			2011-02-25	
Garcia Villegas	Eduard		Universitat Politecnica de Catalyuna (UPC)	Aspirant	170 (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Gardner	James			Ex Voter				
Gast	Matthew			Ex Voter			2011-03-18	
Ghamri-Doudane	Mohamed			Ex Voter			2011-11-11	
Ghanbarinejad	Majid		Huawei R&D USA	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Ghasemi	Amir			Ex Voter			2011-02-25	
Ghazi	Vafa			Ex Voter				
Ghosh	Chittabrata		Intel Corporation	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Ghosh	Monisha			Ex Voter			2016-07-29	
Gilb	James	P	Gilb Consulting, Inc.	ExOfficio				
Gilbert	Jeffrey			Ex Voter			2011-07-22	
Gillmore	Matthew			Ex Voter			2015-03-05	
GIRAUD	Claude			Ex Voter			2011-11-11	
Glibbery	Ronald			Ex Voter			2010-11-12	
Gloger	Reinhard			Ex Voter			2013-03-22	
Godfrey	Tim		Electric Power Research Institute, Inc. (EPRI)	Voter	164* (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		225
GONG	DANING			Ex Voter			2013-11-10	
Gong	Michelle			Ex Voter			2012-05-01	

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Goodall	David			Ex Voter			2014-07-18	
Gossain	Hrishikesh			Ex Voter			2008-03-25	
Gosteau	Jeremy			Ex Voter			2008-07-18	
GOTO	Fumihide		Self	Aspirant	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Gottlib	Elad			Ex Voter			2014-03-21	
Grandhe	Niranjan		Marvell Semiconductor, Inc.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Grandhi	Sudheer	A		Ex Voter			2013-11-10	
Grass	Eckhard		Humboldt-University in Berlin	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Grau	Stephen			Ex Voter			2014-07-18	
Gray	Gordon	P		Ex Voter				
Green	Evan	R		Ex Voter				
Green	Larry			Ex Voter				
Grigat	Michael		Deutsche Telekom AG	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		225
Grodzinsky	Mark			Ex Voter			2011-03-18	
Gu	Daqing			Ex Voter				
Guener	Tugrul			Ex Voter			2008-12-21	
Guo	Jianlin			Ex Voter			2010-03-22	
Guo	Qiang		Huawei R&D USA	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Guo	Yuchen		Huawei Technologies Co., Ltd	Voter	170* (2018-07-01)	Manchester Grand Hyatt,		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
						San Diego, CA, USA		
Gupta	Pratibha			Ex Voter			2008-09-16	
Gupta	Vivek	G		Ex Voter			2010-03-22	
Hadad	Zion			Ex Voter			2017-01-20	
Hailemariam	Meareg		IEEE	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Haines	Russell			Ex Voter			2015-07-28	
Haisch	Fred			Ex Voter				
Halasz	David			Ex Voter			2014-11-07	
Hall	Robert		Johnson Controls Inc	Voter	168* (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Halls	David		Toshiba of Europe Ltd.	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		217
Hamady	Neil			Ex Voter				
Hamilton	Mark		Ruckus Wireless	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		217
HAN	Xiao		Huawei Technologies Co. Ltd	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		225
Han	Yunbo		HUAWEI	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		225
Hanatani	Yoshikazu			Ex Voter			2016-03-18	
Handte	Thomas		Sony Corporation	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Hansen	Christopher	J	Covariant Corporation	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
HAO	CHEN		Huawei Technologies Co., Ltd	Potential Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Hao	Peng			Ex Voter			2015-05-07	
Har Zion	Yuval		Celeno Communications	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Harada	Hiroshi			Ex Voter			2013-11-15	
Hardison	Nathaniel			Ex Voter			2015-11-13	
Harkins	Daniel	N	Aruba Networks, Inc.	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		225
Hart	Brian	D	Cisco Systems, Inc.	Voter	166* (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Hartman	Chris		Apple, Inc.	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Haslestad	Thomas			Ex Voter				
Hassan	Amer	A		Ex Voter			2010-07-11	
Hassel	Vegard			Ex Voter			2010-03-22	
Hattig	Myron			Ex Voter			2008-03-25	
Hauser	James	P		Ex Voter				
Hayakawa	Yutaka			Ex Voter				
Hayase	Shigenori			Ex Voter			2008-11-17	
Hayes	Kevin	V		Ex Voter			2008-11-17	
Hayes	Victor		CONSULTANT	Voter				
He	Haixiang			Ex Voter				

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
He	Linhai		Qualcomm Incorporated	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
he	shiwen		Southeast University, China	Potential Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Heberling	Allen		Tensorcom, Inc.	Potential Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Hedayat	Ahmadreza		Newracom Inc.	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		216
Hedberg	David	J		Ex Voter				
Heide	Carolyn			Ex Voter			2015-11-13	
Heile	Robert	F	Wi-SUN Alliance	ExOfficio				
Henry	Jerome		Cisco Systems, Inc.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Hepworth	Eleanor			Ex Voter				
Hermodsson	Frans			Ex Voter				
Hiertz	Guido	R	Ericsson AB	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Hillman	Garth	D		Ex Voter			2014-03-21	
Hinsz	Christopher	S		Ex Voter			2008-02-13	
Hiraga	Ken			Ex Voter			2012-11-16	
Hirano	Jun			Ex Voter				
Hirata	Ryuichi		Sony Corporation	Aspirant	170 (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Ho	Chin	K		Ex Voter			2013-07-19	
Ho	Duncan		Qualcomm Incorporated	Voter	166 (2017-	Caribe Hotel and Convention		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
					11-05)	Center, Orlando, FL, USA		
Ho	Jin-Meng			Ex Voter				
Hoang	Anh Tuan	T		Ex Voter			2013-11-15	
Hoang	Dien			Ex Voter			2013-07-19	
Hoghooghi	Michael	M		Ex Voter				
Holt	Keith			Ex Voter				
Hong	Hanseul		Yonsei University	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Hong	Seung-Eun			Ex Voter			2011-07-22	
Hong	Song-Nam			Ex Voter			2016-03-18	
Hong	Sungjin		WILUS Institute	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Hong	Wei			Ex Voter			2014-07-18	
Hong	Wei			Ex Voter			2014-03-21	
Hong	Yong-Geun			Ex Voter			2008-05-05	
Honma	Naoki			Ex Voter			2010-03-22	
Horisaki	Koji		TOSHIBA Corporation	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		216
Horne	William			Ex Voter				
Hosur	Srinath			Ex Voter				
Hou	Victor			Ex Voter			2016-11-11	
Housley	Russell	D		Ex Voter				
Howard	David			Ex Voter			2012-05-01	
hsiao	ying-chuan			Ex Voter			2013-11-10	
Hsieh	Jing-Rong			Ex Voter			2016-07-29	

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Hsu	Chien-Fang		MediaTek Inc.	Potential Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Hsu	Jen-Yuan			Ex Voter			2014-05-09	
Hsu	Ju-Lan			Ex Voter			2012-02-19	
Hsu	Yungping			Ex Voter				
Hu	Chunyu		Broadcom Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Hu	Junling			Ex Voter			2008-12-21	
hu	wendong			Ex Voter			2010-11-12	
Huang	He			Ex Voter			2016-11-11	
Huang	Lei		Huawei Technologies Co. Ltd	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Huang	Lei		Panasonic Asia Pacific Pte Ltd.	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Huang	Po-Kai		Intel Corporation	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Huang	Robert	Y		Ex Voter			2010-03-22	
Huang	Rongsheng		MediaTek Inc.	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Huang	Tian-Wei			Ex Voter			2011-07-22	
HUANG	YUN-LIANG		MediaTek Inc.	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Huang	Zhiyong		LitePoint Corporation/Teradyne	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
HUH	JIYOUNG			Ex Voter			2008-02-13	
Humbert	John			Ex Voter			2015-11-08	
Hunter	David		WireFi Networks Inc.	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		217
Hurtarte	Jeorge		Teradyne, Inc.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Hwang	Sung Hyun	H	Electronics and Telecommunications Research Institute (ETRI)	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Ibrahim	Azmi		TM Research & Development	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Ibrahim	Brima			Ex Voter			2017-03-17	
Ikram	Muhammad	Z		Ex Voter				
Imamura	Daichi			Ex Voter				
Inoue	Yasuhiko		Nippon Telegraph and Telephone Corporation (NTT)	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Iqbal	Zabed		Georgia Southern University	Aspirant	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Ishihara	Koichi		Nippon Telegraph and Telephone Corporation (NTT)	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Ishizu	Kentaro		National Institute of Information and Communications Technology (NICT)	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		225

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Iso	Akio			Ex Voter			2012-05-01	
ITO	Takumi			Ex Voter				
Iwaoka	Mitsuru			Ex Voter			2016-03-18	
Iwatani	Junichi		Nippon Telegraph and Telephone Corporation (NTT)	Voter	168* (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Jacobs	Wynona			Ex Voter			2011-11-11	
Jacobsen	Eric	A		Ex Voter				
Jacobson	Scott		Cadence Design Systems, Inc.	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
jafarian	amin			Ex Voter			2015-07-28	
Jain	Avinash			Ex Voter			2011-06-27	
Jalfon	Marc			Ex Voter			2008-05-05	
Jang	KyungHun			Ex Voter				
Jauh	Alan			Ex Voter			2016-07-29	
Jee	Junghoon			Ex Voter			2009-07-20	
Jeffries	Timothy		Huawei R&D USA	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Jeon	Ho-In J	J		Ex Voter			2008-02-13	
Jeon	Hongseok			Ex Voter			2009-11-23	
Jeon	Taehyun			Ex Voter				
Jeong	ByungJang	J		Ex Voter			2012-07-20	
Jeong	Chanyong		SAMSUNG ELECTRO-MECHANICS	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
JEONG	MIN SEOP		SAMSUNG ELECTRONICS	Aspirant	168 (2018-	Hyatt Regency O'Hare,		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
					03-04)	Rosemont, Illinois, USA		
Jeong	Moo Ryong	R		Ex Voter				
Jeong	Wuncheol			Ex Voter			2013-11-15	
Jeong	Yangseok			Ex Voter			2015-03-05	
Jeong	Yeonkwon			Ex Voter			2009-11-23	
Jetcheva	Jorjeta	G		Ex Voter			2012-07-20	
Ji	Chenhe		Huawei Technologies Co., Ltd	Potential Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Ji	Lusheng			Ex Voter			2011-07-22	
Ji	Mingyue		Broadcom Corporation	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Jia	Jia		Huawei Technologies Co., Ltd	Potential Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Jiang	Daniel			Ex Voter			2010-03-22	
jiang	feng		Intel Corporation	Voter	168* (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		225
Jiang	Jinjing		Marvell Semiconductor, Inc.	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Jiang	Robert			Ex Voter			2015-11-08	
Jin	Liang		Spirent Communications	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		225
Jin	Sunggeun			Ex Voter			2013-09-16	
Jin	ZhongYi			Ex Voter			2013-03-22	
Jindal	Nihar			Ex Voter			2015-11-08	

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
jo	junho			Ex Voter			2011-11-11	
Jo	Kyungtae		LG ELECTRONICS	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Johnsson	Kerstin		Intel Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		225
Johnston	David			Ex Voter				
Jokela	Jari	E		Ex Voter			2016-07-29	
Jones	Allan		Activision	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
JONES	JEFFRUM		Qorvo, Inc.	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Jones	Vincent Knowles IV		Qualcomm Incorporated	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
JOO	SEONG-SOON			Ex Voter			2015-03-05	
Jose	Bobby			Ex Voter				
Joshi	Avinash			Ex Voter			2012-07-20	
Josiam	Kaushik		SAMSUNG	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		225
Jun	Haeyoung			Ex Voter			2011-06-27	
Junell	Jari			Ex Voter			2014-03-21	
Kafle	Padam			Ex Voter			2013-07-19	
Kahn	Michael			Ex Voter			2008-07-19	
Kain	Carl	W	Noblis, Inc.	Voter	168* (2018-03-04)	Hyatt Regency O'Hare,		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
						Rosemont, Illinois, USA		
Kakani	Naveen	K	Qualcomm Incorporated	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Kandala	Srinivas			Ex Voter				
Kang	Byeongwoo			Ex Voter			2012-05-01	
Kang	Hyunduk		Electronics and Telecommunications Research Institute (ETRI)	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		225
Kang	Hyunjeong			Ex Voter			2015-11-08	
Kapetanovic	Dzevdan		Ericsson AB	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Karaoguz	Jeyhan			Ex Voter			2011-02-25	
Karcz	Kevin			Ex Voter				
Karnik	Pankaj	R		Ex Voter				
Kasher	Assaf	Y	Qualcomm Incorporated	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Kasslin	Mika			Ex Voter			2014-03-21	
Katagiri	Masami			Ex Voter			2015-07-28	
Kato	Masato			Ex Voter			2009-07-20	
Kato	Shuzo			Ex Voter			2012-09-03	
Kato	Tatsuya			Ex Voter			2010-11-12	
Kavner	Douglas			Ex Voter			2010-03-22	
Kedem	Oren		Intel Corporation	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Kennedy	Richard	H	Hewlett Packard Enterprise	ExOfficio	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Kenney	John			Ex Voter			2016-03-18	
Kerry	Stuart	J	OK-Brit	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Ketchum	John	W		Ex Voter			2008-03-25	
Khakuria	Prithpal			Ex Voter			2012-07-20	
Khine	Thet	H		Ex Voter			2012-05-01	
Khorov	EVGENY		Skoltech	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Khoryaev	Alexey			Ex Voter			2011-06-27	
Khoury	Peter		Ruckus Wireless	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
KI	SANGWON		Newracom Inc.	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Kikuma	Tomohiro			Ex Voter				
Kim	Bonghoe			Ex Voter			2012-11-16	
KIM	BYOUNG-HOON			Ex Voter			2012-11-16	
Kim	Byoung-Jo			Ex Voter				
Kim	Eun	S		Ex Voter			2012-11-16	
Kim	Eung	S		Ex Voter			2010-11-12	
Kim	Eunkyo			Ex Voter			2008-03-25	
Kim	Eunkyung			Ex Voter			2015-03-13	
Kim	Hongsoog			Ex Voter			2015-03-05	
Kim	Igor		Electronics and Telecommunications Research Institute (ETRI)	Potential Voter	168* (2018-03-04)	Hyatt Regency O'Hare,		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
						Rosemont, Illinois, USA		
Kim	Jaehwan			Ex Voter			2015-11-13	
Kim	Jeehoon			Ex Voter			2016-07-29	
Kim	Jeongki		LG ELECTRONICS	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Kim	Jin Min		LG ELECTRONICS	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		216
Kim	Jinho			Ex Voter			2013-11-10	
Kim	Jinkyeong			Ex Voter			2014-03-21	
Kim	Joo Young			Ex Voter			2013-11-10	
Kim	Joonsuk		Apple, Inc.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		225
Kim	Kyeongpyo		Newracom Inc.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Kim	Kyeongsoo			Ex Voter			2008-03-25	
Kim	Myeong-Jin			Ex Voter			2016-03-18	
Kim	Sang Gook		LG ELECTRONICS	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
KIM	SANGKYUN			Ex Voter			2015-03-13	
kim	Seong Soo	S		Ex Voter			2008-12-21	
Kim	Suhwook		LG ELECTRONICS	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Kim	Taejoon			Ex Voter			2013-07-19	
Kim	Yongho		Korea National University of Transportation	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Kim	Yongsuk			Ex Voter				
Kim	Yongsun			Ex Voter			2011-07-22	
Kim	Youhan		Qualcomm Incorporated	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Kim	Youjin			Ex Voter			2008-09-16	
Kim	Youngsoo			Ex Voter			2016-03-18	
Kim	Youn-Kwan		The Catholic University of Korea	Aspirant	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Kim	Yunbae		Electronics and Telecommunications Research Institute (ETRI)	Aspirant	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
kim	yunjoo			Ex Voter			2012-07-20	
Kimhi	Ziv			Ex Voter				
Kinney	Patrick			Ex Voter			2008-03-25	
Kirimis	Dimitri		Newracom Inc.	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Kiryanov	Anton		IITP RAS	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Kishida	Akira			Ex Voter			2015-11-08	
Kitazawa	Shoichi			Ex Voter			2016-11-11	
Kivinen	Tero			Ex Voter			2012-11-16	
Klein	Philippe		Broadcom Corporation	Aspirant				
Kleindl	Gunter			Ex Voter			2008-11-17	

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Klik	Cees			Ex Voter				
Kloper	David		Cisco Systems, Inc.	Aspirant	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
KNECKT	JARKKO		Apple, Inc.	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Ko	Geonjung		WILUS Institute	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Ko	Gwangzeen			Ex Voter			2015-11-13	
KOBAYASHI	MARK	M		Ex Voter			2012-05-01	
Koga	Keiichiro			Ex Voter				
Koh	Benjamin			Ex Voter			2008-03-25	
Kojima	Fumihide		National Institute of Information and Communications Technology (NICT)	Voter	168* (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Kolze	Tom			Ex Voter			2016-07-29	
Koskela	Timo			Ex Voter			2014-07-08	
Kotzer	Igal		General Motors Company	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Kountz	Dennis		Chemours	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		225
Kowalski	John			Ex Voter				
Kraemer	Bruce	P	Marvell Semiconductor, Inc.	Voter				
Krasicki	Maciej			Ex Voter			2015-07-28	
Kruys	Johannes	P		Ex Voter			2009-07-20	
Kudo	Riichi			Ex Voter			2011-11-11	
Kuehnel	Thomas			Ex Voter			2009-06-30	

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
kukil	LIM		WILUS Inc.	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Kulkarni	Parag		Toshiba	Potential Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Kumagai	Tomoaki			Ex Voter				
Kumar	G Rajendra			Ex Voter			2014-07-18	
Kumar	Manish		Marvell Semiconductor, Inc.	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Kumar	Rajesh		Qualcomm Incorporated	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Kumar	Rajneesh			Ex Voter			2008-03-25	
Kumari	Warren		Google	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Kunihiro	Takushi			Ex Voter				
Kurihara	Thomas	M		Ex Voter			2012-11-16	
Kuwahara	Denis			Ex Voter				
Kwak	Byung-Jae		Electronics and Telecommunications Research Institute (ETRI)	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Kwak	Jin-Sam		WILUS Institute	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		216
Kwak	Joseph			Ex Voter			2015-07-28	
KWON	EDWIN			Ex Voter			2009-06-30	
Kwon	Hyoungjin			Ex Voter			2015-11-13	

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
KWON	UI	K		Ex Voter			2011-06-27	
Kwon	Yong-Jin		Newracom Inc.	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Kwon	Young Hoon	H	Newracom Inc.	Voter	168* (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
LAGRANGE	Pascal			Ex Voter			2011-11-11	
Lakkis	Ismail			Ex Voter			2010-11-12	
Lalam	Massinissa		SAGEMCOM SAS	Voter	168* (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Lambert	Paul		Marvell Semiconductor, Inc.	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Lan	Zhou		Huawei Technologies Co. Ltd	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Lanante	Leonardo		Kyushu Institute of Technology	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		216
Landt	Jeremy	A		Ex Voter			2010-11-12	
Lansford	James		Qualcomm Incorporated	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		217
Lanzl	Colin			Ex Voter				
Lauer	Joseph	P		Ex Voter			2011-02-25	
Le Rouzic	Jean-Pierre			Ex Voter			2015-03-13	
Leach	David	J		Ex Voter				
Lee	Anseok			Ex Voter			2013-07-19	
Lee	Daewon		Newracom Inc.	Voter	166* (2017-	Caribe Hotel and Convention		225

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
					11-05)	Center, Orlando, FL, USA		
Lee	Donghun			Ex Voter			2013-11-10	
Lee	Dongjun			Ex Voter				
Lee	Hongsup			Ex Voter			2015-11-08	
lee	hoosung			Ex Voter			2011-07-22	
Lee	Howon		Hankyong National University	Aspirant	170 (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
LEE	Ilgu			Ex Voter			2015-03-05	
Lee	Insun			Ex Voter				
Lee	Jae Seung	S	ETRI	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Lee	Jae-Ho			Ex Voter			2014-03-21	
Lee	Jehun		Newracom Inc.	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Lee	JiHo		Korea University	Aspirant	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Lee	Jihyun			Ex Voter			2012-07-20	
Lee	Jin			Ex Voter			2008-09-16	
LEE	JOONSOO		Newracom Inc.	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
LEE	JUNG WOON		Samsung Electronics Co., Ltd.	Aspirant	170 (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Lee	Ronald		MaxLinear	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
						Center, Berlin, Germany		
Lee	Sok-kyu			Ex Voter				
LEE	SUNGEUN		Cypress Semiconductor Corporation	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Lee	Tae	H		Ex Voter			2009-07-20	
Lee	Wookbong			Ex Voter			2016-01-21	
Lee	Wooyong			Ex Voter			2011-11-11	
Lee	Xiaoyang		DHS/OEC	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Lee	Young Ha		Newracom Inc.	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Lee	Yuro			Ex Voter			2015-11-13	
Lefkowitz	Martin			Ex Voter				
Lei	Zhongding			Ex Voter			2016-07-29	
Leicht	Suzanne		National Security Agency	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
lemberger	Uriel			Ex Voter			2008-03-25	
Lepp	James		BlackBerry	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Leung	Wai Kong	K		Ex Voter			2014-07-08	
Levy	Joseph		InterDigital, Inc.	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Li	Bin			Ex Voter			2011-11-11	
Li	Bo		northwestern polytechnical university	Aspirant	164 (2017-	Estrel Hotel and Convention		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
					07-09)	Center, Berlin, Germany		
Li	Dejian		Huawei Technologies; HiSilicon	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Li	Feng			Ex Voter			2015-11-08	
Li	Guoqing		Apple, Inc.	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
LI	HONGGANG			Ex Voter			2015-03-05	
Li	Huan-Bang		National Institute of Information and Communications Technology (NICT)	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Li	Jing		Huawei Technologies Co. Ltd	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Li	Liang			Ex Voter			2015-03-05	
Li	Lingjie			Ex Voter			2013-03-22	
Li	Pen			Ex Voter				
Li	Qiang		HUAWEI	Potential Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Li	Qinghua		Intel Corporation	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		225
Li	Sheung			Ex Voter			2010-03-22	
Li	Yanchun		Huawei Technologies Co. Ltd	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Li	Yunbo		Huawei Technologies Co. Ltd	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
LI	YUNZHOU			Ex Voter			2013-03-04	
Li	Zhiqiang			Ex Voter			2015-05-07	
Liang	Haixiang		Huawei R&D USA	Potential Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Lim	Dong Guk		LG ELECTRONICS	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Lim	Sungkyun		Georgia Southern University	Aspirant	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Lin	Chih-Che			Ex Voter			2014-11-07	
Lin	Huashih	A		Ex Voter				
Lin	Meilu		HUAWEI	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		225
Lin	Paul			Ex Voter			2011-07-22	
Lin	Wei			Ex Voter			2017-01-20	
Lin	Yingpei		Huawei Technologies Co. Ltd	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Lindskog	Erik		Qualcomm Incorporated	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Link	Jeremy			Ex Voter			2012-05-01	
Liru	Lu			Ex Voter			2014-11-07	
Liu	Changwen			Ex Voter				
LIU	CHENCHEN			Ex Voter			2017-01-20	
Liu	Dapeng			Ex Voter			2014-07-18	
Liu	Der-Zheng		Realtek Semiconductor Corp.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center,		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
						Orlando, FL, USA		
Liu	Fulei		ZTE Corporation	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		225
Liu	Hang			Ex Voter			2011-03-18	
Liu	I-Ru			Ex Voter			2008-05-05	
Liu	Jianhan		MediaTek Inc.	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Liu	Jinnan		HiSilicon Technologies Co., LTD.	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		225
Liu	Le			Ex Voter			2017-01-20	
Liu	Pei			Ex Voter			2017-01-20	
Liu	Pei			Ex Voter			2012-10-09	
Liu	Siyang			Ex Voter			2012-07-20	
Liu	Yong		Apple, Inc.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Liu	Yun		Huawei Technologies Co., Ltd	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Liu	Zongru			Ex Voter			2014-03-21	
Livshitz	Michael			Ex Voter			2009-06-30	
Lo	Titus	K		Ex Voter				
Loc	Peter		Huawei Technologies Co. Ltd	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Lomayev	Artyom		Intel Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center,		217

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
						Orlando, FL, USA		
Lou	Hui-Ling		Marvell Semiconductor, Inc.	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		216
Lu	Su			Ex Voter			2015-07-28	
Lubar	Daniel			Ex Voter			2009-07-20	
Lukaszewski	Chuck			Ex Voter			2016-11-11	
Luo	Haiyun			Ex Voter			2008-07-18	
Luo	Jun		Huawei Technologies Co. Ltd	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Luo	Long			Ex Voter			2014-03-21	
Luo	Yi			Ex Voter			2016-11-11	
Luo	Zhendong		China Academy of Telecommunication Research (CATR)	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Lv	Kaiying		ZTE Corporation	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Lv	Lily		Huawei Technologies Co. Ltd	Potential Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Lynch	Bradley			Ex Voter			2012-05-01	
Lynch	Michael		MJ Lynch & Associates, LLC.	ExOfficio				
M. Hizan	Hizamel		TM Research & Development	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Ma	Hui			Ex Voter			2008-07-19	
Ma	Jing		National Institute of Information and	Voter	170* (2018-	Manchester Grand Hyatt,		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
			Communications Technology (NICT)		07-01)	San Diego, CA, USA		
Maamari	Diana		Huawei R&D USA	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
MADHAVAN	NARENDAR		TOSHIBA Corporation	Voter	168* (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Maeda	Shigeru			Ex Voter			2017-03-17	
Mahadevappa	Ravishankar			Ex Voter				
Maida	Anthony	F		Ex Voter			2008-12-21	
Majkowski	Jakub			Ex Voter			2009-11-23	
Malarky	Alastair			Ex Voter			2011-02-25	
Malek	Majid	m		Ex Voter				
Malik	Rahul		Qualcomm Incorporated	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Malinen	Jouni	K	Qualcomm Incorporated	Voter	168* (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Maltsev	Alexander		Intel Corporation	Potential Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Mangold	Stefan		Itron Inc.	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Mani	Mahalingam			Ex Voter			2008-02-13	
Mano	Hiroshi		Koden Techno Info K.K.	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Marin	James			Ex Voter			2016-11-11	

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Marks	Roger		EthAirNet Associates; Huawei	ExOfficio	170 (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Marshall	Bill			Ex Voter			2011-11-11	
Maruhashi	Kenichi			Ex Voter			2011-11-11	
Maslennikov	Roman	M		Ex Voter			2010-07-16	
Masour	Avi			Ex Voter			2012-05-01	
Matsumoto	Yoichi			Ex Voter				
Matsuo	Ryoko		TOSHIBA Corporation	Aspirant	170 (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
MATTA	SUDHEER			Ex Voter			2008-12-21	
Maufer	Thomas	A		Ex Voter				
Mccann	Stephen		BlackBerry	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
McClellan	Kelly	P		Ex Voter				
Mcfarland	William	J		Ex Voter				
McIntosh	Bill			Ex Voter				
McNamara	Darren	P		Ex Voter			2008-07-18	
Mcnew	Justin	P		Ex Voter			2010-11-12	
Medvedev	Irina			Ex Voter			2008-03-25	
Mehta	Pratik	M		Ex Voter				
Merlin	Simone		Qualcomm Incorporated	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		217
Mese	Murat			Ex Voter			2012-07-20	
Mesecke	Sven			Ex Voter			2015-03-13	
Mestanov	Filip		Ericsson AB	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
						Center, Berlin, Germany		
Meyer	Klaus			Ex Voter			2008-07-18	
Miao	Yannan		Huawei Technologies Co. Ltd	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Miller	James			Ex Voter			2016-07-29	
Miller	Robert	R		Ex Voter			2011-11-11	
Miroll	Jochen			Ex Voter			2011-02-25	
Misawa	Yasunao			Ex Voter			2015-03-13	
Miyoshi	Hidekazu			Ex Voter			2008-05-05	
Mizutani	Keiichi			Ex Voter			2013-11-10	
Mlinarsky	Fanny			Ex Voter			2012-05-01	
Mobasher	Amin		SAMSUNG	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		225
Mody	Apurva		BAE Systems	ExOfficio				
Mohanty	Bibhu		Qualcomm Incorporated	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Monajemi	Pooya		Cisco Systems, Inc.	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		225
Monnerie	Emmanuel			Ex Voter			2012-05-01	
Montemurro	Michael		BlackBerry	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Montenegro	Gabriel			Ex Voter			2008-02-13	
Montreuil	Leo		Broadcom Corporation	Aspirant	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Moon	Sungho			Ex Voter			2016-11-11	
Moore	Rondal			Ex Voter				
Moorti	Rajendra	T		Ex Voter			2012-05-01	
Moreton	Mike			Ex Voter				
Mori	Hiroki			Ex Voter			2016-07-29	
Mori	Kenichi		Space-Time Engineering	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Mori	Masahito			Ex Voter			2017-03-17	
Morioka	Hitoshi		SRC Software	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Morioka	Yuichi		Sony Corporation	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Morley	Steven	A		Ex Voter				
Morris	Roy			Ex Voter				
Moseley	James		Georgia Southern University	Aspirant	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Moskowitz	Robert	G		Ex Voter			2008-01-05	
Motozuka	Hiroyuki		Panasonic Corporation	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Mourot	Patrick			Ex Voter				
Mueller	Robert		Ilmenau University of Technology - TU Ilmenau	Potential Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Mujtaba	Syed	A		Ex Voter				
Murabito	Anthony			Ex Voter			2010-11-12	
Murakami	Yutaka		Panasonic Corporation	Voter	170* (2018-07-01)	Manchester Grand Hyatt,		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
						San Diego, CA, USA		
Murias	Ronald			Ex Voter			2015-07-28	
Murphy	Peter			Ex Voter				
Murphy	Rick			Ex Voter			2014-07-18	
Murray	Peter			Ex Voter			2011-07-22	
Myles	Andrew		Cisco Systems, Inc.	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Nabar	Rohit			Ex Voter			2009-03-16	
Nabetani	Toshihisa			Ex Voter			2017-03-17	
Nadeem	Tamer			Ex Voter			2008-05-05	
Nagai	Yukimasa			Ex Voter			2017-01-20	
Nagao	Yuhei			Ex Voter			2017-01-20	
nagata	kengo			Ex Voter			2009-11-23	
Nakanishi	Kensuke		Toshiba	Aspirant	170 (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Nakano	Hiroki		Kyoto University	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Nakao	Seigo			Ex Voter				
Nakase	Hiroyuki			Ex Voter			2010-03-22	
Nanda	Sanjiv			Ex Voter			2008-03-25	
Nandagopalan	SAI SHANKAR	S	Cypress Semiconductor Corporation	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		225
Narasimhan	Partha			Ex Voter				
Narasimhan	Ravi			Ex Voter				
Nemavat	Pradeep			Ex Voter			2012-11-16	

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Nezou	Patrice		Canon Research Centre France	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Ngo	Chiu			Ex Voter			2016-11-11	
Ni	Qiang			Ex Voter				
Nikolich	Paul		self (YAS), Samsung, Intel, SilverSpringNetworks, HP	ExOfficio				
Nikula	Eero			Ex Voter			2009-11-23	
Nitsche	Gunnar			Ex Voter				
Noble	Erwin			Ex Voter			2008-11-17	
Noens	Richard	H		Ex Voter			2010-03-22	
Noh	Yujin		Newracom Inc.	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Nordstrom	Eric			Ex Voter			2015-11-13	
Notor	John		Notor Research; ARM, Inc.	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Oakes	Ivan	F		Ex Voter				
Odagiri	Hideaki			Ex Voter			2009-03-16	
Odman	Knut			Ex Voter			2017-01-20	
Ogawa	Hiroyo			Ex Voter			2014-11-07	
Oguma	Hiroshi			Ex Voter				
Oh	Jinhyung			Ex Voter			2015-07-28	
Oh	Jisung			Ex Voter			2009-11-23	
Oh	Jong-Ee			Ex Voter			2015-05-07	
Oh	Minseok		Kyonggi University	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		216
OH	MIN-SEOK		LG Electronics	Voter	166 (2017-	Caribe Hotel and Convention		225

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
					11-05)	Center, Orlando, FL, USA		
Oh	Youngseok		SK Telecom	Aspirant	170 (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
O'Hara	Robert			Ex Voter			2008-05-05	
Ohtani	Yoshihiro			Ex Voter				
Okada	Hiraku		Nagoya University	Aspirant	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Okada	Kazuyasu			Ex Voter			2011-11-11	
Olesen	Robert			Ex Voter			2017-01-20	
Olson	Chandra	S		Ex Voter			2009-07-20	
Olson	David			Ex Voter			2013-03-22	
Omori	Youko			Ex Voter			2010-07-16	
Oteri	Oghenekome		InterDigital, Inc.	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		225
Oyama	Satoshi			Ex Voter			2014-03-21	
Ozaki	Kazuyuki		FUJITSU LABORATORIES LIMITED	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Paine	Richard	H		Ex Voter			2010-07-16	
PALANIVELU	Arul	D		Ex Voter			2010-03-22	
Paljug	Michael	J		Ex Voter			2013-07-19	
Palm	Stephen		Broadcom Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Pan	Chun		Huawei Technologies Co., Ltd	Aspirant	170 (2018-	Manchester Grand Hyatt,		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
					07-01)	San Diego, CA, USA		
Pandey	Santosh Ghanshyam	G	Cisco Systems, Inc.	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		216
Pang	Jiyong			Ex Voter			2017-03-17	
Pantelidou	Anna			Ex Voter			2014-03-21	
Papadopoulos	Babis			Ex Voter			2015-11-08	
Pare	Thomas		MediaTek Inc.	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Park	Changmin			Ex Voter			2009-11-23	
Park	Eunsung		LG Electronics	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Park	Giwon			Ex Voter			2015-07-28	
Park	Hyungu		Newracom Inc.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Park	Hyunhee		LG ELECTRONICS	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Park	Jaewoo			Ex Voter			2015-07-28	
Park	Jeonghwan		Newracom Inc.	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		225
Park	Jonghyun			Ex Voter			2012-11-16	
Park	Jungsoo			Ex Voter			2008-12-21	
Park	Minyoung		Intel Corporation	Voter	170* (2018-07-01)	Manchester Grand Hyatt,		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
						San Diego, CA, USA		
Park	Seung-Hoon			Ex Voter			2013-11-10	
PARK	SEUNGKEUN		ETRI	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Park	Sung-jin		LG ELECTRONICS	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Park	Taejoon			Ex Voter			2014-05-09	
Parsons	Glenn		Ericsson AB	ExOfficio				
Patel	Vijaykumar			Ex Voter			2009-11-23	
Pathmasuntharam	Jaya	S		Ex Voter			2013-03-22	
Patil	Abhishek		Qualcomm Incorporated	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Patil	Sandhya			Ex Voter			2013-03-22	
Patkar	Raghavendra		National Instruments Corporation	Aspirant	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Peiris	Bemini	H		Ex Voter			2011-07-22	
Peleg	Yaron			Ex Voter				
Peng	Xiaoming		Institute for Infocomm Research	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Perahia	Eldad			Ex Voter			2016-01-21	
Pereira	Stephanie			Ex Voter			2015-07-28	
Perez Costa	Xavier	P		Ex Voter			2014-07-08	
Persson	Hakan		Ericsson AB	Voter	168* (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Peterson	Harry		Airvine Inc	Aspirant	170 (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Petranovich	James	E	ViaSat, Inc.	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
petrick	Albert		Jones-Petrick and Associates, LLC.	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Petro	John			Ex Voter			2014-07-08	
Petrovic	Vladan			Ex Voter			2015-03-13	
Pienciak	Walter			Ex Voter			2016-11-11	
PILLAI	KRISHNA	M		Ex Voter			2012-11-16	
Ping Ping	Xu	P		Ex Voter			2015-03-13	
Pirhonen	Riku			Ex Voter			2012-09-03	
Pirskanen	Juho			Ex Voter			2014-07-18	
Pirzada	Fahd			Ex Voter			2009-03-16	
Pitarresi	Joe			Ex Voter				
Png	Khiam Boon	B		Ex Voter			2015-03-13	
Poncini	Victoria	M		Ex Voter			2008-03-25	
Ponnampalam	Vishakan			Ex Voter			2013-09-16	
Ponnuswamy	Subburajan			Ex Voter			2008-11-17	
Popa	Daniel			Ex Voter			2012-11-16	
Pope	Steve		Self Employed	Potential Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Popper	Ambroise		Quantenna Communications, Inc.	Aspirant	168 (2018-03-04)	Hyatt Regency O'Hare,		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
						Rosemont, Illinois, USA		
porat	ron		Broadcom Corporation	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Portaro	James	D		Ex Voter			2010-11-12	
Ptasinski	Henry	S		Ex Voter			2013-11-15	
Pulikkoonattu	Rethnakaran		Broadcom Corporation	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Purkovic	Aleksandar			Ex Voter				
Purnadi	Rene			Ex Voter			2011-02-25	
Pustogarov	Ivan			Ex Voter			2011-11-11	
Putta	Satish			Ex Voter			2012-07-20	
Pyo	Chang-Woo	C		Ex Voter			2014-07-18	
Qi	Emily	H	Intel Corporation	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		217
Qian	Luke			Ex Voter			2009-07-20	
Qiao	Dengyu		Huawei Technologies Co. Ltd	Voter	168* (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Qu	Huyu			Ex Voter			2013-03-22	
Qu	Shouxing		BlackBerry	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		216
Raab	Jim	E		Ex Voter			2012-05-01	
Rabarijaona	Verotiana		National Institute of Information and Communications Technology (NICT)	Aspirant	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Rafie	Reza		Self	Aspirant	166 (2017-	Caribe Hotel and Convention		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
					11-05)	Center, Orlando, FL, USA		
Rahman	Mohammad	A		Ex Voter			2010-07-16	
Rai	Vinuth			Ex Voter			2009-11-23	
Raissinia	Ali			Ex Voter			2010-03-22	
Rajagopal	Sridhar			Ex Voter			2011-07-22	
Rajakarunanayake	Yasantha			Ex Voter			2016-11-11	
Rajkumar	Ajay			Ex Voter				
Rakanovic	Demir		u-blox	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Ramamurthy	Harish			Ex Voter			2014-07-18	
Ramasastry	Jayaram			Ex Voter			2013-03-04	
Rangwala	Noman			Ex Voter				
Rantala	Enrico-Henrik		Nokia	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		225
Rayment	Stephen G	G	Ericsson AB	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Razoumov	Leonid			Ex Voter			2008-12-21	
Redlich	Oded		Huawei Technologies Co. Ltd	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Reede	Ivan			Ex Voter			2015-03-13	
Reible	Stanley	A		Ex Voter				
Ren	Yazhen		Huawei Technologies Co. Ltd	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		225
Repice	Joseph	A		Ex Voter			2008-11-17	

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Reuss	Edward		NO AFFILIATION	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Reznik	Alex			Ex Voter			2011-11-11	
Riegel	Maximilian		Nokia Networks	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Rios	Carlos	A		Ex Voter			2008-07-19	
Rison	Mark		Samsung Cambridge Solution Centre	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Robert	Joerg		University of Erlangen-Nuremberg	Aspirant	170 (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
roblot	sandrine			Ex Voter			2011-07-22	
Roebuck	Randal			Ex Voter			2010-07-16	
Roh	Dongwook			Ex Voter			2012-05-01	
Rong	Zhigang		Huawei Technologies Co. Ltd	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Rosdahl	Jon	W	Qualcomm Technologies, Inc.	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		225
Roy	Richard			Ex Voter			2016-01-21	
Ryu	Cheol			Ex Voter			2015-11-13	
Ryu	Kiseon		LG ELECTRONICS	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Sada	Tomoki		KDDI R&D Laboratories	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Sadeghi	Bahareh		Intel Corporation	Voter	168* (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Sadot	Emek			Ex Voter				
Sadri	Ali		Intel Corporation	Potential Voter	166* (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Safonov	Alexander			Ex Voter			2012-05-01	
Sakamoto	Takenori		Panasonic Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Sakoda	Kazuyuki		Sony Corporation	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Salazar Cardozo	Ruben E	S		Ex Voter			2013-09-16	
Sambasivan	Sam		AT&T	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Sampath	Hemanth		Qualcomm Incorporated	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Sanwalka	Anil			Ex Voter				
Sargologos	Nicholas			Ex Voter			2008-09-16	
Sarikaya	Behcet		Huawei R&D USA	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Sarrigeorgidis	Konstantinos			Ex Voter				

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Sarris	Ioannis		u-blox	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Sasaki	Shigenobu		Niigata University	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		225
Sastry	Ambatipudi R	R		Ex Voter			2008-03-25	
SATO	KATSUYOSHI			Ex Voter			2009-07-20	
Sato	Naotaka		Sony Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Sawada	Hirokazu			Ex Voter			2011-07-22	
Scarpa	Vincenzo			Ex Voter			2008-11-17	
Schelstraete	Sigurd		Quantenna Communications, Inc.	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Schlanger	Gabriel			Ex Voter			2008-05-05	
Schmidl	Timothy			Ex Voter			2012-11-16	
Schnacke	Richard			Ex Voter				
Schneider	Daniel			Ex Voter			2016-07-29	
Schultz	Donald			Ex Voter			2010-03-22	
Schwoerer	Jean			Ex Voter			2015-03-13	
Schylander	Erik			Ex Voter				
Scott	Andy		NCTA	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		216
Segev	Jonathan		Intel Corporation	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		225

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Seibert	Cristina			Ex Voter			2014-07-18	
Seminario	Max		ADVANTEST	Aspirant	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Sensendorf	Joe			Ex Voter				
Seok	Yongho		Newracom Inc.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Serafimovski	Nikola		pureLiFi	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Shah	Kunal		Silver Spring Networks Inc.	Voter	168* (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		225
Shao	Huairong			Ex Voter			2014-11-07	
SHAO	PENG			Ex Voter			2016-11-11	
Shao	Zhenhai			Ex Voter			2014-03-21	
Shapira	Nir			Ex Voter			2012-11-16	
Sharma	Neeraj			Ex Voter			2009-07-20	
Sharon	Ariel			Ex Voter			2008-03-25	
Shearer	Steve			Ex Voter			2012-07-20	
Shellhammer	Stephen	J	Qualcomm Incorporated	ExOfficio				
Shen	Bazhong			Ex Voter			2017-01-20	
Shen	Xia		China Academy of Telecommunication Research (CATR)	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Sherlock	Ian		Texas Instruments Incorporated	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		217
Sherman	Matthew			Ex Voter				

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Shi	Kai			Ex Voter			2009-11-23	
SHI	QICAI			Ex Voter			2014-07-18	
Shi	Wei			Ex Voter			2013-07-19	
SHIBAGAKI	Nobuhiko			Ex Voter			2014-07-08	
Shilo	Shimi		Huawei Technologies Co., Ltd	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Shimomura	Tsuyoshi			Ex Voter			2015-03-13	
Shin	ChangSub	S		Ex Voter			2013-11-10	
SHIN	JUNG-CHUL			Ex Voter			2016-07-29	
Shin	Wooram			Ex Voter			2014-11-07	
Shukla	Ashish			Ex Voter			2011-07-22	
Shvodian	William	M		Ex Voter				
Shyy	D.	J		Ex Voter			2008-05-05	
Siep	Thomas	M		Ex Voter			2013-11-15	
Sim	Michael		Panasonic Corporation	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Simon	Francois			Ex Voter			2010-11-12	
Simons	John			Ex Voter			2008-03-25	
Simpson	Floyd			Ex Voter				
Singh	Harkirat			Ex Voter			2009-03-16	
Singh	Shubhranshu			Ex Voter			2010-11-12	
Siti	Massimiliano			Ex Voter			2008-03-25	
Skafidas	Efstratios (Stan)			Ex Voter				
Skidmore	Roger	R		Ex Voter				

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Slater	Robert			Ex Voter			2016-07-29	
Smith	Dwight			Ex Voter			2013-11-10	
Smith	Graham	K	SR Technologies	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		216
Smith	Matt			Ex Voter			2009-11-23	
So	Tricci			Ex Voter				
Sohn	IllSoo	S		Ex Voter			2012-11-16	
Solomon	Yoram			Ex Voter				
Son	Ju-Hyung		WILUS Inc.	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Son	JungBo	B		Ex Voter			2015-11-13	
Song	Chunyi			Ex Voter			2012-05-01	
Song	Hayeong		Newracom Inc.	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Song	Jae-Hyung			Ex Voter			2011-06-27	
Song	Leilei			Ex Voter			2008-07-18	
Song	Myung Sun	S		Ex Voter			2014-07-08	
Song	Nah-Oak		Korea Advanced Institute of Science and Technology (KAIST)	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Song	Yoo-Seung			Ex Voter			2009-06-30	
Sood	Kapil			Ex Voter			2010-03-22	
Soomro	Amjad			Ex Voter				
Soranno	Robert	T		Ex Voter				
Squiers	Ronald		Mentor Graphics	Potential Voter	168 (2018-	Hyatt Regency O'Hare,		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
					03-04)	Rosemont, Illinois, USA		
Sreemanthula	Srinivas			Ex Voter			2008-02-13	
Sridhara	Vinay			Ex Voter			2010-03-22	
Srinivasa	Sudhir		Marvell Semiconductor, Inc.	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Stacey	Robert		Intel Corporation	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Stanley	Dorothy		Hewlett Packard Enterprise	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Steck	William	K		Ex Voter				
Stefani	Lawrence			Ex Voter			2013-11-10	
Stephens	Adrian	P	Intel Corporation	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Stephenson	David	S		Ex Voter			2011-02-25	
Stevenson	Carl	R		Ex Voter			2010-03-14	
Stine	John			Ex Voter			2011-03-18	
Stott	Noel		Ixia	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		225
Strickland	Stuart		Hewlett Packard Enterprise	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Struik	Rene			Ex Voter			2015-03-13	
STRUTT	GUENAEL	T		Ex Voter			2011-06-27	
Suh	JUNG HOON	H	Huawei Technologies Co. Ltd	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Sum	Chin-Sean			Ex Voter			2014-03-21	
Sumi	Takenori		Mitsubishi Electric Corporation	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Sun	Bo		ZTE Corporation	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Sun	Chen		Sony Corporation	Voter	168* (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Sun	Li-Hsiang		InterDigital, Inc.	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
sun	sheng		Huawei Technologies Co. Ltd	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Sun	Yakun			Ex Voter			2017-03-17	
Sun	Yanjun		Qualcomm Incorporated	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		217
Sun	Winston			Ex Voter			2008-02-13	
Surineni	Shravan	K		Ex Voter				
Suzuki	Hideyuki			Ex Voter			2008-07-18	
Szott	Szymon		AGH University of Science and Technology	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Tabibiazar	Arash			Ex Voter			2010-03-22	
Taghavi	Mohammad	H		Ex Voter			2012-11-16	
Takagi	Eiji			Ex Voter			2009-11-23	
Takagi	Masahiro			Ex Voter				

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Takahashi	Kazuaki		Panasonic Corporation	Voter	168* (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Takahashi	Seiichiro			Ex Voter				
Takai	Mineo		Space-Time Engineering	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		217
Takatori	Yasushi			Ex Voter			2016-11-11	
Takeda	Daisuke			Ex Voter				
Tal	Nir			Ex Voter				
Tamaki	Tsuyoshi			Ex Voter				
Tamhane	Sagar		Marvell Semiconductor, Inc.	Voter	168* (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Tan	Pek-Yew			Ex Voter				
Tan	Teik-Kheong			Ex Voter			2010-07-16	
Tanahashi	Masato			Ex Voter			2008-07-19	
Tanaka	Hideki			Ex Voter				
Tanaka	Yusuke		Sony Corporation	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		217
Tandai	Tomoya			Ex Voter			2016-03-18	
Taniguchi	Kentaro		TOSHIBA Corporation	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		217
Tao	Wu		Huawei Technologies Co. Ltd	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		225
Taori	Rakesh		Phazr	Voter	164* (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		225
Tarighat	Alireza			Ex Voter			2016-01-21	
Tayamon	Soma		Ericsson AB	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
						Center, Berlin, Germany		
Teo	Joseph			Ex Voter			2013-07-19	
Tetzlaff	Thomas			Ex Voter			2014-11-07	
Thompson	Geoffrey	O		Ex Voter			2011-09-23	
THOMSON	ALLAN			Ex Voter			2011-07-22	
Thrasher	Jerry			Ex Voter			2013-09-16	
Tian	Bin		Qualcomm Incorporated	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Tian	Qingjiang		Qualcomm Incorporated	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		225
Tian	Tao		Spreadtrum Communications, Inc.	Aspirant	170 (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Tian	Tong			Ex Voter			2014-07-18	
Tingleff	Jens			Ex Voter			2015-11-13	
Tinnakornsrisuphap	Peerapol		Qualcomm Incorporated	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Tokubo	Eric			Ex Voter			2011-02-25	
Tolpin	Alexander			Ex Voter			2008-12-21	
Tomcik	James	D		Ex Voter			2012-05-01	
Tong	Fei		Samsung Cambridge Solution Center	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Torab	Payam		Broadcom Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center,		225

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
						Orlando, FL, USA		
Torkildson	Eric		Nokia	Potential Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Tosato	Filippo			Ex Voter			2016-11-11	
Toyoda	Ichihiko			Ex Voter			2012-05-01	
Trachewsky	Jason			Ex Voter			2010-11-12	
Trainin	Solomon	B	Qualcomm Incorporated	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		225
Tran	Ha Nguyen	N		Ex Voter			2014-07-18	
Tsai	Chia-Hung		MediaTek Inc.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		225
Tsai	Chia-Lung			Ex Voter			2014-05-09	
Tsao	Alvin			Ex Voter			2008-05-05	
Tsao	Jean			Ex Voter			2010-11-12	
Tsodik	Genadiy		Huawei Technologies Co. Ltd	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Tsonev	Dobroslav		pureLiFi	Aspirant	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Tsoulogiannis	Tom			Ex Voter				
tsubaki	toshimitsu			Ex Voter			2016-11-11	
Tsukada	Kazuyoshi			Ex Voter			2015-11-13	
Tu	Yung-Szu			Ex Voter			2011-07-22	
Tuomaala	Esa		Nokia	Aspirant	164 (2017-	Estrel Hotel and Convention		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
					07-09)	Center, Berlin, Germany		
Turner	Sandra	L		Ex Voter				
Tzamaloukas	Mike	E		Ex Voter				
Umehira	Masahiro			Ex Voter			2015-03-13	
Urabe	Yoshio		Panasonic Corporation	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Uyehara	Ashley			Ex Voter			2008-11-17	
Van Erven	Niels			Ex Voter				
Van Leeuwen	Richard			Ex Voter				
Van Nee	Richard	D	Qualcomm Incorporated	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
van Waes	Nico	J		Ex Voter				
Van Zelst	Allert		Qualcomm Incorporated	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Vangelista	Lorenzo		Patavina Technologies	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Vanthournout	Jerome		CEVA-DSP	Potential Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Varlet-Andre	Mathieu			Ex Voter			2009-06-30	
Varsanofiev	Dmitri			Ex Voter				
Varshney	Prabodh		Nokia	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Venkatachalam Jayara	Venkata Ramanan		Qualcomm Incorporated	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Venkatesan	Ganesh		Intel Corporation	Voter	170* (2018-	Manchester Grand Hyatt,		225

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
					07-01)	San Diego, CA, USA		
Venkateswaran	Sriram		Broadcom Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Verma	Karan		Central University of Rajasthan	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Verma	Lochan		Qualcomm Incorporated	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Vermani	Sameer		Qualcomm Incorporated	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Victor	Dalton	T		Ex Voter			2015-03-13	
VIGER	Pascal		Canon Research Centre France	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Villardi	Gabriel			Ex Voter			2015-07-28	
Virk	Bhupender			Ex Voter			2012-07-20	
Vlantis	George	A	STMicroelectronics	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Vogtli	Nanci			Ex Voter				
Volpano	Dennis			Ex Voter				
Wadhwa	Sanjay			Ex Voter			2012-07-20	
Walker	Jesse	R		Ex Voter			2010-07-16	
Wallace	Brad	N		Ex Voter				
Wandile	Vivek			Ex Voter				
Wang	Bo		Huawei Technologies Co., Ltd	Potential Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Wang	Chao Chun		MediaTek Inc.	Voter	170* (2018-	Manchester Grand Hyatt,		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
					07-01)	San Diego, CA, USA		
Wang	Haiguang			Ex Voter			2015-07-28	
Wang	Haiming		Southeast University, China	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Wang	Huaiyuan			Ex Voter				
Wang	Hui			Ex Voter			2008-03-25	
Wang	Huizhao		Quantenna Communications, Inc.	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Wang	James June	J	MediaTek Inc.	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Wang	Junyi			Ex Voter			2012-07-20	
Wang	Lei		Huawei R&D USA	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Wang	Lin			Ex Voter			2014-03-21	
Wang	Qi		Apple, Inc.	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		225
Wang	Stanley			Ex Voter				
Wang	Xiang			Ex Voter			2014-03-21	
Wang	Xiaofei		InterDigital, Inc.	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Wang	Xuehuan		Huawei Technologies Co., Ltd	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Wang	Yi		Huawei Technologies Co. Ltd	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Want	Roy		Google	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Ward	Dennis			Ex Voter			2008-03-25	
Ward	Lisa		Rohde & Schwarz	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Ware	Christopher	G		Ex Voter				
Warren	Craig	D		Ex Voter			2010-07-16	
Watanabe	Fujio		NTT DoCoMo, Inc.	Voter	164* (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
waye	patrick			Ex Voter			2009-06-30	
Webber	Julian		Advanced Telecommunications Research Institute International (ATR)	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Wee	Gaius		Panasonic Asia Pacific Pte Ltd.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		225
Wei-Xia	Zou			Ex Voter			2015-11-13	
Wells	Bryan			Ex Voter				
Wen	Ericson			Ex Voter			2014-03-21	
Wen	Lei			Ex Voter			2013-07-19	
Wendt	Jim			Ex Voter				
Wentink	Menzo	M	Qualcomm Incorporated	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
West	Nicholas			Ex Voter			2012-11-16	
Weytjens	Filip			Ex Voter				
Whetten	Frank			Ex Voter			2010-03-22	
Whitesell	Stephen	R		Ex Voter			2008-02-13	

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Wicaksana	Harya			Ex Voter			2013-11-15	
Wilhelmsson	Leif		Ericsson AB	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		225
Williams	Christopher			Ex Voter			2014-07-08	
Williams	Kyle			Ex Voter			2009-03-16	
Wilson	James	M		Ex Voter				
Wineinger	Gerald			Ex Voter			2008-07-19	
Winters	Jack	H		Ex Voter				
WON	EUN TAE	T		Ex Voter			2015-03-05	
Wong	Eric		Apple, Inc.	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		225
Wong	Ian			Ex Voter			2012-11-16	
Wong	Timothy	G		Ex Voter			2014-03-21	
Worsham	James			Ex Voter			2012-05-01	
Worstell	Harry	R		Ex Voter			2016-03-18	
Wright	Charles	R		Ex Voter				
Wright	Michael			Ex Voter				
Wu	Fonchi			Ex Voter			2010-07-16	
Wu	Gang			Ex Voter				
Wu	Jianbing		Shenzhen iTest Technology Co.,Ltd.	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		225
Wu	Songping			Ex Voter			2008-11-17	
Wu	Tianyu		MediaTek Inc.	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Wu	Ye			Ex Voter			2011-02-25	

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Wu	Zhanji			Ex Voter			2013-09-16	
Xia	Pengfei			Ex Voter			2015-11-08	
Xiao	Zhenyu			Ex Voter			2014-03-21	
Xie	Fang			Ex Voter			2013-11-15	
Xie	Zhen			Ex Voter			2008-03-25	
Xin	Yan		Huawei Technologies Co. Ltd	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		225
Xing	Weimin		ZTE Corporation	Voter	166* (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Xu	Dongmei			Ex Voter			2014-03-21	
Xu	Mingguang			Ex Voter			2015-11-08	
XU	QUANPING			Ex Voter			2014-03-21	
Xue	Qi		Qualcomm Incorporated	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
YAGHOOBI	HASSAN		Intel Corporation	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Yagi	Akiyoshi			Ex Voter			2008-11-17	
Yamada	Akira		NTT DoCoMo, Inc.	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Yamamoto	Takeshi			Ex Voter			2009-11-23	
Yamaura	Tomoya			Ex Voter			2009-03-16	
Yang	Guang-Qi			Ex Voter			2014-07-08	

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Yang	Lin			Ex Voter			2014-07-18	
Yang	Liuyang			Ex Voter			2011-06-27	
Yang	Meng			Ex Voter			2015-03-05	
Yang	Ou		Intel Corporation	Voter	168* (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		225
Yang	Rongzhen			Ex Voter			2015-05-07	
YANG	RUI		InterDigital, Inc.	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		217
Yang	Sihoon			Ex Voter			2008-03-25	
Yang	Xi		Apple, Inc.	Aspirant	170 (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Yang	Xun			Ex Voter			2015-05-07	
Yang	Xun		Huawei Technologies Co. Ltd	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Yang	Yang			Ex Voter			2014-03-21	
Yang	Yunsong		Huawei Technologies Co. Ltd	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Yang	Zhiyu			Ex Voter			2008-09-16	
Yano	Kazuto		Advanced Telecommunications Research Institute International (ATR)	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
YAO	KE		ZTE Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Ye	Fan			Ex Voter			2014-05-09	

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Ye	Huanchun			Ex Voter			2012-07-20	
Yee	James		MediaTek Inc.	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Yee	Jung			Ex Voter			2012-07-20	
Yee	Peter		NSA/IAD	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Yeh	Chi-Hsiang			Ex Voter			2008-03-25	
Yeow	Wai-Leong			Ex Voter			2013-03-22	
Yin	Hujun			Ex Voter			2015-03-05	
Yokohira	Kanji			Ex Voter			2008-03-25	
Yokoo	Kaoru			Ex Voter			2014-03-21	
Yokota	Hidetoshi		Landis Gyr Group Worldwide	Aspirant	170 (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Yong	Su Khiong	K	Apple, Inc.	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Yonge	Larry			Ex Voter			2015-11-08	
Yoon	Chanho			Ex Voter			2012-11-16	
Yoshida	Seiji			Ex Voter			2010-03-22	
Young	Christopher		Broadcom Corporation	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Yu	Bo		Marvell Semiconductor, Inc.	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Yu	Chang Wahn			Ex Voter			2015-03-05	

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Yu	Chinghwa		Spreadtrum Comm.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		225
Yu	Heejung		Yeungnam University	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Yu	Jian		Huawei Technologies Co. Ltd	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Yu	Mao		Marvell Semiconductor, Inc.	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Yu	Patrick			Ex Voter				
Yu	Zhan			Ex Voter			2013-03-22	
Yucek	Tevfik		Qualcomm Incorporated	Aspirant	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Yue	Guangrong			Ex Voter			2014-11-07	
Yun	Ji-Hoon			Ex Voter			2015-07-28	
Yun	SunWoong		LG ELECTRONICS	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Yung	Hon	M		Ex Voter				
Yunoki	Katsuo	D	KDDI R&D Laboratories	Voter	166* (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Yurtkuran	Erol	K		Ex Voter				
Zaks	Artur			Ex Voter			2012-05-01	
Zeleznikar	Alan		ARRIS Group	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Zeng	Kun		Huawei Technologies Co. Ltd	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		225
Zeng	Yan		Huawei Technologies Co., Ltd	Aspirant	170 (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Zhang	Dezhi			Ex Voter			2012-11-16	
Zhang	Hongyuan		Marvell Semiconductor, Inc.	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Zhang	Hui			Ex Voter			2014-03-21	
zhang	huimin			Ex Voter			2009-07-20	
ZHANG	JIAYIN		Huawei Technologies Co. Ltd	Voter	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Zhang	Junjian			Ex Voter			2013-03-22	
Zhang	Nianzu			Ex Voter			2014-05-09	
Zhang	Ning			Ex Voter			2012-05-01	
Zhang	Xin			Ex Voter			2013-11-15	
Zhang	Xingxin		Huawei Technologies Co. Ltd	Potential Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		
Zhang	Yan		Marvell Semiconductor, Inc.	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		
Zhao	Meiyuan			Ex Voter			2010-11-12	
Zhao	Mu			Ex Voter			2016-01-21	
Zhao	Qiang			Ex Voter			2012-05-01	
Zhao	Shiwei			Ex Voter			2011-07-22	

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
ZHAO	XIAOWU		ZTE Corporation	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Zheng	Jun			Ex Voter			2016-07-29	
ZHENG	SHOUKANG			Ex Voter			2015-03-13	
Zheng	Xiayu		Marvell Semiconductor, Inc.	Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Zhou	Jingyi			Ex Voter			2015-11-08	
Zhou	Mingtuo			Ex Voter			2014-07-08	
Zhou	Xun		Huawei Technologies Co. Ltd	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Zhou	Yan		Qualcomm Incorporated	Voter	168 (2018-03-04)	Hyatt Regency O'Hare, Rosemont, Illinois, USA		217
zhou	yuan			Ex Voter			2014-11-07	
Zhu	Chunhui		Huawei Technologies Co., Ltd	Voter	170* (2018-07-01)	Manchester Grand Hyatt, San Diego, CA, USA		225
Zhu	Hufei			Ex Voter			2015-05-07	
Zhu	Jing			Ex Voter			2009-03-16	
Zhu	Jun		Huawei Technologies Co. Ltd	Voter	166* (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		
Zhuang	Yan			Ex Voter			2015-11-13	
Zhuo	Lan		CESI Group	Potential Voter	166 (2017-11-05)	Caribe Hotel and Convention Center, Orlando, FL, USA		

Family Name	Given Name	MI	Affiliation	Status	Expires	Meeting Location	Expired	Last Invalid Ballot
Zorn	Glen			Ex Voter				
Zuckerman	Lawrence			Ex Voter			2012-11-16	
Zuniga	Juan Carlos		SIGFOX	Aspirant	164 (2017-07-09)	Estrel Hotel and Convention Center, Berlin, Germany		
Zweig	Jonathan			Ex Voter			2008-11-17	
Zyren	James			Ex Voter				

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- Click on Affiliation Information

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Appendix BS

BSS Load Information Element for 11ax

Date: 2017-03-15

Authors:

Name	Affiliations	Address	Phone	email
Frank Hsu	MediaTek			frank.hsu@mediatek.com
Chaochun Wang				chaochun.wang@mediatek.com
James Yee				james.yee@mediatek.com
Gabor Bajko				gabor.bajko@mediatek.com
Bo Sun	ZTE			sun.bo1@zte.com.cn

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11ax D1.0 CID of BSS Load

CID	Commenter	P.L	Clause	Comment	Proposed Change
5917	James Yee	67.01	9.4.2.139	With the introduction of new features such as OFDMA and UL MU MIMO, the existing BSS load elements (9.4.2.160 & 9.4.2.28), which address STA numbers, primary/secondary channel busy condition and DL MU-MIMO underutilization (11ac) are not sufficient for addressing the BSS load status in a 11ax BSS. A further enhanced BSS Load element needs to be defined.	Add a new information element to define 11ax BSS Load. The new IE shall address utilization status of OFDMA as well as UL/DL MU MIMO, as well as provisions to allow future extensions.
8165	Ming Gan	67.01	9.4.2.	BSS load element provides the channel utilization such that the unassociated STA can choose the proper AP┤+ε and extended BSS load element further provides the the spatial stream underutilization given the busy channel such that unassociated STA with MU-MIMO capability can choose the proper AP. Now 11ax introduce a OFDMA, there is the probability of frequence underutilization given the busy channel.	Define a HE BSS load element considering frequency utilization such to help unassociated STA to choose a best AP

1875

Summary

- **802.11 defines two BSS load information elements[1] containing**
  - information of current STA population and traffic level in the BSS (BSS load element)
  - information of MIMO spatial stream underutilization and bandwidth utilization (Extended BSS load element)
- **11ax introduces MU of OFDMA and UL MIMO, but current BSS load IEs cannot reflect true loading of 11ax HE BSSs**
- **In this presentation, we propose defining a new information element for conveying HE BSS load information**

1876

11ax MU BSS Load Element

- **Propose to add a new IE containing three categories of information**
  1. 11ax MU capable STA count and active STA counts
  2. MU TXOP time percentage over an observation period
  3. Load Report: Underutilization rate of MU TXOP to reflect potential capacity of an 11ax BSS

1877

11ax MU BSS Load Element Contents(1/4)

1. STA count

- **Total number of MU capable STAs**
  - MU includes MU MIMO and OFDMA
  - Let STAs know how many MU competitors are within the BSS
- **Active STA counts**
  - Some associated STA may not be active for a long time
  - AP can monitor STA's activities during an observation period
    - Prefer to define observation period in units of beacon intervals
  - An active STA: if the AP receives any MPDU from that STA during the observation period. Two active STA counts are defined.
    - Active STA count
    - Active MU capable STA count

1878

11ax MU BSS Load Element Contents(2/4)

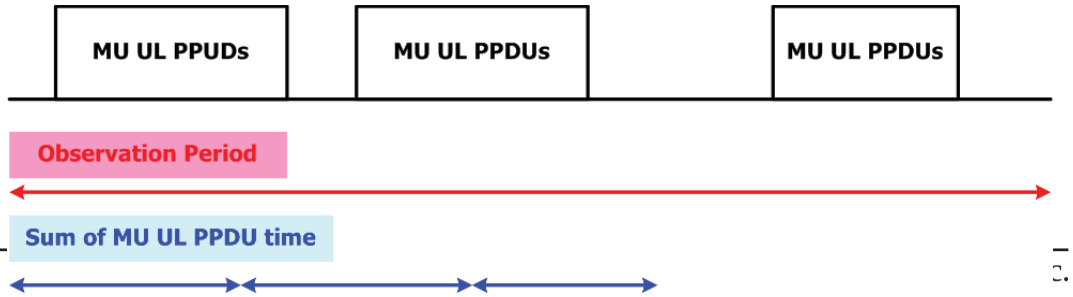
- **Usage Example:**
  - Example: HE BSS1 has 100 active STAs with 5 active MU capable STAs, and HE BSS2 has 100 active STAs with 95 active MU capable STAs. An unassociated HE STA may choose HE BSS2 for more transmit and receive opportunities

1879

11ax MU BSS Load Element Contents(3/4)

2. Time percentage of MU/SU TXOPs

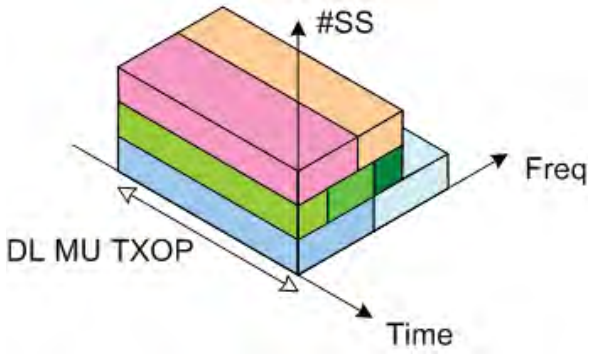
- MU: Report UL and DL separately
- SU: Report DL
- Let STAs know the traffic trend of TXOPs during the observation period. STA may have specific UL/DL requirements
  - `dot11ChannelUtilizationBeaconIntervals` serves as the observation period (50 beacon intervals default)
- Usage Example:
  - High percentage UL TXOP means heavily MU UL loaded BSS
- Illustration



11ax MU BSS Load Element Contents(4/4)

3. Load report of MU TXOPs

- Underutilization percentage over space & frequency
  - Information of available BW and SS
    - Interfered and used RUs shall not be included
  - Separate DL & UL reports
- Report BW
  - Reports of per 20 MHz BW
- Underutilization percentage formula (MU DL example)



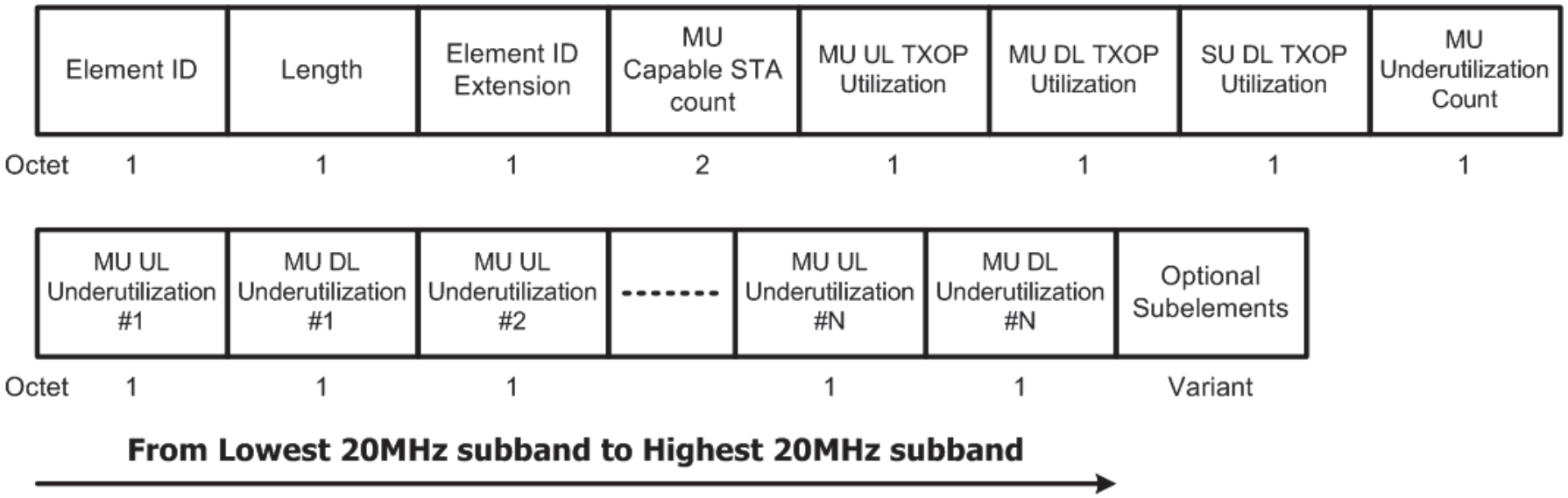
$$\frac{N_{\max_SS} \times RU_{\max} \times \sum_j T_{Busy(MUDL),j} - \sum_j \left[T_{Busy(MUDL),j} \left(\sum_i N_{SS,i,j} \times RU_{Busy,i,j} \right) \right]}{N_{\max_SS} \times RU_{\max} \times \sum_j T_{Busy(MUDL),j}}$$

N_{max_SS}: Max supported spatial stream
RU_{Busy}: Occupied RU weight(Used or interfered)
RU_{max}: RU weight of the available BW
$T_{Busy(MUDL)}$: Time of busy period for MU DL (MU DL TXOP)

1881

11ax MU BSS Load Information Element (1/2)

- **Define a new BSS Load information element for 11ax**
- **For UL/DL underutilization**
  - Variable length dependent on the channel bandwidth
- **Optional subelements carry active STA counts and legacy BSS load IEs (defined in next page)**



11ax MU BSS Load Information Element (2/2)

- **Subelements**
  - Optional active STA counts
  - Able to carry legacy BSS load elements
    - BSS load (9.4.2.28)
    - Extended BSS load (9.4.2.160)

Subelement ID	Name	Extensible
0	Reserved	
1	Active STA count	Yes
2	Active MU capable STA count	Yes
3	BSS load	
4	Extended BSS load	
5-255	Reserved	

- **Active STA count subelements**

	Subelement ID	Length	Active STA count	Observation period in units of beacon intervals
Octets:	1	1	2	1

	Subelement ID	Length	Active MU Capable STA count	Observation period in units of beacon intervals
Octets:	1	1	2	1

1883

Straw poll 1

- **Do you support to add a BSS load information element containing information defined on page 3~7?**
  - Y
  - N
  - A

1884

Straw poll 2

- **Do you support to define the 11ax MU BSS load information element as the formant on page 8~9?**
  - Y
  - N
  - A

1885

References

1. P802.11 2016

1886

1887

BACKUP

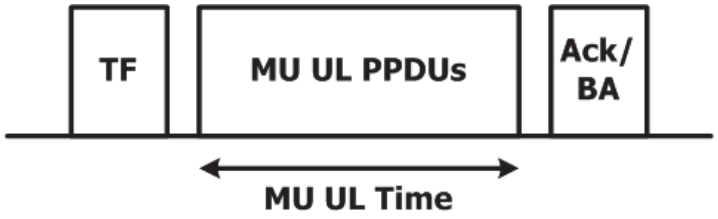
Underutilization Percentage RU Weights

- **RU weights example of report per 20 MHz BW**
  - RU26: 1/9
  - RU52: 2/9
  - RU106: 4/9
  - RU242: 9/9
  - RU484: 9/9 (half on the target 20MHz)

1888

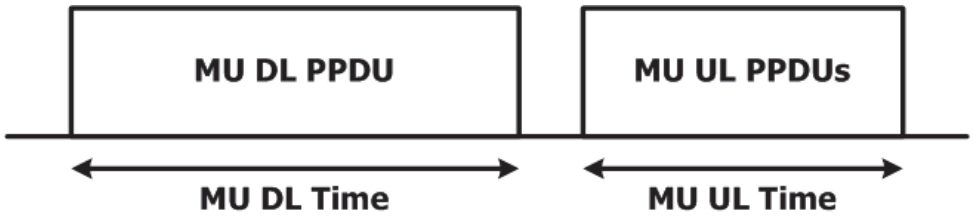
MU UL/DL Time Definitions

- **UL MU by TF**



- **DL MU**

- **Cascaded MU**



1889

Legacy BSS Load IEs

- **BSS load element**

Element ID	Length (5)	Station Count	Channel Utilization	Available Admission Capacity
Octets: 1	1	2	1	2

Figure 9-260—BSS Load element format

- **Extended BSS load element**

Element ID	Length	MU-MIMO Capable STA Count	Spatial Stream Underutilization	Observable Secondary 20 MHz Utilization	Observable Secondary 40 MHz Utilization	Observable Secondary 80 MHz Utilization
Octets: 1	1	2	1	1	1	1

Figure 9-565—Extended BSS Load element format

dot11ChannelUtilizationBeaconIntervals

- **In Annex C**

```
dot11ChannelUtilizationBeaconIntervals OBJECT-TYPE
    SYNTAX Unsigned32 (1..100)
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "This is a control variable.
        It is written by an external management entity.
        Changes take effect as soon as practical in the implementation.

        This attribute indicates the number of beacon intervals over which the
        channel busy time should be averaged."
    DEFVAL { 50 }
    ::= { dot11OperationEntry 16 }
```

1891

Appendix BT

Resolution to CID 7547

Date: 2017-03-02

Authors:

Name	Affiliations	Address	Email
Xiaogang Chen	Intel		Xiaogang.c.chen@intel.com
Ilan Sutskover	Intel		
Michael Simon	Rohde-schwarz		
Lisa Ward	Rohde-schwarz		

1893

Statement of Problem

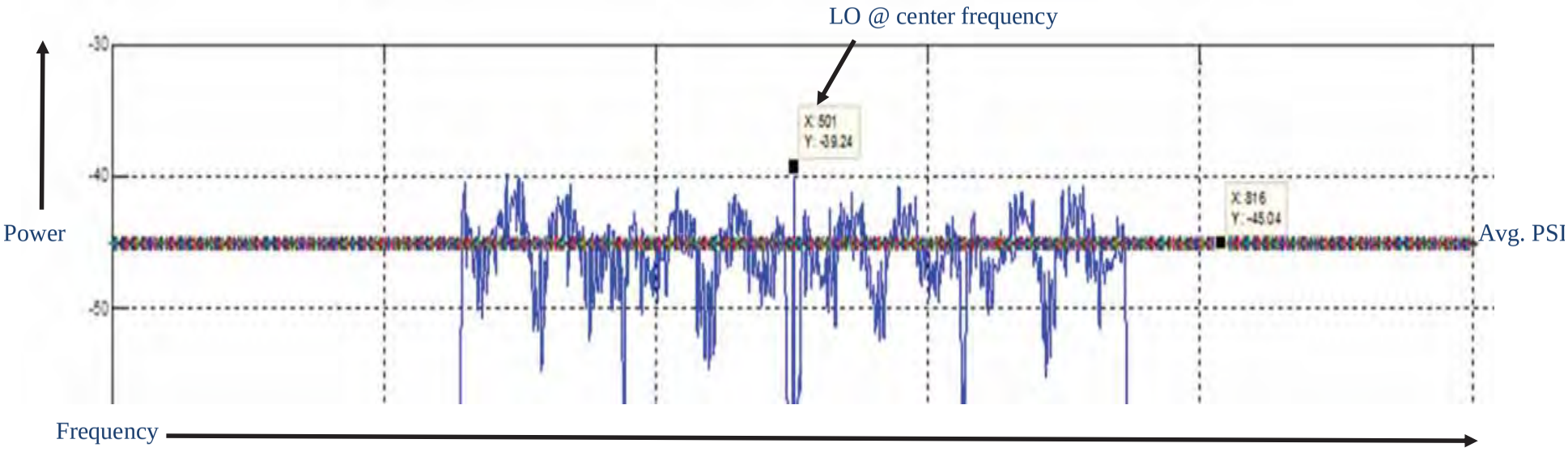
- **Draft 1.0 defines that masks of HE PPDUs are measured with RBW=25kHz and VBW=7.5kHz**
  - A change over former 802.11 that used RBW=100kHz and VBW=30kHz
- **With RBW of 25kHz, each spectrum point for 160MHz transmission is approximately 10LOG(160/0.025)=38dB below the total power. 6dB lower than 11ac.**
  - For in-band spurs, there is more chance that 0dBr at peak spectrum will be touching the CW "spur" instead of the data subcarriers.
  - For out-band spurs, there is more chance the spur break the mask.
- **Smaller RBW requires larger number of points at the SA, resulting in significantly more variance in the frequency domain & higher test time**
- **We have identified that some major SA manufacturers (like Keysight) support RF filtering with a limited RBW granularity only, where RBW=25kHz is not one of the available options**

1894

Spur Resilience (in-band)

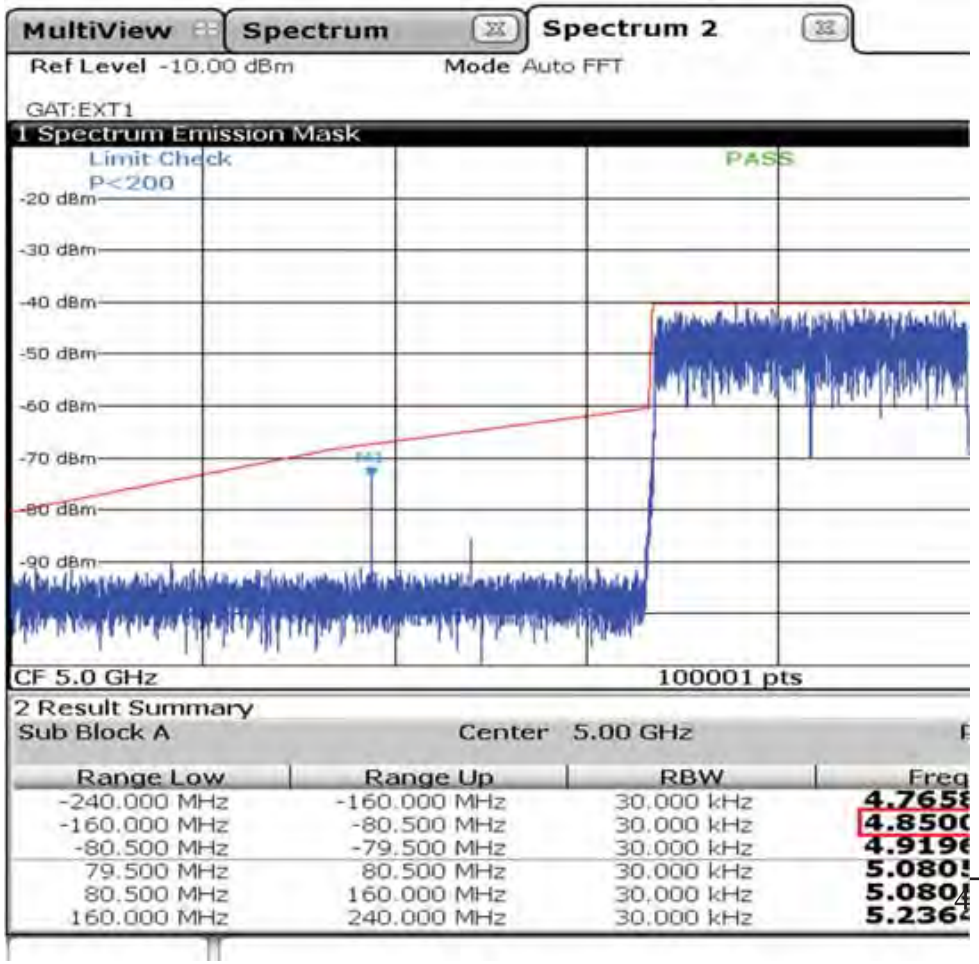
- CW-like signals' power does not vary with RBW, as their bandwidth is infinitely small. But the mask peak spectrum reduces in power with reduction to RBW.
- As a result, resilience to CW-like spurs has degraded by 6dB upon the change from RBW=100kHz to RBW=25kHz

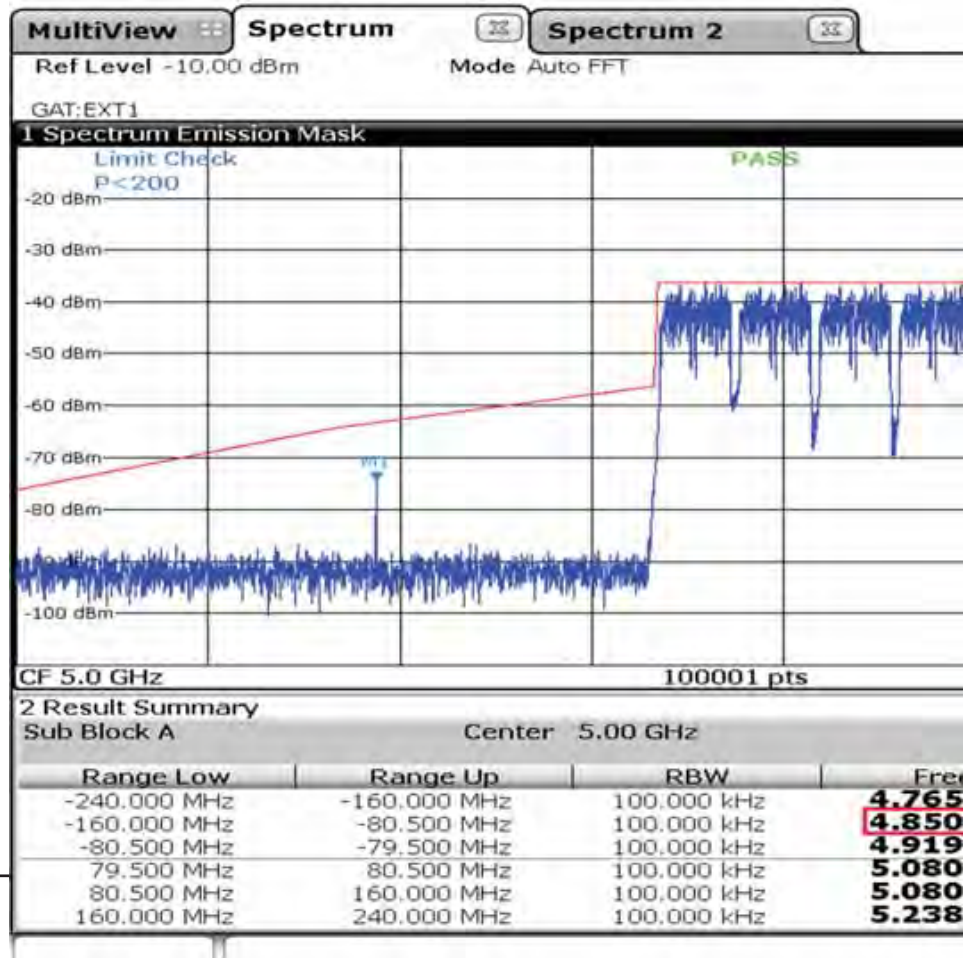
1895



Spur Resilience (out-band)

- Mask drop more due to accumulated power drop from 100kHz to 30kHz;
- Less margin for 30kHz RBW to the mask if out of band spur presents.





Number of Points in the Spectrum Analyzer

- **To ensure proper coverage of the tested span, the number of points measured must cover the spectrum properly. With reduction of RBW by 4X (compared to 11ac and earlier WiFi), 4X points are required to ensure same coverage.**
- **For 160MHz PPDU, span greater than 480MHz is required. With RBW=25kHz, according to R&S guideline (see below), one expects at least 2*480000/25=38400 points.**
- **Number of points has a significant impact on both test time and "deviations" in the spectrum (see next slides). The number of points is an implementation issue and is not defined by the standard.**

1897

Figure 10 - Menu to define the frequency step size

As a rule of thumb, you should keep the frequency step size to around half of the measurement bandwidth. This way there is no possibility of both missing information or an error in the magnitude response. The displayed measurement bandwidths of the network analyzer define the 3 dB bandwidths of the measurement filter, so up to 3 dB error could be expected when the frequency step size comes close to the measurement bandwidth.

With a maximum number of 60,001 data points and a measurement bandwidth of 5 MHz, the maximum frequency span that can be measured is:

2.5 MHz * 60,000 = 150 GHz

https://cdn.rohde-schwarz.com/pws/dl_downloads/dl_application/application_notes/1ez62/1EZ62_0e.pdf

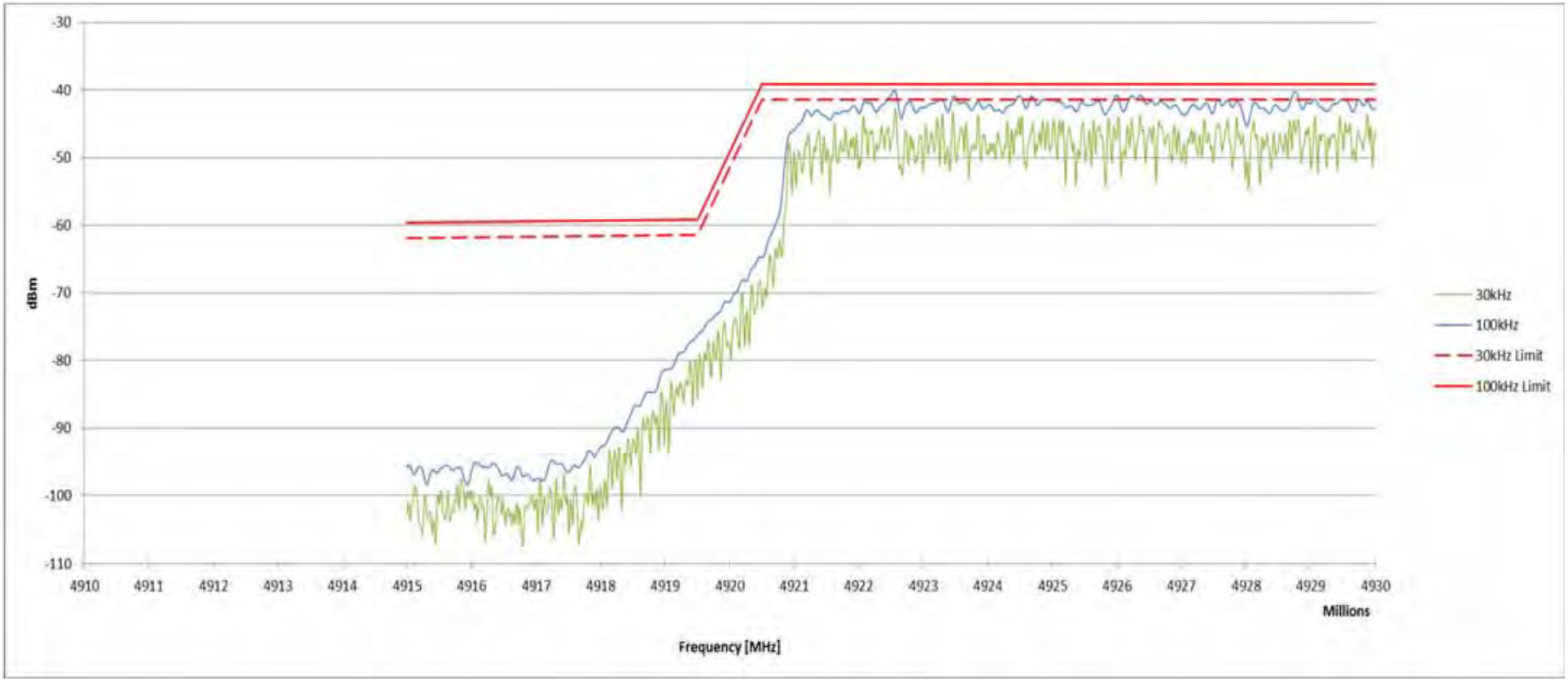
Impacts on the 11ax mask (1/3)

- 11ac transmissions with RBW=24kHz, 100kHz, 400kHz
- Shaping with 4X RBW is only slightly worse (~1 subcarrier spacing) than with 1X RBW.

1898

Impacts on the 11ax mask (2/3)

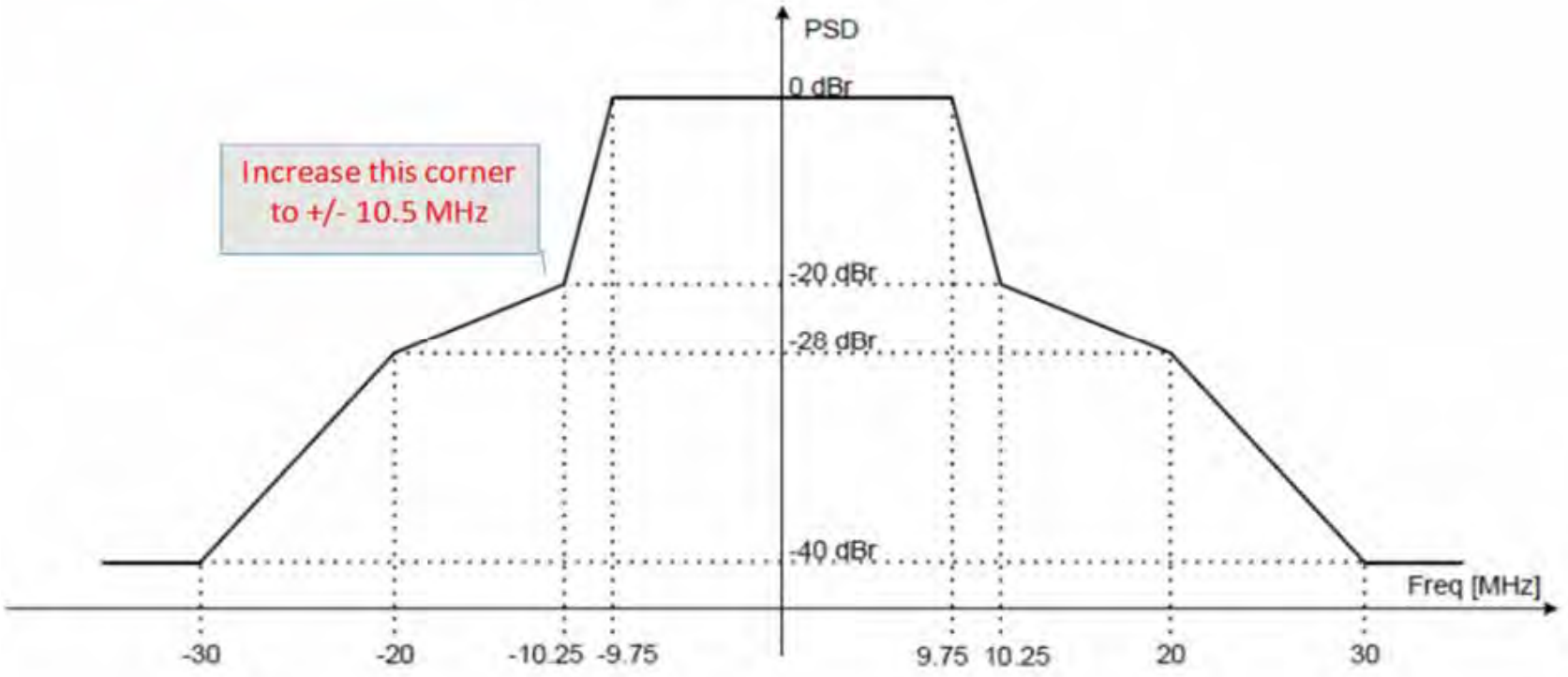
- **Cross check from Rohde-schwarz**



1899

Impacts on the 11ax mask (3/3)

- RBW 100kHz extends the shoulder part of the measured signal;
- If CFO presents in testing, it might be safer to stretch out 20MHz mask a little as shown bellow (to be updated)

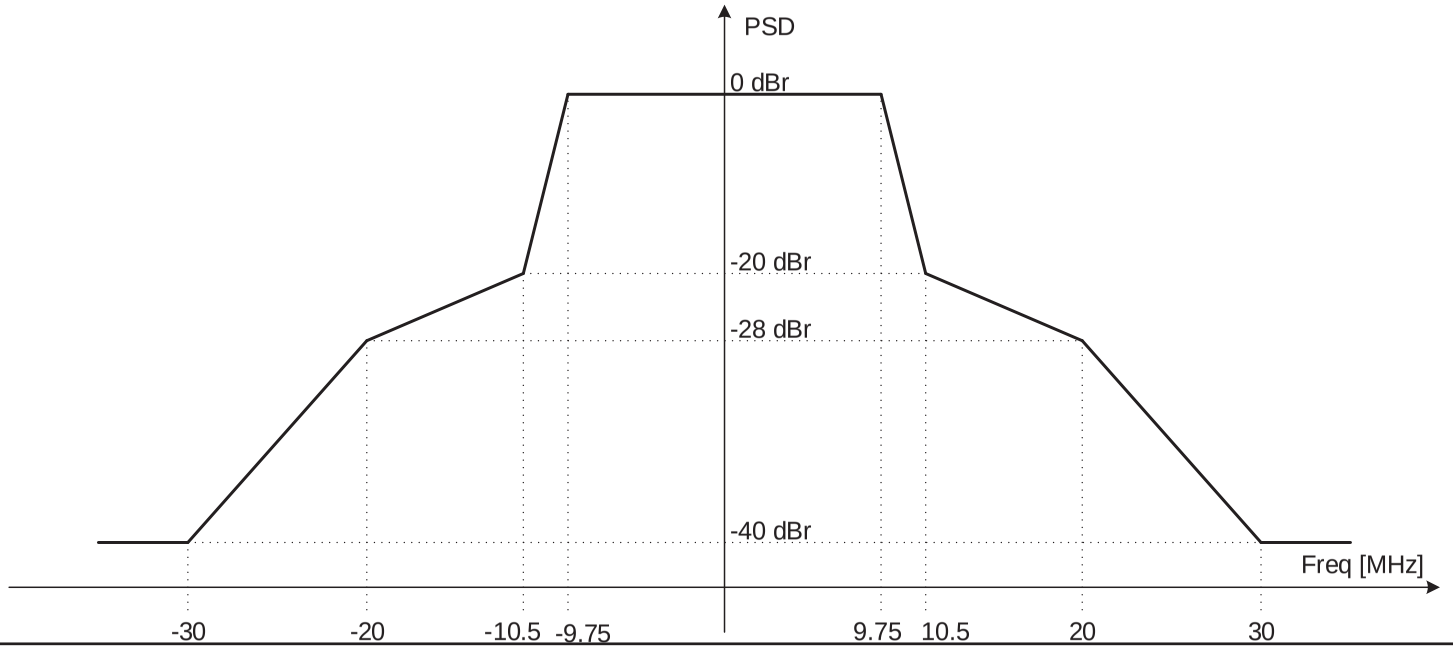


1900

Proposed changes: Revised for CID 7547 per editing instructions in 11-17/0078r1

- ***To the TGax Editor: modify P.L. 353.53 as following***
  - Measurements shall be made using a ~~25~~ 100 kHz resolution bandwidth and a 7.5 kHz video bandwidth.
- ***In addition, replace Figure 28-37 with the bellow figure.***

1901



Appendix C

Status of Project IEEE 802.11ax

High Efficiency (HE) Wireless LAN Task Group

Task Group Leadership

Chair	**Osama Aboul-Magd (Huawei Technologies)**
1st Vice Chair	**Ron Porat (Broadcom Ltd.)**
2nd Vice Chair	**Alfred Asterjadhi (Qualcomm)**
Secretary	**Yasuhiko Inoue (NTT)**
Technical Editor	**Robert Stacey (Intel)**

Background

In May 2013, the High Efficiency WLAN Study Group (HEW SG), a study group within IEEE 802.11 working group had started its activity to consider the improvement of spectrum efficiency to enhance the system throughput/area in high density scenarios of APs and/or STAs.

The study group was created based on the following straw poll and motion:

< Straw Poll >
Do you support starting a new study group called "high efficiency WLAN" to enhance 802.11 PHY and MAC in 2.4 and 5GHz with a focus on:

- Improving spectrum efficiency and area throughput
- Improving real world performance in indoor and outdoor deployments
  - in the presence of interfering sources, dense heterogeneous networks
  - in moderate to heavy user loaded APs

< Motion >
Request an approval by IEEE 802 LMSC to form an 802.11 Study Group to consider High-efficiency WLAN [as described in doc 11-13-0339r2] with the intent of creating a PAR and five criteria.

The HEW SG has successfully developed PAR and CSD documents and the project 802.11ax has started in May 2014.

Task Group Documents

The lastest version of the task group offical documents can be found here.

- 11-14-0165 Project Authorization Request (PAR)
- 11-14-0169 Criteria for Standard Developement (CSD)
- 11-14-0938 TGax Selection Procedure
- 11-14-0980 TGax Simulation Scenarios
- 11-14-0571 TGax Evaluation Methodology
- 11-14-0882 TGax Channel Models

- 11-14-1009 TGax Functional Requirements
- 11-15-0132 TGax Specification Framework

Previous Meetings

Links to the reports of previous meetings.

TGax	2020	November 2020	September 2020	July 2020
		May 2020	March 2020	January 2020
	2019	November 2019	September 2019	July 2019
		May 2019	March 2019	January 2019
	2018	November 2018	September 2018	July 2018
		May 2018	March 2018	January 2018
	2017	November 2017	September 2017	July 2017
		May 2017	March 2017	January 2017
	2016	November 2016	September 2016	July 2016
		May 2016	March 2016	January 2016
	2015	November 2015	September 2015	July 2015
		May 2015	March 2015	January 2015
	2014	November 2014	September 2014	July 2014
		May 2014	---	---
HEW SG	2014	---	March 2014	January 2014
	2013	November 2013	September 2013	July 2013
		May 2013	---	---

November 2020 — Online Meeting

The IEEE 802 Plenary Session November 2020 was held online.
The P802.11ax D8.0 was in the process of the second IEEE-SA recirculation ballot from November 3rd to 12th, 2020.
TGax had two online meetings during the November 2020 plenary.

Main documents

The TGax meeting agenda, draft meeting minutes and closing report can be found here.

- 11-20-1552-21, TGax CRC Teleconference Agendas: October - November - December 2020
- 11-20-1785-01, (draft) TGax November 2020 Meeting Minutes
- 11-20-1822-00, TGax November 2020 Closing Report

Accomplishments

- The TG was scheduled for two time slots - Tuesday @ 16:00 ET and Thursday @ 19:00 ET
- The TG reviewed and approved the report to the EC requesting conditional approval to forward to RevCom.
  The TG approved r3 of the report. R4 is on the server updating the number of unsatisfied comments.
  The report is available at:
  - https://mentor.ieee.org/802.11/dcn/20/11-20-1771-04-00ax-p802-11ax-report-to-ec-on-conditional-approval-to-forward-draft-to-revcom.pptx

- The TG reaffirmed the TG CSD.
  - https://mentor.ieee.org/802.11/dcn/14/11-14-0169-03-0hew-ieee-802-11-hew-sg-proposed-csd.docx
- **The TG is on time to submit the draft (8.0) for the January 2021 RevCom meeting.**

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October 2020 — Status Update

- The first IEEE-SA recirculation ballot on the P802.11ax D7.0 completed successfully with 88% approval ratio. 132 comments were received.
- TGax continued two or three teleconferences to resolve the comments for D7.0.
- During TGax CRC teleconference on October 30th, TGax completed comment resolution for D7.0 and passed the motion
  - to instruct the TGax technical editor to create the IEEE 802.11ax draft 8.0 incorporating the resolutions, and
  - to approve a 10-day IEEE-SA Recirculation Ballot asking the question " Should P802.11ax Draft 8.0 be forwarded to RevCom?"

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September 2020 — Online Meeting

The IEEE 802 Wireless Interim Session September 2020 was held online.
The P802.11ax D7.0 was in the process of the first IEEE-SA recirculation ballot
and the TGax had one online meeting during the week.

Main documents

The TGax meeting agenda and meeting minutes can be found here.

- 11-20-1169-18, TGax CRC Teleconference Agendas: August - September 2020
- 11-20-1522-00, TGax September 2020 Meeting Minutes

Accomplishments

- Approved TGax CRC teleconference minutes from July to August, 2020
- Reaffirmed Ron Porat (Broadcom) and Alfred Asterjadhi (Qualcomm) as the fist and the second vice-chairs, respectively.
- Reaffirmed Yasuhiko Inoue (NTT) as the TGax secretary.
- Reviewed the IEEE-SA Comment Resolution Guideline.

Timeline

- RevCom meeting scheduled at January 26, 2021.
  - Deadline for submission is December 11, 2020.
- 802 WG virtual meeting is scheduled during the period October 30 to November 13, 2020.
  - The CRC needs the 802.11 WG and 802 WG approvals to proceed to RevCom in January.
- The CRC seems to have about 40 days to complete resolutions of all comments received on draft 7.0.

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- TGax had one session continued two teleconferences to resolve the comments for D6.0.
- During TGax CRC teleconference on August 27th, TGax completed comment resolution for D6.0 and passed the motion
  - to instruct the TGax technical editor to create the IEEE 802.11ax draft 7.0 incorporating the resolutions, and

    - to approve a 15-day IEEE-SA Recirculation Ballot asking the question " Should P802.11ax Draft 7.0 be forwarded to RevCom?"
- The 15-day IEEE-SA Recirculation Ballot on the IEEE 802.11ax D7.0 has opened on **September 3rd** and will close on **September 17th, 2020, 23:59 (ET)**.

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August 2020 — Status Update

- TGax continued two teleconferences to resolve the comments for D6.0.
- During TGax CRC teleconference on August 27th, TGax completed comment resolution for D6.0 and passed the motion
    - to instruct the TGax technical editor to create the IEEE 802.11ax draft 7.0 incorporating the resolutions, and
    - to approve a 15-day IEEE-SA Recirculation Ballot asking the question " Should P802.11ax Draft 7.0 be forwarded to RevCom?"
- The 15-day IEEE-SA Recirculation Ballot on the IEEE 802.11ax D7.0 has opened on **September 3rd** and will close on **September 17th, 2020, 23:59 (ET)**.

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July 2020 — Online Meeting

The IEEE 802 Plenary July 2020 Session was held online.
TGax had one meeting during the plenary session and another one after closing plenary.

Main documents

The meeting agenda and minutes of the TGax and its subgroups, and the TGax closing report can be found here.

- TGax
    - 11-20-0538-45, TGax CRC Teleconference march-July 2020 Teleconference Agendas
    - 11-20-1103-00, (Draft) TGax July 2020 Meeting Minutes

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May 2020

The IEEE 802 Wireless Interim Session May 2020 was also cancelled due to COVID-19.
In the meantime, TGax continued to accelerate comment resolution process by two teleconferences every week.

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March 2020

The IEEE 802 Plenary Session March 2020 was cancelled due to COVID-19.
In the meantime, TGax accelerated comment resolution process by having two teleconferences per week.

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January 2020 — Irvine, CA

The TGax had only one meeting during the week since the initial IEEE-SA ballot on the IEEE 802.11ax D6.0 is going on.

	Monday	Tuesday	Wednesday	Thursday
AM1				
AM2	**TGax** **(full session)**			
PM1				
PM2				
PM3				

Main documents

The meeting agenda and minutes of the TGax and its subgroups, and the TGax closing report can be found here.

- TGax
  - 11-19-2118-02, TGax January 2020 Meeting Agenda
  - 11-20-0190-00, TGax January 2020 Closing Report
  - 11-20-0148-00, (Draft) TGax January 2020 Irvine Meeting Minutes

Achievements

1. **Work Completed**
   - The TG was scheduled for one time slot on Monday AM-2
     - Approved November F2F meeting minute and December 13 teleconference minutes.
     - Decided on a TG teleconference schedule.
     - Decided no to have an ad hoc (CRC) meeting in March.
     - Reviewed the rules to be followed during the CRC operation.
   - Draft 6.0 is in SA ballot. The ballot closes on January 24th.
     - Please vote and submit your comments by the deadline.

2. Submissions
   - TGax received no submission to discuss during January 2020 session.

3. Timeline
   - No changes to current timeline.

Goals for the March 2020 session

- comments received on draft D6.0.

Teleconferences

Following TGax teleconferences were authorized during the January 2020 session.

Thursday	January 30th, 2020	10:00 - 12:00 (ET)
Thursday	February 13th & 27th , 2020	10:00 - 12:00 (ET)
Thursday	February 6th, 20th & March 5th, 2020	20:00 - 22:00 (ET)

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November 2019 — Waikoloa, HI

TGax had eight meeting slots during the week.
All sessions are full TG session.

	Monday	Tuesday	Wednesday	Thursday
AM1		**TGax** (full session)	**TGax** (full session)	
AM2		**TGax** (full session)		**TGax** (full session)
PM1			**TGax** (full session)	
PM2	**TGax** (full session)	**TGax** (full session)		**TGax** (full session)
PM3				

Main documents

The meeting agenda and minutes of the TGax and its subgroups, and the TGax closing report can be found here.

- TGax
  - 11-19-1732-09, TGax November 2019 Meeting Agenda
  - 11-19-2096-00, TGax November 2019 Closing Report
  - 11-19-2012-00, (Draft) TGax November 2019 Waikoloa Meeting Minutes

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Achievements

1. **Work Completed**
   - The group completed the resolution of all comments received on draft 5.0.
   - Motion passed in the TG to instruct the Editor to prepare draft 6.0 and start a 15-day recirculation ballot.
   - A new revision of the TG Coexistence Assurance document is available.
     - TGax Coexistence Assurance Document
   - The EC Report on conditional approval to go to SA ballot is available at 11-19/2063.

2. **Technical Submissions**
   TGax received following submissions.
   - 11-19-1684, "CR on dot11HECCAIndicatinMode," Robert Stacey (Intel)
   - 11-19-1796, "Comments on TGax CA doc r6," Eldad Perahia (HPE-Aruba)
   - 11-19-1810, "11ax D5.0 Comment Resolution for NAV related comments," Po-Kai Huang (Intel)
   - 11-19-1814, "11ax D5.0 MAC Comment Resolution for SM Power Save," Po-Kai Huang (Intel)
   - 11-19-1816, "11ax D5.0 MAC Comment Resolution for Duration-based RTS/CTS," Po-Kai Huang (Intel)
   - 11-19-1819, "Resolution to comment to subclause 9.3.1.7.1" Tomoko Adachi (Toshiba)
   - 11-19-1831, "Comment resolutions for miscellaneous comments," Alfred Asterjadhi (Qualcomm)
   - 11-19-1832, "Comment resolutions for subclause 26.8," Alfred Asterjadhi (Qualcomm)/Robert Stacey (Intel)
   - 11-19-1833, "Comment resolution for subclause 26.15," Alfred Asterjadhi (Qualcomm)
   - 11-19-1834, "Comment resolution for subclause 26.17," Alfred Asterjadhi (Qualcomm)
   - 11-19-1835, "Comment resolutions for TWT IE," Alfred Asterjadhi (Qualcomm)
   - 11-19-1871, "Resolution to HESIGB and Related Comments," Brian Hart (Cisco Systems)
   - 11-19-1896, "Comment Resolutions for 11ax D5.0 HE PHY Service Interface Section," Bo Sun (ZTE)
   - 11-19-1905, "Resolution for CIDs related to Multiple BSSID," Abhishek Patil (Qualcomm)
   - 11-19-1906, "Resolution for CIDs related to BSS Color," Abhishek Patil (Qualcomm)
   - 11-19-1922, "Some 802.11ax comment resolutions," Jarkko Kneckt (Apple)
   - 11-19-1936, "Ack related comments," George Cherian (Qualcomm)
   - 11-19-1941, "CIDs on Clause 27.3.10.7 for D5.1," Jianhan Liu (MediaTek)
   - 11-19-1947, "MAC CR on Fragmentation," Ming Gan (Huawei Technologies)

- 11-19-1948, "MAC CR on CID 22386 and 22387," Ming Gan (Huawei Technologies)
- 11-19-1949, "CR for CID 22030, 22031, 22032, 22447," Xiaogang Chen (Intel)
- 11-19-1956, "CR for BSS Color Related CIDs," Xiaofei Wang (InterDigital Communications)
- 11-19-1957, "LB244 CR MAC Miscellaneous," Yongho Seok (MediaTek)
- 11-19-1977, "CR for BSS Color Related CIDs Part 2," Xiaofei Wang (InterDigital Commincations)
- 11-19-1983, "Remaining PHY Math comment resolutions," Yang Zhang (Marvell Semiconductor)
- 11-19-1986, "Sounding CRs 11ax D5.0," Menzo Wentink (Qualcomm)
- 11-19-1995, "CR for MU EDCA parameters," Laurent Carioou (Intel)
- 11-19-1996, "CR for OPS," Laurent Carioou (Intel)
- 11-19-1997, "CR for Out of band discovery," Laurent Cariou (Intel)
- 11-19-1998, "CR for misc CIDs," Laurent Cariou (Intel)
- 11-19-2004, "D5.0 PHY C," Youhan Kim (Qualcomm)
- 11-19-2016, "CR BQR," Zhou Lan (Broadcom)
- 11-19-2020, "11ax D5.0 comment resolution of various cubclauses," Liwen Chu (Marvell)
- 11-19-2021, "Security parameter constraints," Jouni Malinen (Qualcomm)
- 11-19-2023, "CRs on MCS Tables," Bin Tian (Qualcomm)
- 11-19-2025, "11ax D5.0 comment resolution 26.6.3.1," Liwen Chu (Marvell)
- 11-19-2030, "CR on CID 22392," Ross Jian Yu (Huawei Technologies)
- 11-19-2035, "Transmit Spectral Mask for Preamble Punctured Channels," Dorin Viorel (Quantenna Communications)
- 11-19-2041, "Updated Channelizatin for 6 GHz," Imran Latif (Quantenna Communications)
- 11-19-2047, "LB244 CR for FTM CIDs," Jonathan Segev (Intel)
- 11-19-2048, "Proposed resolution for CIDs Related to Quiet Time Period," Kaiying Lu (MediaTek)
- 11-19-2053, "Proposed resolution for CIDs Related to Quiet Time Period," Kaiying Lu (MediaTek)
- 11-19-2057, "CID 22413, 22414," Youhan Kim (Qualcomm)
- 11-19-2068, "11ax D5.0 comment resolution of various subclauses," Liwen Chu (Marvell)
- 11-19-2075, "Proposed resolution for CID 22058," Kaiying Lu (MediaTek)
- 11-19-2077, "CID 22417," Youhan Kim (Qualcomm)
- 11-19-2083, "CR for RNR," Laurent Cariou (Intel)

3. **Timeline**
   No discussion on the timeline during the week.
   However, TGax timeline was updated as shown here.

Goals for the January 2020 session

- Start working on comments received on draft D6.0.

Teleconferences

No TGax teleconferences were authorized during the November 2019 session. A teleconference may be scheduled with a 10-day notice.

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September 2019 — Hanoi, Vietnam

TGax had nine meeting slots during the week.

	Monday	Tuesday		Wednesday	Thursday
AM1				**TGax** (full session)	**TGax** (full session)
AM2	**TGax** (full session)	**TGax** (MAC ad hoc)	**TGax** (MU ad hoc)		
PM1				**TGax** (full session)	**TGax** (full session)

	Monday	Tuesday	Wednesday	Thursday
PM2	**TGax** (MAC ad hoc) **TGax** (PHY ad hoc)	**TGax** (MAC ad hoc) **TGax** (PHY ad hoc)		
PM3	**TGax** (full session)			

Main documents

The meeting agenda and minutes of the TGax and its subgroups, and the TGax closing report can be found here.

- TGax
  - 11-19-1409-06, TGax September 2019 Meeting Agenda
  - 11-19-1708-00, TGax September 2019 Closing Report
  - 11-19-1630-00, TGax September 2019 Hanoi Meeting Minutes
- TGax PHY ad hoc
  - 11-19-1634-01, TGax September 2019 Meeting - PHY Ad hoc Agenda
- TGax MAC ad hoc
  - 11-19-1409-06, TGax September 2019 Meeting Agenda (Agenda for the MAC ad hoc is contained in the TGax agenda)
- TGax MU ad hoc
  - 11-19-1649-02, September 2019 TGax MU Ad hoc Meeting Agenda

Achievements

1. **Work Completed**
   - The group completed the resolution of all comments received on draft 4.0.
   - Motion passed in the TG to instruct the Editor to prepare draft 5.0 and start a 15-day recirculation ballot.
   - Motion passed to approve the new revision of the TG Coexistence Assurance document.
     - TGax Coexistence Assurance Document
   - Motion passed to approve the TG MDR

2. **Technical Submissions**
   TGax received following submissions.
   - PHY submissions
     - 11-19-0422, "CR for CID 21501, 21502, 21436," Xiaogang Chen (Intel)
     - 11-19-1377, "11ax D4.2 Comment Resolution for PHY Introduction," Sameer Vermani (Qualcomm)
     - 11-19-1386, "Resolution to PHY-related CID 21366," Brian Harts (Cisco Systems)
     - 11-19-1515, "Remaining PHY Math comment resolutions," Yan Zhang (Marvell)
     - 11-19-1530, "LB238 CID 20742, 20751," Youhan Kim (Qualcomm)
     - 11-19-1531, "LB238 CID 20785, 20934," Youhan Kim (Qualcomm)
     - 11-19-1560, "D4.0 CR PHY Misc," Tianyu Wu (Samsung)
     - 11-19-1581, "HE-SIG-A fields proposed text changes," Yan Zhang (Marvell)
   - MAC submissions
     - 11-19-0463, "Comment resolutions for Miscellaneous 11ax CID," David Kloper (Cisco Systems)
     - 11-19-0552, "CID 20073," Abhishek Patil (Qualcomm)
     - 11-19-0594, "Comment resolutions for transmit power control - part 2," Alfred Asterjadhi (Qualcomm)
     - 11-19-0619, "Proposed Resolutions to selected comments on D4.0," Mark Rison (Samsung)
     - 11-19-0770, "LB238 CR PPDU format, BW, MCS, NSS and DCM slection," Yongho Seok (MediaTek)
     - 11-19-0966, "Comment resolutions for miscellaneous TWT - part 2," Alfred Asterjadhi (Qualcomm)
     - 11-19-0968, "Proposed changes for some bug fixes and clarifications," Alfred Asterjadhi (Qualcomm)
     - 11-19-1064, "CR Disallowed Subchannels," Matthew Fischer (Broadcom)
     - 11-19-1137, "11ax sounding comments D4.0," Menzo Wentink (Qualcomm)
     - 11-19-1150, "Resolution for CIDs related to Co-located BSSID," Abhishek Patil (Qualcomm)
     - 11-19-1155, "LB-238 Miscellaneous Comment Resolution," Osama Aboul-Magd (Huawei Technologies)
     - 11-19-1167, "11ax D4.2 MAC Comment Resolution for SM Power Save Part II," Po-Kai Huang (Intel)

        - 11-19-1209, "11ax D4.0 CR for TXOP Duration-based RTS Threshold," Huizhao Wang (Quantenna Communications)
        - 11-19-1219, "Comment resolution for one CID," Alfred Asterjadhi (Qualcomm)
        - 11-19-1275, "Proposed Resolution to TGax D4.0 CR 20268," Srinivas Kandala (Samsung)
        - 11-19-1388, "Comment resolutions for non-AP STA scanning - part 2," Alfred Asterjadhi (Qualcomm)
        - 11-19-1390, "Comment resolutions for additional rules for preassociation," Alfred Asterjadhi (Qualcomm)
        - 11-19-1496, "Comment resolutions for 2 CIDs," Alfred Asterjadhi (Qualcomm)
        - 11-19-1520, "Resolution for CIDs related to Multiple BSSID - Part 3," Abhishek Patil (Qualcomm)
        - 11-19-1590, "CBF contents padding to 8bits," Huizhao Wang (Quantenna Communications)
        - 11-19-1610, "Comment resolutions for Reason Code CIDs," Pooya Monajemi (Cisco Systems)
        - 11-19-1618, "CR for CIDs 20475, 20788 and 21618," Jarkko Kneckt (Apple)
        - 11-19-1629, "11ax D4.0 MAC miscellaneous CIDs," Liwen Chu (Marvell)
        - 11-19-1631, "Proposed resolution for CIDs Related to Quiet Time Period," Kaiying Lu (MediaTek)
        - 11-19-1635, "Comment resolution on CID 20566," Edward Au (Huawei Technologies)
        - 11-19-1655, "11ax Comment Resolution Misc.," Zhou Lan (Broadcom)
        - 11-19-1658, "LB238 CR MAC Miscellaneous Part 2," Yongho Seok (MediaTek)
        - 11-19-1661, "Comment resolution on CIDs 20644 and 20645," Edward Au (Huawei Technologies)
        - 11-19-1662, "Resolutions to comments 20111 and 21011 of LB 238," Srinivas Kandala (Samsung)
        - 11-19-1667, "Resolutions for some comments on 11ax/D4.0 (LB238)," Mark Rison (Samsung)
        - 11-19-1668, "EOF handling in ack-enabled A-MPDU," Jarkko Kneckt (Apple)
        - 11-19-1673, "Proposed Resolution to TGax D4.0 CR20268," Srinivas Kandala (Samsung)
        - 11-19-1676, "MAC CR Fragment Flush," Ming Gan (Huawei Technologies)
        - 11-19-1682, "Comment resolutions for UORA," Chittabrata Ghosh (Intel)
        - 11-19-1684, "CR on dot11HECCAIndicationMode," Robert Stacey (Intel)
        - 11-19-1690, "Comment Resolution on MU Operation Part 2," Lochan Verma (Qualcomm)
    - MU submissions
        - 11-19-0765, "CR MU EDCA Timer," Zhou Lan (Broadcom)
        - 11-19-0908, "MU EDCA parameter update frame," Matthew Fischer (Broadcom)
        - 11-19-0917, "UORA Misc," Matthew Fischer (Broadcom)
        - 11-19-1186, "Comment Resolution on MU Operation," Lochan Veram (Qualcomm)
        - 11-19-1609, "MAC CR MU cascading," Ming Gan (Huawei Technologies)
        - 11-19-1627, "Last CIDs and fixes," Laurent Cariou (Intel)
    - SR submissions
        - 11-19-0613, "SRP Comments," Matthew Fischer (Broadcom)
    - Other submissions
        - 11-16-1348, "TGax Coexistence Assurance Document," Eldad Perahia (HPE/Aruba)
        - 11-19-0292, "Comments on TGax D4.0," Robert Stacey (Intel)
        - 11-19-1236, "Comment resolution on MIBs for LB238," Edward Au (Huawei Technologies)
        - 11-19-1243, "Comment Resolution on PICS for LB238," Edward Au (Huawei Technologies)

3. **Timeline**
   No discussion on the timeline during the week.
   However, TGax timeline was updated as shown here.

Goals for the November 2019 session

- Start working on comments received on draft D5.0.

Teleconferences

No TGax teleconferences were authorized during the September 2019 session. However, one teleconference was announced by a 10-day notice.

Tuesday	October 29th, 2019	13:00 - 15:00 (ET)

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July 2019 — Vienna, Austria

TGax had ten meeting slots during the week.

	Monday	Tuesday	Wednesday	Thursday
AM1	**TGax ad hoc** (full session)			
AM2		**TGax** (PHY ad hoc) **TGax** (MAC ad hoc)		**TGax** (full session)
PM1	**TGax** (full session)	**TGax** (PHY ad hoc) **TGax** (MAC ad hoc)	**TGax full** (PHY topic)	
PM2		**TGax ad hoc** (full session)	**TGax full** (MAC topic)	**TGax** (full session)
PM3	**TGax** (MAC ad hoc) **TGax** (MU ad hoc)			

Main documents

The meeting agenda and minutes of the TGax and its subgroups, and the TGax closing report can be found here.

- TGax
  - 11-19-0983-06, TGax July 2019 Meeting Agenda
  - 11-19-1347-00, TGax July 2019 Closing Report
  - 11-19-1264-00, TGax July 2019 Vienna Meeting Minutes
- TGax PHY ad hoc
  - 11-19-1274-03, TGax July 2019 Meeting Agenda - PHY Adhoc
  - 11-19-xxxx-yy, (Draft) TGax PHY Ad Hoc July 2019 Meeting Minutes (not available)
- TGax MAC ad hoc
  - 11-19-1279-02, TGax MAC Adhoc July 2019 Meeting Agenda
  - 11-19-1294-00, (Draft) July 15 PM3 TGax MAC Ad hoc meeting minutes
  - 11-19-1312-00, (Draft) July 16 TGax MAC Ad hoc meeting minutes
- TGax MU ad hoc
  - 11-19-1292-01, July 2019 TGax MU Ad hoc Meeting Agenda
  - 11-19-xxxx-yy, (Draft) TGax MU ad hoc July 2019 meeting minutes (not available)

Achievements

1. **Work Completed**
   - More time is needed to complete the resolution of all comments submitted during LB 238 on draft D4.0.
     - Almost 260 technical comments are remaining.

2. **Technical Submissions**

   TGax received following submissions.
   - PHY submissions
     - 11-19-0422, "CR for CID 21497, 21501, 21502," Xiaogang Chen (Intel)
     - 11-19-0793, "Remaining PHY Math comment resolutions," Yan Zhang (Marvell)
     - 11-19-0826, "CR on DCM and STBC Combinations," Youhan Kim (Qualcomm)
     - 11-19-0827, "CR on Punctured Non-HT Duplicate PPDU," Youhan Kim (Qualcomm)
     - 11-19-0830, "CR on Clause 17," Youhan Kim (Qualcomm)

- 11-19-0831, "D4.0 Comment Resolution - Part 2," Youhan Kim (Qualcomm)
- 11-19-0836, "D4.0 Comment Resolution - Part 3," Youhan Kim (Qualcomm)
- 11-19-0837, "CR on HE Capabilities," Youhan Kim (Qualcomm)
- 11-19-0858, "PHY CR in Clause 10," Youhan Kim (Qualcomm)
- 11-19-0866, "CR for Misc.," Xiangang Chen (Intel)
- 11-19-0971, "CR on CID 20760 and 20793," Ross Jian Yu (Huawei Technologies)
- 11-19-0972, "Remaining CR on SIG-B Part I," Ross Jian Yu (Huawei Technologies)
- 11-19-0973, "Resolution to CID20718," Yujin Noh (Newracom)
- 11-19-1013, "Spec Text Changes on MCS Table," Ross Jian Yu (Huawei Technologies)
- 11-19-1125, "Remaining CR on SIG-B Part II," Dandan Liang (Huawei Technologies)
- 11-19-1127, "Comment Resolution on CIDs on Clause 27.3.10.7," Jianhan Liu (MediaTek)
- 11-19-1150, "Proposed resolutions to comments on clause 26.3.10.15 (Packet Extension)," Ross Jian Yu (Huawei Technologies)
- 11-19-1185, "CR on PHY SIGB," Ming Gan (Huawei Technologies)
- 11-19-1225, "D4.0 Comment Resolution - Part 3," Youhan Kim (Qualcomm)
- 11-19-1226, "D4.0 Comment Resolution - Part 4," Youhan Kim (Qualcomm)
- 11-19-1271, "PHY Miscellaneous Comment Resolution," Sameer Vermani (Qualcomm)

- MAC submissions
  - 11-19-0339, "11ax D4.0 MAC Comment Resolution for Co-hosted BSSID," Po-Kai Huang (Intel)
  - 11-19-0414, "CR for NFRP," Laurent Cariou (Intel)
  - 11-19-0417, "CR for 6 GHz out of band," Laurent Cariou (Intel)
  - 11-19-0488, "CR for Reduced Neighbor Report," Jarkko Kneckt (Apple)
  - 11-19-0494, "Resolution for CID 20346 related to BSS Color," Kaiying Lu (ZTE)
  - 11-19-0594, "Comment resolutions for transmit power control - part 2," Alfred Asterjadhi (Qualcomm)
  - 11-19-0604, "11ax D4.1 MAC Comment Resolution for NAV part I," Po-Kai Huang (Intel)
  - 11-19-0696, "OMI Comment Resolutions," Jarkko Kineckt (Apple)
  - 11-19-0734, "11ax D4.0 Comment Resolution 9.7.3," Liwen Chu (Marvell)
  - 11-19-0735, "11ax D4.0 Comment Resolution 10.24," Liwen Chu (Marvell)
  - 11-19-0736, "11ax D4.0 Comment Resolution 10.32.2," Liwen Chu (Marvell)
  - 11-19-0737, "11ax D4.0 comment-resolution 9.2.4.6, 9.4.2.242.2," Liwen Chu (Marvell)
  - 11-19-0745, "MAC CR for subclause 9.4.2," Ming Gan (Huawei)
  - 11-19-0748, "11ax D4.0 Comment Resolution 26.2.8," Liwen Chu (Marvell)
  - 11-19-0750, "11ax D4.0 comment-resolution 26.5.3.4," Liwen Chu (Marvell)
  - 11-19-0769, "CR for NFRP," Laurent Cariou (Intel)
  - 11-19-0771, "LB238 CR HE Subchannnel Selective Transmission," Yongho Seok (MediaTek)
  - 11-19-0835, "Comment resolution for subclause 26.2.2," Kaiying Lu (MediaTek)
  - 11-19-0910, "Comment resolutions for fast passive scanning," Alfred Asterjadhi (Qualcomm)
  - 11-19-0915, "Fragment Flushing," Matthew Fischer (Broadcom)
  - 11-19-0961, "Comment resolutions for group addressed MPDUs delivery," Alfred Asterjadhi (Qualcomm)
  - 11-19-0962, "Comment resolutions for non-AP STA scanning (26.17.2.3.3)," Alfred Asterjadhi (Qualcomm)
  - 11-19-0963, "Comment resolutions for HE BSS operation - part 2," Alfred Asterjadhi (Qualcomm)
  - 11-19-0964, "Comment resolutions for additional rules for preassociation," Alfred Asterjadhi (Qualcomm)
  - 11-19-0965, "Comment resolutions for HE BSS operation in 6 GHz - part 2," Alfred Asterjadhi (Qualcomm)
  - 11-19-0967, "Comment resolutions for fast passive scanning - part 2," Alfred Asterjadhi (Qualcomm)
  - 11-19-1023, "11ax D4.0 Comment Resolution 21.6.4.1," Liwen Chu (Marvell)
  - 11-19-1035, "11ax D4.0 Comment Resolution 26.6.4.2 26.6.4.4," Liwen Chu (Marvell)
  - 11-19-1061, "Comment resolutions for HE FTM in 6 Ghz," Alfred Asterjadhi (Qualcomm)
  - 11-19-1064, "CR Disallowed Subchannels," Matthrew Fischer (Broadcom)
  - 11-19-1138, "LB238 CR HLA," Yongho Seok (MediaTek)
  - 11-19-1139, "LB238 CR AID assignment," Yongho Seok (MediaTek)
  - 11-19-1141, "LB238 CR MAC Miscellaneous," Yongho Seok (MediaTek)
  - 11-19-1147, "CID 20000," Abhishek Patil (Qualcomm)
  - 11-19-1148, "Resolution for CIDs related to Multiple BSSID - Part 2," Abhishek Patil (Qualcomm)
  - 11-19-1149, "Resolution for CIDs 21172 and 20013," Abhishek Patil (Qualcomm)

        - 11-19-1155, "LB-238 Miscellaneous Comment Resolution," Osama Aboul-Magd (Huawei Technologies)
        - 11-19-1161, "CR for Misc CIDs," Laurent Cariou (Intel)
        - 11-19-1163, "Proposed resolution for CIDs Related to Quiet Time Period," Kaiying Lu (MediaTek)
        - 11-19-1167, "11ax D4.2 MAC Comment Resolution for SM Power Save Part II," Po-Kai Huang (Intel)
        - 11-19-1183, "Comment Resolution on Trigger Frame Format," Lochan Verma (Qualcomm)
        - 11-19-1184, "CR for MAC Misc," Ming Gan (Huawei Technologies)
        - 11-19-1200, "Resolutions to comments 20104, 20648, 21124, and 21469," Tomoko Adachi (Toshiba)
        - 11-19-1209, "11ax D4.0 sounding comments," Huizhao Wang (Quantenna Communications)
        - 11-19-1211, "Ack related CRs," George Cherian (Qualcomm)
        - 11-19-1219, "Comment resolutions for one CID," Alfred Asterjadhi (Qualcomm)
        - 11-19-1222, "CR for 20253, 20255, 20264 and 20265," Jarkko Kneckt (Apple)
        - 11-19-1236, "Comment resolution on MIBs for LB238," Edward Au (Huawei Technologies)
        - 11-19-1237, "Proposed resolution for some CIDs in section 3.2 and 4.3.15a," Guoqing Li (Apple)
        - 11-19-1243, "Comment resolution on PICs for LB238," Edward Au (Huawei Technologies)
        - 11-19-1259, "LB 238 Annex G Comment Resolution," Osama Aboul-Magd (Huawei Technologies)
        - 11-19-1275, "Proposed Resolution to Tgax D4.0 CR20268," Srinivas Kandala (Samsung)
    - MU submissions
        - 11-19-0765, "CR MU EDCA Timer," Zhou Lan (Broadcom)
        - 11-19-0908, "MU EDCA parameters update frame," Matthew Fischer (Broadcom)
        - 11-19-0917, "UORA Misc," Matthew Fischer (Broadcom)
        - 11-19-1130, "11ax D4.0 Comment Resolution for RDG MU," Yunbo Li (Huawei Technologies)
        - 11-19-1140, "LB238 CR UL MU Power Capabilities," Yongho Seok (MediaTek)
        - 11-19-1186, "Comment Resolution on MU Operation," Lochan Verma (Qualcomm)
        - 11-19-1204, "CR for CID20624," Laurent Cariou (Intel)
        - 11-19-1217, "Resolution for CID 21110," Abhishek Patil (Qualcomm)
        - 11-19-1218, "Resolution for CIDs related to UORA - Part 2," Abhishek Patil (Qualcomm)
        - 11-19-1263, "11ax D4.2 RA Setting for Response to Trigger frame," Po-Kai Huang (Intel)
    - SR submissions
        - 11-19-0416, "CR for Spatial reuse," Laurent Cariou (Intel)
        - 11-19-0613, "SRP Comments," Matthew Fischer (Broadcom)
    - Other submissions (presented in TG full session)
        - 11-19-0099, "11ax D4.0 sounding comments," Huizhao Wang (Quantenna Communications)
        - 11-19-0619, "Proposed Resolutions to select comments on D4.0," Mark Rison (Samsung)
        - 11-19-0863, "11ax D4.0 sounding comments," Menzo Wentink (Qualcomm)
        - 11-19-0876, "Updated Channelization for 6 GHz," Imran Latif (Quantenna Communications)
        - 11-19-0909, "Comment resolutions for 6 ghz scanning," Alfred Asterjadhi (Qualcomm)
        - 11-19-0912, "Editorial changes to approved resolutions," Robert Stacey (Intel)
        - 11-19-1017, "D4.0 CR for 6GHz channelization," Ruchen Duan (Samsung)
        - 11-19-1122, "11ax D4.2 Padding for Random Access," Po-Kai Huang (Intel)
        - 11-19-1123, "Editorial Comments on TGax/D4.0," Po-Kai Huang/Robert Stacey (Intel)
        - 11-19-1183, "Comment Resolution on Trigger Frame Format," Lochan Verma (Qualcomm)
        - 11-19-1199, "Updated Channelization for 6 GHz," Imran Latif (Quantenna Communications)
3. **Timeline**

    No discussion on the timeline during the week.

    Here is the current timeline.

Current Timeline	
May 2014	**Start of TG**
November 2014	**First draft of the TG SFD approved**
January 2016	**Proposed TG draft**
March 2016	**Draft 0.1 was approved and Comment Collection started**
November 2016	**Issue Draft 1.0 and start WG Letter Ballot — Failed (57.77%)** **LB 225: opened Dec. 1st, 2016 and closed Jan. 8th, 2017**

September 2017	**Draft 2.0 and WG Letter Ballot — Failed (62.84%)** **LB 230: opened Oct. 5th, 2017 and closed Nov. 4th, 2017**
May 2018	**Draft 3.0 and WG Letter Ballot — Passes (86.5%)**
Janury 2019	**Draft 4.0 and Recirculation Ballot — Passes (92.2%)**
May 2019	**Mandatory Draft Review**
June 2019	**Formation of Sponsor Ballot pool**
August 2019	**Initial Sponsor Ballot**
January 2020	**Final 802.11 Approval**
March 2020	**Conditional EC Approval**
June 2020	**RevCom submittal and publication**

Goals for the September 2019 session

- Complete the comment resolution on draft D4.0.
- Instruct the TG Editor to prepare draft D5.0 and start a new WG Recirculation ballot.
- Approve the new revision of the TG Coexistence Assurance document.

Teleconferences

Following TGax teleconferences were authorized during the July 2019 session.

Thursday	August 1st, 2019	10:30 - 13:30 (ET)
Thursday	August 8th, 2019	19:00 - 22:30 (ET)
Thursday	August 15th, 2019	10:30 - 13:30 (ET)
Thursday	August 22nd, 2019	19:00 - 22:30 (ET)
Thursday	August 29th, 2019	10:30 - 13:30 (ET)
Thursday	September 5th, 2019	19:00 - 22:30 (ET)

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May 2019 — Atlanta, GA

TGax had eight meeting slots during the week.

	Monday	Tuesday	Wednesday	Thursday
AM1				**TGax** **(full session)**
AM2	**TGax** **(full session)**	**TGax** **(PHY ad hoc)** **TGax** **(MAC ad hoc)**		
PM1	**TGax** **(PHY ad hoc)** **TGax** **(MAC ad hoc)**	**TGax** **(PHY ad hoc)** **TGax** **(MAC ad hoc)**	**TGax** **(full session)**	**TGax** **(full session)**
PM2			**TGax** **(PHY ad hoc)** **TGax** **(MAC ad hoc)**	
PM3				

Main documents

The meeting agenda and minutes of the TGax and its subgroups, and the TGax closing report can be found here.

- TGax
  - 11-19-0615-06, TGax May 2019 Meeting Agenda
  - 11-19-0925-00, TGax May 2019 Closing Report
  - 11-19-0872-00, TGax May 2019 Atlanta Meeting Minutes
- TGax PHY ad hoc
  - 11-19-0880-01, TGax Mar 2019 Meeting Agenda - PHY Adhoc
  - 11-19-0xxx-00, Draft TGax PHY Ad Hoc May 2019 Meeting Minutes (not available)
- TGax MAC ad hoc
  - 11-19-0881-03, TGax MAC Adhoc May 2019 Meeting Agenda
  - 11-19-0918-00, TGax MAC Ad-hoc meeting minutes May 2019

Achievements

1. **Work Completed**
   - The TG completed the resolution of about 430 comments.
   - The TG passed a motion to have an ad-hoc meeting in Rennes, France hosted by Cannon during the period July 10-12.
   - Discussed the TG timeline and made few adjustments.

2. **Technical Submissions**
   TGax received following submissions.
   - PHY submissions
     - 11-18-1774, "Resolution to CID 16624 (HESIGB)," Brian Hart (Cisco Systems)
     - 11-19-0378, "D4.0 CID20395 Unused Tone EVM," Youhan Kim (Qualcomm)
     - 11-19-0379, "D4.0 Comment Resolution - Part 1," Youhan Kim (Qualcomm)
     - 11-19-0385, "Resolution for CIDs in 27.1.1," Sameer Vermani (Qualcomm)
     - 11-19-0386, "CR Disallowed Subchannels," Ron Porat (Broadcom)
     - 11-19-0407, "Comment Resolutions PHY xVECTORs," Bo Sun (ZTE)
     - 11-19-0422, "CR for CID 21497, 21501, 21502," Xiaogang Chen (Intel)
     - 11-19-0553, "Comment Resolutions on Clause 27.3.15.2 (Beamforming feedback matrix V)," Kome Oteri (InterDigital)
     - 11-19-0793, "Remaining PHY Math comment resolutions," Yan Zhang (Marvell)
     - 11-19-0826, "CR on DCM and STBC Combinations," Youhan Kim (Qualcomm)
     - 11-19-0827, "CR on Punctured Non-HT Duplicate PPDU," Youhan Kim (Qualcomm)
     - 11-19-0830, "CR on Clause 17," Youhan Kim (Qualcomm)
     - 11-19-0831, "D4.0 Comment Resolution - Part 2," Youhan Kim (Qualcomm)
     - 11-19-0836, "D4.0 Comment Resolution - Part 3," Youhan Kim (Qualcomm)
     - 11-19-0837, "CR on HE Capabilities," Youhan Kim (Qualcomm)
     - 11-19-0858, "PHY CR in Clause 10," Youhan Kim (Qualcomm)
     - 11-19-0866, "CR for Misc.," Xiangang Chaen (Intel)
   - MAC submissions
     - 11-18-0218, "Fragment Flush BlockAckReq," Matthew Fischer (Broadcom)
     - 11-18-1822, "Temporarily Limited Connection," Matthew Fischer (Broadcom)
     - 11-19-0288, "CR for HE Beacon," Po-Kai Huang (Intel)
     - 11-19-0292, "Comments on TGax D4.0," Po-Kai Huang (Intel)
     - 11-19-0301, "Comment resolutions for HE beacon in 6 Ghz band," Alfred Asterjadhi (Qualcomm)
     - 11-19-0302, "Comment resolutions for HE BSS operation," Alfred Asterjadhi (Qualcomm)
     - 11-19-0303, "Comment Resolution for QoS Control," Alfred Asterjadhi (Qualcomm)
     - 11-19-0304, "Comment resolutions for HE BSS operation in 6 GHz," Alfred Asterjadhi (Qualcomm)
     - 11-19-0305, "Comment resolutions for transmit power control," Alfred Asterjadhi (Qualcomm)
     - 11-19-0309, "Comment resolutions for Frame Control," Alfred Asterjadhi (Qualcomm)
     - 11-19-0315, "Comment resolutions for TWT power save," Alfred Asterjadhi (Qualcomm)

- 11-19-0316, "Comment resolutions for BSR operation," Alfred Asterjadhi (Qualcomm)
- 11-19-0325, "11ax D4.0 MAC Comment Resolution for SM Power Save," Po-Kai Huang (Intel)
- 11-19-0339, "11ax D4.0 MAC Comment Resolution for Co-hosted BSSID," Po-Kai Huang (Intel)
- 11-19-0394, "Resolution for CIDs in 9.3.1.22," Abhishek Patil (Qualcomm)
- 11-19-0395, "Resolution for CIDs related to BSS Color - Part 1," Abhishek Patil (Qualcomm)
- 11-19-0413, "CR for MU EDCA," Laurent Cariou (Intel)
- 11-19-0414, "CR for NFRP," Laurent Cariou (Intel)
- 11-19-0415, "CR for OPS," Laurent Cariou (Intel)
- 11-19-0417, "CR for 6 GHz out of band," Laurent Cariou (Intel)
- 11-19-0427, "Comment resolution on CID 20175," Zhou Lan (Broadcom)
- 11-19-0436, "Resolution for CIDs in clause 11.1.4," Abhishek Patil (Qualcomm)
- 11-19-0447, "Resolutions to CID 20256, 20257," Jarkko Kneckt (Apple)
- 11-19-0479, "Resolution for CID 20012," Abhishek Patil (Qualcomm)
- 11-19-0488, "CR for Reduced Neighbor Report," Jarkko Kneckt (Apple)
- 11-19-0492, "11ax D4.0 MAC Comment Resolution for MU-RTS/CTS," Po-Kai Huang (Intel)
- 11-19-0494, "Resolution for CID 20346 related to BSS Color," Kaiying Lu (ZTE)
- 11-19-0505, "Resolution for CIDs related to BSS Color - Part 2," Abhishek Patil (Qualcomm)
- 11-19-0506, "Resolution for CIDs related to Multiple BSSID," Abhishek Patil (Qualcomm)
- 11-19-0508, "Resolution for CIDs related to UORA," Abhishek Patil (Qualcomm)
- 11-19-0510, "Resolution for CIDs related to MU Operation," Abhishek Patil (Qualcomm)
- 11-19-0548, "Resolution for CIDs related to TF format (9.3.1.22) - Part 2," Abhishek Patil (Qualcomm)
- 11-19-0561, "Comment resolutions for miscellaneous TWT," Alfred Asterjadhi (Qualcomm)
- 11-19-0593, "Comment resolutions for Frame Control," Alfred Asterjadhi (Qualcomm)
- 11-19-0594, "Comment resolutions for transmit power control - part 2," Alfred Asterjadhi (Qualcomm)
- 11-19-0604, "11ax D4.1 MAC Comment Resolution for NAV part I," Po-Kai Huang (Intel)
- 11-19-0605, "11ax D4.0 MAC Comment Resolution for MU-RTS part II," Po-Kai Huang (Intel)
- 11-19-0652, "Comment resolutions for TWT Information frames," Alfred Asterjadhi (Qualcomm)
- 11-19-0696, "OMI Comment Resolutions," Jarkko Kineckt (Apple)
- 11-19-0703, "11ax D4.0 comment and resolution for Trigger frame MAC padding," Tianyu Wu (Apple)
- 11-19-0724, "Comment resolutions for broadcast TWT," Alfred Asterjadhi (Qualcomm)
- 11-19-0725, "Comment resolutions for Individual TWT," Alfred Asterjadhi (Qualcomm)
- 11-19-0734, "11ax D4.0 Comment Resolution 9.7.3," Liwen Chu (Marvell)
- 11-19-0735, "11ax D4.0 Comment Resolution 10.24," Liwen Chu (Marvell)
- 11-19-0737, "11ax D4.0 comment-resolution 9.2.4.6, 9.4.2.242.2," Liwen Chu (Marvell)
- 11-19-0745, "MAC CR for subclause 9.4.2," Ming Gan (Huawei)
- 11-19-0748, "11ax D4.0 Comment Resolution 26.2.8," Liwen Chu (Marvell)
- 11-19-0750, "11ax D4.0 comment-resolution 26.5.3.4," Liwen Chu (Marvell)
- 11-19-0751, "Figure 26-3a," Abhishek Patil (Qualcomm)
- 11-19-0753, "11ax D4.1 MAC Multiple BSSID Minor Bug Fix," Po-Kai Huang (Intel)
- 11-19-0756, "Ack related CRs on Section 26.4," George Cherian (Qualcomm)
- 11-19-0765, "CR MU EDCA Timer," Zhou Lan (Broadcom)
- 11-19-0769, "CR for NFRP," Laurent Cariou (Intel)
- 11-19-0770, "LB238 CR PPDU format, BW, MCS, NSS, and DCM selection," Yongho Seok (MediaTek)
- 11-19-0785, "MAC CR Comment Resolution," Ming Gan (Huawei)
- 11-19-0795, "Visio file for (updated) Figure 26-5," Abhishek Patil (Qualcomm)
- 11-19-0816, "Resolutions to comments to subclause 9.3.1.8," Tomoko Adachi (Toshiba)
- 11-19-0835, "Comment resolution for subclause 26.2.2," Kaiying Lu (ZTE)

◦ SR submissions

- 11-19-0416, "CR for Spatial reuse," Laurent Cariou (Intel)
- 11-19-0613, "SRP Comments," Matthew Fischer (Broadcom)

3. **Timeline**

A little adjustments to the current timeline are made.

Current Timeline

May 2014	**Start of TG**
November 2014	**First draft of the TG SFD approved**
January 2016	**Proposed TG draft**
March 2016	**Draft 0.1 was approved and Comment Collection started**
November 2016	**Issue Draft 1.0 and start WG Letter Ballot — Failed (57.77%)** **LB 225: opened Dec. 1st, 2016 and closed Jan. 8th, 2017**
September 2017	**Draft 2.0 and WG Letter Ballot — Failed (62.84%)** **LB 230: opened Oct. 5th, 2017 and closed Nov. 4th, 2017**
May 2018	**Draft 3.0 and WG Letter Ballot — Passes (86.5%)**
Janury 2019	**Draft 4.0 and Recirculation Ballot — Passes (92.2%)**
May 2019	**Mandatory Draft Review**
June 2019	**Formation of Sponsor Ballot pool**
August 2019	**Initial Sponsor Ballot**
January 2020	**Final 802.11 Approval**
March 2020	**Conditional EC Approval**
June 2020	**RevCom submittal and publication**

Goals for the July 2019 session

- Complete the comment resolution on draft D4.0.
- Instruct the TG Editor to prepare draft D5.0 and start a new WG Recirculation ballot.

Teleconferences

Following TGax teleconferences were authorized during the March 2019 session.

Thursday	May 23rd, 2019 (approved during the March 2019 meeting)	10:00 - 12:00 (ET)
Thursday	May 30th, 2019	20:00 - 22:00 (ET)
Thursday	June 13th, 2019	10:00 - 12:00 (ET)
Thursday	June 20st, 2019	20:00 - 22:00 (ET)
Thursday	June 27th, 2019	10:00 - 12:00 (ET)

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March 2019 — Vancouver, BC, Canada

TGax had seven meeting slots during the week.

	Monday	Tuesday	Wednesday	Thursday
AM1				**TGax** **(full session)**
AM2		**TGax** **(PHY ad hoc)** **TGax** **(MAC ad hoc)**		
PM1	**TGax** **(full session)**		**TGax** **(full session)**	**TGax** **(full session)**

	Monday	Tuesday		Wednesday		Thursday
PM2		**TGax** (PHY ad hoc)	**TGax** (MAC ad hoc)	**TGax** (PHY ad hoc)	**TGax** (MAC ad hoc)	
PM3						

Main documents

The meeting agenda and minutes of the TGax and its subgroups, and the TGax closing report can be found here.

- TGax
  - 11-19-0238-05, TGax March 2019 Meeting Agenda
  - 11-19-0521-00, TGax March 2019 Closing Report
  - 11-19-0428-00, TGax March 2019 Vancouver Meeting Minutes
- TGax PHY ad hoc
  - 11-19-0457-02, TGax Mar 2019 Meeting Agenda - PHY Adhoc
  - 11-19-0462-00, TGax March 2019 Vancouver PHY Ad Hoc Meeting Minutes
- TGax MAC ad hoc
  - 11-19-0453-02, TGax MAC Adhoc March 2019 Meeting Agenda
  - 11-19-0501-00, TGax MAC Ad-hoc meeting minutes March 2019

Achievements

1. **Work Completed**
   - The TG completed the resolution of about 200 comments.
   - Completed the assignment of almost all the CIDs.
   - The TG passed a motion to have an adhoc meeting in San Diego during the period May 8-10.

2. **Technical Submissions**
   TGax received following submissions.
   - PHY submissions
     - 11-18-1774, "Resolution to HESIGB-related CIDs," Brian Hart (Cisco Systems)
     - 11-19-0378, "D4.0 CID20395 - Unused Tone EVM," Youhan Kim (Qualcomm)
     - 11-19-0379, "D4.0 PHY Comment Resolution - Part 1," Youhan Kim (Qualcomm)
     - 11-19-0385, "Resolution for CIDs in 27.1.1," Sameer Vermani (Qualcomm)
     - 11-19-0386, "Disallowed Subchannels Comment Resolution," Ron Porat (Broadcom)
     - 11-19-0407, "Comment Resolutions for xVECTORs," Bo Sun (ZTE)
     - 11-19-0422, "CR for CID 21497, 21501, 21502," Xiaogang Chen (Intel)
   - MAC submissions
     - 11-18-0218, "Fragment Flushing BlockAckReq," Matthew Fischer (Broadcom Ltd.)
     - 11-18-1822, "Temporary Limited Connection," Matthew Fischer (Broadcom Ltd.)
     - 11-19-0301, "Comment resolutions for HE beacon in 6 Ghz band," Alfred Asterjadhi (Qualcomm)
     - 11-19-0302, "Comment resolutions for HE BSS operation," Alfred Asterjadhi (Qualcomm)
     - 11-19-0303, "Comment resolutions for QoS Control," Alfred Asterjadhi (Qualcomm)
     - 11-19-0305, "Comment resolutions for transmit power control," Alfred Asterjadhi (Qualcomm)
     - 11-19-0309, "Comment resolutions for Frame Control," Alfred Asterjadhi (Qualcomm)
     - 11-19-0315, "Comment resolutions for TWT power save," Alfred Asterjadhi (Qualcomm)
     - 11-19-0316, "Comment resolutions for BSR operation," Alfred Asterjadhi (Qualcomm)
     - 11-19-0325, "11ax D4.0 MAC Comment Resolution for SM Power Save," Po-Kai Huang (Intel)
     - 11-19-0339, "11ax D4.0 MAC Comment Resolution for Co-hosted BSSID," Po-Kai Huang (Intel)
     - 11-19-0394, "Resolution for CIDs in 9.3.1.22," Abhishek Patil (Qualcomm)
     - 11-19-0395, "Resolution for CIDs related to BSS Color - Part 1," Abhishek Patil (Qualcomm)
     - 11-19-0413, "CR for MU EDCA parameters," Laurent Cariou (Intel)
     - 11-19-0414, "CR for NFRP," Laurent Cariou (Intel)
     - 11-19-0416, "CR for Spatial reuse," Laurent Cariou (Intel)

- 11-19-0427, "Comment resolution on CID 20175," Zhou Lan (Broadcom Ltd.)
- 11-19-0436, "Resolution for CIDs in clause 11.1.4," Abhishek Patil (Qualcomm)

3. **Timeline**

   No change to current timeline.

Current Timeline	
May 2014	**Start of TG**
November 2014	**First draft of the TG SFD approved**
January 2016	**Proposed TG draft**
March 2016	**Draft 0.1 was approved and Comment Collection started**
November 2016	**Issue Draft 1.0 and start WG Letter Ballot — Failed (57.77%)** **LB 225: opened Dec. 1st, 2016 and closed Jan. 8th, 2017**
September 2017	**Draft 2.0 and WG Letter Ballot — Failed (62.84%)** **LB 230: opened Oct. 5th, 2017 and closed Nov. 4th, 2017**
May 2018	**Draft 3.0 and WG Letter Ballot — Passes (86.5%)**
Janury 2019	**Draft 4.0 and Recirculation Ballot — Passes (92.2%)**
February 2019	**Formation of Sponsor Ballot pool**
March 2019	**Mandatory Draft Review**
July 2019	**Initial Sponsor Ballot**
January 2020	**Final 802.11 Approval**
March 2020	**Conditional EC Approval**
June 2020	**RevCom submittal and publication**

Goals for the May 2019 session

- Continue the comment resolution on draft D4.0.

Teleconferences

Following TGax teleconferences were authorized during the March 2019 session.

Thursday	March 29th, 2019	10:00 - 12:00 (ET)
Thursday	April 11th, 2019	10:00 - 12:00 (ET)
Thursday	April 25th, 2019	10:00 - 12:00 (ET)
Thursday	May 21st, 2019	10:00 - 12:00 (ET)

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January 2019 — St. Louis, MO

TGax planed ten sessions during the week.
During WG mid-week plenary session, one more session was added on Thursday PM2.

	Monday	Tuesday	Wednesday	Thursday
AM1		**TGax** **(full session)**	**TGax** **(full session)**	**TGax** **(full session)**

	Monday	Tuesday	Wednesday	Thursday
AM2	**TGax** (full session)	**TGax** (full session)		
PM1	**TGax** (full session)		**TGax** (full session)	**TGax** (full session)
PM2		**TGax** (full session)		**TGax** (full session)
PM3	**TGax** (full session)	**TGax** (full session)		

Main documents

The meeting agenda and minutes of the TGax and its subgroups, and the TGax closing report can be found here.

- TGax
  - 11-18-2114-10, TGax January 2019 Meeting Agenda
  - 11-19-0208-00, TGax January 2019 Closing Report
  - 11-19-0126-00, Draft TGax January 2019 St. Louis Meeting Minutes

Achievements

1. **Work Completed**
   - The TG completed the resolution of all comments submitted on draft D3.0.
   - The TG passed a motion to allow the Editor to prepare draft D4.0 and start a 15 day WG Ballot.
   - The TG approved a new revision of the Coexistence Assurance document.
   - TGax Timeline was adjusted.

2. **Technical Submissions**
   TGax received following submissions during the TGax sessions.
   - 11-18-0218, "Fragment Flushing BlockAckReq," Matthrew Fischer (Broadcom Ltd.)
   - 11-18-1211, "Comment resolutions for 27.16.1 related to 6 Ghz band," Alfred Asterjadhi (Qualcomm)
   - 11-18-1227, "CR for 6GHz - Discovery," Laurent Cariou (Intel)
   - 11-18-1471, "Comment resolutions for 27.16.1 related to 6 GHz band," Alfred Asterjadhi (Qualcomm)
   - 11-18-1472, "Comment resolutions for 27.7.4," Alfred Asrterjadhi (Qualcomm)
   - 11-18-1489, "Operation at 6GHz Band," Liwen Chu (Marvell Semiconductor)
   - 11-18-1506, "LB233 CR ER Beacon," Yongho Seok (MediaTek)
   - 11-18-1697, "MAC CR 27.7.3," Alfred Asterjadhi (Qualcomm)
   - 11-18-1779, "LB233 CR Transmit Power Control," Yongho Seok (MediaTek)
   - 11-18-1807, "Resolutions for Miscellaneous CIDs," Yasuhiko Inoue (NTT)
   - 11-18-1821, "Maximum RX PPDU Duration Signaling," Matthew Fischer (Broadcom Ltd.)
   - 11-18-1822, "TLC Signaling," Matthew Fischer (Broadcom Ltd.)
   - 11-18-1827, "6 GHz operation for 11ax follow up," Wookbong Lee (Samsung)
   - 11-18-1831, "Comment resolution to CIDs 15990, 17031 and 17033," Jarkko Kneckt (Apple)
   - 11-18-1853, "Resolutions to comments to subclauses 10.3.7, 3.1, 3.2, and 27.5.1.1," Tomoko Adachi (Toshiba)
   - 11-18-1855, "Comment Resolution for 27.16.4," Chao-Chun Wang (MediaTek)
   - 11-18-1859, "11ax D3.0 Comment Resolution 27.10.4," Liwen Chu (Marvell Semiconductor)
   - 11-18-1866, "CR for OBSS_PD," Laurent Cariou (Intel)
   - 11-18-1887, "11ax D3.2 MAC Comment Resolution for Section 27.5," Zhou Lan (Broadcom Ltd.)
   - 11-18-1932, "Proposed Resolutions to Miscs PHY and MAC CIDs," Peter Loc (Huawei Technologies)
   - 11-18-1987, "D3.0 Comment Resolution on MAC Miscellaneous," Jae Seung Lee (ETRI)
   - 11-18-1995, "Resolution for CIDs: 15302, 15906, 16750," Huizhao Wang (Quantenna Communications)
   - 11-18-1999, "RTS CTS protection coverage," Jarkko Kneckt (Apple)
   - 11-18-2033, "Changes to D3.3," Xiaogang Chen (Intel)
   - 11-18-2040, "11ax D3.0 Comment Resolution miscellaneous," Liwen Chu (Marvell Semiconductor)
   - 11-18-2085, "11ax D3.0 MAC Comment Resolution for Capability of MU Transmission and Reception," Po-Kai Huang (Intel)
   - 11-19-0002, "HE beamforming feedback subcarriers," Mark Rison (Samsung)

- 11-19-0006, "CR Default UORA Parameters," Matthew Fischer (Broadcom Ltd.)
- 11-19-0028, "Multiple BSSID Clarification - Part 3," Abhishek Patil (Qualcomm)
- 11-19-0041, "TWT Capability Support Signaling," Matthew Fischer (Broadcom Ltd.)
- 11-19-0061, "CR for 6GHz - Active Scanning Part I," Jarkko Kneckt (Apple)
- 11-19-0076, "LB233 CR on CID 16486 17140 and 16449," Ming Gan (Huawei Technologies)
- 11-19-0085, "LB233 CR MAC Miscellaneous Part 2," Yongho Seok (MediaTek)
- 11-19-0095, "CR for 6GHz - Active Scanning Part II," Jarkko Kneckt (Apple)
- 11-19-0096, "Comment resolutions for TWT fixes," Alfred Asterjadhi (Qualcomm)
- 11-19-0097, "Comment resolutions for HE SU beacon and miscellaneous rules for 6 GHz," Alfred Asterjadhi (Qualcomm)
- 11-19-0098, "11ax D3.0 Comment Resolution miscellaneous," Liwen Chu (Marvell Semiconductor)
- 11-19-0099, "11ax D3.0 sounding comments," Huizhao Wang (Quantenna Communications)
- 11-19-0117, "Changes to D3.3 (Power Deboosting Pre HE)," Xiaogang Chen (Intel)
- 11-19-0120, "CR for CID 15153," Guoqing Li (Apple)
- 11-19-0121, "Proposed Spec Text change on Trigger Frame MAC padding," Tianyu Wu (Samsung)
- 11-19-0140, "CR misc MAC," Matthew Fischer (Broadcom Ltd.)
- 11-19-0148, "CR for CID 17129," Yunbo Li (Huawei Technologies)
- 11-19-0160, "11ax D3.0 MAC Comment Resolution for Co-hosted BSS," Po-Kai Huang (Intel)
- 11-19-0161, "CR misc MAC - CID 16535," Sean Coffey (RealTek)
- 11-19-0162, "11ax D3.0 MAC MU-CTS Clarification," Po-Kai Huang (Intel)
- 11-19-0166, "11ax D3.0 MAC Comment Resolution for Bandwidth Queue Report," Zhou Lan (Broadcom Ltd.)
- 11-19-0170, "Remaining Ack related CRs," George Cherian (Qualcomm)
- 11-19-0177, "CR for OPS," Laurent Cariou (Intel)
- 11-19-0180, "FTM in 6 GHz," Alfred Asterjadhi (Qualcomm)
- 11-19-0184, "CID 16444 and 15178 discussion -- Why 11ax should maintain current data channel access rules on 6GHz," Guoqing Li (Apple)
- 11-19-0192, "Comment resolutions for last CIDs," Alfred Asterjadhi (Qualcomm)
- 11-19-0194, "Clarification of HE TB PPDU timing requirements," Mark Rison (Samsung)

3. **Timeline update**
   Current timeline has been updated as follow.

Current Timeline (Updated)	
May 2014	**Start of TG**
November 2014	**First draft of the TG SFD approved**
January 2016	**Proposed TG draft**
March 2016	**Draft 0.1 was approved and Comment Collection started**
November 2016	**Issue Draft 1.0 and start WG Letter Ballot — Failed (57.77%)** **LB 225: opened Dec. 1st, 2016 and closed Jan. 8th, 2017**
September 2017	**Draft 2.0 and WG Letter Ballot — Failed (62.84%)** **LB 230: opened Oct. 5th, 2017 and closed Nov. 4th, 2017**
May 2018	**Draft 3.0 and WG Letter Ballot — Passes (86.5%)**
Janury 2019	**Draft 4.0 and Recirculation Ballot**
February 2019	**Formation of Sponsor Ballot pool**
March 2019	**Mandatory Draft Review**
July 2019	**Initial Sponsor Ballot**
January 2020	**Final 802.11 Approval**
March 2020	**Conditional EC Approval**
June 2020	**RevCom submittal and publication**

Goals for the March 2019 session

- Start comment resolution on draft D4.0.

Teleconferences

TGax teleconferences will be scheduled with a 10-day notice.

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November 2018 — Bangkok, Thailand

TGax planed ten sessions during the week.
During WG mid-week plenary session, one more session was added in Thursday PM2.

	Monday	Tuesday	Wednesday	Thursday
AM1	**TGax** (full ad hoc session)	**TGax** (MAC ad hoc)	**TGax** (full session)	**TGax** (full session)
AM2		**TGax** (PHY ad hoc) **TGax** (MAC ad hoc)		**TGax** (full session)
PM1			**TGax** (PHY ad hoc) **TGax** (MAC ad hoc)	
PM2	**TGax** (full)	**TGax** (PHY ad hoc) **TGax** (MAC ad hoc)		**TGax** (full session)
PM3		**TGax** (MAC ad hoc)		

Submissions for MU and SR ad hoc groups were considered in the MAC ad hoc group.

Main documents

The meeting agenda and minutes of the TGax and its subgroups, and the TGax closing report can be found here.

- TGax
  - 11-18-1517-08, TGax November 2018 Meeting Agenda
  - 11-18-2061-00, TGax November 2018 Closing Report
  - 11-18-1933-00, TGax November 2018 Bangkok Meeting Minutes

  - PHY ad hoc
    - 11-18-1997-02, TGax Nov 2018 Meeting Agenda - PHY Adhoc
    - 11-18-2024-00, IEEE 802.11 TGax November 2018 Bangkok PHY Ad Hoc Meeting Minutes
  - MAC ad hoc
    - 11-18-2006-02, TGax November 2018 MAC ad hoc Meeting Agenda
    - 11-18-2008-00, Minutes of TGax MAC ad hoc meeting November 2018 in Bangkok

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Achievements

1. **Work Completed**
   - The TG approved resolutions to 500+ technical comments
   - The TG needs more time to complete resolutions of the rest of the comments ~ 250 to 300 CIDs are left
   - The TG plans to complete the comment resolution in January 2019

2. **Technical Submissions**
   TGax received following submissions during the TGax sessions.
   - PHY Submissions
     - 11-18-1492, "Remaining PHY Math comment resolutions," Yan Zhang (Marvell Semiconductor)
     - 11-18-1534, "CR for PPDU formats," Tianyu Wu (Samsung)
     - 11-18-1734, "PHY subcarriers and RU part 2," Yujin Noh (Newracom)

- 11-18-1735, "CR on PHY Intro," Yujin Noh (Newracom)
- 11-18-1759, "Comment Resolutions for xVECTORs," Bo Sun (ZTE)
- 11-18-1764, "CR on HE-SIG-A and HE-SIG-B - Part 6," Ross Jian Yu (Huawei Technologies)
- 11-18-1774, "Resolution to CID 16624 (HE-SIG-B)," Brian Hart (Cisco Systems)
- 11-18-1790, "CR on PHY Miscellaneous," Yujin Noh (Newracom)
- 11-18-1832, "D3.0 Comment Resolution on CID for 28.4.3," Jianhan Liu (MediaTek)
- 11-18-1841, "Comment Resolution on PHY Introduction," Bin Tian (Qualcomm)
- 11-18-1842, "Comment Resolution on PHY Miscellaneous," Bin Tian (Qualcomm)
- 11-18-1848, "CID 17100," Youhan Kim (Qualcomm)
- 11-18-1849, "D3.0 Comment Resolution Part 3," Youhan Kim (Qualcomm)
- 11-18-1850, "D3.0 Comment Resolution Part 4," Youhan Kim (Qualcomm)
- 11-18-1891, "Discussions on Trigger Frame MAC Padding," Hongyuan Zhang (Marvell Semiconductor)
- 11-18-1906, "Comment Resolution on Trigger Frame MAC Padding," Hongyuan Zhang (Marvell Semiconductor)
- 11-18-1907, "Comment Resolution of MU-CTS Scrambling," Hongyuan Zhang (Marvell Semiconductor)
- 11-18-1980, "D3.0 CR for PHY Misc," Tianyu Wu (Samsung)
- 11-18-2007, "Changes to D3.0," Xiaogang Chen (Intel)
- 11-18-2017, "PHY Remaining CSD," Bin Tian (Qualcomm)
- 11-18-2019, "Resolution for SIG_B_Compression_Mode definition in TxVector," Jerome Vanthournout (CEVA-DSP)
- 11-18-2023, "Comment Resolution on CID 16768," Jianhan Liu (MediaTek)

- MAC Submissions
  - 11-18-0218, "Fragment Flushing BlockAckReq," Matthew Fischer (Broadcom Ltd.)
  - 11-18-1432, "Doze Transition Signaling," Matthew Fischer (Broadcom Ltd.)
  - 11-18-1454, "Figure 27-12," Abhishek Patil (Qualcomm)
  - 11-18-1471, "Comment resolutions for 27.16.1 related to 6 Ghz band," Alfred Asterjadhi (Qualcomm)
  - 11-18-1472, "Comment resolutions for 27.7.4," Alfred Asterjadhi (Qualcomm)
  - 11-18-1473, "Comment resolutions for miscellaneous CIDs - Part 1," Alfred Asterjadhi (Qualcomm)
  - 11-18-1474, "Comment resolutions for 27.7.2," Alfred Asterjadhi (Qualcomm)
  - 11-18-1487, "11ax D3.0 Comment Resolution 27.5.3.2.3," Liwen Chu (Marvell Semiconductor)
  - 11-18-1498, "CR for 27.5.6," Laurent Cariou (Intel)
  - 11-18-1505, "LB233 CR MAC TXVECTOR," Yongho Seok (MediaTek)
  - 11-18-1506, "LB233 CR ER Beacon," Yongho Seok (MediaTek)
  - 11-18-1507, "11ax D3.0 MAC Comment Resolution for Co-located BSS," Po-Kai Huang (Intel)
  - 11-18-1508, "11ax D3.0 MAC Comment Resolution for Multiple BSSID," Po-Kai Huang (Intel)
  - 11-18-1519, "11ax D3.0 MAC Comment Resolution for Control response," Robert Stacey (Intel)
  - 11-18-1696, "Comment resolutions for 9.6.25," Alfred Asterjadhi (Qualcomm)
  - 11-18-1697, "Comment resolutions for 27.7.3," Alfred Asterjadhi (Qualcomm)
  - 11-18-1698, "Comment resolutions for miscellaneous CIDs part 2," Alfred Asterjadhi (Qualcomm)
  - 11-18-1699, "Comment resolutions for subclause 9.2.4," Alfred Asterjadhi (Qualcomm)
  - 11-18-1703, "Resolution to CID 17150," Tomoko Adachi (Toshiba)
  - 11-18-1733, "CID 16364 on Packet Extension," Yujin Noh (Newracom)
  - 11-18-1775, "Comment resolutions for miscellaneous - Part 3," Alfred Asterjadhi (Qualcomm)
  - 11-18-1777, "Ack-related CIDs remaining," George Cherian (Qualcomm)
  - 11-18-1778, "LB233 CR subclause 27.15.2 and 27.15.3," Yongho Seok (MediaTek)
  - 11-18-1779, "LB233 CR Transmit Power Control," Yongho Seok (MediaTek)
  - 11-18-1780, "LB233 CR MAC Miscellaneous," Yongho Seok (MediaTek)
  - 11-18-1799, "CR for 16668," Po-Kai Huang (Intel)
  - 11-18-1800, "CR for Miscelaneous CIDs," Po-Kai Huang (Intel)
  - 11-18-1807, "Proposed Resolutions for Miscellaneous CIDs," Yasuhiko Inoue (NTT)
  - 11-18-1808, "Proposed Resolutions for CIDs related to HE MAC Capabilities," Yasuhiko Inoue (NTT)
  - 11-18-1812, "Resolution for CIDs related to Random Access," Abhishek Patil (Qualcomm)
  - 11-18-1814, "Resolution for CIDs related to Multiple BSSID - Part 2," Abhishek Patil (Qualcomm)
  - 11-18-1815, "Resolution for miscellaneous CIDs," Abhishek Patil (Qualcomm)
  - 11-18-1817, "Figure 9-63j1," Abhishek Patil (Qualcomm)
  - 11-18-1820, "Doze Transition Signaling MoreData," Matthew Fischer (Broadcom Ltd.)

- 11-18-1821, "Maximum RX PPDU Duration Signaling," Matthew Fischer (Broadcom Ltd.)
- 11-18-1822, "Temporarily Limited Connection," Matthew Fischer (Broadcom Ltd.)
- 11-18-1830, "CR for TSPEC," Jarkko Kneckt (Apple)
- 11-18-1831, "OMI comment resolution," Jarkko Kneckt (Apple)
- 11-18-1844, "LB233 CR on Fragmentation," Ming Gan (Huawei Technologies)
- 11-18-1851, "Resolutions to comments to subclause 9.3.1.9," Tomoko Adachi (Toshiba)
- 11-18-1852, "General and Annex G Comment Resolution," Osama Aboul-Magd (Huawei Technologies)
- 11-18-1853, "Resolutions to comments to subclauses 10.3.7, 3.1, 3.2, and 27.5.1.1," Tomoko Adachi (Toshiba)
- 11-18-1855, "Comments Resolution - 27.16.4," Chao-Chun Wang (MediaTek)
- 11-18-1856, "11ax D3.0 Comment Resolution 9.7.1," Liwen Chu (Marvell)
- 11-18-1857, "11ax D3.0 Comment Resolution 27.10.1 27.10.3" Liwen Chu (Marvell)
- 11-18-1858, "11ax D3.0 Comment Resolution 9.7.3," Liwen Chu (Marvell)
- 11-18-1859, "11ax D3.0 Comment Resolution 27.10.4," Liwen Chu (Marvell)
- 11-18-1867, "CR for OPS 2," Laurent Cariou (Intel)
- 11-18-1868, "CR for Clause 4," Guoqing Li (Apple)
- 11-18-1876, "Resolutions to Miscellaneous MAC Comments," Osama Aboul-Magd (HuaweiTechnoloies)
- 11-18-1887, "11ax D3.2 MAC Comment Resolution for Section 27.5," Zhou Lan (Broadcom Ltd.)
- 11-18-1900, "11ax D3.2 MAC Comment Resolution for Section 27.7.7," Zhou Lan (Broadcom Ltd.)
- 11-18-1901, "D3.0 Comment Resolution - Part 5," Youhan Kim (Qualcomm)
- 11-18-1921, "11ax D3.0 sounding comments," Menzo Wentink (Qualcomm)
- 11-18-1932, "Proposed Resolutions to Miscs PHY and MAC CIDs," Peter Loc (Huawei Technologies)
- 11-18-1935, "Resolutions to CIDs 15935 and 16150," Osama Aboul-Magd (Huawei Technologies)
- 11-18-1939, "Comment resolution on MIBs - part 1," Edward Au (Huawei Technologies)
- 11-18-1942, "Comment resolution on PICs," Edward Au (Huawei Technologies)
- 11-18-1944, "Comment resolution on MIBs - part 2," Edward Au (Huawei Technologies)
- 11-18-1958, "CR for CID 16643," Yunbo Li (Huawei Technologies)
- 11-18-1969, "Proposed resolution for CIDs for 27-2-2-Part 2," Kaiying Lv (ZTE)
- 11-18-1975, "11ax D3.0 Comment Resolution 27.5.3.4," Liwen Chu (Marvell Semiconductor)
- 11-18-1987, "D3.0 Comment Resolution on MAC Miscellaneous," Jae Seung Li (ETRI)
- 11-18-1995, "Resolution for CIDs: 15302, 15906, 16750," Huizhao Wang (Quantenna)
- 11-18-1999, "RTS CTS protection coverage," Jarkko Kneckt (Apple)

- MU Submissions
  - 11-18-1803, "CR on MU-RTS/CTS part II," Po-Kai Huang (Intel)
  - 11-18-1812, "Resolution for CIDs related to Random Access - Part 2," Abhishek Patil (Qualcomm)
- SR Submission
  - 11-18-1531, "Spatial Reuse DSC and TPC," Graham Smith (SR Technologies)
  - 11-18-1866, "CR for OBSS_PD 2," Laurent Cariou (Intel)
- TG submissions
  - 11-18-0496, "Disallowed Sub-Channels," Matthew Fischer (Broadcom Ltd.)
  - 11-18-1489, "Operation at 6GHz Band," Liwen Chu (Marvell Semiconductor)
  - 11-18-1500, "CR for 6 GHz - 6 GHz Map," Laurent Cariou (Intel)
  - 11-18-1532, "TGax Coexistence Assurance Document Comments," Eldad Perahia (HP Enterprize)
  - 11-18-1827, "6 GHz operation for 11ax follow up," Wook Bong Lee (Samsing)
  - 11-18-1828, "D3.0 CR for 6GHz Post Association," Wook Bong Lee (Samsing)
  - 11-18-1922, "Considerations on 6 GHz Discovery," Thomas Derham (Broadcom Ltd.)
  - 11-18-1959, "CR for 6GHz - Out-of-band association," Lauernt Cariou (Intel)
  - 11-18-1960, "6 GHz - Out-of-band discovery discussion," Laurent Cariou (Intel)
  - 11-18-1961, "6 GHz association discussion," Laurent Cariou (Intel)

3. **Timeline update**

   Current timeline needs to be updated. Details will be discussed in the January 2019 session.

Current Timeline (to be updated)	
May 2014	**Start of TG**
November 2014	**First draft of the TG SFD approved**

January 2016	**Proposed TG draft**
March 2016	**Draft 0.1 was approved and Comment Collection started**
November 2016	**Issue Draft 1.0 and start WG Letter Ballot — Failed (57.77%)** **LB 225: opened Dec. 1st, 2016 and closed Jan. 8th, 2017**
September 2017	**Draft 2.0 and WG Letter Ballot — Failed (62.84%)** **LB 230: opened Oct. 5th, 2017 and closed Nov. 4th, 2017**
May 2018	**Draft 3.0 and WG Letter Ballot — Passes (86.5%)**
November 2018	**Mandatory Draft Review**
November 2018	**Draft 4.0 and Recirculation Ballot**
February 2019	**Formation of Sponsor Ballot pool**
March 2019	**Draft 5.0 and Recirculation (unchanged)**
July 2019	**Initial Sponsor Ballot**
January 2020	**RevCom submittal and publication**

Goals for the January 2019 session

- Complete the resolution of comments received on draft D3.0, generate draft D4.0, and go to recirculation ballot.

Teleconferences

Following TGax teleconferences were authorized during the September 2018 session.

Thursday	November 29th, 2018	18:00 - 20:00 (ET)
Thursday	December 06th, 2018	10:00 - 12:00 (ET)
Thursday	December 13th, 2018	18:00 - 20:00 (ET)
Thursday	December 20th, 2018	10:00 - 12:00 (ET)
Thursday	January 03rd, 2019	10:00 - 12:00 (ET)

Additional TGax teleconference may be scheduled with 10-day notice if needed.

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September 2018 — Waikoloa, HI

TGax had ten sessions during the week.

	Monday	Tuesday	Wednesday	Thursday
AM1		**TGax (full)** **6 GHz discussion**	**TGax (full)** **6 GHz discussion**	**TGax** **(full)**
AM2		**TGax** **(PHY ad hoc)** **TGax** **(MAC ad hoc)**		
PM1	**TGax** **(full)**	**TGax** **(PHY ad hoc)** **TGax** **(MAC ad hoc)**	**TGax** **(PHY ad hoc)** **TGax** **(MAC ad hoc)**	**TGax (full)** **COEX discussion with 802.19**
PM2		**TGax** **(PHY ad hoc)** **TGax** **(MAC ad hoc)**	**TGax** **(full)**	
PM3	**TGax** **(SR ad hoc)** **TGax** **(MAC ad hoc)**	**TGax (full)** **(6 GHz discussions)**		

Submissions for MU ad hoc were considered in the MAC ad hoc.

Main documents

The meeting agenda and minutes of the TGax and its subgroups, and the TGax closing report can be found here.

- TGax
  - 11-18-1373-05, TGax September 2018 Meeting Agenda
  - 11-18-1672-00, TGax September 2018 Closing Report
  - 11-18-1617-00, TGax September 2018 Waikoloa Meeting Minutes

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Achievements

1. **Work Completed**
   - The TG approved resolutions to 500+ technical comments
   - The plan is to have draft D4.0 ready for recirculation after November meeting.
   - The TG reviewed a number of submissions on 6 GHz discovery and management. More discussion is needed to reach consensus.
   - The TG revisited the coexistence issues with members from 802.15 and 802.18.
   - The TG is planning a 3-day ad hoc meeting in Shenzhen, China the week before the November F2F meeting on November 7-9. The PHY ad hoc has a 2-day meeting on November 8-9.

2. **Technical Submissions**
   TGax received following submissions during the TGax sessions.
   - PHY Submissions
     - 11-18-1258, "Punctured NDP Comment Resolution," Ron Porat (Broadcom Ltd.)
     - 11-18-1434, "CR on HE-SIG-A and HE-SIG-B - Part 1," Ross Jian Yu (Huawei Technologies)
     - 11-18-1435, "CR on HE-SIG-A and HE-SIG-B - Part 2," Ross Jian Yu (Huawei Technologies)
     - 11-18-1436, "CR on HE-SIG-A and HE-SIG-B - Part 3," Ross Jian Yu (Huawei Technologies)
     - 11-18-1441, "CR on HE-SIG-A and HE-SIG-B - Part 4," Xin Zuo (Huawei Technologies)
     - 11-18-1442, "Spec Text Changes Regarding Single Stream Pilot," Ross Jian Yu (Huawei Technologies)
     - 11-18-1452, "CR on Packet Extension," Yujin Noh (Newracom)
     - 11-18-1453, "CR on PHY subcarriers and RU part 1," Yujin Noh (Newracom)
     - 11-18-1459, "Comment Resolution on PHY Introduction Part - 1," Lochan Verma (Qualcomm)
     - 11-18-1460, "Comment Resolution on PHY Introduction Part - 2," Lochan Verma (Qualcomm)
     - 11-18-1492, "Remaining PHY Math comment resolutions," Yan Zhang (Marvell)
     - 11-18-1493, "Changes to D3.0," Xiaogang Chen (Intel)
     - 11-18-1514, "Preamble Comment Resolution," Ron Porat (Broadcom Ltd.)
     - 11-18-1522, "Comment Resolution of Nominal Packet Padding Definition," Hongyuan Zhang (Marvell)
     - 11-18-1534, "D3.0 CR for PHY 28.3.4/28.3.16/28.3.17," Tianyu Wu (Samsung)
     - 11-18-1590, "D3.0 Comment Resolution - Part 1," Youhan Kim (Qualcomm)
     - 11-18-1591, "D3.0 Comment Resolution - Part 2," Youhan Kim (Qualcomm)
     - 11-18-1601, "CR on HE-SIG-A and HE-SIG-B - Part 5," Ross Jian Yu (Huawei Technologies)
   - MAC & MU Submissions
     - 11-18-0496, "Disallowed Sub channels," Matthew Fischer (Broadcom Ltd.)
     - 11-18-0946, "No Action frame in multi-TID A-MPDU," Robert Stacey (Intel)
     - 11-18-1181, "11ax D3.0 MAC Comment Resolution for FTM," Jonathan Segev (Intel)
     - 11-18-1189, "11ax D3.0 MAC Comment Resolution for NAV - Part I," Po-Kai Huang (Intel)
     - 11-18-1246, "OM Control Comment Resolutions," Jarkko Kneckt (Apple)
     - 11-18-1266, "Resolution for CIDs related to Random Access," Abhishek Patil (Qualcomm)
     - 11-18-1320, "Resolution for CIDs related to Multiple BSSID," Abhishek Patil (Qualcomm)
     - 11-18-1415, "11ax D3.0 MAC Comment Resolution for SM Power Save," Po-Kai Huang (Intel)
     - 11-18-1418, "11ax D3.0 MAC Comment Resolution for MU-RTS/CTS - Part I," Po-Kai Huang (Intel)
     - 11-18-1432, "Doze Transition Signaling," Matthew Fischer (Broadcom Ltd.)
     - 11-18-1454, "Figure 27-12," Abhishek Patil (Qualcomm)

- 11-18-1455, "Resolution for CIDs in 27.5.3.3," Abhishek Patil (Qualcomm)
- 11-18-1458, "11ax D3.0 MAC Comment Resolution for Random Access with multiple BSS," Pascal Vigar (Canon Research)
- 11-18-1465, "Comment resolutions for 9.4.2.200," Alfred Asterjadhi (Qualcomm)
- 11-18-1466, "Comment resolutions for 10.43.1," Alfred Asterjadhi (Qualcomm)
- 11-18-1467, "Comment resolutions for 27.16.1 not related to 6 GHz band," Alfred Asterjadhi (Qualcomm)
- 11-18-1468, "Comment resolutions for 27.7.7," Alfred Asterjadhi (Qualcomm)
- 11-18-1469, "Comment resolutions for 27.7.6," Alfred Asterjadhi (Qualcomm)
- 11-18-1470, "Comment resolutions for 27.7.5," Alfred Asterjadhi (Qualcomm)
- 11-18-1471, "Comment resolutions for 27.16.1 related to 6 Ghz band," Alfred Asterjadhi (Qualcomm)
- 11-18-1484, "11ax D3.0 Comment Resolution 27.15.2," Liwen Chu (Marvell Semiconductors)
- 11-18-1485, "11ax D3.0 Comment Resolution 27.5.3.2.1," Liwen Chu (Marvell Semiconductors)
- 11-18-1486, "11ax D3.0 Comment Resolution 27.5.3.5," Liwen Chu (Marvell Semiconductors)
- 11-18-1496, "CR for MU EDCA parameters," Laurent Cariou (Intel)
- 11-18-1497, "CR for OPS," Laurent Cariou (Intel)
- 11-18-1498, "CR for 27.5.6," Laurent Cariou (Intel)
- 11-18-1501, "Remaining Ack related CRs on misc sections," George Cheria (Qualcomm)
- 11-18-1502, "CR on differentiating non-TB and TB sounding," Robert Stacey (Intel)
- 11-18-1504, "LB233 CR A-Control Subfield," Yongho Seok (MediaTek)
- 11-18-1507, "11ax D3.0 MAC Comment Resolution for Co-located BSS," Po-Kai Huang (Intel)
- 11-18-1511, "LB233 CR on CID 17024," Ming Han (Huawei Technologies)
- 11-18-1512, "LB233 CR on MU Cascadingu," Ming Han (Huawei Technologies)
- 11-18-1515, "11ax D3.0 MAC Comment Resolution for Bandwidth Queue Report," Zhou Lan (Broadcom Ltd.)
- 11-18-1516, "11ax D3.0 MAC Comment Resolution for Bandwidth Queue Report," Zhou Lan (Broadcom Ltd.)
- 11-18-1519, "11ax D3.0 MAC Comment Resolution for Control response," Robert Stacey (Intel)
- 11-18-1548, "CR for CID 15105," Kiseon Ryu (LG Electronics)

◦ SR Submission
- 11-18-1410, "LB233 CR Spatial Reuse," Matthew Fischer (Broadcom Ltd.)
- 11-18-1495, "CR for OBSS_PD," Laurent Cariou (Intel)
- 11-18-1531, "TGax Spatial Reuse DSC and TPC," Graham Smith (SR Technologies)

◦ TG submissions
- 11-18-1211, "Comment resolutions for 27.16.1 related to 6 Ghz band," Alfred Asterjadhi (Qualcomm)
- 11-18-1227, "CR for 6GHz - Discovery," Laurent Cariou (Intel)
- 11-18-1229, "CR for 6GHz - Policy," Laurent Cariou (Intel)
- 11-18-1256, "802.11ax operation in 6GHz band," George Cherian (Qualcomm)>
- 11-18-1489, "Operation at 6GHz Band," Liwen Chu (Marvell)
- 11-18-1500, "CR for 6GHz - 6GHz Map," Laurent Cariou (Intel)
- 11-18-1508, "11ax D3.0 MAC Comment Resolution for Multiple BSS," Po-Kai Huang (Intel)
- 11-18-1532, "TGax Coexistence Assurance Document Comments," Eldad Perahia (HP Enterprize)
- 11-18-1607, "6 GHz operation for 11ax," Ravi Gidvani (Samsung)
- 11-18-1624, "Discovery Channels For 6 GHz Band," Alfred Asterjadhi (Qualcomm)

3. **Timeline update**

There are small adjustments to the TGax Timeline.

Current Timeline	
May 2014	**Start of TG**
November 2014	**First draft of the TG SFD approved**
January 2016	**Proposed TG draft**
March 2016	**Draft 0.1 was approved and Comment Collection started**
November 2016	**Issue Draft 1.0 and start WG Letter Ballot — Failed (57.77%)** **LB 225: opened Dec. 1st, 2016 and closed Jan. 8th, 2017**
September 2017	**Draft 2.0 and WG Letter Ballot — Failed (62.84%)** **LB 230: opened Oct. 5th, 2017 and closed Nov. 4th, 2017**
May 2018	**Draft 3.0 and WG Letter Ballot — Passes (86.5%)**

November 2018	**Mandatory Draft Review**
November 2018	**Draft 4.0 and Recirculation Ballot**
February 2019	**Formation of Sponsor Ballot pool**
March 2019	**Draft 5.0 and Recirculation (unchanged)**
July 2019	**Initial Sponsor Ballot**
January 2020	**RevCom submittal and publication**

Goals for the November 2018 session

- Complete the resolution of comments received on draft D3.0.
- Generate draft D4.0.
- Go to the WG recirculation ballot.

Teleconferences

Following TGax teleconferences were authorized during the September 2018 session.

Thursday	September 20th, 2018	10:00 - 12:00 (ET)
Thursday	September 27th, 2018	20:00 - 22:00 (ET)
Thursday	October 04th, 2018	10:00 - 12:00 (ET)
Thursday	October 11th, 2018	20:00 - 22:00 (ET)
Thursday	October 18th, 2018	10:00 - 12:00 (ET)
Thursday	November 01st, 2018	10:00 - 12:00 (ET)

Additional TGax teleconference may be scheduled with 10-day notice if needed.

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July 2018 — San Diego, CA

TGax had eight sessions during the week.

	Monday	Tuesday	Wednesday	Thursday
AM1	**TGax** (ad hoc)		**TGax** (with 802.19)	**TGax** (full)
AM2		**TGax** (full)		
PM1	**TGax** (full)			**TGax** (full)
PM2		**TGax** (full)	**TGax** (full)	
PM3				

Main documents

The meeting agenda and minutes of the TGax and its subgroups, and the TGax closing report can be found here.

- TGax
  - 11-18-1036-05, TGax July 2018 Meeting Agenda
  - 11-18-1330-00, TGax July 2018 Closing Report
  - 11-18-1093-00, Draft TGax July 2018 San Diego Meeting Minutes

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802.11 WG Letter Ballot #233

- The IEEE 802.11ax draft 3.0 passed the WG Letter Ballot #233 with 86.5 % approval ratio.
  - Visit http://www.ieee802.org/11/LetterBallots.shtml for more information.
- About 2250 comments are received.

Achievements

1. **Work Completed**
   - The TG started the resolution of comments received on draft D3.0
   - Members of 802.19 WG were invited to make a presentation on their concerns related to the TG Coexistence Assurance document.
     - 19-18-0040, ``802.11ax and 802.15.4 HRP_LRP Coexistence," Tim Harrington (Pro-ID)
   - The TG approved the proposed the PAR extension request and the revised CSD accommodating comments received from 802.3 WG.
   - The TG prepared and approved a liaison response to WBA.
     - https://mentor.ieee.org/802.11/dcn/18/11-18-1291-02-00ax-proposed-response-to-liaison-from-wba-on-11ax.docx

2. **Technical Submissions**
   TGax received following submissions during the TGax sessions.
   - PHY Submissions
     - 11-18-0477, "Punctured NDP," Ron Porat (Broadcom Ltd.)
     - 11-18-1183, "Spec text change for error correction on STBC," Jianhan Liu (MediaTek)
   - MAC Submissions
     - 11-18-0496, "Disallow Sub-Channels," Matthew Fischer (Broadcom Ltd.)
     - 11-18-1181, "CR in FTM," Jonathan Segev (Intel)
     - 11-18-1189, "CR for NAV Part 1," Po-kai Huang (Intel)
     - 11-18-1211, "MAC CR subclause 27.16.1," Alfred Asterjadhi (Qualcomm)
     - 11-18-1219, "CR for ER SU Disable," Po-Kau Huang (Intel)
     - 11-18-1220, "CR for Random Access," Po-Kai Huang (Intel)
     - 11-18-1244, "Resolutions for CIDs related to BSS Color," Abhishek Patil (Qualcomm)
     - 11-18-1252, "D3.0 Comment Resolution for CIDs on Clause 6," Jae Seung Lee (ETRI)
     - 11-18-1246, "CR for OMI," Jarkko Kneckt (Apple)
   - MU Submission
     - 11-18-1266, "Resolution for CIDs related to random access - Part 1," Abhishek Patil (Qualcomm)
   - TG submissions
     - 11-18-1227, "CR for 6GHz - Discovery," Laurent Cariou (Intel)
     - 11-18-1229, "CR for 6GHz - Policy," Laurent Cariou (Intel)
     - 11-18-1256, "11ax 6GHz Operation," George Cherian (Qualcomm)
     - 11-18-1258, "CR for Punctured NDP," Ron Porat (Broadcom Ltd.)
3. **Timeline update**
   TG reviewed the timeline - No change.

Current Timeline	
May 2014	**Start of TG**
November 2014	**First draft of the TG SFD approved**
January 2016	**Proposed TG draft**
March 2016	**Draft 0.1 was approved and Comment Collection started**

November 2016	**Issue Draft 1.0 and start WG Letter Ballot — Failed (57.77%)** **LB 225: opened Dec. 1st, 2016 and closed Jan. 8th, 2017**
September 2017	**Draft 2.0 and WG Letter Ballot — Failed (62.84%)** **LB 230: opened Oct. 5th, 2017 and closed Nov. 4th, 2017**
May 2018	**Draft 3.0 and WG Letter Ballot — Passes (86.5%)**
July 2018	**Mandatory Draft Review**
November 2018	**Draft 4.0 and Recirculation Ballot**
February 2019	**Formation of Sponsor Ballot pool**
September 2019	**Initial Sponsor Ballot**
December 2019	**RevCom submittal**

Goals for the September 2018 session

- Continue the resolution of comments on draft D3.0.

Teleconferences

Following TGax teleconferences were authorized during the July 2018 plenary.

Thursday	July 26th, 2018	10:00 - 12:00 (ET)
Thursday	August 02nd, 2018	20:00 - 22:00 (ET)
Thursday	August 09th, 2018	10:00 - 12:00 (ET)
Thursday	August 16th, 2018	20:00 - 22:00 (ET)
Thursday	August 23rd, 2018	10:00 - 12:00 (ET)
Thursday	August 30th, 2018	20:00 - 22:00 (ET)
Thursday	September 20rd, 2018	10:00 - 12:00 (ET)

Additional TGax teleconference may be scheduled with 10-day notice if needed.

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May 2018 — Warsaw, Poland

TGax had nine sessions during the week.

	Monday	Tuesday	Wednesday	Thursday
AM1			**TGax (full)**	**TGax (full)**
AM2		**TGax** (PHY ad hoc) **TGax** (MAC ad hoc)		
PM1	**TGax (full)**			**TGax (full)**
PM2		**TGax** (PHY ad hoc) **TGax** (MAC ad hoc)	**TGax** (SR ad hoc) **TGax** (MAC ad hoc)	
PM3	**TGax** (SR ad hoc) **TGax** (MAC ad hoc)	**TGax** (PHY ad hoc) **TGax** (MAC adx hoc)		

Main documents

The meeting agenda and minutes of the TGax and its subgroups, and the TGax closing report can be found here.

- TGax
  - 11-18-0635-10, TGax May 2018 Meeting Agenda
  - 11-18-0976-00, TGax May 2018 Closing Report
  - 11-18-0888-00, TGax May 2018 Warsaw Meeting Minutes

  - TGax PHY ad hoc group
    - 11-18-0800-01, TGax May 2018 Meeting Agenda - PHY Ad Hoc
  - TGax MAC ad hoc group
    - 11-18-0914-03, TGax May 2018 MAC Ad Hoc Meeting Agenda
    - 11-18-0920-00, TGax MAC Ad hoc May 2018 Meeting Minutes
  - TGax SR ad hoc group
    - 11-18-0912-01, Agenda of the IEEE 802.11ax Spatial Reuse ad hoc group
    - 11-18-0922-00, IEEE 802.11ax Spatial Reuse ad hoc minutes

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Achievements

1. **Work Completed**
   - The TG completed resolution of comments submitted on draft D2.0.
   - The TG passed a motion to instruct the TGax Editor to prepare draft D3.0 and start a 30-day WG letter Ballot.
   - The TG approved the PAR extension.
   - The TG approved the updated Coexistence Assurance document 11-16/1348r3 that has already been discussed during the TGax teleconference.
   - No changes to the TG timeline.
2. **Technical Submissions**
   TGax received following submissions during the TGax ad hoc meeting and in the TGax sessions.
   - PHY Submissions
     - 11-18-0469, "CR Packet Extension," Ron Porat (Broadcom Ltd.)
     - 11-18-0477, "Punctured NDP," Ron Porat (Broadcom Ltd.)
     - 11-18-0725, "Comment Resolutions on PHY Sounding Part 1," Lochan Verma (Qualcomm)
     - 11-18-0753, "PHY CR on midamble TxEVM," Hongyuan Zhang (Marvell Semiconductors)
     - 11-18-0754, "CID14038 scrambler," Hongyuan Zhang (Marvell Semiconductors)
     - 11-18-0755, "HE Capabilities on HE MU single user full BW," Hongyuan Zhang (Marvell Semiconductors)
     - 11-18-0756, "Capabilities on midamble Tx," Hongyuan Zhang (Marvell Semiconductors)
     - 11-18-0765, "CR on HE PHY MIB attributes," Edward Au (Huawei Technologies)
     - 11-18-0779, "D2.0 PHY Comment Resolution - Part 3," Youhan Kim (Qualcomm)
     - 11-18-0799, "Comment resolution on CIDs 11727 and12102," Jianhan Liu (MediaTek)
     - 11-18-0803, "Spec text change on PHY padding," Tianyu Wu (Samsung)
     - 11-18-0806, "PHY Miscellaneous CIDs," Bin Tian (Qualcomm)
     - 11-18-0807, "D2.0 DFS Comment Resolution," Youhan Kim (Qualcomm)
     - 11-18-0815, "D2.0 DFS Comment Resolution," Sigurd Schelstraete (Quantenna Communications)
     - 11-18-0819, "comment-resolution-on-cids-for-28-3-part-3," Jianhan Liu (MediaTek)
     - 11-18-0823, "D2.0 CR for SAP and TRIGVECTOR," Tianyu Wu (Samsug)
     - 11-18-0868, "Spec. change on Receiver minimum input sensitivity on 1024-QAM for 20MHz bandwidth, Jianhan Liu (MediaTek)
   - MAC Submissions
     - 11-17-1860, "Resolution for CID 11002," Abhishek Patil (Qualcomm)
     - 11-18-0044, "LB230 MAC CR 27.7 and 27.7.1," Alfred Asterjadhi (Qualcomm)
     - 11-18-0077, "D2.0 comment resolution 27.4.2," Liwen Chu (Marvell)
     - 11-18-0083, "LB230 CR for BSS Load Text," Frank Hsu (MediaTek)

- 11-18-0155, "Resolutions for CIDs related to GCR," Yusuke Tanaka (SONY)
- 11-18-0161, "CR CID 13754," Zhou Lan (Broadcom Ltd)
- 11-18-0181, "LB230 CR on BSS Load Information in subclause 9.4.2," Ming Gan (Huawei)
- 11-18-0200, "Decouple Channel Width Capabilities Between VHT and HE Modes," Huizhao Wang
- 11-18-0218, "Fragment Flushing BlockAckReq," Matthew Fischer (Broadcom Ltd.)
- 11-18-0368, "Muliple BSSID," Abhishek Patil (Qualcomm)
- 11-18-0378, "Comment resolutions for 9.3.1.20 Ppart 2," Alfred Asterjadhi (Qualcomm)
- 11-18-0380, "Comment resolution for some CIDs in 9.4.2.237," Alfred Asterjadhi (Qualcomm)
- 11-18-0424, "D2.0 comment resolution-CID 11327," Liwen Chu (Marvell)
- 11-18-0425, "D2.0 comment resolution 9.7.1," Liwen Chu (Marvell)
- 11-18-0426, "D2.0 comment resolution 9.7.3," Liwen Chu (Marvell)
- 11-18-0427, "D2.0 comment resolution 27.10.2," Liwen Chu (Marvell)
- 11-18-0428, "D2.0 comment resolution 27.10.3," Liwen Chu (Marvell)
- 11-18-0431, "comment-resolution-on-cid-13082-13083-and-14141," Jason Yuchen Guo (Huawei)
- 11-18-0454, "CR for CID 11499 and 14324," Kiseon Ryu (LG Electronics)
- 11-18-0496, "Disallowed Sub-Channels," Matthew Fischer (Broadcom Ltd.)
- 11-18-0548, "CR for CID 13415," Yunbo Li (Huawei)
- 11-18-0558, "Comment resolution for 27.2.2 part 1," Kaiying Lv (ZTE)
- 11-18-0602, "LB230 CR CID 13870," Yongho Seok (MediaTek)
- 11-18-0603, "LB230 CR CID 13530 and 14183," Yongho Seok (MediaTek)
- 11-18-0604, "LB230 CR Preamble Puncturing," Yongho Seok (MediaTek)
- 11-18-0627, "LB230 CR HT Control," Yongho Seok (MediaTek)
- 11-18-0628, "LB230 CR STA_ID_LIST," Yongho Seok (MediaTek)
- 11-18-0629, "LB230 CR UPLINK_FLAG," Yongho Seok (MediaTek)
- 11-18-0630, "LB230 CR HE Sounding NDP," Yongho Seok (MediaTek)
- 11-18-0660, "Comment resolution for several miscellaneous comments part 2," Alfred Asterjadhi (Qualcomm)
- 11-18-0661, "Comment resolution for 27.7.2," Alfred Asterjadhi (Qualcomm)
- 11-18-0662, "LB230-MAC-CR-27.7.3.1," Alfred Asterjadhi (Qualcomm)
- 11-18-0663, "LB230-MAC-CR-27.7.3.2," Alfred Asterjadhi (Qualcomm)
- 11-18-0664, "LB230-MAC-CR-27.7.3.3," Alfred Asterjadhi (Qualcomm)
- 11-18-0665, "LB230-MAC-CR-10.22.2.9-revisit," Alfred Asterjadhi (Qualcomm)
- 11-18-0684, "LB230-MAC-CR-Misc Part 3," Alfred Asterjadhi (Qualcomm)
- 11-18-0685, "LB230-MAC-CR-Misc Part 4," Alfred Asterjadhi (Qualcomm)
- 11-18-0688, "CR for NAV Part IV," Po-Kai Huang (Intel)
- 11-18-0693, "Multiple BSSID Group Addressed Transmission," Po-Kai Huang (Intel)
- 11-18-0705, "CR-section 4 and 5," Guoqing Li (Apple)
- 11-18-0717, "Remaining Ack related CRs," George Cherian (Qualcomm)
- 11-18-0720, "Comment Resolution for 27.15.2," Guoqing Li (Apple)
- 11-18-0724, "Remaining Ack related CRs on misc sections," George Cherian (Qualcomm)
- 11-18-0726, "LB230 CR MAC Miscellaneous," Yongho Seok (Mediatek)
- 11-18-0733, "Resolutions to LB230 comments submitted to subclauses 9.3.1.8 and 10.24.6," Tomoko Adachi (Toshiba)
- 11-18-0734, "Resolutions to LB230 comments submitted to subclause 9.3.1.9.1," Tomoko Adachi (Toshiba)
- 11-18-0737, "Single-STA trigger-based sounding," Mark Rison (Samsung)
- 11-18-0739, "CIDs in 27.7.3.1 (TWT)," Abhishek Patil (Qualcomm)
- 11-18-0740, "Various CIDs in Clause 9," Abhishek Patil (Qualcomm)
- 11-18-0741, "Various CIDs in 27.5," Abhishek Patil (Qualcomm)
- 11-18-0744, "CID 13078," Abhishek Patil (Qualcomm)
- 11-18-0745, "CR BQR part2," Zhou Lan (Broadcom Ltd.)
- 11-18-0763, "CR for PICS comments on D2.0 - Part 2," Edward Au (Huawei)
- 11-18-0764, "LB230 CR on Fragmentation - Part 3," Ming Gan (Huawei)
- 11-18-0767, "CR related to 27.5.6 - Misc," Laurent Cariou (Intel)
- 11-18-0792, "11ax D2.0 Comment Resolution 10.13.1 10.13.3," Liwen Chu (Marvell)
- 11-18-0793, "11ax D2.0 Comment Resolution 9.4.2.237.2," Liwen Chu (Marvell)
- 11-18-0794, "11ax D2.0 Comment Resolution CID 11314, 12883," Liwen Chu (Marvell)

- 11-18-0795, "11ax D2.0 BSS Operation BW," Liwen Chu (Marvell)
- 11-18-0796, "11ax D2.0 Comment Resolution 27.10.4.2, 27.10.4.3," Liwen Chu (Marvell)
- 11-18-0797, "11ax D2.0 Comment Resolution 27.10.4.1," Liwen Chu (Marvell)
- 11-18-0798, "11ax D2.0 Comment Resolution 9.4.1.62," Liwen Chu (Marvell)
- 11-18-0811, "11ax D2.0 MAC Comment Resolution for Dynamic Fragmentation Coexistence," Frank Hsu (MediaTek)
- 11-18-0813, "CR for CID 12295," Jeongki Kim (LG Electronics)
- 11-18-0869, "CR on remaining CIDs for BSR," Kiseon Ryu (LG Electronics)
- 11-18-0890, "Resolutions to LB230 comments submitted to subclauses 9.3.1.9.3 and 9.3.1.9.7," Tomoko Adachi (Toshiba)

◦ MU Submissions
- 11-18-0388, "Comment resolution for CID 13084," Stephane Baron (Canon Research)
- 11-18-0390, "CIDs related to Random Access for unassociated STAs," Stephane Baron (Canon Research)
- 11-18-0445, "ACK non QoS data frame in TB PPDU," Zhou Lan (Broadcom Ltd.)
- 11-18-0692, "Comment Resolution for Random Access," Po-Kai Huang (Intel)
- 11-18-0694, "CIDs resolution for UORA procedure - part 2," Stephane Baron (Canon Research)
- 11-18-0695, "CIDs resolution for UORA procedure - part 1," Stephane Baron (Canon Research)
- 11-18-0707, "CIDs related to MU Cascading," David Xun Yang (Huawei Technologies)
- 11-18-0724, "CIDs related to random access," Abhishek Patil (Qualcomm)
- 11-18-0906, "DL MU MIMO signaling," Guoqing Li (Apple)

◦ SR Submissions
- 11-18-0026, "CR-SRG-and-SRP," Matthew Fischer (Broadcom Ltd.)
- 11-18-0225, "CR-SRG-Management-CID-12044-12304," Matthew Fischer (Broadcom Ltd.)
- 11-18-0456, "lb230-cr-txvector-parameter-bss-color," Yongho Seok (MediaTek)
- 11-18-0579, "11ax D2.0 CR on SR and CCA," Yuichi Morioka (Sony)
- 11-18-0617, "Dynamic OBSS_PD level," Graham Smith (SR Technologies)
- 11-18-0743, "CIDs related to BSS Color," Abhishek Patil (Qualcomm)

◦ TG Submission
- 11-18-0902, "CID 12102: Remove DCM," Sean Coffey (RealTek)

3. **Timeline update**
   TG reviewed the timeline - No change.

Current Timeline	
May 2014	**Start of TG**
November 2014	**First draft of the TG SFD approved**
January 2016	**Proposed TG draft**
March 2016	**Draft 0.1 was approved and Comment Collection started**
November 2016	**Issue Draft 1.0 and start WG Letter Ballot — Failed (57.77%)** **LB 225: opened Dec. 1st, 2016 and closed Jan. 8th, 2017**
September 2017	**Draft 2.0 and WG Letter Ballot — Failed (62.84%)** **LB 230: opened Oct. 5th, 2017 and closed Nov. 4th, 2017**
May 2018	**Draft 3.0 and WG Letter Ballot**
July 2018	**Mandatory Draft Review**
February 2019	**Formation of Sponsor Ballot pool**
May 2019	**Initial Sponsor Ballot**
December 2019	**RevCom submittal**

Goals for the July 2018 session

- Start resolving comments received on draft D3.0.

Teleconferences

Following TGax teleconferences has already approved during the March 2018 plenary.

Thursday	May 17th, 2018	10:00 - 12:00 (ET)

Additional TGax teleconference may be scheduled with 10-day notice if needed.

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March 2018 — Rosemont, IL

TGax had ten sessions during the week.

	Monday	Tuesday	Wednesday	Thursday
AM1	**TGax (full, ad hoc)**	**TGax (MAC & MU ad hoc)**	**TGax (full)**	
AM2		**TGax (PHY ad hoc)** **TGax (MAC & MU ad hoc)**		**TGax (full)**
PM1	**TGax (full)**			
PM2		**TGax (PHY ad hoc)** **TGax (MAC & MU ad hoc)**	**TGax (PHY ad hoc)** **TGax (MAC & MU ad hoc)**	**TGax (full)**
PM3		**TGax (SR ad hoc)** **TGax (MAC & MU ad hoc)**		

Main documents

The meeting agenda and minutes of the TGax and its subgroups, and the TGax closing report can be found here.

- TGax
  - 11-18-0286-06, TGax March 2018 Meeting Agenda
  - 11-18-0582-00, TGax March 2018 Closing Report
  - 11-18-0518-00, TGax March 2018 Rosemont Meeting Minutes

  - TGax PHY ad hoc group
    - 11-18-0535-02, TGax March 2018 Meeting Agenda - PHY Ad Hoc
    - 11-18-0594-00, IEEE 802.11 TGax March 2018 Rosemont Plenary Ad Hoc Meeting Minutes
  - TGax MAC/MU ad hoc group
    - 11-18-0545-04, TGax MU/MAC Ad-hoc March 2018 Meeting Agenda
    - 11-18-0566-00, March 2018 TGax MAC/MU Ad hoc Meeting Minutes
  - TGax SR ad hoc group
    - 11-18-0526-02, 802.11ax Spatial Reuse Ad Hoc Group Agenda

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Achievements

1. **Work Completed**
   - Approved resolutions to over 800 technical CIDs.
   - The TG Editor is planning to produce a new revision based on approved resolutions.
   - A TG motion passed to hold an ad hoc meeting in Rennes during the period from February 28th to March 2nd, 2018.
   - No changes to the TG timeline.

2. **Technical Submissions**

TGax received following submissions during the TGax ad hoc meeting and in the TGax sessions.

- MAC/MU Submissions
  - 11-17-1860, "Resolution for CID 11002," Abhishek Patil (Qualcomm)
  - 11-18-0012, "Comment resolutions for 27.15.2, Alfred Asterjadhi (Qualcomm)
  - 11-18-0029, "Default UORA Parameters," Matthew Fischer (Broadcom)
  - 11-18-0044, "Comment resolutions for 27.7 and 27.7.1," Alfred Asterjadhi (Qualcomm)
  - 11-18-0055, "CR for CID 14324," Zhou Lan (Broadcom)
  - 11-18-0056, "CR for CID 14328," Zhou Lan (Broadcom)
  - 11-18-0075, "11ax D2.0 Comment Resolution 27.5.3.2.2," Liwen Chu (Marvell)
  - 11-18-0078, "11ax D2.0 Comment Resolution 27.6.4," Liwen Chu (Marvell)
  - 11-18-0149, "CR for NDP feedback report - part 1," Laurent Cariou (Intel)
  - 11-18-0161, "CR of CID 13754," Zhou Lan (Broadcom)
  - 11-18-0185, "CR of CID 11001," Zhou Lan (Broadcom)
  - 11-18-0200, "Decouple Channel Width Capabilities between VHT and HE PHY Mode," Huizhao Wang (Quantenna)
  - 11-18-0218, "Fragment Flushing BlockAckReq," Matthew Fischer (Broadcom)
  - 11-18-0241, "Comment resolutions for Misc CIDs," Alfred Asterjadhi (Qualcomm)
  - 11-18-0312, "Comment resolutions for 27.6.3," Alfred Asterjadhi (Qualcomm)
  - 11-18-0337, "Comment resolutions for 10.43" Alfred Asterjadhi (Qualcomm)
  - 11-18-0338, "Comment resolutions for 27.16.1," Alfred Asterjadhi (Qualcomm)
  - 11-18-0343, "Comment resolutions for CID 13744," Alfred Asterjadhi (Qualcomm)
  - 11-18-0360, "CIDs related to Random Accessb - Part 2," Abhishek Patil (Qualcomm)
  - 11-18-0361, "visio file for fig 10-1," Abhishek Patil (Qualcomm)
  - 11-18-0362, "CIDs in 10.2.6," Abhishek Patil (Qualcomm)
  - 11-18-0363, "Resolution for CID 13136," Abhishek Patil (Qualcomm)
  - 11-18-0364, "CID 11001," Abhishek Patil (Qualcomm)
  - 11-18-0365, "CIDs related to BSS Color - Part 1," Abhishek Patil (Qualcomm)
  - 11-18-0366, "Resolutions to various CIDs in Trigger Frame format," Abhishek Patil (Qualcomm)
  - 11-18-0367, "Resolutions to CIDs in 27.5.3.3," Abhishek Patil (Qualcomm)
  - 11-18-0368, "Address inconsistencies & ambiguities in 11.1.3.8 (Multiple BSSID topic)," Abhishek Patil (Qualcomm)
  - 11-18-0369, "Resolutions to various CIDs in clause 9," Abhishek Patil (Qualcomm)
  - 11-18-0370, "Comment resolutions for 27.7.5," Alfred Asterjadhi (Qualcomm)
  - 11-18-0371, "Comment resolutions for 27.7.4," Alfred Asterjadhi (Qualcomm)
  - 11-18-0372, "Comment resolutions for 9.4.2.200 part 2," Alfred Asterjadhi (Qualcomm)
  - 11-18-0373, "Comment resolutions for 27.7.3.4," Alfred Asterjadhi (Qualcomm)
  - 11-18-0379, "Comment resolutions for 9.3.3.X," Alfred Asterjadhi (Qualcomm)
  - 11-18-0380, "Comment resolutions for some CIDs in 9.4.2.237," Alfred Asterjadhi (Qualcomm)
  - 11-18-0390, "CIDs related to 27.5.1," Pascal Viger (Canon Research)
  - 11-18-0423, "11ax D2.0 Comment Resolution CID14318," Liwen Chu (Marvell)
  - 11-18-0425, "11ax D2.0 Comment Resolution 9.7.1," Liwen Chu (Marvell)
  - 11-18-0426, "11ax D2.0 Comment Resolution 9.7.3," Liwen Chu (Marvell)
  - 11-18-0427, "11ax D2.0 Comment Resolution 27.10.2," Liwen Chu (Marvell)
  - 11-18-0428, "11ax D2.0 Comment Resolution 27.10.2," Liwen Chu (Marvell)
  - 11-18-0429, "11ax D2.0 Comment Resolution 27.5.3.2.4 remaining CIDs," Liwen Chu (Marvell)
  - 11-18-0432, "LB230 CR on Fragmentation - Part 4," Ming Gan (Huawei)
  - 11-18-0433, "LB230 CR on Fragmentation - Part 2," Ming Gan (Huawei)
  - 11-18-0443, "11ax D1.0 MAC Comment Resolution for 9.4.2.24," Chao-Chun Wang (MediaTek)
  - 11-18-0444, "11ax D2.0 MAC Comment Resolution for 27.16.4," Chao-Chun Wang (MediaTek)
  - 11-18-0455, "LB230 CR TXOP duration-based RTS/CTS," Yongho Seok (MediaTek)
  - 11-18-0512, "11ax D2.0 Comment Resolution for CID 14207," Yunbo Li (Huawei)
- SR Submissions
  - 11-18-0026, "CR SRG and SRP," Matthew Fischer (Broadcom)
  - 11-18-0106, "LB230 CR Spatial Reuse Operation on Secondary Channel," Yongho Seok (MediaTek)
  - 11-18-0225, "CR Spatial Reuse Group Management CID 12044 12304," Matthew Fischer (Broadcom)

        - 11-18-0391, "CID 11775 Should be re-considered," Graham Smith (SR Technologies)
    - PHY Submissions
        - 11-18-0059, "PPE Threshold Field," Hongyuan Zhang (Marvell)
        - 11-18-0110, "11ax Comment Resolutions for PHY Preamble," Yan Zhang (Marvell)
        - 11-18-0111, "11ax Comment Resolutions for PHY Data field," Yan Zhang (Marvell)
        - 11-18-0136, "Comment Resolutions for Clause 28.2.2 (TXVECTOR and RXVECTOR parameters) Part 1," Bo Sun (ZTE)
        - 11-18-0150, "CR for CIDs related to HE ER SU PPDU," Tianyu Wu (MediaTek)
        - 11-18-0151, "CR for PHY PPDU formats," Tianyu Wu (MediaTek)
        - 11-18-0162, "LB230 CR on CID 12060 and 13047," Ming Gan (Huawei)
        - 11-18-0324, "CR on HE-SIG-B part 3," Yujin Noh (Newracom)
        - 11-18-0349, "Comment Resolutions on Clause 28.3.3 (OFDMA and SU Tone Allocation)," Jung Hoon Suh (Huawei)
        - 11-18-0352, "CR for HE-SIG-B," Tianyu Wu (MediaTek)
        - 11-18-0359, "PHY Comment Resolution on 1024 QAM," Ron Porat (Broadcom)
        - 11-18-0404, "Comment Resolutions on PHY INTRODUCTION Part 4," Lochan Verma (Qualcomm)
        - 11-18-0409, "Comment Resolutions on PHY INTRODUCTION Part 5," Lochan Verma (Qualcomm)
        - 11-18-0463, "Proposed Changes to D2.2 Clause 28.3.20, 28.3.21," Xiaogang Chen (Intel)
        - 11-18-0469, "PHY Comment Resolution on Packet Extension," Ron Porat (Broadcom)
        - 11-18-0475, "Comment resolution on CIDs on Clause 28.3 Part 2," Jianhan Liu (MediaTek)
        - 11-18-0476, "Comment resolution on CIDs on Clause 28.3.18.1 for signal leakage to preamble punctured channels," Jianhan Liu (MediaTek)
        - 11-18-0478, "Comment resolution on CID 11896," Jianhan Liu (MediaTek)
        - 11-18-0483, "Corrections to "Number Of HE-LTF Symbols And Midamble Periodicity" subfield," Sigurd Schelstraete (Quantenna)
        - 11-18-0508, "D2.0 PHY Comment Resolution - Part 2," Youhan Kim (Qualcomm)
3. **Timeline update**
   TG reviewed the timeline - No change.

Current Timeline	
May 2014	**Start of TG**
November 2014	**First draft of the TG SFD approved**
January 2016	**Proposed TG draft**
March 2016	**Draft 0.1 was approved and Comment Collection started**
November 2016	**Issue Draft 1.0 and start WG Letter Ballot — Failed (57.77%)** **LB 225: opened Dec. 1st, 2016 and closed Jan. 8th, 2017**
September 2017	**Draft 2.0 and WG Letter Ballot — Failed (62.84%)** **LB 230: opened Oct. 5th, 2017 and closed Nov. 4th, 2017**
May 2018	**Draft 3.0 and WG Letter Ballot**
July 2018	**Mandatory Draft Review**
February 2019	**Formation of Sponsor Ballot pool**
May 2019	**Initial Sponsor Ballot**
December 2019	**RevCom submittal**

Goals for the May 2018 session

- Complete comment resolution and initiate a 30-day WG letter ballot.
- Approve a new revision of the Coexistence. Assurance document taking into account the new added band.
- Prepare and approve PAR extension.

Teleconferences

TGax teleconferences are scheduled after the March 2018 session as follows:

Thursday	March 22nd, April 5th, April 19th, 2018	10:00 - 12:00 (ET)
Thursday	March 29th, April 12th, April 26th, 2018	20:00 - 22:00 (ET)
Thursday	May 17th, 2018	10:00 - 12:00 (ET)

TGax PHY calls are scheduled instead of face-to-face ad hoc meeting:

Wednesday	May 2nd, 2018	20:00 - 22:00 (ET)
Thursday	May 3rd, 2018	20:00 - 22:00 (ET)
Friday	May 4th, 2018	10:00 - 12:00 (ET)

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January 2018 — Orlando, FL

TGax had nine sessions during the week.

	Monday	Tuesday	Wednesday	Thursday
AM1			**TGax (full)**	
AM2		**TGax** (PHY ad hoc) **TGax** (MAC & MU ad hoc)		**TGax (full)**
PM1	**TGax (full)**			
PM2		**TGax** (PHY ad hoc) **TGax** (MAC & MU ad hoc)	**TGax** (PHY ad hoc) **TGax** (MAC & MU ad hoc)	**TGax (full)**
PM3	**TGax** (PHY ad hoc) **TGax** (MAC & MU ad hoc)	**TGax** (SR ad hoc) **TGax** (MAC & MU ad hoc)		

Main documents

The meeting agenda and minutes of the TGax and its subgroups, and the TGax closing report can be found here.

- TGax
  - 11-17-1851-06, TGax January 2018 Meeting Agenda
  - 11-18-0213-00, TGax January 2018 Irvine Meeting Minutes
  - 11-18-0261-00, TGax January 2018 Closing Report
  - TGax PHY ad hoc group
    - 11-18-0201-03, TGax January 2018 Meeting Agenda - PHY Ad Hoc
    - 11-18-0255-00, IEEE 802.11 TGax Jan 2018 Irvine Interim PHY Ad Hoc Meeting Minutes
  - TGax MAC MU ad hoc group
    - 11-18-0204-02, TGax MAC-MU Ad-hoc January 2018 Meeting Agenda
    - 11-18-0245-00, IEEE 802.11 TGax Jan 2018 TGax MAC/MU Ad hoc Meeting Minutes
  - TGax SR ad hoc group
    - 11-18-0217-01, Agenda of the IEEE 802.11ax Spatial Reuse ad hoc group
    - 11-18-0239-00, Minutes of the January 2018 meeting of the IEEE 802.11ax Spatial Reuse ad hoc group

Achievements

1. **Work Completed**
   - Approved resolutions for about 750 technical CIDs.
   - Approved resolutions of Editorial CIDs implemented in draft D 2.1.
   - The TG Editor is planning to produce a new revision based on approved resolutions.
   - A TG motion passed to hold an ad hoc meeting in the Bay Area during the period from February 28th to March 2nd, 2018.
   - No changes to the TG timeline.
2. **Technical Submissions**

   TGax received following submissions during the TGax ad hoc meeting and in the TGax sessions.
   - PHY - 25 submissions
     - 11-18-0006, "Misc CR," Ross Jian Yu (Huawei Technologies)
     - 11-18-0023, "Changes to D2.0 Clause 28.2.5, 28.2.6," Xiaogang Chen (Intel)
     - 11-18-0024, "Changes to D2.0 Clause 28.3.5," Xiaogang Chen (Intel)
     - 11-18-0025, "Proposed Changes to D2.0 Clause 28.3.6," Xiaogang Chen (Intel)
     - 11-18-0028, "Proposed Changes to D2.0 on the HE TB NDP feedback," Xiaogang Chen (Intel)
     - 11-18-0036, "Comment Resolutions on PHY INTRODUCTION Part 1," Lochan Verma (Qualcomm)
     - 11-18-0037, "Comment Resolutions on PHY INTRODUCTION Part 2," Lochan Verma (Qualcomm)
     - 11-18-0038, "Comment Resolutions on HE-SIG-A Part 1," Lochan Verma (Qualcomm)
     - 11-18-0046, "Comment Resolutions on PHY INTRODUCTION Part 3," Lochan Verma (Qualcomm)
     - 11-18-0050, "CR on HE-SIG-B part 1," Yujin Noh (Newracom)
     - 11-18-0051, "CR on HE-SIG-B part 2," Yujin Noh (Newracom)
     - 11-18-0057, "D2.0 PHY Comment Resolution," Youhan Kim (Qualcomm)
     - 11-18-0058, "Comment Resolutions on Midamble," Hongyuan Zhang (Marvell Semiconductors)
     - 11-18-0059, "PPE Threshold Field," Hongyuan Zhang (Marvell Semiconductors)
     - 11-18-0079, "Comment Resolutions on Clause 28.3.15 (SU-MIMO and DL MU-MIMO beamforming)," Kome Oteri (InterDigital)
     - 11-18-0080, "Comment Resolutions on Clause 9.4.1.63 D2.0 (HE Compressed Beamforming Report field)," Kome Oteri (InterDigital)
     - 11-18-0109, "11ax Comment Resolutions for PHY mathematical descriptions," Yan Zhang (Marvell Semiconductors)
     - 11-18-0110, "11ax Comment Resolutions for PHY Preamble," Yan Zhang (Marvell Semiconductors)
     - 11-18-0111, "11ax Comment Resolutions for PHY Data field," Yan Zhang (Marvell Semiconductors)
     - 11-18-0118, "PHY Comment Resolution," Ron Porat (Broadcom Ltd.)
     - 11-18-0136, "Comment Resolutions for Clause 28.2.2 (TXVECTOR and RXVECTOR parameters) Part 1," Bo Sun (ZTE)
     - 11-18-0150, "CR for CIDs related to HE ER SU PPDU," Tianyu Wu (Samsung)
     - 11-18-0151, "CR for PHY PPDU formats," Tianyu Wu (Samsung) - not on the server
     - 11-18-0159, "Comment resolution on CIDs on Clause 28.3 Part 1," Jianhan Liu (MediaTek)
     - 11-18-0162, "LB230 CR on CID 12060 and 13047," Ming Gan (Huawei Technologies)
     - 11-18-0187, "Tx EVM for Beamformed Transmission," Bin Tian (Qualcomm) - not on the server
     - 11-18-0230, "Misc CR Follow up," Ross Jian Yu (Huawei Technologies)
   - MAC 37 submissions
     - 11-17-1837, "11ax D2.0 Comment Resolution 27.5.3.5," Liwen Chu (Marvell Semiconductors)
     - 11-17-1847, "CIDs related to Multiple BSSID topic - Part 1," Abhishek Patil (Qualcomm)
     - 11-17-1850, "Resolution for CIDs in 9.4.2.37," Abhishek Patil (Qualcomm)
     - 11-17-1857, "CIDs related to Multiple BSSID topic - Part 2," Abhishek Patil (Qualcomm)
     - 11-17-1858, "Resolution for CID 13142," Abhishek Patil (Qualcomm)
     - 11-17-1859, "Resolution for CID 11742," Abhishek Patil (Qualcomm)
     - 11-17-1861, "CIDs related to Multiple BSSID topic - Part 3," Abhishek Patil (Qualcomm)
     - 11-17-1874, "11ax D2.0 MAC Comment Resolution for NAV Part I," Po-Kai Huang (Intel)
     - 11-17-1893, "CR TWT IE," Matthew Fischer (Broadcom Ltd.)
     - 11-18-0009, "LB230 MAC CR 10.22.2.4," Alfred Asterjadhi (Qualcomm)
     - 11-18-0010, "LB230 MAC CR 26.8.36," Alfred Asterjadhi (Qualcomm)
     - 11-18-0012, "LB230 MAC CR 27.15.2," Alfred Asterjadhi (Qualcomm)

- 11-18-0013, "LB230 MAC CR 27.15.3," Alfred Asterjadhi (Qualcomm)
- 11-18-0014, "LB230 MAC CR 27.15.4," Alfred Asterjadhi (Qualcomm)
- 11-18-0015, "LB230 MAC CR 27.17," Alfred Asterjadhi (Qualcomm)
- 11-18-0027, "Ack related CIDs Section 27.4," George Cherian (Qualcomm)
- 11-18-0035, "OMI Comment Resolutions," Jarkko Kneckt (Apple)
- 11-18-0039, "LB230 MAC CR 10.22.2.5," Alfred Asterjadhi (Qualcomm)
- 11-18-0040, "LB230 MAC CR 10.22.2.6-9," Alfred Asterjadhi (Qualcomm)
- 11-18-0041, "LB230 MAC CR 11.24," Alfred Asterjadhi (Qualcomm)
- 11-18-0044, "LB230 MAC CR 27.7 and 27.7.1," Alfred Asterjadhi (Qualcomm) - not on the server
- 11-18-0055, "CR CID 14324," Zhou Lan (Broadcom Ltd.)
- 11-18-0066, "Resolution for CIDs in 9.4.2.245," Abhishek Patil (Qualcomm)
- 11-18-0068, "Resolution for CID 11374," Abhishek Patil (Qualcomm)
- 11-18-0074, "11ax D2.0 Comment Resolution 27.5.3.2.4 10.22.2.7, " Liwen Chu (Marvell)
- 11-18-0075, "11ax D2.0 comment resolution 27.5.3.2.2," Liwen Chu (Marvell)
- 11-18-0076, "11ax D2.0 comment resolution 27.5.3.2.3," Liwen Chu (Marvell)
- 11-18-0077, "11ax D2.0 comment resolution 27.4.2," Liwen Chu (Marvell) - not on the server
- 11-18-0078, "11ax D2.0 comment resolution 27.6.4," Liwen Chu (Marvell)
- 11-18-0081, "11ax D2.0 MAC Comment Resolution for HE link adaptation," Frank Hsu (MediaTek)
- 11-18-0082, "LB230 CR for BSS Load Slides," Frank Hsu (MediaTek) - not on the server
- 11-18-0083, "LB230 CR for BSS Load Text," Frank Hsu (MediaTek) - not on the server
- 11-18-0088, "CR CID 14349," Zhou Lan (Broadcom Ltd.) - not on the server
- 11-18-0090, "CR for Opportunistic power save," Laurent Carious (Intel)
- 11-18-0098, "LB230 CR on CIDs 12757, 11149 and 13675," Ming Gan (Huawei Technologies)
- 11-18-0099, "LB230 CR on Fragmentation - Part 1," Ming Gan (Huawei Technologies)
- 11-18-0105, "LB230 CR Multi-TID Capability Indication," Yongho Seok (MediaTek)
- 11-18-0107, "LB230 CR 20MHz only STA on Secondary Channel," Yongho Seok (MediaTek) - not on the server
- 11-18-0149, "CR for 27.5.6," Laurent Cariou (Intel) - not on the server
- 11-18-0153, "Resolution for CID 11742," Po-Kai Huang (Intel)
- 11-18-0155, "Resolutions for CIDs related to GCR," Yusuke Tanaka (Sony)
- 11-18-0161, "CR of CID 13754," Zhou Lan (Broadcom Ltd.)
- 11-18-0182, "11ax D2.0 MAC Comment Resolution for CID 18555," Guoqing Li (Apple)
- 11-18-0200, "Decouple Channel Width Capabilities between VHT and HE PHY Mode," Huizhao Wang (Quantenna Communications)

◦ Multi-User (MU) - 19 submissions
- 11-17-1828, "CR for MU EDCA parameters," Laurent Cariou (Intel)
- 11-17-1849, "CIDs related to Random Access - Part 1," Abhishek Patil (Qualcomm)
- 11-17-1860, "Resolution for CID 11002," Abhishek Patil (Qualcomm)
- 11-17-1878, "11ax D2.0 MAC Comment Resolution for NAV Part II," Po-Kai Huang (Intel)
- 11-18-0008, "LB230-MAC-CR-9.3.1.20," Alfred Asterjadhi (Qualcomm)
- 11-18-0011, "Comment resolutions for 27.5.3.4," Alfred Asterjadhi (Qualcomm)
- 11-18-0029, "Default UORA Parameters," Matthew Fischer (Broadcom Ltd.)
- 11-18-0030, "ER DL Protection Sequence," Matthew Fischer (Broadcom Ltd.) - not on the server
- 11-18-0031, "BQRP BQR LCTS DL MU," Matthew Fischer (Broadcom Ltd.)
- 11-18-0042, "Comment resolutions for 27.6.2," Alfred Asterjadhi (Qualcomm)
- 11-18-0043, "Comment resolutions for 27.6 and 27.6.1," Alfred Asterjadhi (Qualcomm)
- 11-18-0053, "CR of BQR (on D2.0)," Zhou Lan (Broadcom Ltd.)
- 11-18-0054, "CR of DL MU procedure (D2.0)," Zhou Lan (Broadcom Ltd.)
- 11-18-0056, "CR of CID 14328," Zhou Lan (Broadcom Ltd.)
- 11-18-0063, "CR on UORA Power Saving," Jeongki Kim (LG Electronics)
- 11-18-0065, "Resolution for CIDs in 9.3.1.23," Abhishek Patil (Qualcomm)
- 11-18-0079, "Comment Resolutions on Clause 28.3.15 (SU-MIMO and DL MU-MIMO beamforming)," Kome Oteri (InterDigital)
- 11-18-0080, "Comment Resolutions on Clause 9.4.1.63 D2.0 (HE Compressed Beamforming Report field)," Kome Oteri (InterDigital)

        - 11-18-0108, "CIDs for: Section 27.5.3.6 HE buffer status feedback operation for UL MU," Kiseon Ryu (LG Electronics)
        - 11-18-0185, "CR of CID 11001," Zhou Lan (Broadcom)
    - Spatial Reuse (SR) - 3 submissions
        - 11-17-1852, "CR for 27.9," Laurent Cariou (Intel)
        - 11-18-0026, "CR SRG and SRP," Matthew Fischer (Broadcon Ltd.)
        - 11-18-0105, "LB230 CR Spatial Reuse," Yongho Seok (MediaTek)
3. **Timeline update**
   TG reviewed the timeline - No change.

Current Timeline	
May 2014	**Start of TG**
November 2014	**First draft of the TG SFD approved**
January 2016	**Proposed TG draft**
March 2016	**Draft 0.1 was approved and Comment Collection started**
November 2016	**Issue Draft 1.0 and start WG Letter Ballot — Failed (57.77%)** **LB 225: opened Dec. 1st, 2016 and closed Jan. 8th, 2017**
September 2017	**Draft 2.0 and WG Letter Ballot — Failed (62.84%)** **LB 230: opened Oct. 5th, 2017 and closed Nov. 4th, 2017**
May 2018	**Draft 3.0 and WG Letter Ballot**
July 2018	**Mandatory Draft Review**
February 2019	**Formation of Sponsor Ballot pool**
May 2019	**Initial Sponsor Ballot**
December 2019	**RevCom submittal**

Goals for the March 2018 session

- Continue with comment resolution on draft D2.0.

Teleconferences

TGax teleconferences are scheduled after the January 2018 session as follows:

Thursday	January 25th, 2018	20:00 - 22:00 (ET)
Thursday	February 1st, 2018	10:00 - 12:00 (ET)
Thursday	February 8th, 2018	20:00 - 22:00 (ET)
Thursday	February 22nd, 2018	20:00 - 22:00 (ET)

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November 2017 — Orlando, FL

TGax had four sessions during the week.

	Monday	Tuesday	Wednesday	Thursday
AM1			**TGax (full)**	
AM2		**TGax (full)**		**TGax (full)**
PM1	**TGax (full)**			
PM2		**TGax (cancelled)**	**TGax (cancelled)**	**TGax (cancelled)**
PM3				

Main documents

The meeting agenda and minutes of the TGax and its subgroups, and the TGax closing report can be found here.

- TGax
  - 11-17-1546-04, TGax November 2017 Meeting Agenda
  - 11-17-1727-00, TGax November 2017 Orlando Meeting Minutes
  - 11-17-1789-00, TGax November 2017 Closing Report

WG Letter Ballot #230 on IEEE 802.11ax draft 2.0

- Ballot opened on Oct. 5th, 2017 and closed on Nov. 4th, 2017 (30 days).
- Failed with 62.84% approval.
- 3374 comments are collected.

Achievements

1. **Work Completed**
   - The TG almost completed the assignment of comments received on draft D2.0.
     - A lead is identified for various clauses of the draft. The lead is responsible for coordinating resolutions of relevant CIDs.
   - The TG approved resolutions to 36 CIDs.
   - The TG updated its timeline to reflect the outcome of WG LB #230
   - The TG passed a motion to hold an ad hoc meeting in San Diego during the period of January 10 - 12, 2018.
2. **Technical Presentations**
   TGax received 12 submissions. All of the submissions are presented during the week.
   - 11-17-1682, "Comments on TGax D2.0," Robert Stacy (Intel)
   - 11-17-1687, "TGax Editor's Report," Robert Stacy (Intel)
   - 11-17-1717, "Associated Congestion Avoidance Method Based on Dynamic Adjustment of Beacon Interval," Hongyan Li (Xidian Univ.)
   - 11-17-1719, "Contention Based UL-OFDMA Random Access without back-off," Hongyan Li (Xidian Univ.)
   - 11-17-1723, "TPC combined with channel allocation method for OBSS environment," Hongyan Li (Xidian Univ.)
   - 11-17-1730, "PHY CID 17890 Resolution," Hongyuan Zhang (Marvell)
   - 11-17-1731, "PHY CID 17895 Resolution," Hongyuan Zhang (Marvell)
   - 11-17-1763, "CRs for 20 MHz-only STA - RU Restriction," Sungeun Lee (Cypress)
   - 11-17-1764, "CRs for 28.4.2 and 28.4.4," Sungeun Lee (Cypress)
   - 11-17-1766, "D2.0 Comment Resolution for CIDs on MLME SAP (Clause 6)," Jae Seung Lee (ETRI)
   - 11-17-1769, "Discussion on Dynamic Fragmentation Level 3," Huizhao Wang (Quantenna Communications)
   - 11-17-1774, "Resolution for the TBD in Annex C.3," Edward Au (Huawei Technologies)
   - 11-17-1775, "CR for PICS comments on D2.0 - Part 1," Edward Au (Huawei Technologies)
3. **Timeline update**
   TG reviewed the timeline. No change was made.

Previous Timeline	Modified (new) Timeline

May 2014	Start of TG	May 2014	Start of TG
November 2014	First draft of the TG SFD approved	November 2014	First draft of the TG SFD approved
January 2016	Proposed TG draft	January 2016	Proposed TG draft
March 2016	Draft 0.1 was approved and Comment Collection started	March 2016	Draft 0.1 was approved and Comment Collection started
November 2016	Issue Draft 1.0 and start WG Letter Ballot LB 225: opened Dec. 1st, 2016 and closed Jan. 8th, 2017	November 2016	Issue Draft 1.0 and start WG Letter Ballot — Failed (57.77%) LB 225: opened Dec. 1st, 2016 and closed Jan. 8th, 2017
September 2017	Draft 2.0 and WG Letter Ballot LB 230: opened Oct. 5th, 2017 and closed Nov. 4th, 2017	September 2017	Draft 2.0 and WG Letter Ballot — Failed (62.84%) LB 230: opened Oct. 5th, 2017 and closed Nov. 4th, 2017
May 2018	Mandatory Draft Review	May 2018	Draft 3.0 and WG Letter Ballot
May 2018	Formation of Sponsor Ballot pool	July 2018	Mandatory Draft Review
November 2018	Initial Sponsor Ballot	February 2019	Formation of Sponsor Ballot pool
July 2019	RevCom submittal	May 2019	Initial Sponsor Ballot
		December 2019	RevCom submittal

Goals for the January 2018 session

- Continue with comment resolution on draft D2.0.

Teleconferences

TGax teleconferences are scheduled after the November 2017 session as follows:

Thursday	November 30th, 2017	10:00 - 12:00 (ET)
Thursday	December 7th, 2017	20:00 - 22:00 (ET)
Thursday	December 14th, 2017	10:00 - 12:00 (ET)
Thursday	December 21st, 2017	20:00 - 22:00 (ET)
Thursday	January 4th, 2018	10:00 - 12:00 (ET)
Thursday	January 25th, 2018	20:00 - 22:00 (ET)

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September 2017 — Waikoloa, Big Island, HI

TGax had 11 sessions during the week.
Seven out of eleven sessions were assigned to the ad hoc groups.

	Monday	Tuesday	Wednesday	Thursday
AM1			TGax (full)	
AM2	TGax (full)	TGax (PHY ad hoc) TGax (MAC ad hoc)		
PM1			TGax (PHY ad hoc) TGax (MAC ad hoc)	TGax (full)

	Monday		Tuesday		Wednesday		Thursday
PM2	**TGax** (PHY ad hoc)	**TGax** (MAC ad hoc)	**TGax** (PHY ad hoc)	**TGax** (MAC ad hoc)	**TGax** (PHY ad hocs)	**TGax** (MAC ad hoc)	**TGax (full)**
PM3	**TGax** (PHY ad hocs)	**TGax** (MAC ad hoc)	**TGax** (MU ad hocs)	**TGax** (MAC ad hoc)			

Main documents

The meeting agenda and minutes of the TGax and its subgroups, and the TGax closing report can be found here.

- TGax
  - 11-17-1219-06, TGax September 2017 Meeting Agenda
  - 11-17-1465-00, TGax September 2017 Waikoloa Meeting Minutes
  - 11-17-1515-00, TGax September 2017 Closing Report

  - TGax PHY ad hoc group
    - 11-17-1434-03, TGax Sep 2017 Meeting PHY Ad Hoc Agenda
    - 11-17-1531-00, IEEE 802.11 TGax September 2017 Hawaii PHY Ad Hoc Meeting Minutes
  - TGax MAC ad hoc group
    - 11-17-1453-04, TGax MAC Ad-hoc September 2017 Meeting Agenda
    - 11-17-1543-00, IEEE 802.11 TGax, MAC Ad hoc, September 2017 TGax Meeting Minutes
  - TGax MU ad hoc group
    - 11-17-1487-01, TGax September 2017 Meeting MU ad-hoc Agenda
    - 11-17-1491-02, IEEE 802.11 TGax, MU ad hoc, September 2017 TGax Meeting Minutes

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Achievements

1. **Work Completed**
   - The TG completed the comment resolution on comments received during WG LB225 on draft D1.0.
   - The TG approved a motion to prepare draft D2.0 and start a WG LB.
   - Motion passed to affirm the applicability of the IEEE P802.11ax CSD to the modified PAR.
2. **Technical Presentations**

   Following documents are discussed during the TGax teleconferences and the ad hoc meeting after July 2017 session.
   - 11-17-0389, "CIDs-for-27-2-1-part1," Kaiying Lv (ZTE)
   - 11-17-0553, "LB225 11ax D1.0 Comment Resolution 27.10.4 Part 1," Liwen Chu (Marvell)
   - 11-17-0777, "CR TWT IE," Matthew Fischer (Broadcom)
   - 11-17-0811, "Comment Resolution on TIM Broadcast," Jarkko Kneckt (Apple)
   - 11-17-0925, "CR on HE Duration-based RTS," Huizhao Wang (Quantenna)
   - 11-17-1009, "Quiet time period - part 3 (27.26.3.x)," Chao-Chun Wang (MediaTek)
   - 11-17-1010, "Quiet time period - part 4 (9.4.2.223-225)," Chao-Chun Wang (MediaTek)
   - 11-17-1011, "Quiet time period - part 5 (9.6.29.x)," Chao-Chun Wang (MediaTek)
   - 11-17-1034, "Quiet time period - part 6," Chao-Chun Wang (MediaTek)
   - 11-17-1067, "LB225 11ax D1.0 Comment Resolution OMI and Operation Mode," Liwen Chu (Marvell)
   - 11-17-1068, "LB225 11ax D1.0 Comment Resolution 10.7," Liwen Chu (Marvell)
   - 11-17-1072, "Remaining OMI comment resolutions," Jarkko Kneckt (Apple)
   - 11-17-1082, "Comment resolutions for BRP and BSRP trigger frames," Menzo Wentink (Qualcomm)
   - 11-17-1135, "CR QOS SF," Matthew Fischer (Broadcom)
   - 11-17-1173, "Proposed Resolutions to CID 5011, 6900, 6998, and 9056," Osama Aboul-Magd (Huawei Technologies)
   - 11-17-1174, "Clauses 3.2, 3.3, and 3.4 Comment Resolutions," Osama Aboul-Magd (Huawei Technologies)
   - 11-17-1183, "CR for CID 5772, 9476, 9480," Po-Kai Huang (Intel)
   - 11-17-1220, "Clause 10.2 Comment Resolution," Osama Aboul-Magd (Huawei Technologies)
   - 11-17-1248, "Clause 27.1 Comment Resolution," Osama Aboul-Magd (Huawei Technologies)
   - 11-17-1263, "Misc for HE Ops IE," Alfred Asterjadhi (Qualcomm)
   - 11-17-1267, "LB225 11ax D1.0 Comment Resolution 27.10.2, 27.10.3," Liwen Chu (Marvell)

- 11-17-1268, "Clause 4.3.14a Comment Resolution," Osama Aboul-Magd (Huawei Technologies)
- 11-17-1270, "LB225 CR 10.22.2.11 CID 5374," Yongho Seok (MediaTek) Need more discussion
- 11-17-1271, "LB225 CR 9.7.3 CID 9389," Yongho Seok (MediaTek)
- 11-17-1272, "LB225 CR 10.3.2.10.3 CID 9429," Yongho Seok (MediaTek)
- 11-17-1275, "CIDs related to TF," Abhishek Patil (Qualcomm)
- 11-17-1276, "CIDs related to Random Access," Abhishek Patil (Qualcomm)
- 11-17-1277, "Pending CIDs in 27.16," Abhishek Patil (Qualcomm)
- 11-17-1278, "Proposed Resolution for CID 9846," Abhishek Patil (Qualcomm)
- 11-17-1279, "Various CIDs in Clause 9," Abhishek Patil (Qualcomm)
- 11-17-1283, "CR for 10.5 MPDU Fragmentation," Woojin Ahn (WILUS)
- 11-17-1313, "LB225 CR CID 8538 9377," Yongho Seok (MediaTek)
- 11-17-1317, "CR for 10.3.2.10," Kiseon Ryu (LG Electronics)
- 11-17-1335, "CR for 27.3.1," Laurent Cariou (Intel)
- 11-17-1336, "CR for 9.4.2.240," Laurent Cariou (Intel)
- 11-17-1342, "PHY CR 8348 6433," Alfred Asterjadhi (Qualcomm)
- 11-17-1351, "CR on 27.14.2," Jeongki Kim (LG Electronics)
- 11-17-1362, "CIDs on Subclause 27.3.3 Part 2," Ming Gan (Huawei Technologies)
- 11-17-1363, "CIDs on Subclause 27.3.3 Part 3," Ming Gan (Huawei Technologies)

TGax received 62 submissions. All of the submissions are presented during the week.

- **PHY** — 21 submissions
  - 11-17-0995, "Doppler Comment Resolution," Hongyuan Zhang (Marvell)
  - 11-17-1001, "Comment Resolutions on Clause 28.2.2 (TXVECTOR and RXVECTOR parameters) Part 1," Bo Sun (ZTE)
  - 11-17-1296, "Comment Resolutions on Miscellaneous Comments," Lochan Verma (Qualcomm)
  - 11-17-1306, "CRs on Clause 28.3.3.2," Xiaogang Chen (Intel)
  - 11-17-1307, "Changes for the Tx/Rx Vectors related to HE TB NDP feedback," Xiaogang Chen (Intel)
  - 11-17-1315, "Comment Resolution to CID8576," Yujin Noh (Newracom)
  - 11-17-1320, "N_{SYM} and T_{PE} at RX side for Midamble design - Follow up," Yujin Noh (Newracom)
  - 11-17-1324, "Usage of Doppler bit in A-Control subfield," Yujin Noh (Newracom)
  - 11-17-1325, "Text Proposal on Usage of Doppler bit in A-Control subfield," Yujin Noh (Newracom)
  - 11-17-1327, "Interleaver for HE-SIGA and HE-SIGB," Dongguk Lim (LG Electronics)
  - 11-17-1332, "Comment Resolutions on Clause 28.3.3.4 (Pilot subcarriers)," Junghoon Suh (Huawei Technologies)
  - 11-17-1350, "On TX EVM," Ron Porat (Broadcom)
  - 11-17-1357, "Capability on Doppler Mode," Ross jian Yu (Huawei Technologies)
  - 11-17-1361, "CRs for 20 MHz-only STA - Part 4," Sungeun Lee (Cypress)
  - 11-17-1366, "Midamble Design Continued," Yang Zhang (Marvell)
  - 11-17-1374, "On Amplitude Drift Compensation," Jianhan Liu (MediaTek)
  - 11-17-1375, "Text Changes on Transmitter modulation accuracy (EVM) test," Jianhan Liu (MediaTek)
  - 11-17-1376, "Usage of Doppler Bit in 11ax," Jianhan Liu (MediaTek)
  - 11-17-1380, "HE SIG-B Spatial Configuration Field Fixing," Hongyuan Zhang (Marvell)
  - 11-17-1381, "DCM in HE TB PPDU," Yan Zhang (Marvell)
  - 11-17-1383, "Proposed Change to the Resolution to CID 9551," Yasuhiko Inoue (NTT)
- **MAC** — 37 submissions
  - 11-17-0307, "HE BSS Load Information Element," Frank Hsu (MediaTek)
  - 11-17-0308, "HE BSS Load Information Element for 11ax," Frank Hsu (MediaTek)
  - 11-17-0619, "Proposed Text Changes for Client Management," Eldad Perahia (HPE-Aruba)
  - 11-17-0719, "Unifying QoS Control and BSR A-Control for Buffer Status Report," Zhou Lan (Broadcom)
  - 11-17-0765, "Follow UP of Unifying Queue Size Report," Zhou Lan (Broadcom)
  - 11-17-1054, "LB225 CR 27.13 (Link Adaptation," Frank Hsu (MediaTek)
  - 11-17-1069, "LB225 11ax D1.0 Comment Resolution 9.7.3," Liwen Chu (Marvell)
  - 11-17-1081, "Comment Resolutions for HE NDP Announcement frame," Menzo Wentink (Qualcomm)
  - 11-17-1087, "MAC CR CIDs 4813-4814," Alfred Asterjadhi (Qualcomm)
  - 11-17-1138, "CR TWT Operation," Matthew Fischer (Broadcom)
  - 11-17-1244, "BSS Basic HE-MCS per Bandwidth," Matthew Fischer (Broadcom)
  - 11-17-1258, "Resolution to CID9863," Yujin Noh (Newracom)

- 11-17-1262, "Miscellaneous for HE sounding," Alfred Asterjadhi (Qualcomm)
- 11-17-1264, "Misc for Trigger frame format," Alfred Asterjadhi (Qualcomm)
- 11-17-1280, "visio file for figure 27.12," Abhishek Patil (Qualcomm)
- 11-17-1282, "LB225 11ax D1.0 Comment Resolution 27.11.1, 27.11.2," Liwen Chu (Marvell)
- 11-17-1285, "LB225 11ax D1.0 Comment Resolution HE MAC Capabilities," Liwen Chu (Marvell)
- 11-17-1290, "LB225 11ax D1.0 Comment Resolution HE PHY Capabilities, PPE," Liwen Chu (Marvell)
- 11-17-1294, "LB225 11ax D1.0 Comment Resolution 10.7 Remaining CIDs," Liwen Chu (Marvell)
- 11-17-1295, "Proposed Resolution for CID 9501," Guoqing Li (Apple)
- 11-17-1299, "CID 10276 related to 27.5.5," Laurent Cariou (Intel)
- 11-17-1301, "11ax D1.4 MAC Comment Resolution for CID 9636, 9699," Po-Kai Huang (Intel)
- 11-17-1304, "LB225 11ax D1.0 Comment Resolution on Clause 10.9 HT Control Field," James Yee (MesiaTek)
- 11-17-1330, "CIDs: Acknowledgment related comments," George Cherian (Qualcomm)
- 11-17-1337, "CR for CID5859 and CID 5971," Jarkko Kneckt (Apple)
- 11-17-1338, "TWT SP initiation and termination and legacy PS," Jarkko Kneckt (Apple)
- 11-17-1339, "Improvement to TWT Parameter set," Jarkko Kneckt (Apple)
- 11-17-1341, "PHY CR 8348 6433," Alfred Asterjadhi (Qualcomm) -- not available
- 11-17-1346, "Individual constrained TWT agreements," jarkkoKneckt (Apple)
- 11-17-1364, "CIDs on Subclause 27.3.3 Part 3," Ming Gan (Huawei Technologies) -- not available
- 11-17-1365, "CIDs on Subclause 27.3.3 Part 3," Ming Gan (Huawei Technologies) -- not available
- 11-17-1377, "11ax D1.0 MAC Comment Resolution for 27.13 and 9.4.2.218.2," Frank Hsu (MediaTek)
- 11-17-1399, "Resolution for CID 3099," Edward Au (Huawei Technologies)
- 11-17-1401, "Resolution for CIDs 5285, 6198, 7603," Edward Au (Huawei Technologies)
- 11-17-1402, "Resolution for PICS," Edward Au (Huawei Technologies)
- 11-17-1429, "Annex G Comment Resolution," Osama Aboul-Magd (Huawei Technologies)
- 11-17-1456, "Resolution for CID 8555," Abhishek Patil (Qualcomm)

◦ **MU** — 4 submissions
- 11-17-1060, "CR on CID 6053," Jeongki Kim (LG Electronics)
- 11-17-1091, "Proposed resolution for comments related to CIDs in 27.5.2," Jing Ma
- 11-17-1139, "Comment Resolution on retransmission of OFDMA random access," Jing Ma (NICT)
- 11-17-1286, "CR DL MU procedure," Zhou Lan (Broadcom)

3. **Timeline discussion**
   TG reviewed the timeline. No change was made.

Current Timeline	
May 2014	**Start of TG**
November 2014	**First draft of the TG SFD approved**
January 2016	**Proposed TG draft**
March 2016	**Draft 0.1 was approved and Comment Collection started**
November 2016	**Issue Draft 1.0 and start WG Letter Ballot**
September 2017	**Draft 2.0 and WG Letter Ballot**
May 2018	**Mandatory Draft Review**
May 2018	**Formation of Sponsor Ballot pool**
November 2018	**Initial Sponsor Ballot**
July 2019	**RevCom submittal**

Goals for the November 2017 session

- Start and complete comment assignment.
- Start comment resolution on draft D2.0.

Teleconferences

TGax teleconferences are scheduled after the September 2017 session as follows:

Approved in July	Thursday	September 28th, 2017	10:00 - 12:00 (ET)
	Thursday	September 21st, 2017	20:00 - 22:00 (ET)
New!	Thursday	November 2nd, 2017	10:00 - 12:00 (ET)

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July 2017 — Berlin, Germany

TGax originally planned 10 sessions during the week.
One ad hoc session was added during the WG mid-week plenary.
Seven out of eleven sessions were assigned to the ad hoc groups.

	Monday	Tuesday	Wednesday	Thursday
AM1			**TGax (full)**	**TGax** (MAC ad hoc)
AM2		**TGax** (PHY ad hoc) **TGax** (MAC ad hoc)		
PM1	**TGax (full)**		**TGax** (PHY ad hoc) **TGax** (MAC ad hoc)	**TGax (full)**
PM2	**TGax** (PHY ad hoc) **TGax** (MAC ad hoc)	**TGax** (MU/SR ad hoc) **TGax** (MAC ad hoc)	**TGax** (PHY ad hocs) **TGax** (MAC ad hoc)	**TGax (full)**
PM3		**TGax** (PHY ad hocs) **TGax** (MAC ad hoc)		

Main documents

The meeting agenda and minutes of the TGax and its subgroups, and the TGax closing report can be found here.

- TGax
  - 11-17-0887-06, TGax July 2017 Meeting Agenda
  - 11-17-1105-00, TGax July 2017 Berlin Meeting Minutes
  - 11-17-1158-00, TGax July 2017 Closing Report
  - TGax PHY ad hoc group
    - 11-17-1099-04, TGax Jul 2017 Meeting PHY Ad Hoc Agenda
    - 11-17-1094-00, TGax July 2017 Berlin PHY Ad Hoc Meeting Minutes
  - TGax MAC ad hoc group
    - 11-17-1098-03, TGax MAC Ad-hoc July 2017 Meeting Agenda
    - 11-17-1154-00, July 2017 TGax MAC Ad hoc Meeting Minutes
  - TGax MU & SR ad hoc group
    - 11-17-1116-01, TGax July 2017 Meeting MU & SR ad-hoc Agenda
    - 11-17-1148-00, TGax MU and SR ad hoc group meeting minutes — Berlin, July 2017

Achievements

1. **Work Completed**
   - Continued with the comment resolution on draft D1.0.

        - Resolutions of about 480 comments were approved.
        - The TG Editor is planning to produce draft D1.4 based on the resolved comments.
    - Discussed options and need for volunmrees for the .
    - Motin passswd to extend 802.11ax scope to include frequency bands up to 7.125 GHz
    - Ad hoc meeting is planned for September in the Bay area.

2. **Technical Presentations**

    TGax received 48 submissions. All of the submissions are presented during the week.

    - **PHY** — 21 submissions
        - 11-17-0650, "LB 225 — Clause 18.2 Comment Resolution," Osama Aboul-Magd (Huawei Technologies)
        - 11-17-0902, "Comment Resolutions on Clause 28 (HE PHY) Part 1," Lochan Verma (Qualcomm)
        - 11-17-0945, "CRs on 28.3.3.8," Yujin Noh (Newracom)
        - 11-17-0946, "Text modification on HE-SIG-B," Yujin Noh (Newracom)
        - 11-17-0960, "Follow-up on Doppler Design in 802.11ax," Lochan Verma (Qualcomm)
        - 11-17-0961, "Miscellaneous clarifications On HE PHY Part 1," Lochan Verma (Qualcomm)
        - 11-17-0973, "TGax D1.0 Comment Resolutions on 28.3.3.10 and 28.3.3.2," Jinsoo Choi (LG Electronics)
        - 11-17-0985, "CRs for the HE TB NDP feedback," Xiaogang Chen (Intel)
        - 11-17-0986, "CRs for the HE Trigger-based NDP feedback," Xiaogang Chen (Intel)
        - 11-17-0993, "11ax Comment Resolutions on Data Field," Yang Zhang (Marvell)
        - 11-17-0994, "Midamble Design," Hongyuan Zhang (Marvell)
        - 11-17-0995, "Doppler Comment Resolution," Hongyuan Zhang (Marvell)
        - 11-17-0996, "Update on Timing Related Constants and Some Equations," Bin Tian (Qualcomm)
        - 11-17-0998, "N_{SYM} and T_{PE} at RX side for Midamble design," Yujin Noh (Newracom)
        - 11-17-1001, "Comment Resolutions on Clause 28.2.2 (TXVECTOR and RXVECTOR parameters) Part 1," Bo Sun (ZTE)
        - 11-17-1006, "Miscellaneous HE-SIG-B related CIDs," Sigurd Schelstraete (Quantenna)
        - 11-17-1007, "Proposed resolution for CID 9021," Sigurd Schelstraete (Quantenna)
        - 11-17-1016, "Improvement Comment on Clause 28.3.3.4 (Pilot subcarriers)," Jung Hoon Suh (Huawei Technologies)
        - 11-17-1021, "Usage of Doppler Bit in 11ax," Jianhan Liu (MediaTek)
        - 11-17-1050, "Additional Editorial Update Related to CID 9769," Youhan Kim (Qualcomm)
        - 11-17-1063, "DCM Text Correction," Tianyu Wu (MediaTek)
    - **MAC** — 28 submissions
        - 11-17-0389, "Proposed resolution for CIDs for 27-2-1," Kaiying Lv (ZTE)
        - 11-17-0533, "LB225 CR Sub-clause 27.16.1," Yongho Seok (Newracom)
        - 11-17-0553, "LB225 11ax D1.0 Comment Resolution 27.10.4 Part 1," Liwen Chu (Marvell)
        - 11-17-0693, "11ax D1.0 MAC Comment Resolution for Quiet Time Period Part 1," Chao-Chun Wang (MediaTek)
        - 11-17-0759, "Comment Resolution on trigger frame for random access," Jason Yuchen Guo (Huawei Technologies)
        - 11-17-0812, "Trigger Frame for Random Access," Jason Yuchen Guo (Huawei Technologies)
        - 11-17-0925, "LB225 11ax D1.0 Comment Resolution 10.3.x," Huizhao Wang (Quantenna)
        - 11-17-0926, "CR HE MCS NSS Not Supported," Matthew Fischer (Broadcom Limited)
        - 11-17-0957, "Comment resolution for Fragmentation," Suhwook Kim (LG Electronics)
        - 11-17-1002, "Comment resolution for HCF," Suhwook Kim (LG Electronics)
        - 11-17-1009, "11ax D1.0 MAC Comment Resolution for Quiet Time Period Part 3," Chao-Chun Wang (MediaTek)
        - 11-17-1010, "11ax D1.0 MAC Comment Resolution for Quiet Time Period Part 4," Chao-Chun Wang (MediaTek)
        - 11-17-1011, "11ax D1.0 MAC Comment Resolution for Quiet Time Period Part 5," Chao-Chun Wang (MediaTek)
        - 11-17-1014, "Resolution for CIDs on Association Exchange with DL MU," Stephane Baron (Canon Research)
        - 11-17-1023, "LB225 CR Sub-clause 27.11.3," Yongho Seok (Newracom)
        - 11-17-1031, "CR for remaining CIDs related to 27.5.5," Laurent Cariou (Intel)
        - 11-17-1032, "Proposed resolution for comments in 27.5.2," Abhishek Patil (Qualcomm)
        - 11-17-1034, "11ax D1.0 MAC Comment Resolution for Quiet Time Period Part 6," Chao-Chun Wang (MediaTek)
        - 11-17-1044, "CIDs: Acknowledgment related comments," George Cherian (Qualcomm)
        - 11-17-1046, "Proposed Resolution to CID 7043," Kaiying Lv (ZTE)
        - 11-17-1049, "Target RSSI field," Laurent Cariou (Intel) — *Not on the server*
        - 11-17-1052, "HE MCS and NSS Comment resolutions," Alfred Asterjadhi (Qualcomm)
        - 11-17-1053, "Comment resolutions for remaining CIDs in OM Control," Alfred Asterjadhi (Qualcomm)
        - 11-17-1054, "LB225 CR 27.13 (Link Adaptation)," Frank Hsu (MediaTek)

        - 11-17-1055, "LB225 CR CID 7407,"Yongho Seok (Newracom) — *Not on the server*
        - 11-17-1060, "CR on CID 6053," Jeongki Kim (LG Electronics)
        - 11-17-1062, "Proposed resolution for CID 9958," Abhishek Patil (Qualcomm)
        - 11-17-1067, "LB225 11ax D1.0 Comment Resolution OMI and Operation Mode," Liwen Chu (Marvell)
        - 11-17-1068, "LB225 11ax D1.0 Comment Resolution 10.7," Liwen Chu (Marvell)
        - 11-17-1069, "LB225 11ax D1.0 Comment Resolution 9.7.3," Liwen Chu (Mervall) —*Not on the server*
        - 11-17-1070, "Resolution for CID 5863," Kiseon Ryu (LG Electronics)
        - 11-17-1072, "OMI comment resolutions," Jarkko Kneckt (Apple)
        - 11-17-1077, "11ax D1.3 MAC Comment Resolution for 10.3.2.4 and 27.2.2 Part III," Po-Kai Huang (Intel)
        - 11-17-1081, "11ax D1.0 MAC Comment Resolution for 9.3.1.20," Menzo Wentink (Qualcomm)
        - 11-17-1082, "11ax D1.0 MAC Comment Resolution for 9.3.1.23.2/5," Menzo Wentink (Qualcomm)
        - 11-17-1087, "MAC-CR-CIDs 4813-4814," Alfred Asterjadhi (Qualcomm)
        - 11-17-1088, "Editorial fixes," Alfred Asterjadhi (Qualcomm)
        - 11-17-1091, "Proposed resolution for comments related to CIDs in 27.5.2," Jing Ma (NICT) — *Not on the server*
    - **SR** — 3 submissions
        - 11-17-0669, "Proposed resolution for CID 4928," Kaiying Lv (ZTE)
        - 11-17-0941, "CR for 27.9 spatial reuse," Laurent Cariou (Intel)
        - 11-17-1003, "Text DSC, CCAT and OBSS_PD to Resolve SR Comments," Graham Smith (SRT Wireless)
    - **MU** — 3 submissions
        - 11-17-0935, "Comment resolution for UL OFDMA-based random access (UORA)," Patrice Nezou (Canon Research)
        - 11-17-1059, "CR on 27.5.2.6.2 Part 3," Jeongki Kim (LG Electronics)
        - 11-17-1071, "Resolution for CID 6106, 9571, 10173," Kiseon Ryu (LG Electronics)
    - **Others (covered in the TGax full sessions)** — 7 submissions
        - 11-17-0308, "BSS Load Information Element for 11ax," Frank Hsu (MediaTek)
        - 11-17-0711, "Comment Resolution on PHY-CCA.indication," Rojan Chitrakar (Panasonic)
        - 11-17-0913, "P802.11ax PAR Modification to support 6 GHz band," Richard Kennedy (HPE)
        - 11-17-0933, "P802.11ax PAR Modification," Richard Kennedy (HPE)
        - 11-17-1058, "Proposed resolution for comments related to Section 4.3.14a," Guoqing Li (Apple)
        - 11-17-1066, "CR on UL OFDMA in DFS Channels," Youhan Kim (Qualcomm)
        - 11-17-1080, "Providing Reference Waveform Generator For 11ax PHY Specification," Fei Tong (Samsung)
3. **Timeline discussion**
   TG discussed the timeline. No change was made.

Current Timeline	
May 2014	**Start of TG**
November 2014	**First draft of the TG SFD approved**
January 2016	**Proposed TG draft**
March 2016	**Draft 0.1 was approved and Comment Collection started**
November 2016	**Issue Draft 1.0 and start WG Letter Ballot**
September 2017	**Draft 2.0 and WG Letter Ballot**
May 2018	**Mandatory Draft Review**
May 2018	**Formation of Sponsor Ballot pool**
November 2018	**Initial Sponsor Ballot**
July 2019	**RevCom submittal**

Goals for the September 2017 session

- Continue with the resolution of comments on draft D1.0.
- Prepare draft D2.0 and plan for WG letter ballot.

Teleconferences

TGax teleconferences are scheduled after the July 2017 session as follows:

Thursday	July 20th, 2017	10:00 - 12:00 (ET)
Thursday	July 27th, 2017	20:00 - 22:00 (ET)
Thursday	August 3rd, 2017 August 17th, 2017 August 31st, 2017	10:00 - 12:00 (ET)
Thursday	August 10th, 2017 August 24th, 2017	10:00 - 12:00 (ET)
Thursday	September 21st, 2017	20:00 - 22:00 (ET)
Thursday	September 28th, 2017	10:00 - 12:00 (ET)

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May 2017 — Daejeon, South Korea

TGax had 11 sessions during the week.
Six out of eleven sessions were assigned to the ad hoc groups.

	Monday		Tuesday		Wednesday		Thursday
AM1					**TGax (full)**		
AM2	**TGax (full)**		**TGax (full)**				
PM1					**TGax** (PHY ad hoc)	**TGax** (MAC ad hoc)	**TGax (full)**
PM2	**TGax** (PHY ad hoc)	**TGax** (MAC ad hoc)	**TGax** (SR ad hoc)	**TGax** (MAC ad hoc)	**TGax** (PHY ad hocs)	**TGax** (MAC ad hoc)	**TGax (full)**
PM3	**TGax** (PHY ad hocs)	**TGax** (MAC ad hoc)	**TGax** (SR ad hocs)	**TGax** (MAC ad hoc)			

Main documents

The meeting agenda and minutes of the TGax and its subgroups, and the TGax closing report can be found here.

- TGax
  - 11-17-0555-05, TGax May 2017 Meeting Agenda
  - 11-17-0749-00, IEEE 802.11 TGax May 2017 Deajeon Meeting Minutes
  - 11-17-0832-00, TGax May 2017 Closing Report
  - TGax PHY ad hoc group
    - 11-17-0783-02, TGax May 2017 Meeting PHY Ad Hoc Agenda
    - 11-17-0850-00, IEEE 802.11 TGax May 2017 PHY Ad Hoc Meeting Minutes
  - TGax MAC ad hoc group
    - 11-17-0786-02, TGax MAC Ad-hoc May 2017 Meeting Agenda
    - 11-17-0829-00, May 2017 TGax MAC Ad hoc Meeting Minutes
  - TGax MU ad hoc group

- Submissions for the MU ad hoc was presented in the MAC ad hoc session.
- TGax SR ad hoc group
  - 11-17-0797-02, TGax Spatial Reuse Ad Hoc Group May 2017 Meeting Agenda
  - 11-17-0817-00, Minutes of the May 2017 meetings of the Spatial Reuse ad hoc group of IEEE Task Group AX (TGax)

Achievements

1. **Work Completed**
   - Continued with the comment resolution on draft D1.0.
     - Good progress during the ad hoc meeting and this meeting.
     - Resolutions of over 900 comments were approved.
     - The TG Editor is planning to produce draft D1.3 based on the resolved comments.
   - Discussed the need to produce a reference waveform generator similar to that for HT and VHT $#151 looking for volunteers.
   - No ad hoc meeting is planned for June/July.
     - Increase the frequency of the teleconferences during the week of June 26.
2. **Technical Presentations**

   TGax received 48 submissions. All of the submissions are presented during the week.
   - **PHY** — 19 submissions
     - 11-17-0044, "NDP Feedback Report Design," Ron Porat (Broadcom Limited)
     - 11-17-0232, "CR_clause 28.3.6," Xiaogang Chen (Intel)
     - 11-17-0233, "CR_4905," Xiaogang Chen (Intel)
     - 11-17-0288, "CRs on HE-SIG-B 28.3.10.8.4-5 part 1," Yujin Noh (Newracom)
     - 11-17-0289, "CRs on HE-SIG-B terminologies on 28.3.10.8.1-3," Yujin Noh (Newracom)
     - 11-17-0290, "CRs on TX specification," Yujin Noh (Newracom)
     - 11-17-0465, "CR on TXTIME and PSDU_LENGTH," Youhan Kim (Qualcomm)
     - 11-17-0648, "CR on HE-SIG-A," Ron Porat (Broadcom Limited)
     - 11-17-0650, "LB 225 - Cluase 18.2 Comment Resolution," Osama Aboul-Magd (Huawei Technologies)
     - 11-17-0678, "Discussion of CID 9021," Sigurd Schelstraete (Quantenna Communications)
     - 11-17-0690, "CRs on 28.3.10.7.3," Yujin Noh (Newracom)
     - 11-17-0694, "CRs for packet extension in 28.3.12," Sungeun Lee (Cypress)
     - 11-17-0698, "CRS on Miscellaneous PHY CIDs," Bin Tian (Qualcomm)
     - 11-17-0714, "CSD update for 28.3.6," Dongguk Lim (LG Electronics)
     - 11-17-0734, "Doppler Discussions," Hongyuan Zhang (Marvell)
     - 11-17-0736, "HE Link Adaptation," Xiaogang Chen (Intel)
     - 11-17-0769, "CRs for 20MHz-only STA - Part 3," Sungeun Lee (Cypress)
     - 11-17-0773, "Thoughts on Doppler Design in 802.11ax," Lochan Verma (Qualcomm)
     - 11-17-0774, "CID 8975 resolution," Hongyuan Zhang (Marvell)
   - **MAC** — 28 submissions
     - 11-17-0073, "CR for 27.5.2.7 NDP feedback report," Laurent Cariou (Intel)
     - 11-17-0088, "Discussion for CR on 10.22.2.8 TXOP limits," Woojin Ahn (Wilus)
     - 11-17-0340, "CR for 11-1-3-10," Yonggang Fang (ZTE)
     - 11-17-0360, "LB225 CR for Subclause 27.3.3-Part 1," Ming Gan (Huawei Technologies)
     - 11-17-0389, "CIDs-for-27-2-1-part1," Kaiying Lv (ZTE)
     - 11-17-0553, "LB225 11ax D1.0 Comment Resolution 27.10.4 Part 1," Liwen Chu (Marvell)
     - 11-17-0576, "Resolutions for Comments related to Extended Range Beacon," Tomoko Adachi (Toshiba)
     - 11-17-0581, "LB225-MAC-CR-Miscellaneous," Alfred Asterjadhi (Qualcomm)
     - 11-17-0586, "lb225-cr-mac_miscellaneous_part2," Yongho Seok (Newracom)
     - 11-17-0602, "Misc 27_12," Alfred Asterjadhi (Qualcomm)
     - 11-17-0603, "Misc 27_15," Alfres Asterjadhi (Qualcomm)
     - 11-17-0604, "Misc RDP Control," Alfred Asterjadhi (Qualcomm)
     - 11-17-0607, "LB225-MAC-CR-Misc BSR Control," Alfred Asterjadhi (Qualcomm)
     - 11-17-0621, "CRs for Section 27.4 - part 2," George Cherian (Qualcomm)
     - 11-17-0677, "CRs for Section 9.3.1.9 block ack - part 2," George Cherian (Qualcomm)
     - 11-17-0688, "LB225 11ax D1.0 Comment Resolution 27.10.4 - Part II," Chittabrata Ghosh (Intel)

- 11-17-0702, "CR for CID 9574," Kaiying Lv (ZTE)
- 11-17-0727, "LB225 MAC CR for Clause 10-9," James Yee (MediaTek)
- 11-17-0729, "CR for CID 7250, 7251 and 7252," Kiseon Ryu (LG Electronics)
- 11-17-0730, "CR for CID 7255," Kiseon Ryu (LG Electronics)
- 11-17-0733, "Comment Resolution on TIM broadcast," Jason Yuchen Guo (Huawei Technologies)
- 11-17-0735, "CR to CID4850 and CID8153 on TWT," Jarkko Kneckt (Apple)
- 11-17-0744, "CR for 10.3.2.4 and 27.2.2 Part II," Po-Kai Huang (Intel)
- 11-17-0759, "Comment Resolution on CID 9333 and 9969," Jason Yuchen Guo (Huawei Technologies)
- 11-17-0765, "Follow up unify queue size report," Zhou Lan (Broadcom Limited)
- 11-17-0766, "Spec text unify queue size report," Zhou Lan (Broadcom Limited)
- 11-17-0775, "Non-HT definition," Matthew Fischer (Broadcom Limited)
- 11-17-0777, "CR TWT IE," Matthew Fischer (Broadcom Limited)

◦ **MU** — 1 submissions
- 11-17-0751, "Comment Resolution on retransmission of OFDMA random access," Yunbo Li (Huawei Technologies)

◦ **SR** — 5 submissions
- 11-17-0633, "CR 27.9 spatial reuse updates," Matthew Fischer (Broadcom Limited)
- 11-17-0640, "CR 27.2 SRG updates," Matthew Fischer (Broadcom Limited)
- 11-17-0669, "CR for CID 4928," Kaiying Lv (ZTE)
- 11-17-0724, "LBS2 various," Matthew Fischer (Broadcom Limited)
- 11-17-0748, "Supplementary instructions related to OBSS_PD spatial reuse Disallow / Prohibit," Sean Coffey (RealTek)

◦ **Others (covered in the TGax full sessions)** — 10 submissions
- 11-17-0112, "Link Transmit Power," Matthew Fischer (Broadcom Limited)
- 11-17-0123, "Link Transmit Power text," Matthew Fischer (Broadcom Limited)
- 11-17-0308, "BSS Load Information Element for 11ax," Frank Hsu (MediaTek)
- 11-17-0336, "CR for CID 8555 - Virtual CS during UL MU CS," Rojan Chitrakar (Panasonic)
- 11-17-0337, "Explanation of CR for CID 8555," Rojan Chitrakar (Panasonic)
- 11-17-0361, "BSS Load Information in 802.11ax," Ming Gan (Huawei Technologies)
- 11-17-0582, "OBSS_PD/TPC Examined," Graham Smith (SR Technologies)
- 11-17-0665, "Proposed Resolutions to CID 6901 and 7690," Osama Aboul-Magd (Huawei Technologies)
- 11-17-0707, "CR for CID 8555," Po-Kai Huang (Intel)
- 11-17-0711, "CR for PHY-CCA.indication," Rojan Chitrakar (Panasonic)

3. **Timeline discussion**
   TG discussed and updated the timeline.

Current Timeline		Modified Timeline	
May 2014	**Start of TG**	**May 2014**	**Start of TG**
November 2014	**First draft of the TG SFD approved**	**November 2014**	**First draft of the TG SFD approved**
January 2016	**Proposed TG draft**	**January 2016**	**Proposed TG draft**
March 2016	**Draft 0.1 was approved and Comment Collection started**	**March 2016**	**Draft 0.1 was approved and Comment Collection started**
November 2016	**Issue Draft 1.0 and start WG Letter Ballot**	**November 2016**	**Issue Draft 1.0 and start WG Letter Ballot**
September 2017	**Draft 2.0 and WG ~~Recirculation~~ Ballot**	**September 2017**	**Draft 2.0 and WG Letter Ballot**
May 2018	**Mandatory Draft Review**	**May 2018**	**Mandatory Draft Review**
May 2018	**Formation of Sponsor Ballot pool**	**May 2018**	**Formation of Sponsor Ballot pool**
November 2018	**Initial Sponsor Ballot**	**November 2018**	**Initial Sponsor Ballot**
July 2019	**RevCom submittal**	**July 2019**	**RevCom submittal**

Goals for the July 2017 session

- Continue with the resolution of comments on draft D1.0.

Teleconferences

TGax teleconferences are scheduled after the May 2017 session as follows:

Thursday	May 18th, 2017	20:00 - 22:00 (ET)
Thursday	May 25th, 2017	10:00 - 12:00 (ET)
Thursday	June 1st, 2017 June 15th, 2017	20:00 - 22:00 (ET)
Thursday	June 8th, 2017 June 22nd, 2017	10:00 - 12:00 (ET)
Monday Tuesday Wednesday Thursday	June 26th, 2017 June 27th, 2017 June 28th, 2017 June 29th, 2017	20:00 - 22:00 (ET) 10:00 - 12:00 (ET) 20:00 - 22:00 (ET) 10:00 - 12:00 (ET)
Thursday	July 20th, 2017	10:00 - 12:00 (ET)

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March 2017 — Vancouver, BC, Canada

TGax had 10 sessions during the week.
Six out of ten sessions were assigned to the ad hoc groups.

	Monday	Tuesday	Wednesday	Thursday
AM1			**TGax (full)**	
AM2		**TGax** (PHY ad hoc) **TGax** (MAC ad hoc)		
PM1	**TGax (full)**		**TGax** (MAC ad hoc) **TGax** (PHY ad hoc)	**TGax (full)**
PM2	**TGax** (MAC ad hoc) **TGax** (PHY ad hoc)	**TGax** (MAC ad hoc) **TGax** (PHY ad hoc)	**TGax** (MU/PHY ad hocs) **TGax** (MAC ad hoc)	**TGax (full)**
PM3		**TGax** (MAC ad hoc)		

Main documents

The meeting agenda and minutes of the TGax and its subgroups, and the TGax closing report can be found here.

- TGax
  - 11-17-0199-06, TGax March 2017 Meeting Agenda
  - 11-17-0454-00, IEEE 802.11 TGax March 2017 Vancouver Meeting Minutes
  - 11-17-0512-00, TGax March 2017 Closing Report

  - TGax PHY ad hoc group
    - 11-17-0464-02, TGax Ad Hoc PHY Session Mar 2017 Pre-Meeting Agenda
    - 11-17-0494-00, IEEE 802.11 TGax January 2017 Atlanta PHY Ad Hoc Meeting Minutes
  - TGax MAC ad hoc group

        - 11-17-0453-05, TGax MAC Ad-hoc March 2017 Meeting Agenda
        - 11-17-0155-01, March 2017 TGax MAC Ad hoc Meeting Minutes
    - TGax MU ad hoc group
        - 11-17-0485-01, TGax MU Ad Hoc Agenda - March 2017
        - 11-17-0495-00, March 2017 TGax MU Ad hoc Meeting Minutes
    - TGax SR ad hoc group
        - 11-17-0482-01, TGax SR Ad-hoc March 2017 Meeting Agenda
        - 11-17-0504-00, Spatial Reuse ad hoc group March 2017 minutes

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Achievements

1. **Work Completed**
    - Continued with the comment resolution on draft D1.0.
        - Very good progress during the ad hoc meeting and this meeting.
        - The TG Editor is planning to generate a new revision of the TG draft (D1.2) and a new revision of the status of the comment resolution.
    - Spatial Reuse issues were discussed at length.
        - Some progress on spatial reuse.
    - Agreed to hold an ad hoc meeting in Seoul, Korea, May 3-5.
        - PHY ad hoc meeting will be only for one day, Friday May 5.
2. **Technical Presentations**

    TGax received 48 submissions. All of the submissions are presented during the week.
    - **PHY** — 11 submissions
        - 11-17-0044, "NDP Feedback Report Design," Ron Porat (Broadcom)
        - 11-17-0078, "RBW of 11ax," Xiaogang Chen (Intel)
        - 11-17-0231, "CR_clause 28.3.5," Xiaogang Chen (Intel)
        - 11-17-0234, "CR_clause 28.3.19_28.3.20," Xiaogang Chen (Intel)
        - 11-17-0247, "CR HE PHY Introduction Part 4," Lochan Verma (Qualcomm)
        - 11-17-0261, "CR HE PHY Transmit Requirements HE_TRIG_PPDU Part 1," Lochan Verma (Qualcomm)
        - 11-17-0290, "CRs on TX specification," Yujin Noh (Newracom)
        - 11-17-0345, "LB225 CR on TXOP_DURATION (28.2.2)," Jeongki Kim (LG Electronics)
        - 11-17-0398, "11ax Comment Resolutions for HE Preamble," Yan Zhang (Marvell)
        - 11-17-0400, "CRs for 20MHz-only STA - Part 1," Sungeun Lee (Cypress)
        - 11-17-0404, "CR on Pre-HE preamble transmission for trigger based PPDU," Ross Jian Yu (Huawei)
        - 11-17-0414, "CR on clause 28-3-11 HE PHY data field," Tianyu Wu (MediaTek)
        - 11-17-0436, "LB225 Comment Resolution of CID 7517," Jianhan Liu (MediaTek)
    - **MAC** — 25 submissions
        - 11-17-0074, "Explanations for CR on 27.5.2.7," Laurent Cariou (Intel)
        - 11-17-0088, "Discussion for CR on 10.22.2.8 TXOP limits," Woojin Ahn (Wilus)
        - 11-17-0239, "LB225-MAC-CR-HT Control subclause 9.2.4.6.X and 10.1 - Block 2," Alfred Asterjadhi (Qualcomm)
        - 11-17-0240, "LB225-MAC-CR-HT Control subclause 9.2.4.6.X and 10.1 - Block 3," Alfred Asterjadhi (Qualcomm)
        - 11-17-0283, "lb225-mac-cr-9-3-1-23," Raja Banerjea (Qualcomm)
        - 11-17-0285 (not available), "LB225-MAC-CR-HE MCS_NSS resolutions," Alfred Asterjadhi (Qualcomm)
        - 11-17-0308, "CR for section 9.4.2 BSS load PPT," Frank Hsu (MediaTek)
        - 11-17-0319, "CR for Section 27.4," George Cherian (Qualcomm)
        - 11-17-0341, "LB225 11ax D1.0 Comment Resolution 10.13," Liwen Chu (Marvell)
        - 11-17-0344, "LB225 CR on EIFS and TXOP_DURATION (10.3.2.3.7 and 27.11.5)," Jeongki Kim (LG Electronics)
        - 11-17-0346, "LB225 CR on TXOP Truncation (10.22.2.9)," Jeongki Kim (LG Electronics)
        - 11-17-0347, "LB225 CR on Intra-PPDU PS (27.14.1)," Jeongki Kim (LG Electronics)
        - 11-17-0353, "LB225-CRs-on-OFDMA-based-random-access-Response," Suhwook Kim (LG Electronics)
        - 11-17-0359, "Comment resolution for CS Required subfield," Raja Banerjea (Qualcomm)
        - 11-17-0360, "LB225 CR for CID5917 and CID8165," Ming Gan (Huawei)
        - 11-17-0361, "BSS Load Information in 802.11ax," Ming Gan (Huawei)
        - 11-17-0362, "LB225 CR for Subclause 9.4.2.218.2," Ming Gan (Huawei)

- 11-17-0384, "LB225, Comment resolution for 10.24.10," Reza Hedayat (Newracom)
- 11-17-0389, "CIDs-for-27-2-1-part1," Kaiying Lv (ZTE)
- 11-17-0395, "LB225-CR-on-Pre-association," Ming Gan (Huawei)
- 11-17-0396, "Association Exchange using Contention based UL OFDMA," Ming Gan (Huawei)
- 11-17-0421, "cr-for-11.49-HE BSS operation," Chao-Chun Wang (MediaTek)
- 11-17-0443, "LB225-CRs-on-OFDMA-based-random-access-Figure," Suhwook Kim (LG Electronics)
- 11-17-0445, "CR on Per-TID All Ack in Multi-STA BlockAck Frame," Geonjung Ko (Wilus)
- 11-17-0448, "Proposed resolution for comments related to CIDs in 27.5.2," Jing Ma (NICT)

◦ **MU** — 9 submissions
- 11-17-0271, "CR for 17.2.2.1 and 17.3.9.10," Po-kai Huang (Intel)
- 11-17-0282, "11-17-xxxx-0x-00ax-lb225-mac-cr-number-of-ss-9-3-1-23," Raja Banerjea (Qualcomm)
- 11-17-0302, "D1.0 MAC Resolution CR for 27.5.2.4," Po-Kai Huang (Intel)
- 11-17-0325, "CR for 27.14.3 OPS," Laurent Cariou (Intel)
- 11-17-0335, "CR for CID 8142 - Random Access acronym," Rojan Chitrakar (Panasonic)
- 11-17-0338, "CR for 27.5.2.4 - Physical CS CIDs," Rojan Chitrakar (Panasonic)
- 11-17-0349, "LB225 CR for 25.5.2.4 Setting of CS Required Bit," Kiseon Ryu (LG Electronics)
- 11-17-0403, "CR-Subclause-27-5-3-MU-Cascading," David Xun Yang (Huawei)
- 11-17-0442, "LB225, CR CIDs 3215, 3216," Reza Hedayat (Newracom)

◦ **SR** — 10 submissions
- 11-16-1063, "Unified SR text DSC, ATPC, inter-BSS," Graham Smith (SR Technologies)
- 11-16-1476, "CR-for section-25-9-spatial-reuse-operation-for-HE-PPDU," Matthew Fischer (Broadcom)
- 11-17-0075, "SRP-based SR Summary and Update," Matthew Fischer (Broadcom)
- 11-17-0163, "DSC as OBSS_PD," Graham Smith (SR Technologies)
- 11-17-0267, "CR for 25.9.2.2 OBSS_PD Spatial reuse," Laurent Cariou (Intel)
- 11-17-0383, "Spatial Reuse Group Challenges," Reza Hedayat (Newracom)
- 11-17-0452, "LB225, CR for CID3222," Reza Hedayat (Newracom)
- 11-17-0455, "Some clarifications on current SR spec text," Laurent Cariou (Intel)
- 11-17-0458, "OBSS_PD: Threshold problems," Sean Coffey (RealTek)
- 11-17-0459 (not available), Kaiying Lv (ZTE)

◦ **Others (covered in the TGax full sessions)** — 5 submissions
- 11-17-0112, "Link Transmit Power," Matthew Fischer (Broadcom)
- 11-17-0328, "Link Adaptation Feedback for Combating Interference," Feng Jiang (InterDigital)
- 11-17-0334, "Proposed Text for Simulation Scenarios," Frank Hsu (MediaTek)
- 11-17-0369, "Some CIDs related to 20MHz operation," Guoqing Li (Apple)
- 11-17-0370, "Some CIDs related to 20MHz operation -- text," Guoqing Li (Apple)

3. **Timeline discussion**

TG discussed and updated the timeline.

Current Timeline		Modified Timeline	
May 2014	**Start of TG**	**May 2014**	**Start of TG**
November 2014	**First draft of the TG SFD approved**	**November 2014**	**First draft of the TG SFD approved**
January 2016	**Proposed TG draft**	**January 2016**	**Proposed TG draft**
March 2016	**Draft 0.1 was approved and Comment Collection started**	**March 2016**	**Draft 0.1 was approved and Comment Collection started**
November 2016	**Issue Draft 1.0 and start WG Letter Ballot**	**November 2016**	**Issue Draft 1.0 and start WG Letter Ballot**
May 2017	**Draft 2.0 and WG recirculation ballot**	**September 2017**	**Draft 2.0 and WG recirculation ballot**
November 2017	**Mandatory Draft Review**	**May 2018**	**Mandatory Draft Review**
January 2018	**Formstion of Sponsor Ballot pool**	**May 2018**	**Formation of Sponsor Ballot pool**
March 2018	**Initial Sponsor Ballot**	**November 2018**	**Initial Sponsor Ballot**
December 2018	**RevCom submittal**	**July 2019**	**RevCom submittal**

Goals for the May 2017 session

- Continue with the resolution of comments on draft D1.0.

Teleconferences

TGax teleconferences are scheduled after the March 2017 session as follows:

Thursday	March 23rd, 2017	20:00 - 22:00 (ET)
Thursday	March 30th, 2017	10:00 - 12:00 (ET)
Thursday	April 6th, 2017	20:00 - 22:00 (ET)
Thursday	April 13th, 2017	10:00 - 12:00 (ET)
Thursday	April 20th, 2017	20:00 - 22:00 (ET)
Thursday	April 27th, 2017	10:00 - 12:00 (ET)
Thursday	May 18th, 2017	20:00 - 22:00 (ET)
Thursday	May 25th, 2017	10:00 - 12:00 (ET)

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January 2017 — Atlanta, GA

TGax had 9 sessions during the week.
Three out of nine sessions were the ad hoc sessions of PHY and MAC ad hocs.

	Monday	Tuesday	Wednesday	Thursday
AM1			**TGax (full)**	
AM2	**TGax (full)**	**TGax (PHY ad hoc)** **TGax (MAC ad hoc)**		
PM1			**TGax (full)**	**TGax (full)**
PM2	**TGax (PHY ad hoc)** **TGax (MAC ad hoc)**	**TGax (PHY ad hoc)** **TGax (MAC ad hoc)**	**TGax (full)**	**TGax (full)**
PM3				

Main documents

The meeting agenda and minutes of the TGax and its subgroups, and the TGax closing report can be found here.

- TGax
  - 11-16-1587-05, TGax January 2017 Meeting Agenda
  - 11-17-0126-00, IEEE 802.11 TGax January 2017 Atlanta Meeting Minutes
  - 11-17-0179-00, TGax January 2017 Closing Report

  - TGax PHY ad hoc group
    - 11-17-0127-03, TGax PHY Ad Hoc Jan 2017 Meeting Agenda
    - IEEE 802.11 TGax January 2017 Atlanta PHY Ad Hoc Meeting Minutes

- TGax MAC ad hoc group
  - 11-17-0128-02, TGax MAC Ad Hoc January 2017 Meeting Agenda
  - 11-17-0155-00, IEEE 802.11 TGax, MAC Ad hoc January 2017 TGax MAC Ad hoc Meeting Minutes

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Achievements

1. **Work Completed**
   - The working group letter ballot #225 on the IEEE 802.11ax draft 1.0 was conducted from December 1st, 2016 to January 8th, 2017.
   - The 802.11ax draft 1.0 did *NOT* meet the requirement of >= 75% approval ratio.
   - Over 7300 comments received.
     - About 4700 out of 7300 comments are technical and general comments.
     - Assignment of comments is completed during the first session of the week.
   - The TG started discussing resolutions of comments submitted on draft D1.0.
     - Approximately 200 comments are resolved.
   - Spatial Reuse issues were discussed at length.
     - Slow progress on SRP-based SR.
   - Proposal to include simplified simulation models in the TG simulation scenarios document was discussed and passed straw poll.
   - Agreed to hold an ad hoc meeting in San Diego, from March 8th to 10th, 2017.
   - Vacant positions of ad hoc co-chairs are filled.

MAC	PHY	Multi-User (MU)	Spatial Reuse (SR)
Eric Wong (Apple)	Bo Sun (ZTE)	Sigurd Schelstraete (Quantenna)	Laurent Cariou (Orange)
Reza Hedayat (Newracom)	Jianhan Liu (MediaTek)	Kiseon Ryu (LG Electronics)	Guido R. Hiertz (Ericsson)
" open " → Chao-Chun Wang (MadiaTek)	Hongyuan Zhang (Marvell)	" open " → David Xun Yang (Huawei)	Jae Seung Lee (ETRI)

2. **Technical Presentations**

   TGax received 48 submissions. All of the submissions are presented during the week.
   - **PHY** — 11 submissions
     - 11-17-0044, "NDP Feedback Report Design," Ron Porat (Broadcom)
     - 11-17-0047, "lb225-cr-28_4_3," Yongho Seok (Newracom)
     - 11-17-0056, "CR HE PHY Capabilities_Part_1," Lochan Verma (Qualcomm)
     - 11-17-0060, "comment resolution for the CCA of preamble puncturing," Yunbo Li (Huawei)
     - 11-17-0072, "CID 6124 Resolution: Remove 2x LTF+08.us GI for UL Transmission," Jianhan Liu (MediaTek)
     - 11-17-0077, "Proposed changes to Draft 1.0," Xiaogang Chen (Intel)
     - 11-17-0078, "RBW of 11ax," Xiaogang Chen (Intel)
     - 11-17-0110, "Discussions on Signaling for UL HE MU PPDU," John Son (Wilus)
     - 11-17-0112, "Link Transmit Power," Mattew Fischer (Broadcom)
     - 11-17-0113, "Steering Vector Sanctity," Matthew Fischer (Broadcom)
     - 11-17-0114, "CID-Trigger frame_Part-1," Lochan Verma (Qualcomm)
   - **MAC** — 14 submissions
     - 11-17-0037, "Comment resolution for clause 10.28," Jarkko Kneckt (Apple)
     - 11-17-0045, "lb225-cr-27_11_4," Yongho Seok (Newracom)
     - 11-17-0046, "lb225-cr-27_6_4," Yongho Seok (Newracom)
     - 11-17-0073, "CR for 27.5.2.7 NDP feedback report," Laurent Cariou (Intel)
     - 11-17-0074, "Explanations for CR on 27.5.2.7," Laurent Cariou (Intel)
     - 11-17-0082, "comment resolution for subclause 11.2.2.8," Kaiying Lv (ZTE)
     - 11-17-0085, "CR for 9.2.5.2 and 9.2.5.7," Po-Kai Huang (Intel)
     - 11-17-0088, "CR on 10.22.2.8 TXOP limits," Woojin Ahn (Wilus)
     - 11-17-0089, "Discussion for CR on 10.22.2.8 TXOP limits," Woojin Ahn (Wilus)
     - 11-17-0104, "Discussion on CR for CID 5066," Dengyu Qiao (Huawei)

- 11-17-0115, "Comment resolution to clause 27.8," Jarkko Kneckt (Apple)
- 11-17-0116, "TWT Schedule Bitmap," Mattew Fischer (Broadcom)
- 11-17-0117, "Broadcast TWT TIM," Mattew Fischer (Broadcom)
- 11-17-0118, "Mandated Response MCS," Mattew Fischer (Broadcom)

- **Others (covered in the TGax full sessions)** — 13 submissions
  - 11-16-0947, "Proposed text changes for OBSS_PD-based SR parameters," Matthew Fischer (Broadcom)
  - 11-16-1063, "Unified SR text DSC, ATPC, inter-BSS," Graham Smith (SR Technologies)
  - 11-16-1363, "PAR Verification Through OFDMA," Suhwook Kim (LG Electronics)
  - 11-16-1476, "CR-for section-25-9-spatial-reuse-operation-for-HE-PPDU," Matthew Fischer (Broadcom)
  - 11-16-1567, "Proposal for DSC, ATPC, Inter-BSS with Responses to Comments," Graham Smith (SR Technologies)
  - 11-17-0032, "Proposal on Simulation Scenario Document for 11ax PAR verification," Suhwook Kim (LG Electronics)
  - 11-17-0075, "SRP-based SR Summary and Update," James Wang (MediaTek)
  - 11-17-0076, "Multiple BSS Simulations for PAR Verification," Frank Hsu (MediaTek)
  - 11-17-0081, "consideration of spatial reuse," Kaiying Lv (ZTE)
  - 11-17-0090, "11ax PAR Verification using UL MU-MIMO," Narendar Madhavan (Toshiba)
  - 11-17-0095, "Proposal on Simulation Scenario Document for 11ax PAR verification(doc)," Suhwook Kim (LG Electronics)
  - 11-17-0099, "Additional background for CID 8908," Sigurd Schelstraete (Quantenna)
  - 11-17-0102, "LB225 comments on Spatial Reuse," Sean Coffey (RealTek)

Goals for the March 2017 session

- Continue with the resolution of comments on draft D1.0.

Teleconferences

TGax teleconferences are scheduled after the January 2017 session as follows:

Thursday	February 2nd, 2017	10:00 - 12:00 (ET)
Thursday	February 16th, 2017	20:00 - 22:00 (ET)
Thursday	February 23rd, 2017	10:00 - 12:00 (ET)
Thursday	March 2nd, 2017	20:00 - 22:00 (ET)
Thursday	March 23rd, 2017	20:00 - 22:00 (ET)
Thursday	March 30th, 2017	10:00 - 12:00 (ET)
Thursday	April 6th, 2017	20:00 - 22:00 (ET)

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November 2016 — San Antonio, TX

TGax had 12 sessions during the week.
Six out of twelve sessions were the ad hoc sessions.

	Monday	Tuesday	Wednesday	Thursday
AM1	**TGax** (full, ad hoc)		**TGax (full)**	**TGax (full)**

	Monday	Tuesday	Wednesday	Thursday
AM2		**TGax** (PHY ad hoc) **TGax** (MAC ad hoc)		
PM1	**TGax (full)**		**TGax** (PHY ad hoc) **TGax** (MAC ad hoc)	**TGax (full)**
PM2	**TGax** (PHY ad hoc) **TGax** (MAC ad hoc)	**TGax** (MU ad hoc) **TGax** (SR ad hoc)	**TGax** (MU ad hoc) **TGax** (MAC ad hoc)	**TGax (full)**
PM3	**TGax** (MU ad hoc) **TGax** (SR ad hoc)			

Main documents

The meeting agenda and minutes of the TGax and its subgroups, and the TGax closing report can be found here.

- TGax
  - 11-16-1310-05, TGax November 2016 Meeting Agenda
  - 11-16-1466-01, IEEE 802.11 TGax November 2016 San Antonio Meeting Minutes
  - 11-16-1546-00, TGax November 2016 Closing Report

  - TGax PHY ad hoc group
    - 11-16-1475-03, TGax PHY Ad Hoc Nov 2016 Meeting Agenda
    - 11-16-1530-00, November 2016 San Antonio PHY Ad Hoc Meeting Minutes
  - TGax MAC ad hoc group
    - 11-16-1478-02, TGax MAC Ad Hoc November 2016 Meeting Agenda
    - 11-16-1480-01, November 2016 TGax MAC Ad hoc Meeting Minutes
  - TGax Multi-User (MU) ad hoc group
    - 11-16-1487-01, TGax MU Ad-hoc Agenda November 2016
    - 11-16-1520-00, IEEE 802.11 TGax, MU Ad hoc September 2016 TGax Meeting Minutes
  - TGax Spatial Reuse (SR) ad hoc group
    - 11-16-1481-02, 802.11ax Spatial Reuse Ad Hoc Group Agenda
    - 11-16-1569-00, TGax Spatial Reuse ad hoc group meeting minutes - San Antonio, November 2016

Achievements

1. **Work Completed**
   - The TG completed the discussion of all the submissions received.
   - Completed resolution of most of the comments received on draft D0.1.
   - Passed a motion to prepare draft D1.0 and start 30-day WG LB.
2. **Technical Presentations**

   TG received 90 submissions which are classified into PHY, MAC, MU, SR and TG submimssions.
   - **PHY** — 29 submissions
     - 11-16-1295, "CC23 PHY CR Miscellaneous Part-1," Yongho Seok (Newracom)
     - 11-16-1340, "CR HE-PHY Miscellaneous Part-3," Lochan Verma (Qualcomm)
     - 11-16-1341, "CR HE-PHY-Introduction-Part-2," Lochan Verma (Qualcomm)
     - 11-16-1356, "Spec text for HE NDP," Yongho Seok (Newracom)
     - 11-16-1370, "Proposed Spec Text for CCA Section," Laurent Cariou (Intel)
     - 11-16-1371, "CR HE-SIG-B part III," Ross Jian Yu (Huawei)
     - 11-16-1372, "Some proposed changes to D0.5," Ross Jian Yu (Huawei)
     - 11-16-1374, "Resolution on CID495 and Removal of Unnecessary PHY TBDs," Yujin Noh (Newracom)
     - 11-16-1375, "Comment Resolution for CID2867 and Text Change Proposal of 26.3.10.8 HE-SIG-B," Yujin Noh (Newracom)
     - 11-16-1377, "Comment resolution on Clauses 26.3.9 and 26.3.10," Yusuke Asai (NTT)
     - 11-16-1387, "Comment resolution on CID2506 and proposed changes," Jinsoo Chio (LG Electronics)
     - 11-16-1393, "EVM Definition for UL OFDMA," Ron Porat (Broadcom)
     - 11-16-1398, "CR for CID 2077," Sriram Venkateswaran (Broadcom)

- 11-16-1399, "Changes to D0.5," Sriram Venkateswaran (Broadcom)
- 11-16-1402, "11ax Receiver Specification," Bin Tian (Qualcomm)
- 11-16-1406, "Spec Text for 11ax Receiver Requirements," Bin Tian (Qualcomm)
- 11-16-1407, "Changes to D0.5," Xiaogang Chen (Intel)
- 11-16-1408, "PHY CRs 26.3.3,26.3.18,26.3.19," Xiaogang Chen (Intel)
- 11-16-1410, "Clause 26 Fixes," Hongyuan Zhang (Marvell)
- 11-16-1411, "TXTIME and RXTIME Fixes," Hongyuan Zhang (Marvell)
- 11-16-1421, "Smoothness Recommendation for 4x HE-LTF," Feng Jiang (Intel)
- 11-16-1427, "Remove TBDs in PHY Transmit Spec.," Yujin Noh (Newracom)
- 11-16-1434, "Miscellaneous HE PHY corrections," Lochan Verma (Qualcomm)
- 11-16-1437, "Updated Text for DCM," Jianhan Liu (MediaTek)
- 11-16-1438, "0.8us GI with 4x HE LTF," Jianhan Liu (MediaTek)
- 11-16-1439, "Error correction to D0.5_on Beam-change text," Jianhan Liu (MediaTek)
- 11-16-1443, "Spec text: Smoothness Recommendation for HE-LTF," Feng Jiang (Intel)
- 11-16-1448, "Remaining CR on secition-26-2-2 TXRXVECTOR Parameters," Ke Yao (ZTE)
- 11-16-1449, "Proposed Text Changes to TXRXVECTOR in Clause 26.2.2," Ke Yao (ZTE)

◦ **MAC** — 36 submissions
- 11-16-1238, "Setting Quiet time period - text," Chao-Chun Wang (MediaTek)
- 11-16-1352, "CC23 MAC CR Miscellaneous Part-1," Yongho Seok (Newracom)
- 11-16-1354, "CC23 CR Annex C," Yongho Seok (Newracom)
- 11-16-1355, "Spec text for 10.22.2.5 and 3.2," Yongho Seok (Newracom)
- 11-16-1358, "CC0-Remaining CIDs on BA," Alfred Asterjadhi (Qualcomm)
- 11-16-1359, "CC0-Some remaining CIDs related to TWT," Alfred Asterjadhi (Qualcomm)
- 11-16-1360, "CC0-HE variant HT control - Some Remaining CIDs," Alfred Asterjadhi (Qualcomm)
- 11-16-1362, "CC0-Complete RTS Enablement," Alfred Asterjadhi (Qualcomm)
- 11-16-1367, "NDP feedback report," Laurent Cariou (Intel)
- 11-16-1368, "Follow-up on MU EDCA parameters," Laurent Cariou (Intel)
- 11-16-1380, "Proposed text changes for TWT in congested environment," Laurent Cariou (Intel)
- 11-16-1381, "Proposed text changes for fragmentation operation," Laurent Cariou (Intel)
- 11-16-1404, "Early TWT SP Termination in TWT Operation," Jayh hyunhee Park (LG Electronics)
- 11-16-1409, "A-MSDU Fragmentation," Matthew Fischer (Broadcom)
- 11-16-1413, "CID 193 BSS Color Disabled Indication," Abhishek Patil (Qualcomm)
- 11-16-1415, "CID 72 BSS Color change mechanism," Abhishek Patil (Qualcomm)
- 11-16-1416, "CC0-HE BSS operation11-16-xxxx-00-00ax-CC0-HE BSS operation," Alfred Asterjadhi (Qualcomm)
- 11-16-1417, "CC0-HE BSS operation," Alfred Asterjadhi (Qualcomm)
- 11-16-1418, "CC0-HE Multirate Support and 2G4 40MHz HE STA," Alfred Asterjadhi (Qualcomm)
- 11-16-1419, "MCS_NSS_BW_PPDU_Selection_for_11ax," Alfred Asterjadhi (Qualcomm)
- 11-16-1420, "TWT Information frames in 11ax," Alfred Asterjadhi (Qualcomm)
- 11-16-1423, "NAV Update Rule Considering UL MU Operation," Geonjung Ko (WILUS)
- 11-16-1424, "Issue on the CWmax value in MU EDCA," Woojin Ahn (WILUS)
- 11-16-1425, "Clarification on applying MU EDCA parameter set," Woojin Ahn (WILUS)
- 11-16-1431, "IEEE 802.11ax Annex G," Osama Aboul-Magd (Huawei Technologies)
- 11-16-1442, "Spec texts for section 25.4 BA," Jeongki Kim (LG Electronics)
- 11-16-1452, "Multiple BSSID and MU," Liwen Chu (Marvell)
- 11-16-1453, "A-MPDU content," Liwen Chu (Marvell)
- 11-16-1454, "Multiple BSSID and MU Discussion," Liwen Chu (Marvell)
- 11-16-1456, "A-MPDU content discussion," Liwen Chu (Marvell)
- 11-16-1458, "Comment Resolution for Sub-clause 25.13.2," Chittabrata Ghosh (Intel)
- 11-16-1459, "Considerations on Quiet Time Period," Jinsoo Ahn (Yonsei Univ.)
- 11-16-1461, "MU BAR comment resolutions," Reza Hedayat (Newracom)
- 11-16-1464, "RD Protocol," Jarkko Kneckt (Apple)
- 11-16-1468, "A-MPDU Content Capabilities," Raja Banerjea (Qualcomm)
- 11-16-1477, "CC23 Proposed Resolution (Update for) TWT Element," Matthew Fischer (Broadcom)

◦ **Multi-User (MU)** — 12 submissions

        - 11-16-1353, "CC23 MAC CR Miscellaneous Part-2," Yongho Seok (Newracom)
        - 11-16-1357, "CC0 Remaining CIDs on sounding," Alfred Asterjadhi (Qualcomm)
        - 11-16-1361, "CC0- Remaining CIDs on MU Operation," Alfred Asterjadhi (Qualcomm)
        - 11-16-1382, "MAC support of preamble puncture," Zhou Lan (Broadcom)
        - 11-16-1383, "Spec Text: MAC support of preamble puncture," Zhou Lan (Broadcom)
        - 11-16-1389, "Comment Resolution for CID 807," Po-Kai Huang (Intel)
        - 11-16-1390, "Spec Text: Revision for NAV Setting Rule under Immediate Response," Po-Kai Huang (Intel)
        - 11-16-1391, "Comment Resolution Random Access miscellaneous," Young Hoon Kwon (Newracom)
        - 11-16-1392, "Comment Resolution CID 2624 and 2738," Young Hoon Kwon (Newracom)
        - 11-16-1426, "DL/UL indication in MU-RTS," Woojin Ahn (WILUS)
        - 11-16-1441, "Consideration on Internal Contention Between Data and Trigger Frame," Jing Ma (NICT)
        - 11-16-1457, "11ax D0.1 Comment Resolution for Clause 25.5.3," David Xun Yang (Huawei)
    - **Spatial Reuse (SR)** — 9 submissions
        - 11-16-0947, "Proposed text changes for OBSS_PD-based SR parameters," Matthew Fischer (Broadcom)
        - 11-16-1063, "Unified SR text DSC, ATPC, inter-BSS," Graham Smith (SR Technologies)
        - 11-16-1064, "Unified SR approach DSC, ATPC and Inter-BSS," Graham Smith (SR Technologies)
        - 11-16-1121, "Spec Texts: Spatial Reuse Indication for Trigger," Po-Kai Huang (Intel)
        - 11-16-1337, "CR on SR CCA rules clause 25.9," Bo Sum (ZTE)
        - 11-16-1403, "SR Backoff Procedure," Jayh Hyunhee Park (LG Electronics)
        - 11-16-1430, "Comment Resolution for SR on BSS Color," Junichi Iwatani (NTT)
        - 11-16-1440, "Proposed Resolutions to CID 2719," Jing Ma (NICT)
        - 11-16-1450, "CR for CID 2492 section 25.9 spatial reuse operation," Kaiying Lv (ZTE)
    - **Others (covered in the TGax full sessions)** — 4 submissions
        - 11-16-0995, "Editor's report," Robert Stacy (Intel)
        - 11-16-1363, "11ax PAR Verification through OFDMA," Suhwook Kim (LG Electronics)
        - 11-16-1414, "Verifying 11axfs PAR by UL MU-MIMO," Jason Yuchen Guo (Huawei)
        - 11-16-1435, "PAR Verification Simulation Followup," James Yee (MediaTek)

Timeline

TG discussed the timeline. No changes since last update.

Current Timeline	
May 2014	**Start of TG**
November 2014	**First draft of the TG, SFD approved**
January 2016	**Proposed TG draft**
March 2016	**Draft 0.1 was approved and CC started**
November 2016	**Issue Draft 1.0 and start WG Letter Ballot**
May 2017	**Draft 2.0 and WG recirculation ballot**
November 2017	**Mandatory Draft Review**
January 2018	**Formation of Sponsor Ballot pool**
March 2018	**Initial Sponsor Ballot**
December 2018	**RevCom submittal**

Goals for the January 2017 session

- Start Comment Resolutions on the IEEE 802.11ax draft D1.0.

Teleconferences

Weekly teleconferences are scheduled after the November 2016 session.

Thursday	December 1st, 2016	21:00 - 23:00 (ET)
Thursday	December 8th, 2016	21:00 - 23:00 (ET)
Thursday	December 15th, 2016	21:00 - 23:00 (ET)
Tuesday	January 5th, 2017	11:00 - 13:00 (ET)
Thursday	January 12th, 2017	20:00 - 22:00 (ET)

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September 2016 — Warsaw, Poland

The TGax had 11 sessions during the week.
Six out of eleven sessions were assigned to the ad hoc group sessions.

	Monday	Tuesday	Wednesday	Thursday
AM1			**TGax (full)**	
AM2	**TGax (full)**	**TGax** (MU ad hoc) **TGax** (MAC ad hoc)		**TGax (full)**
PM1			**TGax** (PHY ad hoc) **TGax** (MAC ad hoc)	**TGax (full)**
PM2	**TGax** (PHY ad hoc) **TGax** (MAC ad hoc)	**TGax** (PHY ad hoc) **TGax** (MAC ad hoc)	**TGax** (MU ad hoc) **TGax** (MAC ad hoc)	**TGax (full)**
PM3	**TGax** (PHY ad hoc) **TGax** (SR ad hoc)			

Main documents

The meeting agenda and minutes of the TGax and its subgroups, and TGax closing report can be found here.

- TGax
  - 11-16-1077-06, TGax September 2016 Meeting Agenda
  - 11-16-1231-00, IEEE 802.11 TGax September 2016 Warsaw Meeting Minutes
  - 11-16-1284-00, TGax September 2016 Closing Report
  - TGax PHY ad hoc group
    - 11-16-1246-06, TGax PHY Ad Hoc Sep 2016 Meeting Agenda
    - 11-16-1276-00, IEEE 802.11 TGax September 2016 Warsaw PHY Ad Hoc Meeting Minutes
  - TGax MAC ad hoc group
    - 11-16-1247-02, TGax MAC Ad Hoc September 2016 Meeting Agenda
    - 11-16-1252-01, IEEE 802.11 TGax, MAC Ad hoc September 2016 Warsaw TGax MAC Ad hoc Meeting Minutes
  - TGax Multi-User (MU) ad hoc group
    - 11-16-1244-01, TGax MU Ad-hoc Agenda September 2016
    - 11-16-1275-00, IEEE 802.11 TGax, MU Ad hoc September 2016 TGax Meeting Minutes
  - TGax Spatial Reuse (SR) ad hoc group
    - 11-16-1245-02, TGax Spatial Reuse Ad-hoc Agenda September 2016 Meeting
    - 11-16-1300-00, TGax Spatial Reuse ad hoc group meeting minutes — Warsaw, September 2016

Achievements

1. **Work Completed**
   - TG received 90 submissions.
     - Number of submissions: PHY/MAC/MU/SR/TG = 28/43/12/9/6.
       The TG completed the discussion of all the submissions.
       Exact count of resolved CIDs will be published by the Editor.
   - The TG editor is planning to have draft revision D0.5 ready based on resolved comments.
2. **Technical Presentations**

   TG received 90 submissions which are categorized into PHY, MAC, MU, SR and TG.
   - **PHY** — 28 submissions
     - 11-16-1133, "11ax sounding modes reduction," Yan Zhang (Marvell)
     - 11-16-1134, "11ax spec text on sounding modes reduction," Yan Zhang (Marvell)
     - 11-16-1135, "11ax comment resolutions for clause 26.3.5," Yan Zhang (Marvell)
     - 11-16-1136, "11ax comment resolutions for clause 26.3.8," Yan Zhang (Marvell)
     - 11-16-1137, "11ax comment resolutions for clause 26.3.9," Yan Zhang (Marvell)
     - 11-16-1138, "11ax comment resolutions for clause 26.3.10," Yan Zhang (Marvell)
     - 11-16-1148, "CR HE-SIG-A part III," Ross Jian Yu (Huawei)
     - 11-16-1149, "CR HE-SIG-A part II," Ross Jian Yu (Huawei)
     - 11-16-1150, "CR Packet Extension part I," Ross Jian Yu (Huawei)
     - 11-16-1160, "Comment Resolution for CID 355," Eunsung Park (LG Electronics)
     - 11-16-1167, "UL MU Clarifications," Ron Porat (Broadcom)
     - 11-16-1168, "DCM TBDs," Sriram Venkateswaran (Broadcom)
     - 11-16-1169, "CR Duplicate MU MIMO," Sriram Venkateswaran (Broadcom)
     - 11-16-1170, "HE PHY Capabilities," Lochan Verma (Qualcomm)
     - 11-16-1171, "PHY Miscellaneous Part-1," Lochan Verma (Qualcomm)
     - 11-16-1176, "PHY CR Miscellaneous Part-2," Lochan Verma (Qualcomm)
     - 11-16-1179, "PHY section editorial comments on D0.4," Sungeun Lee (Cypress)
     - 11-16-1190, "Tx Quality Requirements," Daewon Lee (Newracom)
     - 11-16-1191, "Comment Resolution for CIDs on PHY Transmit Spec," Daewon Lee (Newracom)
     - 11-16-1192, "Comment Resolution for CID 1450," Daewon Lee (Newracom)
     - 11-16-1193, "HE variant HT Control - HE Link Adaptation," Daewon Lee (Newracom)
     - 11-16-1194, "Removal of Unnecessary PHY TBDs," Daewon Lee (Newracom)
     - 11-16-1202, "CR HE-LTF," Ming Gan (Huawei)
     - 11-16-1227, "cr-on-26-3-7," Shahrnaz Azizi (Intel)
     - 11-16-1232, "Text change proposal of TXTIME in 26.3.19 and 26.4.3," Daewon Lee (Newracom)
     - 11-16-1233, "CR for DCM related CID 503, 504 and 2750," Daewon Lee (Newracom)
     - 11-16-1240, "Packet Extension Factor calculation fix," Yan Zhang (Marvell)
     - 11-16-1242, "spec text for packet extension factor calculation fix," Yan Zhang (Marvell)
   - **MAC** — 43 submissions
     - 11-16-0864, "Comment Resolutions on Clause 6 & 8 comments," Yasuhiko Inoue (NTT)
     - 11-16-0869, "Misc. TWT comment resolution," Zhou Lan (Broadcom)
     - 11-16-0881, "Comment resolution on ROMI," Jayh Park (LG Electronics)
     - 11-16-0882, "Comment resolution on TOMI," Alfred Asterjadhi (Qualcomm)
     - 11-16-0883, "Comment resolution for CID152," JayhPark (LG Electronics)
     - 11-16-0884, "Spec. Text for HE Operation element and AID Assign Rule," Jianhan Liu (MediaTek)
     - 11-16-0913, "SU Multi-TID Rules," Jarkko Kneckt (Apple)
     - 11-16-0917, "Text for TID value of ALL ACK signaling," Woojin Ahn (WILUS)
     - 11-16-0918, "Discussions on Partial BSS Color," Geonjung Ko (WILUS)
     - 11-16-0924, "NAV resetting with RTS/MU-RTS," Weiming Xing (ZTE)
     - 11-16-0925, "Spec text on NAV resetting with RTS/MU-RTS," Weiming Xing (ZTE)
     - 11-16-0941, "CR HE Fragmentation - part 2," Ming Gan (Huawei)
     - 11-16-0942, "CR Service Field," Ming Gan (Huawei)
     - 11-16-0960, "AP access procedure for UL MU operation," Jinsoo Ahn (Yonsei Univ.)

- 11-16-0961, "Consideration on Multi-STA BlockAck Optimization," Hanseul Hong (Yonsei Univ.)
- 11-16-0962, "EDCA rules-follow up 1," Jing Ma (NICT)
- 11-16-0963, "EDCA rules-follow up 2," Jing Ma (NICT)
- 11-16-0998, "Rules for 2 EDCA parameters," Laurent Cariou (Intel)
- 11-16-1110, "Comment Resolution on subclause 10.22.2 and 10.22.4," Yongho Seok (Newracom)
- 11-16-1131, "Comment Resolution on MU Ack Policy," Yongho Seok (Newracom)
- 11-16-1154, "MAC CR for CID 966," Weiming Xing (ZTE)
- 11-16-1157, "Comment resolution on SU_MU ACK procedures," Jeongki Kim (LG Electronics)
- 11-16-1173, "Comment Resolution on Two NAVs - Part II," Po-Kai Huang (Intel)
- 11-16-1180, "Proposed text changes for MU EDCA parameters," Laurent Cariou (Intel)
- 11-16-1181, "CW value after UL MU procedure," Woojin Ahn (WILUS)
- 11-16-1182, "HE Sounding Feedback Segmentation," Liwen Chu (Marvell)
- 11-16-1183, "MU RTS CTS data rate comment," Liwen Chu (Marvell)
- 11-16-1184, "A-MPDU 25.10 25.10.2 comment resolution," Liwen Chu (Marvell)
- 11-16-1185, "A-MPDU 25.10.3 comment resolution," Liwen Chu (Marvell)
- 11-16-1186, "A-MPDU Content Comment Resolution," Liwen Chu (Marvell)
- 11-16-1188, "MAC Capabilities in HE Capabilities IE," Alfred Asterjadhi (Qualcomm)
- 11-16-1189, "CC0-TWT operation," Alfred Asterjadhi (Qualcomm)
- 11-16-1195, "MAC Clarifications," Alfred Asterjadhi (Qualcomm)
- 11-16-1204, "Intra-PPDU Power Save for a Multiple BSSID Set Case," Geonjung Ko (Wilus)
- 11-16-1205, "Text for Intra-PPDU Power Save for a Multiple BSSID Set Case," Geonjung Ko (Wilus)
- 11-16-1210, "Comment Resolution on MU acknowledgement procedure," Junichi Iwatani (NTT)
- 11-16-1211, "CR_CID_122_576_972_2598," Huizao Wang (Quantenna)
- 11-16-1213, "CR TWT and HE element related," Matthew Fischer (Broadcom)
- 11-16-1220, "MU mode EDCA control," Jinsoo Ahn (Yonsei Univ.)
- 11-16-1234, "Spec Text for TWT Protection field," Hanseul Hong (Yonsei Univ.)
- 11-16-1236, "Text for Partial BSS Color and AID Assignment Rule," Geonjung Ko (Wilus)
- 11-16-1237, "Setting Quiet Time Period," Chao-Chun Wang (MediaTek)
- 11-16-1238, "Setting Quiet Time Period - text," Chao-Chun Wang (MediaTek)

◦ **Multi-User (MU)** — 12 submissions
- 11-16-0773, "Comment Resolution Section 25.6 HE Sounding," Raja Banerjea (Qualcomm)
- 11-16-0929, "CR - UL MU Operation," Simone Merlin (Qualcomm)
- 11-16-1152, "DL OFDMA Ack rule for uplink trigger based PPDU," Ming Gan (Huawei)
- 11-16-1158, "Comment resolution on OFDMA random access procedure," Jeongki Kim (LG Electronics)
- 11-16-1162, "Comment Resolution on Retransmission of OFDMA Random Access," Yunbo Li (Huawei)
- 11-16-1163, "Concluding OFDMA M-BA transmission," Zhou Lan (Broadcom)
- 11-16-1177, "comment-resolution-TXOP-truncation," Young Hoon Kwon (Newracom)
- 11-16-1199, "Proposed text changes for DL OFDMA Acknowledge rule for trigger based PPDU," Ming Gan (Huawei)
- 11-16-1222, "Comment Resolution on UL OFDMA Random Access," Chittabrata Ghosh (Intel)
- 11-16-1224, "Random Access Parameter Set (RAPS) element," Chittabrata Ghosh (Intel)
- 11-16-1239, "Trigger Frame MU BAR part 1," Raja Banerjea (Qualcomm)
- 11-16-1241, "Trigger Frame MU BAR part 2," Raja Banerjea (Qualcomm)

◦ **Spatial Reuse (SR)** — 9 submissions
- 11-16-0945, "Clarification for OBSS_PD-based SR parameters," Matthew Fischer (Broadcom)
- 11-16-0947, "Proposed text changes for OBSS_PD-based SR parameters," Laurent Cariou (Intel)
- 11-16-1064, "Unified SR approach DSC, ATPC and Inter-BSS," Graham Smith (SR Technologies)
- 11-16-1155, "SR Comment Resolution for CID994," Kaiying Lv (ZTE) - not available
- 11-16-1161, "Simulation-based evaluation of OBSS_PD-based SR default parameters," Tanguy Ropitault (NIST)
- 11-16-1178, "comment-resolution-SR-RSSI," Young Hoon Kwon (Newracom)
- 11-16-1216, "SR Field SRP Table for HE-Trigger-Based PPDU," James Wang (MediaTek)
- 11-16-1223, "CR for Section 25.9.2 OBSS_PD Spatial reuse," Laurent Cariou (Intel)
- 11-16-1225, "Heads We Win, Tails We Don't Lose: Proposals for Dynamic CCA," Sean Coffey (RealTek)

◦ **Others (covered in the TGax full session)** — 6 submissions
- 11-15-1095, "OFDMA performance in 11ax," Suhwook Kim (LG Electronics)

- 11-16-1143, "11ax PAR Verification," Paul Cheng (MediaTek)
- 11-16-1159, "Summary of Mandatory or Optional Features of 802.11ax," Joonsuk Kim (Apple)
- 11-16-1166, "Meeting PAR requirements with UL OFDMA," Sriram Venkateswaran (Broadcom)
- 11-16-1198, "Preliminary 11ax PAR Verification," Jiyong Pang (Huawei)
- 11-16-1219, "Considerations on CR for 2665 and 2715," Jing Ma (NICT)

3. **Timeline discussion**
   TG discussed and updated the timeline.

Current Timeline		Modified Timeline	
May 2014	**Start of TG**	**May 2014**	**Start of TG**
November 2014	**First draft of the TG SFD approved**	**November 2014**	**First draft of the TG SFD approved**
January 2016	**Proposed TG draft**	**January 2016**	**Proposed TG draft**
March 2016	**Draft 0.1 was approved and CC started**	**March 2016**	**Draft 0.1 was approved and CC started**
September 2016	**Issue Draft 1.0 and start WG Letter Ballot**	**November 2016**	**Issue Draft 1.0 and start WG Letter Ballot**
March 2017	**Draft 2.0 and WG recirculation ballot**	**May 2017**	**Draft 2.0 and WG recirculation ballot**
November 2017	**Mandatory Draft Review and formstion of Sponsor Ballot pool**	**January 2018**	**Mandatory Draft Review and formation of Sponsor Ballot pool**
March 2018	**Initial Sponsor Ballot**	**March 2018**	**Initial Sponsor Ballot**
December 2018	**RevCom submittal**	**December 2018**	**RevCom submittal**

Goals for the November 2016 session

- Continue with comment resolutions.
- Prepare draft 1.0 and start WG letter ballot.

Teleconferences

TGax teleconferences are scheduled after the September 2016 session as follows.

Thursday	September 29th, 2016	10:00 - 12:00 (ET)
Thursday	October 20th and 27th, 2016	10:00 - 12:00 (ET)
Thursday	October 30th, 2016	20:00 - 22:00 (ET)
Thursday	November 17th, 2016	10:00 - 12:00 (ET)

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July 2016 — San Diego, CA

The TGax had 11 sessions during the week.
Six out of eleven sessions were assigned to the ad hoc group sessions.

	Monday	Tuesday		Wednesday	Thursday
AM1	**TGax** (full, ad hoc)			**TGax** (full)	
AM2		**TGax** (PHY ad hoc)	**TGax** (MAC ad hoc)		**TGax** (full)

	Monday	Tuesday		Wednesday		Thursday
PM1				**TGax** (PHY ad hoc)	**TGax** (MAC ad hoc)	**TGax** (full)
PM2	**TGax** (full)	**TGax** (MU ad hoc)	**TGax** (SR ad hoc)	**TGax** (full)		
PM3		**TGax** (PHY ad hoc)	**TGax** (MAC ad hoc)			

Main documents

The meeting agenda and minutes of the TGax and its subgroups, and TGax closing report can be found here.

- TGax
  - 11-16-0779-06, TGax July 2016 Meeting Agenda
  - 11-16-0967-00, IEEE 802.11 TGax July 2016 San Diego Meeting Minutes
  - 11-16-1051-00, TGax July 2016 Closing Report

  - TGax PHY ad hoc group
    - 11-16-1007-03, TGax PHY Ad Hoc July 2016 Meeting Agenda
    - 11-16-1040-00, IEEE 802.11 TGax July 2016 San Diego PHY Ad Hoc Meeting Minutes
  - TGax MAC ad hoc group
    - 11-16-0997-01, TGax MAC Ad Hoc July 2016 Meeting Agenda
    - 11-16-1000-02, July 2016 San Diego TGax MAC Ad hoc Meeting Minutes
  - TGax Multi-User (MU) ad hoc group
    - 11-16-1012-00, TGax MU Ad-hoc Agenda July 2016
    - 11-16-1027-00, IEEE 802.11 TGax, MU Ad hoc July 2016 Meeting Minutes
  - TGax Spatial Reuse (SR) ad hoc group
    - 11-16-1016-01, 802.11ax Spatial Reuse Ad Hoc Group Agenda
    - 11-16-1022-00, TGax Spatial Reuse ad hoc group meeting minutes

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Achievements

1. **Work Completed**
   - TGax received about 90 submissions.
     - Number of submissions: PHY/MAC/MU/SR/TG = 26/34/12/10/8.

     Most of the submissions are proposed resolutions for the comments on the draft 0.1.
     A number of submissions were proposing new text to be added to the draft.
     - A long list of submissions are yet to be considered.
   - Approved the resolutions of about 230 comments discussed during telecons.
     - Exact count of resolved CIDs will be published by the Editor.
     - The TG editor is planning to have draft revision D0.3 ready based on resolved comments.
2. **Technical Presentations**

   Here is the list of 90 submissions.
   - **PHY** — 26 submissions
     - 11-16-0816, "Comment Resolution for CID 2183," Daewon Lee (Newracom)
     - 11-16-0872, "CR HE-SIG-A Part II," Ross Jian Yu (Huawei Technologies)
     - 11-16-0873, "CR HE-SIG-A Part I," Ross Jian Yu (Huawei Technologies)
     - 11-16-0891, "LDPC for 1024QAM," Hongyuan Zhang (Marvell)
     - 11-16-0892, "Spec Text on LDPC for 1024QAM," Hongyuan Zhang (Marvell)
     - 11-16-0893, "11ax Extended Range PPDU," Bin Tian (Qualcomm)
     - 11-16-0894, "HE-LTF Capabilities," Hongyuan Zhang (Marvell)
     - 11-16-0895, "Spec Text for HE-LTF Capabilities," Hongyuan Zhang (Marvell)
     - 11-16-0896, "11ax Beamformee Capabilities," Hongyuan Zhang (Marvell)
     - 11-16-0897, "Spec Text for Beamformee Capabilities," Hongyuan Zhang (Marvell)

- 11-16-0898, "BW Field in HE-MU Format," Hongyuan Zhang (Marvell)
- 11-16-0899, "Spec Text for BW Field in HE-MU Format," Hongyuan Zhang (Marvell)
- 11-16-0900, "PHY Comment Resolution for CID 1052 and 2519," Bin Tian (Qualcomm)
- 11-16-0903, "Gamma phase rotation for HE PPDU," Yujin Noh (Newracom)
- 11-16-0904, "Proposed text for gamma phase rotation for HE PPDU," Yujin Noh (Newracom)
- 11-16-0906, "RU restriction on 20MHz operating STAs," Joonsuk Kim (Apple)
- 11-16-0908, "CR - proposed text on RU restriction of 20MHz STAs," Joonsuk Kim (Apple)
- 11-16-0910, "Minimum Occupied Bandwidth," Ron Porat (Broadcom)
- 11-16-0914, "Bit field finalization of HE-SIG-A," Lochan Verma (Qualcomm)
- 11-16-0915, "Text for bit field finalization of HE-SIG-A," Lochan Verma (Qualcomm)
- 11-16-0920, "PHY comment resolution for CID 1659,493,494," Xiaogang Chen (Intel)
- 11-16-0922, "PHY CR 1024 QAM," Sriram Venkateswaran (Broadcom)
- 11-16-0923, "PHY CR DCM Constellation Mapping," Sriram Venkateswaran (Broadcom)
- 11-16-0928, "CR on Section 26.3.9.8 - HE-SIG-B," Kaushik Josiam
- 11-16-0937, "11ax Comment Resolutions for Clauses 26.3.2-26.3.9.3-26.3.9.4-26.3.9.5-26.3.10.2- 26.3.10.13," Rui Cao (Marvell)
- 11-16-0964, "Considerations on MAC-PHY interactions during SR operations," Jing Ma (NICT)

- **MAC** — 34 submissions
  - 11-16-0828, "HE Fragmentation - part 1," Alfred Asterjadhi (Qualcomm)
  - 11-16-0829, "Comment Resolution for Section 10.24.10 Block Ack/GCR block ack," Reza Hedayat (Newracom)
  - 11-16-0844, "CC0-Intra_PPDU_PS," Alfred Asterjadhi (Qualcomm)
  - 11-16-0856, "Issue of Buffer Status reporting," Stephane Baron (Canon)
  - 11-16-0860, "comment resolution on A-MPDU format," Yongho Seok (Newracom)
  - 11-16-0861, "comment resolution on mu acknowledgment procedure," Yongho Seok (Newracom)
  - 11-16-0862, "comment resolution on subclause 25.11," Yongho Seok (Newracom)
  - 11-16-0864, "d0.1 comment resolution on clause 6," Yasuhiko Inoue (NTT)
  - 11-16-0867, "CIDs for CIDs: Section 9.3.1.9.3 Compressed BA format," George Cherian (Qualcomm)
  - 11-16-0868, "CIDs for Section 9.3.1.9.7 Multi STA BAs," George Cherian (Qualcomm)
  - 11-16-0869, "Comment resolution section 9.3 TWT," Zhou Lan (Broadcom)
  - 11-16-0871, "Trigger Frame Per User Info Order," Zhou Lan (Broadcom)
  - 11-16-0877, "Comment resolution on CID 783 (TXOP Duration field format)," Jeongki Kim (LG Electronics)
  - 11-16-0878, "Comment resolution on CID 782 (Intra-PPDU PS)," Jeongki Kim (LG Electronics)
  - 11-16-0881, "Comment resolution on ROMI," Jayh Park (LG Electronics)
  - 11-16-0882, "Comment resolution on TOMI," Jayh Park (LG Electronics)
  - 11-16-0883, "Comment resolution for CID 152," Jayh Park (LG Electronics)
  - 11-16-0884, "Spec. Text for HE Operation element and AID Assign Rule," Jianhan Liu (MediaTek)
  - 11-16-0890, "Comment Resolution on NAV Setting of Single and Multiple Protection and Control Response," Po-Kai Huang (Intel)
  - 11-16-0913, "SU Multi-TID Rules," Jarkko Kneckt (Apple)
  - 11-16-0916, "TID value of ALL ACK signaling," Woojin Ahn (Wilus Institute)
  - 11-16-0917, "Text for TID value of ALL ACK signaling," Woojin Ahn (Wilus Institute)
  - 11-16-0918, "Discussions on Partial BSS Color," Geonjung Ko (Wilus Institute)
  - 11-16-0924, "NAV resetting with RTS/MU-RTS," Weimin Xing (ZTE)
  - 11-16-0925, "Spex text on NAV resetting with RTS/MU-RTS," Weimin Xing (ZTE)
  - 11-16-0941, "CR HE Fragmentation - part 2," Ming Gan (Huawei technologies)
  - 11-16-0942, "CR Service Field," Ming Gan (Huawei Technologies)
  - 11-16-0951, "Setting for TXOP Duration Field," Po-Kai Huang (Intel)
  - 11-16-0952, "Spec text trigger frame per user info order," Zhou Lan (Broadcom)
  - 11-16-0953, "Comment Resolution and Spec Text for Setting for TXOP Duration field," Po-Kai Huang (Intel)
  - 11-16-0960, "AP access procedure for UL MU operation," Jinsoo Ahn (Yonsei Univ.)
  - 11-16-0961, "Consideration on Multi-STA BlockAck Optimization," Hanseul Hong (Yonsei Univ.)
  - 11-16-0962, "EDCA rules follow up 1," Jing Ma (NICT)
  - 11-16-0963, "EDCA rules follow up 2," Jing Ma (NICT)
  - 11-16-0966, "CID 71 and CID 190 Resolutions," Jarkko Kneckt (Apple)

        - 11-16-0998, "2 sets of EDCA parameters," Laurent Cariou (Intel)
    - **Multi-User (MU)** — 12 submissions
        - 11-16-0866, "Comment Resolution of Section 26.3.13 MU-MIMO," Kome Oteri (InterDigital)
        - 11-16-0875, "CR for the section 10.3.2.8a CS Condition to Respond CTS," Kiseon Ryu (LG Electronics)
        - 11-16-0876, "CR for the section 25.5.2.4 UL MU CS CCA and CS Required Bit," Kiseon Ryu (LG Electronics)
        - 11-16-0880, "UL MU Transmission Rules - EDCA backoff," Jayh Park (LG Electronics)
        - 11-16-0885, "Comment Resolution on UL MU CS NAV Consideration," Po-Kai Huang (Intel)
        - 11-16-0886, "Comment Resolution for some UL MU CS TBD," Po-Kai Huang (Intel)
        - 11-16-0887, "Spec Text for MU-RTS restriction on HE MU PPDU," Po-Kai Huang (Intel)
        - 11-16-0926, "Soliciting UL_MU_ACK," Raja Banerjea (Qualcomm)
        - 11-16-0929, "CR - UL MU Operation," Simone Merlin (Qualcomm)
        - 11-16-0930, "CR - DL MU Operation," Simone Merlin (Qualcomm)
        - 11-16-0938, "Comment Resolution for Sub-clause 25.10.4," Chittabrata Ghosh (Intel)
        - 11-16-0958, "UL OFDMA for Unassociated STAs," Leonardo Lanante (Kyushu Institute of Tech.)
    - **Spatial Reuse (SR)** — 10 submissions
        - 11-16-0879, "Comment resolution on SR for VHT PPDUs," Jeongki Kim (LG Electronics)
        - 11-16-0889, "Comment Resolution for Spatial Reuse (Intra BSS detection)," Young Hoon Kwon (Newracom)
        - 11-16-0901, "Clarification of SR Fields in HE Trigger Based PPDU," Daewon Lee (Newracom)
        - 11-16-0902, "Proposed Text Changes for SR Fields in HE Trigger-Based PPDU," Daewon Lee (Newracom)
        - 11-16-0905, "SR Fields Clarification," Ron Porat (Broadcom)
        - 11-16-0919, "Discussions on SR Fields in HE Trigger-based PPDU," Geonjung Ko (Wilus Institute)
        - 11-16-0310, "DSC Proposal Text," Graham Smith (SR Technologies)
        - 11-16-0945, "Clarifications for OBSS_PD-based SR parameters," Laurent Cariou (Intel)
        - 11-16-0947, "Proposed text changes for OBSS_PD-based SR parameters," Laurent Cariou (Intel)
        - 11-16-0957, "Comment Resolutions on OBSS_PD Conditions in 25.9.3," James Wang (MediaTek)
    - **Others (covered in the TGax full sessions)** — 8 submissions
        - 11-15-1095, "OFDMA Performance in 11ax," Suhwook Kim (LG Electronics)
        - 11-16-0835, "EIFS," Alfred Asterjadhi (Qualcomm)
        - 11-16-0870, "Conclusing MAC Trigger Padding," Zhou Lan (Broadcom)
        - 11-16-0907, "20MHz HE devices," Joonsuk Kim (Apple)
        - 11-16-0909, "CR - proposed text on 20 MHz devices," Joonsuk Kim (Apple)
        - 11-16-0949, "MAC trigger frame padding follow up," Zhou Lan (Broadcom)
        - 11-16-0965, "On High Efficiency WLAN (HEW) TG PAR Scope," Osama Aboul-Magd (Huawei Technologies)
3. **Timeline**
   TG discussed the timeline. No changes since last update.

Current Timeline	
May 2014	**Start of TG**
November 2014	**First draft of the TG SFD approved**
January 2016	**Proposed TG draft**
March 2016	**Draft 0.1 was approved and CC started**
September 2016	**Issue Draft 1.0 and start WG Letter Ballot**
March 2017	**Draft 2.0 and WG recirculation ballot**
July 2017	**MDR (Mandatory Draft Review)**
November 2017	**Formstion of Sponsor Ballot pool**
March 2018	**Initial Sponsor Ballot**
December 2018	**RevCom submittal**

Goals for the September 2016 session

- Continue with Comment Resolutions.

Teleconferences

TGax teleconferences are scheduled after the July 2016 session.

Thursday	August 4th, 2016	20:00 - 22:00 (ET) (approved during the May 2016 session)
Thursday	August 11th and 25th, 2016, September 1st, 2016	10:00 - 12:00 (ET)
Thursday	August 18th, 2016, September 1st and 22nd, 2016	20:00 - 22:00 (ET)

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May 2016 — Waikoloa, HI

The TGax had 10 sessions during the week.
Six out of ten sessions were assigned to the ad hoc groups.

	Monday		Tuesday		Wednesday		Thursday
AM1							
AM2	**TGax** (full)		**TGax** (MU ad hoc)	**TGax** (MAC+SR ad hoc)			**TGax** (full)
PM1					**TGax** (PHY ad hoc)	**TGax** (MAC+SR ad hoc)	
PM2	**TGax** (PHY ad hoc)	**TGax** (MAC+SR ad hoc)	**TGax** (PHY ad hoc)	**TGax** (MU ad hoc)	**TGax** (PHY ad hoc)	**TGax** (MAC+SR ad hoc)	**TGax** (full)
PM3	**TGax** (PHY ad hoc)	**TGax** (MU ad hoc)					

Main documents

The meeting agenda and minutes of the TGax and its subgroups, and the TGax closing report can be found here.

- TGax
  - 11-16-0512-04, TGax May 2016 Meeting Agenda
  - 11-16-0686-00, IEEE 802.11 TGax May 2016 Waikoloa Meeting Minutes
  - 11-16-0739-00, TGax May 2016 Closing Report

  - TGax PHY ad hoc group
    - 11-16-0693-03, TGax PHY Ad Hoc May 2016 Meeting Agenda
    - 11-16-0755-00, May 2016 Waikoloa PHY Ad Hoc Meeting Minutes
  - TGax MAC and Spatial Reuse (SR) ad hoc group
    - 11-16-0698-04, TGax MAC and Spatial Reuse Ad Hoc Agenda May 2016 Meeting
    - 11-16-0701-00, Combined Spatial Reuse and MAC ad hoc group meeting minutes
  - TGax Multi-User (MU) ad hoc group
    - 11-16-0697-02, TGax MU Ad-hoc Agenda May 2016
    - 11-16-0716-00, May 2016 Waikoloa TGax MU Ad Hoc Meeting minutes

Achievements

1. **Work Completed**
   - TGax received about 70 submissions.
     - Numbers of submissions: PHY/MAC/MUSR/TG = 33/18/9/3/6.

     Majority of the submission were requesting changes to the TG Specification Framework.

     Few submissions were addressing comment resolution mainly of the PHY clause.
   - Agreed to terminate the Specification Framework process. The frame of reference is Draft D0.1.
     - Future submissions shall bring text to continue developing the TG draft.
     - The TG Technical Editor is planning to generate draft D0.2 based on outcome of this meeting.
   - Approved the resolutions of about 200 comments, most of them addressing the PHY clause.
   - Revisited and accepted a new modified timeline.
2. **Technical Presentations**

   70 technical submissions have been received and have been covered during the week.

   A list of the submissions is also available in the agenda document.
   - **PHY** — 33 submissions
     - 11-16-0608, "Beamforming Feedback Report Structure," Sameer Vermani (Qualcomm)
     - 11-16-0610, "CR HE-SIG-A Part I," Ross Jian Yu (Huawei Technologies)
     - 11-16-0611, "Remaining Issues in Trigger Frame Design," Sameer Vermani (Qualcomm)
     - 11-16-0613, "SIG-B Related Issues," Lochan Verma (Qualcomm)
     - 11-16-0614, "Comment Resolution on Clause 26.1.1 Part 1," Lochan Verma (Qualcomm)
     - 11-16-0615, "Comment Resolution on Clause 26.3.12 Part 1," Lochan Verma (Qualcomm)
     - 11-16-0617, "Remaining Topics in Power Control," Bin Tian (Qualcomm)
     - 11-16-0618, "11ax CSD Design," Bin Tian (Qualcomm)
     - 11-16-0619, "PAPR Reduction of HE-SIGB," Bin Tian (Qualcomm)
     - 11-16-0620, "DCM PHY Parameters," Hongyuan Zhang (Marvell)
     - 11-16-0621, "DCM Interleaver," Tianyu Wu (MediaTek)
     - 11-16-0622, "16 QAM Napping for DCM," Sudhir Srinivasa (Marvell)
     - 11-16-0623, "CR on Section 26.3.10.12," Bin Tian (Qualcomm)
     - 11-16-0625, "CR on Section 26.3.6," Bin Tian (Qualcomm)
     - 11-16-0626, "Feedback Element Compression for 802.11ax," Kome Oteri (InterDigital Communications)
     - 11-16-0633, "Left over Issues in RU Signaling for HE-SIGB," Yan Zhang (Marvell)
     - 11-16-0634, "11ax Comment Resolutions for Clauses 26.3.2," Yan Zhang (Marvell)
     - 11-16-0635, "BW indication for Non-contiguous Channel Bonding," Yunbo Li (Huawei Technologies)
     - 11-16-0636, "TXOP Duration field in HE-SIG-A," Jeongki Kim (LG Electronics)
     - 11-16-0637, "Load balancing indication for MU-MIMO over 484-tone and larger RU in OFDMA," Ming Gan (Huawei Technologies)
     - 11-16-0638, "Discussions for Non-contiguous Channel Bonding," John Son (Wilus)
     - 11-16-0639, "Follow-up on HE-SIG-B user-specific field," Jinsoo Choi (LG Electronics)
     - 11-16-0649, "Feedback Tone Map and Quantization," Sriram Venkateswaran (Broadcom)
     - 11-16-0652, "Power scaling of 4 extra tones," Xiaogang Chen (Intel)
     - 11-16-0653, "CR on section 26.3.3," Xiaogang Chen (Intel)
     - 11-16-0654, "CP and LTF Options and Signaling," Ron Porat (Broadcom)
     - 11-16-0655, "On MCS0 DCM Modulation and DCM Capability," Jianhan Liu (MediaTek)
     - 11-16-0656, "1024QAM Modulation," Jianhan Liu (MediaTek)
     - 11-16-0658, "CR on 26.3.7.1," Jinsoo Choi (LG Electronics)
     - 11-16-0659, "CR on 26.3.9.9 and 26.3.5," Eunsung Park (LG Electronics)
     - 11-16-0663, "CR on Secition 26.2.2," Ke Yao (ZTE)
     - 11-16-0681, "Comment Resolution CID 215 2486," Daewon Lee (Newracom)
     - 11-16-0682, "CR CID on PHY data field other," Daewon Lee (Newracom)
   - **MAC** — 18 submissions
     - 11-16-0583, "Backoff Procedure Handling Upon TF Reception," Yu Wang (Ericsson)
     - 11-16-0584, "Need of SDU Fragmentation to Reduce Padding Ratio in UL-OFDMA Transmission," Yu Wang (Ericsson)
     - 11-16-0588, "Channel State Estimation based Bidirectional Initialized Random Access," Bo Li (Northwestern Polytechnical Univ.)

- 11-16-0590, "Multi-BSS Association for Edge Users Throughput Improvements," Mao Yang (Northwestern Polytechnical Univ.)
- 11-16-0616, "BlockAck generation and selection rules," Alfred Asterjadhi (Qualcomm)
- 11-16-0627, "ROM Recovery Rules," Jayh Hyunhee Park (LG Electronics)
- 11-16-0628, "Buffer Status Report in HE Control field," Jayh Hyunhee Park (LG Electronics)
- 11-16-0640, "BSS Color Collision," Geonjung Ko (Wilus Institute)
- 11-16-0641, "Regarding HE fragmentation," Woojin Ahn (Yonsei Univ.)
- 11-16-0643, "HE Control Scheduling," Liwen Chu (Marvell)
- 11-16-0644, "SS Allocation in Trigger," Liwen Chu (Marvell)
- 11-16-0645, "MU Minimum MPDU Start Spacing," Liwen Chu (Marvell)
- 11-16-0646, "HE Beamforming Feedback," Liwen Chu (Marvell)
- 11-16-0657, "In-device Multi-radio Coexistence and UL MU operation," Robert Stacy (Intel)
- 11-16-0673, "Multi-User EDCA," Jinsoo Ahn (Yonsei Univ.)
- 11-16-0674, "EIFS excess problem of Acknowledgement for UL MU procedure," Hanseul Hon (Yonsei Univ.)
- 11-16-0675, "comment resolution for CID2383," Yonggang Fang (ZTE)
- 11-16-0684, "Channel Access Efficiency," Evgeny Khorov (IITP)

◦ **Multi-User (MU)** — 9 submissions
- 11-16-0582, "Random Access RU Allocation in the Trigger Frame," Evgeny Khorov (IITP)
- 11-16-0591, "Issues related to OCW management," Patrice Nezou (Canon)
- 11-16-0592, "Follow up on Issue related to unused UL OFDMA RUs," Stephane Baron (Canon)
- 11-16-0648, "MU-RTS/CTS PHY Format," Po-Kai Huang (Intel)
- 11-16-0661, "Adaptive Random Access UL OFDMA," Leonardo Lanante (Kyushu Institute of Technology)
- 11-16-0662, "Further consideration on channel access rule to facilitate MU transmission opportunity," Jing Ma (NICT)
- 11-16-0664, "Consideration on backoff procedure for UL MU transmission," Jing Ma (NICT)
- 11-16-0665, "Some Notes on Interference Alignment for Downlink Multi-User MIMO," Dzevdan Kapetanovic (Ericsson)
- 11-16-0667, "Signaling of Multi-TID Aggregation Limit," Chittabrata Ghosh (Intel)

◦ **Spatial Reuse (SR)** — 3 submissions
- 11-16-0581, "Proposed changes to SR clause," Soma Tayamon (Ericsson)
- 11-16-0589, "Fractional-Backoff Procedure and Dynamic CCA," Bo Li (Northwestern Polytechnical University)
- 11-16-0647, "Consideration of Spatial Reuse for Trigger Frame," Po-Kai Huang (Intel)

◦ **Others (covered in TGax full sessions)** — 6 submissions
- 11-16-0571, "QoS Handling of Trigger Frame," Yu Wang (Ericsson)
- 11-16-0597, "TG ax Indoor Enterprise Scenarios, Color, DSC and TPC," Graham Smith (SR Technologies)
- 11-16-0604, "Simulation-based evaluation of DSC in enterprise scenario," Tanguy Ropitault (NIST)
- 11-16-0609, "HE NDPA frame format," Ross Jian Yu (Huawei)
- 11-16-0612, "Mandatory/Optional Issues for 802.11ax," Sameer Vermani (Qualcomm)
- 11-16/0629, "Box 5 Calibration Results," Marik Hsiao (MediaTek)

3. **Timeline**

TG discussed and revised the timeline as follows.

Current Timeline		Modified Timeline	
May 2014	**Start of TG**	**May 2014**	**Start of TG**
November 2014	**First draft of the TG SFD approved**	**November 2014**	**First draft of the TG SFD approved**
January 2016	**Proposed TG draft**	**January 2016**	**Proposed TG draft**
March 2016	**Draft 0.1 was approved and CC started**	**March 2016**	**Draft 0.1 was approved and CC started**
July 2016	**Issue Draft 1.0 and start WG Letter Ballot**	**September 2016**	**Issue Draft 1.0 and start WG Letter Ballot**
March 2017	**Draft 2.0 and WG recirculation ballot**	**March 2017**	**Draft 2.0 and WG recirculation ballot**
		July 2017	**MDR (Mandatory Draft Review)**
		November 2017	**Formation of Sponsor Ballot pool**
January 2018	**Initial Sponsor Ballot**	**March 2018**	**Initial Sponsor Ballot**
		December 2018	**RevCom submittal**

Goals for the July 2016 session

- Continue with comment resolutions.

Teleconferences

Weekly teleconferences are planned after the May 2016 session.

Thursday	June 2nd, 2016	10:00 - 12:00 (ET)
Thursday	June 16th, 2016	10:00 - 12:00 (ET)
Thursday	June 23rd, 2016	20:00 - 22:00 (ET)
Thursday	June 30th, 2016	10:00 - 12:00 (ET)
Thursday	July 7th, 2016,	20:00 - 22:00 (ET)
Thursday	July 14th, 2016	10:00 - 12:00 (ET)
Thursday	August 4th, 2016	20:00 - 22:00 (ET)

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March 2016 — Macau

The TGax had 9 sessions during the week.
Five out of nine sessions were assigned to the ad hoc groups.

	Monday	Tuesday	Wednesday	Thursday
AM1				
AM2		**TGax** (PHY ad hoc) **TGax** (MAC ad hoc)		**TGax** (full)
PM1	**TGax** (full)		**TGax** (PHY ad hoc) **TGax** (MAC ad hoc)	
PM2		**TGax** (MAC ad hoc) **TGax** (SR ad hoc)	**TGax** (MAC ad hoc) **TGax** (MU ad hoc)	**TGax** (full)
PM3	**TGax** (SR ad hoc) **TGax** (MU ad hoc)	**TGax** (full)		

Main documents

The meeting agenda and minutes of the TGax and its subgroups, and the TGax closing report can be found here.

- TGax
  - 11-16-0235-07, TGax March 2016 Meeting Agenda
  - 11-16-0415-00, IEEE 802.11 TGax March 2016 Macau Meeting Minutes
  - 11-16-0475-00, TGax March 2016 Closing Report

  - TGax PHY ad hoc group
    - 11-16-0421-03, TGax PHY Ad Hoc March 2016 Meeting Agenda
    - 11-16-0509-00, TGax March 2016 Macau PHY Ad Hoc Meeting Minutes
  - TGax MAC ad hoc group

- 11-16-0427-04, TGax MAC Ad Hoc March 2016 Meeting Agenda
- 11-16-0439-01, March 2016 Macau TGax MAC ad hoc meeting minutes

- TGax Multi-User (MU) ad hoc group
  - 11-16-0419-02, TGax MU Ad-hoc Agenda March 2016
  - 11-16-0466-00, TGax MU Ad Hoc Meeting minutes March 2016
- TGax Spatial Reuse (SR) ad hoc group
  - 11-16-0422-02, TGax SR Ad Hoc March 2016 Agenda
  - 11-16-0537-00, TGax SR Ad Hoc group March 2016 minutes

Achievements

1. **Passed a number of motions affecting all aspects of the TG Specification Framework**
   - PHY — 22 motions passed.
   - MAC — 17 motions passed.
   - MU — 9 motions passed.
   - SR — 2 motions passes.
2. **TG Documents**
   - Latest revision of the Specification Framework is available at; https://mentor.ieee.org/802.11/dcn/15/11-15-0132-16-00ax-spec-framework.docx
   - Other TG documents
     - Simulation Scenarios: https://mentor.ieee.org/802.11/dcn/14/11-14-0980-16-00ax-simulation-scenarios.docx
     - Evaluation Methodology: https://mentor.ieee.org/802.11/dcn/14/11-14-0571-12-00ax-evaluation-methodology.docx
     - Channel Models: https://mentor.ieee.org/802.11/dcn/14/11-14-0882-04-00ax-tgax-channel-model-document.docx
     - Functional Requirements: https://mentor.ieee.org/802.11/dcn/14/11-14-1009-02-00ax-proposed-802-11ax-functional-requirements.doc
3. **Technical Presentations**

   48 technical submissions have been covered during the week.

   Here is the list of submissions which is also available in the agenda document.
   - **PHY** — 12 submissions
     - 11-15-1354, "SIGA fields and Bitwidths," Ron Porat (Broadcom)
     - 11-16-0203, "Signalling Support for Full Bandwidth MU-MIMO Compressed SIG-B Mode," Lei Huang (Panasonic)
     - 11-16-0319, "I-Q Decoupled OFDM: A Solution To I/Q Imbalance," Shouxing Simon Qu (Blackberry)
     - 11-16-0335, "HE-STF sequences for 160/80+80MHz," Eunsung Park (LG Electronics)
     - 11-16-0343, "Spectral Mask Discussion," Hongyuan Zhang (Marvell)
     - 11-16-0344, "PHY Padding Related Issues," Hongyuan Zhang (Marvell)
     - 11-16-0346, "11ax Pilot Sequence," Bin Tian (Qualcomm)
     - 11-16-0349, "HE-SIG-B Compression Mode," Kaushik Josiam (Samsung)
     - 11-16-0367, "Power Scaling of L-LTF and L-STF," Yakun Sun (Marvell)
     - 11-16-0389, "Sounding Design," Sriram Venkateswaran (Broadcom)
     - 11-16-0395, "Preamble transmission for Uplink OFDMA," Ming Gan (Huawei)
     - 11-16/0397, "HE-SIG-B Signaling Discussions," John Son (WILUS Institute)
   - **MAC** — 18 submissions
     - 11-16-0297, "Results for beacon collisions," Evgeny Khorov (IITP RAS)
     - 11-16-0345, "Simultaneous NAK for MU GCR-BA," Jinsoo Ahn (Yonsei Univ.)
     - 11-16-0347, "Fragmentation for MU frames-Follow up on parameters," Alfred Asterjadhi (Qualcomm)
     - 11-16-0352, "Considerations on MU initial link setup," Woojin Ahn (Yonsei Univ.)
     - 11-16-0353, "MU-RTS/CTS for TWT Protection," Hanseul Hong (Yonsei Univ.)
     - 11-16-0358, "Maximal A-MPDU Size," Liwen Chu (Marvell)
     - 11-16-0359, "Management ACK," Liwen Chu (Marvell)
     - 11-16-0361, "Ack Policy of UL MU frame," Jeongki Kim (LG Electronics)
     - 11-16-0362, "Multi-TID Aggregation Limit," Chittabrata Ghosh (Intel)
     - 11-16-0365, "Multi-STA BA Design," Xiaofei Wang (InterDigital)
     - 11-16-0368, "MAC padding options for legacy trigger frame," Zhou Lan (Broadcom)
     - 11-16-0369, "M-BA aggregated trigger frame," Zhou Lan (Broadcom)

        - 11-16-0377, "Sounding Sequences Clarifications," Simone Merlin (Qualcomm)
        - 11-16-0378, "Extended BA Bitmap," Simone Merlin (Qualcomm)
        - 11-16-0383, "RU Signaling in Trigger Frame," Yunbo Li (Huawei)
        - 11-16-0396, "Issues on BSS Color Bits Collision," Geonjung Ko (WILUS Institute)
        - 11-16-0399, "Considerations on Trigger Frame for Random Access Procedure," Evgeny Khorov (IITP RAS)
        - 11-16-0404, "BlockAck Bitmap," Dengyu Qiao (Huawei)
    - **Multi-User (MU)** — 6 submissions
        - 11-16-0331, "Power Control for Multi-User Transmission in 802.11ax," Kome Oteri (InterDigital)
        - 11-16-0333, "Issue related to unused UL OFDMA RUs," Stephane Baron (Canon)
        - 11-16-0340, "Random Access UL MU Resource Allocation and Indication," Leonardo Lanante (Kyushu Institute of Technology)
        - 11-16-0371, "Further consideration for MU-RTS/CTS," Jing Ma (NICT)
        - 11-16-0379, "Trigger Frame Format," Simone Merlin (Qualcomm)
        - 11-16-0413, "Power Control for UL MU," Arjun Bharadwaj (Qualcomm)
    - **Spatial Reuse (SR)** — 7 submissions
        - 11-16-0212, "Enterprise Scenario DSC and Color," Graham Smith (SR Technplogies)
        - 11-16-0310, "DSC Proposed Text," Graham Smith (SR Technplogies)
        - 11-16-0350, "Enterprise Scenario TPC and DSC," Graham Smith (SR Technplogies)
        - 11-16-0360, "Simulation results of spatial reuse with various MCSs," Junichi Iwatani (NTT)
        - 11-16-0382, "Discussion on Spatial Reuse Operations in 11ax," Yunbo Li (Huawei)
        - 11-16-0403, "Spatial Re-Use with Adaptive CCA and TPC Simulation," Frank Hsu (MediaTek)
        - 11-16-0414, "Adjustment Rules for Adaptive CCA and TPC," James Wang (MediaTek)
    - **Others (covered in the TGax full session)** — 5 submissions
        - 11-15-1095, "OFDMA Performance in 11ax," Suhwook Kim (LG Electronics)
        - 11-16-0066, "Views on UL MU Features," Joonsuk Kim (Apple)
        - 11-16-0355, "Snapshot of Residential Use 2016," Carol Ansley (ARRIS Group)
        - 11-16-0364, "AID Assign Rules Based on BSS Color and HE Operation Element," Jianhan Liu (MediaTek)
        - 11-16-0394, "Achieving High Efficiency in Medium Access via Roster Mode," Sean Coffey (RealTek)
4. **Draft Specification**
   The TGax approved version 0.1 of the draft specification.

> **< TG Motion >**
> Move to accept document 11-16/0024r1 as the TG draft specification D0.1, and start a 21 day comment collection period.
>
> - The submission is available at: https://mentor.ieee.org/802.11/dcn/16/11-16-0024-01-00ax-proposed-draft-specification.docx
>
> Moved by Robert Stacey, Second by Simone Merlin.
> Result: Y/N/A = 75/0/5, motion passes.

Goals for the May 2016 session

- Comment Resolution.
- Technical presentations.
- Revisit the timeline based on the number of comments received.

Teleconferences

TGax teleconferences are planned before the May 2016 session.

Thursday	April 14th, 2016,	10:00 - 12:00 (ET)

Thursday	April 21st, 2016	20:00 - 22:00 (ET)
Thursday	April 28th, 2016,	10:00 - 12:00 (ET)
Thursday	May 5th, 2016	20:00 - 22:00 (ET)

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January 2016 — Atlanta, GA

The TGax had 10 sessions during the week.
Four out of ten sessions were assigned to the ad hoc groups.

	Monday	Tuesday	Wednesday	Thursday
AM1			**TGax** (full)	
AM2	**TGax** (full)	**TGax** (PHY ad hoc) **TGax** (MAC ad hoc)		**TGax** (full)
PM1		**TGax** (PHY ad hoc) **TGax** (MAC ad hoc)	**TGax** (full)	
PM2	**TGax** (MAC ad hoc) **TGax** (SR ad hoc)		**TGax** (full)	**TGax** (full)
PM3		**TGax** (MU ad hoc)		

Main documents

The meeting agenda and minutes of the TGax and its subgroups, and the TGax closing report can be found here.

- TGax
  - 11-15-1516-03, TGax January 2016 Meeting Agenda
  - 11-16-0096-00, IEEE 802.11 TGax January 2016 Atlanta Meeting Minutes
  - 11-16-0187-00, TGax January 2016 Closing Report

  - TGax PHY ad hoc group
    - 11-16-0108-02, TGax PHY Ad Hoc January 2016 Meeting Agenda
    - 11-16-0119-00, TGax January 2016 Atlanta PHY Ad Hoc Meeting Minutes
  - TGax MAC ad hoc group
    - 11-16-0109-02, TGax MAC Ad Hoc January 2016 Meeting Agenda
    - 11-16-0110-00, Jan 2016 Atlanta TGax MAC ad hoc meeting minutes
  - TGax Multi-User (MU) ad hoc group
    - 11-16-0147-01, TGax MU Ad-hoc Agenda January 2016
    - 11-16-0150-00, January 2016 Atlanta TGax MU Ad Hoc Meeting minutes

Achievements

1. **Passed a number of motions affecting all aspects of the TG Specification Framework**
   - PHY — 30 motions passed.
   - MAC — 9 motions passed.
   - MU — 7 motions passed.
2. **TG Documents**
   - Latest revision (rev. 15) of the Specification Framework is available at; https://mentor.ieee.org/802.11/dcn/15/11-15-0132-15-00ax-spec-framework.docx

- Other TG documents
  - Simulation Scenarios: https://mentor.ieee.org/802.11/dcn/14/11-14-0980-16-00ax-simulation-scenarios.docx
  - Evaluation Methodology: https://mentor.ieee.org/802.11/dcn/14/11-14-0571-12-00ax-evaluation-methodology.docx
  - Channel Models: https://mentor.ieee.org/802.11/dcn/14/11-14-0882-04-00ax-tgax-channel-model-document.docx
  - Functional Requirements: https://mentor.ieee.org/802.11/dcn/14/11-14-1009-02-00ax-proposed-802-11ax-functional-requirements.doc

3. **Technical Presentations**

   48 technical submissions have been covered during the week.

   A list of the submissions is available in the agenda document.

   - **PHY** — 22 submissions
     - 11-16-0030, "Maximum Tone Grouping Size for 802.11ax Feedback with MU-MIMO," Kome Oteri (InterDigital)
     - 11-16-0033, "1x HE-LTF for ULMUMIMO," Hongyuan Zhang (Marvell)
     - 11-16-0034, "Beamforming with HE-LTF Compression," Hongyuan Zhang (Marvell)
     - 11-16-0036, "CRC Generation for HE-SIG," Yakun Sun (Marvell)
     - 11-16-0037, "Continuous Puncturing for HE-SIGB Encoding," Yakun Sun (Marvell)
     - 11-16-0038, "Sequence for 1x LTF," Daewon Lee (Newracom)
     - 11-16-0039, "RU Allocation in SIG-B," Daewon Lee (Newracom)
     - 11-16-0040, "Issues with Compressed SIG-B Mode," Yujin Noh (Newracom)
     - 11-16-0041, "Link Adaptation for HE WLAN," Yujin Noh (Newracom)
     - 11-16-0044, "MCS Levels and TX EVM Requirement for 1024 QAM," Eunsung Park (LG Electronics)
     - 11-16-0045, "Flexible Wider Bandwidth Transmission," John Son (WILUS)
     - 11-16-0046, "Content for the extra tones in LSIG and RLSIG," Jiayin Zhang (Huawei)
     - 11-16-0047, "Discussion on the HE Extended Range SU PPDU," Jiayin Zhang (Huawei)
     - 11-16-0052, "Remaining HE-LTF Sequence Design," Le Liu (Huawei)
     - 11-16-0053, "Requirements for UL MU Transmissions," Arjun Bharadwaj (Qualcomm)
     - 11-16-0056, "On QPSK DCM Modulation and LDPC Tone Mapper for DCM," Jianhan Liu (MediaTek)
     - 11-16-0071, "Packet Extension Follow Up," Ron Porat (Broadcom)
     - 11-16-0079, "Allocation sizes for BCC in OFDMA," Ken Taniguchi (Toshiba)
     - 11-16-0080, "1x/2x/4x OFDM Symbol in HE SU PPDU with BCC," Heejung Yu (Yeungnam Univ./NEWRACOM)
     - 11-16-0088, "Ng for Compressed Beamforming feedback," Sriram Venkateswaran (Broadcom)
     - 11-16-0089, "Single Stream Pilots in UL MU MIMO," Sriram Venkateswaran (Broadcom)
     - 11-16-0104, "Rate Matching for HE-SIG-B," Daewon Lee (Newracom)
   - **MAC** — 12 submissions
     - 11-16-0015, "Explicit Block Ack Request in DL MU PPDU," Yongho Seok (Newracom)
     - 11-16-0017, "Beacon Collision Avoidance," Evgeny Khorov (IITP)
     - 11-16-0018, "TDMA for Eliminating Hidden Station Effect in Dense Networks," Evgeny Khorov (IITP)
     - 11-16-0028, "Follow Up for Multi-STA BA for SU Transmissions," Xiaofei Wang (InterDigital)
     - 11-16-0029, "TXOP Truncation Enhancement," Xiaofei Wang (InterDigital)
     - 11-16-0042, "BSS Color Settings for a Multiple BSSID Set," Geonjung Ko (WILUS)
     - 11-16-0050, "Fragmentation for MU frames-Follow up on acks," Alfred Asterjadhi (Qualcomm)
     - 11-16-0051, "Response Give Trigger Type," David Xun Yang (Huawei)
     - 11-16-0068, "BSS Color and Multiple BSSID," Liwen Chu (Marvell)
     - 11-16-0069, "Multi-TID A-MPDU in MU Transmission," Liwen Chu (Marvell)
     - 11-16-0087, "NAV cancellation issues on MU protection," Jinsoo Ahn (Yonsei Univ.)
     - 11-16-0102, "High Efficiency Medium Access via Rosters," Sean Coffey (RealTek)
   - **Multi-User (MU)** — 9 submissions
     - 11-16-0031, "Proposed UL MU CS Rules," Lei Wang (Marvell)
     - 11-16-0048, "Protection using MU RTS/CTS," Young Hoon Kwon (Newracom)
     - 11-16-0054, "UL MU CCA Response," Kaiying Lv (ZTE)
     - 11-16-0057, "Indication for UL MU Carrier Sensing," Kiseon Ryu (LG Electronics)
     - 11-16-0065, "Duration/ID field in UL-MU," Tomo Adachi (Toshiba)
     - 11-16-0066, "Views on UL-MU Features," Joonsuk Kim (Apple)
     - 11-16-0067, "MAC Padding in Trigger Frame," Liwen Chu (Marvell)
     - 11-16-0085, "Congestion control for UL MU random access," Woojin Ahn (Yonsei Univ.)

        - 11-16-0091, "Regarding HE NDPA frame for DL Sounding Sequence," Narendar Madhavan (Toshiba)
    - **Spatial Reuse (SR)** — 1 submission
        - 11-16-0060, "Recipient-aware Spatial Reuse," Reza Hedayat (Newracom)
    - **Others (presented in the TGax full session)** — 4 submissions
        - 11-15-1095, "OFDMA Performance in 11ax," Suhwook Kim (LG Electronics)
        - 11-16-0024, "Proposed draft specification," Robert Stacy (Intel)
        - 11-16-0043, "Clarification of SFD Texts," John Son (WILUS)
        - 11-16-0059, "Non-contiguous Channel Bonding in 11ax," Yunbo Li (Huawei)
4. **Draft Specification**
    - Document 11-16-0024-00 was submitted by the TG Editor and it includes a "draft" draft specification.
    - The submission was reviewed by the TG Editor and is available on mentor to be reviewed by TG members.
5. **Plan for Progressing TG Draft**
    - Approve the TG draft specification during the March 2016 meeting.
        - Draft 0.1
    - Start a comment collection (CC) for 30 days on draft 0.1 - Ends some time in April.
    - Comment resolution (May and July)
    - Draft 1.0 in July 2016 and start WG LB.

Goals for the March 2016 session

- Discuss Proposals affecting the TG Specification Framework document
- Approve D0.1 of the TG Draft
- Approve a 30-day Comment Collection Process.

Teleconferences

Three teleconferences are planned before the March 2016 session.

Thursday	February 4th, 2016,	10:00 - 12:00 (ET)
Thursday	February 18th, 2016	20:00 - 22:00 (ET)
Thursday	March 3rd, 2016,	10:00 - 12:00 (ET)

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November 2015 — Dallas, TX

The TGax originally planned 10 sessions during the week.
One session was added during the WG mid-week plenary session.
Five out of eleven sessions were assigned to the ad hoc groups.

	Monday	Tuesday	Wednesday	Thursday
AM1	**TGax** (full, ad hoc)		**TGax** (full)	**TGax** (full)
AM2		**TGax** (PHY ad hoc) **TGax** (MAC ad hoc)		**TGax** (full)
PM1	**TGax** (full)	**TGax** (MU ad hoc) **TGax** (SR ad hoc)	**TGax** (PHY ad hoc) **TGax** (SR ad hoc)	**TGax** (full)
PM2			**TGax** (PHY ad hoc) **TGax** (MU ad hoc)	
PM3		**TGax** (PHY ad hoc) **TGax** (MAC ad hoc)		

Main documents

The meeting agenda and minutes of the TGax and its subgroups, and the TGax closing report can be found here.

- TGax
  - 11-15-1232-04, TGax November 2015 Meeting Agenda
  - 11-15-1368-01, IEEE 802.11 TGax November 2015 Dallas Meeting Minutes
  - 11-15-1457-00, TGax November 2015 Closing Report

  - TGax PHY ad hoc group
    - 11-15-1385-03, TGax PHY Ad Hoc November 2015 Meeting Agenda
    - 11-15-1442-00, November 2015 Dallas TGax PHY Ad Hoc Meeting Minutes
  - TGax MAC ad hoc group
    - 11-15-1382-03, TGax MAC Ad Hoc November 2015 Meeting Agenda
    - 11-15-1414-00, Nov 2015 Dallas TGax MAC ad hoc meeting minutes
  - TGax Multi-User (MU) ad hoc group
    - 11-15-1418-02, TGax MU Ad-hoc Agenda November 2015
    - 11-15-1423-01, November 2015 Dallas TGax MU Ad Hoc Meeting minutes
  - TGax Spatial Reuse (SR) ad hoc group
    - 11-15-1403-06, TGax SR Ad Hoc November 2015 Agenda
    - 11-15-1421-01, Minutes of the IEEE 802.11ax Spatial Reuse ad hoc group meeting - Dallas, November 2015

Achievements

1. **Passed a number of motions affecting all aspects of the TG Specification Framework**
   - PHY — 33 motions.
   - MAC — 16 motions.
   - Multi-User (MU) — 12 motions.
   - Spatial Reuse (SR) — 1 motion.
2. **TG Documents**
   - Latest revision of the Specification Framework is available
     - https://mentor.ieee.org/802.11/dcn/15/11-15-0132-10-00ax-spec-framework.docx
   - Approved new revisions of the TGax Simulation Scenario and Evaluation Methodology documents.
     - Simulation Scenarios
     - Evaluation Methodology
   - Other documents
     - TGax Channel Models
     - 802.11ax Functional Requirements
3. **Technical Presentations**
   70 technical submissions have been covered during the week.
   A list of the submissions is here which is also contained in the agenda document.
   - **PHY** — 27 submissions
     - 11-15-1059, "SIG-B Encoding Structure Part II," Ron Porat (Broadcom)
     - 11-15-1289, "Non-Uniform Constellations for 1024-QAM," Thomas Handte (Sony)
     - 11-15-1303, "LTF Sequence Designs," Sungho Moon (Newracom)
     - 11-15-1304, "Supported Resource Allocations in SIG-B," Sungho Moon (Newracom)
     - 11-15-1305, "STBC and Padding Discussions" Hongyuan Zhang (Marvell)
     - 11-15-1309, "Extended Range Support for 11ax," Sameer Vermani (Qualcomm)
     - 11-15-1310, "11ax LDPC Tone Mapper for 160MHz," Bin Tian (Qualcomm)
     - 11-15-1311, "11ax Spectral Mask," Bin Tian (Qualcomm)
     - 11-15-1315, "HE-SIG-B Mapping and Compression," Kaushik Josiam (Samsung)
     - 11-15-1320, "Maximum Tone Grouping Size for 802.11ax Feedback," Kome Oteri (InterDigital)

- 11-15-1321, "Reducing Explicit MIMO Compressed Beamforming Feedback Overhead for 802.11a," Kome Oteri (InterDigital)
- 11-15-1322, "Channel Estimation Enhancement and Transmission Efficiency Improvement Using Beam-Change Indication and 1x HE-LTF," Jianhan Liu (MediaTek)
- 11-15-1323, "HE-STF Sequence," Ensung Park (LG Electronics)
- 11-15-1324, "MCS for HE-SIG-B," Dongguk Lim (LG Electronics)
- 11-15-1327, "Diversity Mode in OFDMA," Yujin Noh (Newracom)
- 11-15-1329, "Link Adaptation for HE WLAN," Yujin Noh (Newracom)
- 11-15-1331, "PHY Padding Capability Signaling," Daewon Lee (Newracom)
- 11-15-1332, "Implicit Sounding for HE WLAN," Daewon Lee (Newracom)
- 11-15-1334, "HE-LTF Sequence Design," Le Liu (Huawei)
- 11-15-1335, "HE-SIG-B Contents," Le Liu (Huawei)
- 11-15-1347, "Strategies to reduce MIMO feedback overhead," Filippo Tosato (Toshiba)
- 11-15-1349, "Sounding for Uplink Transmission," Sungho Moon (Newracom)
- 11-15-1350, "Spatial Configuration And Signaling for MU-MIMO," Yakun Sun (Marvell)
- 11-15-1353, "Preamble Formats," Ron Porat (Broadcom)
- 11-15-1354, "SIGA fields and Bitwidths," Ron Porat (Broadcom)
- 11-15-1357, "Extra tones in the preamble," Xiaogang Chen (Intel)
- 11-15-1372, "L-LENGTH Equation Updates," Hongyuan Zhang (Marvell)

- **MAC** — 14 submissions
  - 11-15-1265, "RTS/CTS for UL DL OFDMA Control," Cheeha Kim (POSTECH)
  - 11-15-1278, "HE MU Acknowledgment Procedure," Yongho Seok (Newracom)
  - 11-15-1300, "DL MU transmission sequence," Yong Hoon Kwon (Newracom)
  - 11-15-1318, "Fragmentation for MU frames-Follow up," Alfred Asterjadhi (Qualcomm)
  - 11-15-1319, "Scheduled Trigger frames-Follow up," Alfred Asterjadhi (Qualcomm)
  - 11-15-1330, "A method of transmitting Multi-STA Block frame," Jeongki Kim (LG Electronics)
  - 11-15-1341, "Reception Status of Frames Transmitted in Random Access RUs," Tomoko Adachi (Toshiba)
  - 11-15-1344, "Trigger Frame Format," Simone Merlin (Qualcomm)
  - 11-15-1345, "Trigger type specific information," Kiseon Ryu (LG Electronics)
  - 11-15-1346, "Ack Policy for UL MU Ack transmission," Kiseon Ryu (LG Electronics)
  - 11-15-1351, "Rate MCS Selection Rules for M-BA and DL OFDMA BA," Liwen Chu (Marvell)
  - 11-15-1352, "broadcast STAID in HE SIG B," Liwen Chu (Marvell)
  - 11-15-1355, "Considerations for TDLS transmission in 11ax," Yingpei Lin (Huawei)
  - 11-15-1359, "System Performance Evaluation of 802.11ae," Yu Wang (Ericsson)
- **Multi-User (MU)** — 12 submissions
  - 11-15-1280, "Traffic priority for random Multi User Uplink OFDMA," Stephane Baron (Canon)
  - 11-15-1301, "NAV Rule for UL MU Response," Yingpei Lin (Huawei)
  - 11-15-1312, "MU BAR Frame Format," Reza Hedayat (Newracom)
  - 11-15-1314, "I/Q Imbalance Impact to TGax OFDMA Uplink Reception," Rui Yang (InterDigital)
  - 11-15-1325, "MU-RTS/CTS Follow Up," Po-Kai Huang (Intel)
  - 11-15-1326, "NAV Consideration for UL MU Response Follow Up," Po-Kai Huang (Intel)
  - 11-15-1328, "Scheduling information for UL OFDMA Acknowledgement,"Yujin Noh (Newracom)
  - 11-15-1340, "NDP Announcement for HE Sequence," Narendar Madhavan (Toshiba)
  - 11-15-1364, "Signaling Trigger Information for STAs in 11ax," Chittabrata Ghosh (Intel)
  - 11-15-1369, "Random access based buffer status report," Woojin Ahn (Yunsei Univ.)
  - 11-15-1370, "UL OFDMA Random Access Control," Jinsoo Ahn (Yonsei Univ.)
  - 11-15-1374, "Consideration for protecting cascading MU DL/UL transmission with MU RTS/CTS," Jing Ma (NICT)
- **Spatial Reuse (SR)** — 9 submissions
  - 11-15-1259, "Use of TG ax Scenarios for Spatial Reuse," Graham Smith (SR Tecnologies)
  - 11-15-1284, "Simulation results for spatial reuse in 11ax," Jinmin Kim (LG Electronics)
  - 11-15-1313, "Considerations for Spatial Reuse," Reza Hedayat (Newracom)
  - 11-15-1316, "DSC calibration results with NS-3," M. Shahwaiz Afaqui (T.U. Catalonia)
  - 11-15-1336, "BSS Color Field Size Measurements," Chuck Lukaszewski (Aruba-HP)
  - 11-15-1337, "Secondary Channel CCA of HE STA," John Son (Willus Institute)

- 11-15-1338, "Improving Spatial Reuse During OBSS UL MU Procedure," Geonjung Ko (Willus Institute)
- 11-15-1348, "Multiple NAVs for Spatial Reuse," Sigurd Schelstraete (Quantenna)
- 11-15-1427, "Drivers of the dynamic CCA adaptation," Eduard Garcia-Villegas (Technical Univ. of Catalonia)

- **Others (presented in the TGax full session)** — 8 submissions
  - 11-15-1288, "An issue of wider bandwidth operation at real denser environment," Katsuo Yunoki (KDDI R&D Labs)
  - 11-15-1302, "System Level Simulator Evaluation with/without Capture Effect," Vida Ferdowsi (Newracom)
  - 11-15-1360, "Implications of wrap-around for TGax Scenario 3 and Scenario 4 - follow-up," Marcin Filo (Univ. of Surrey)
  - 11-15-1361, "Energy consumption with Scheduled PSP," Dmitry Akhmetov (Intel)
  - 11-15-1362, "On TGax Scenario 4 channel model - follow-up," Marcin Filo (Univ. of Surrey)
  - 11-15-1363, "Regulatory Landscape for Narrowband Transmissions in 11ax," Ilan Sutskover (Intel)
  - 11-15-1373, "Updated Box5 Calibration Results," Narendar Madhavan (Toshiba)
  - 11-15-1375, "11ax Support for IoT - Requirements and Technological Implications," Shimo Shilo (Huawei)

Goals for the January 2016 session

- Continue to advance TG documents based on submissions.
  - Priority to the TG Specification Framework document.
- TG timeline indicates draft D0.1 will be available in January 2016.
- Technical Presentations.

Teleconferences

One teleconference is planned before the January 2016 session.

Thursday	December 10th, 2015	10:00 - 12:00 (ET)

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September 2015 — Bangkok, Thailand

The TGax originally planned to have 10 sessions during the week.
However, two more sessions are added due to a large number of contributions.
Six out of twelve sessions were assigned to the ad hoc groups.

	Monday	Tuesday	Wednesday	Thursday
AM1			**TGax** (full)	**TGax** (full)
AM2	**TGax** (full)	**TGax** (PHY ad hoc) **TGax** (MAC ad hoc)		
PM1	**TGax** (PHY ad hoc) **TGax** (MAC ad hoc)	**TGax** (MU ad hoc) **TGax** (SR ad hoc)	**TGax** (PHY ad hoc) **TGax** (SR ad hoc)	**TGax** (full)
PM2		**TGax** (full)	**TGax** (full)	
PM3	**TGax** (PHY ad hoc) **TGax** (MAC ad hoc)	**TGax** (MU ad hoc) **TGax** (SR ad hoc)		

Main documents

The meeting agenda and minutes of the TGax and its subgroups, and the TGax closing report can be found here.

- TGax
  - 11-15-0987-06, TGax September 2015 Meeting Agenda

- 11-15-1093-00, IEEE 802.11 TGax September 2015 Bangkok Meeting Minutes
- 11-15-1190-00, TGax September 2015 Closing Report

- TGax PHY ad hoc group
  - 11-15-1125-04, TGax PHY Ad Hoc September 2015 Meeting Agenda
  - 11-15-1205-00, September 2015 Bangkok TGax PHY Ad hoc Meeting Minutes
- TGax MAC ad hoc group
  - 11-15-1126-03, TGax MAC Ad Hoc September 2015 Meeting Agenda
  - 11-15-1130-02, Sep 2015 Bangkok TGax MAC Ad hoc Meeting Minutes
- TGax Multi-User (MU) ad hoc group
  - 11-15-1141-02, TGax MU Ad-hoc Agenda September 2015
  - 11-15-1160-00, September 2015 Bangkok TGax MU Ad Hoc Meeting Minutes
- TGax Spatial Reuse (SR) ad hoc group
  - 11-15-1143-03, TGax Spatial Reuse Ad Hoc September 2015 Agenda
  - 11-15-1206-00, Minutes of the IEEE 802.11ax Spatial Reuse ad hoc group meeting - Bangkok, September 2015

Achievements

1. **Passed a number of motions affecting all aspects of the TG Specification Framework**
   - PHY — 29 motions.
   - MAC — 12 motions.
   - Multi-User (MU) — 15 motions.
   - Spatial Reuse (SR) — 4 motion.
2. **TG Documents**
   - Latest revision of the Specification Framework is available
     - https://mentor.ieee.org/802.11/dcn/15/11-15-0132-09-00ax-spec-framework.docx
   - Approved new revisions of the TGax Simulation Scenarios and Evaluation Methodology documents.
     - Simulation Scenarios (rev. 14)
     - Evaluation Methodology (rev. 10)
   - Other documents
     - TGax Channel Models
     - 802.11ax Functional Requirements
3. **Technical Presentations**

   70 technical submissions have been covered during the week.

   A list of the submissions is here which is also contained in the agenda document.
   - **PHY** — 24 submissions
     - 11-15-0579, "Preamble Design and Auto-detection," Hongyuan Zhang (Marvell)
     - 11-15-0580, "11ax Coding Discussion," Hongyuan Zhang (Marvell)
     - 11-15-0602, "HE-LTF squence for UL MU-MIMO," Xiaogang Chen (Intel)
     - 11-15-0810, "HE PHY Padding and Packet Extension," Hongyuan Zhang (Marvell)
     - 11-15-0823, "Preamble Design and Auto-Detection for 11ax," Sungho Moon (Newracom)
     - 11-15-0826, "HE-SIG-A Transmission for Range Extension," Jiayin Zhang (Huawei)
     - 11-15-0853, "Extensible Preamble Format Design," Leonardo Lanante (Kyutech)
     - 11-15-1031, "DL MU Signaling," Katsuo Yunoki (KDDI)
     - 11-15-1051, "HE NDP frame for sounding," Young Hoon Kwon (Newracom)
     - 11-15-1059, "SIG-B Encoding Structure Part II," Ron Porat (Broadcom)
     - 11-15-1066, "HE-SIG-B Contents," Kaushik Josiam (Samsung)
     - 11-15-1068, "Reliable Transmission Scheme for HE-SIG-B and Data," Jianhan Liu (MediaTek)
     - 11-15-1070, "1024 QAM Proposal," Eunsung Park (LG Electronics)
     - 11-15-1071, "Tone Grouping Factors and NDP format for 11ax," Sameer Vermani (Qualcomm)
     - 11-15-1075, "Number of BSS Color bits," Junichi Iwatani (NTT)
     - 11-15-1077, "HE-SIG-A Content," Jiayin Zhang (Huawei)
     - 11-15-1088, "LTF Design for Uplink MU-MIMO," Daewon Lee (Newracom)
     - 11-15-1089, "Considerations on PHY Padding and Packet Extension in 11ax," Yujin Noh (Newracom)

- 11-15-1091, "Considerations on Range Extension with SIG-A Repetition," Yujin Noh (Newracom)
- 11-15-1092, "Support of 1x/2x/4x OFDM Symbol in HE SU PPDU," Heejung Yu (Yeungnam Univ.)
- 11-15-1106, "SIG-B Structure," Reza Hedayat (Newracom)
- 11-15-1111, "SIG-B Resource Unit Allocation Coding," Amin Jafarian (Newracom)
- 11-15-1119, "Discussions on HE SIG-A Structure," John Son (Wilus Institute)
- 11-15-1122, "Identifiers in HE PPDUs for power saving," Alfed Asterjadhi (Qualcomm)

- **MAC** — 18 submissions
  - 11-15-1013, "802.11ae & 802.11ax," Guido R. Hiertz (Ericsson)
  - 11-15-1014, "Multiple BSSID Element," Guido R. Hiertz (Ericsson)
  - 11-15-1015, "Proxy ARB in 802.11ax," Guido R. Hiertz (Ericsson)
  - 11-15-1033, "Data field in HE PPDU," Yongho Seok (Newracom)
  - 11-15-1034, "Notification of Operating Mode Changes," Yongho Seok (Newracom)
  - 11-15-1044, "Further Study of 11ax Multicast," Kazuyuki Sakoda (Sony)
  - 11-15-1052, "Bandwidth for UL MU transmission," Young Hoon Kwon (Newracom)
  - 11-15-1060, "Receive Operating Mode Indication for Power Save," Eric Wong (Apple)
  - 11-15-1063, "11ax Channel access procedure," Chao-Chun Wang (MediaTek)
  - 11-15-1067, "MU TXOP truncation," Jeongki Kim (LG Electronics)
  - 11-15-1096, "Recovery Procedures in Cascading Sequences," John Son (Wilus Institute)
  - 11-15-1098, "ACK/BA frame for UL MU under cascading structure," Narendar Madhavan (Toshiba)
  - 11-15-1114, "Airtime Analysis of EDCA," Sean Coffey (RealTek)
  - 11-15-1115, "High Efficiency in Accessing the Medium," Sean Coffey (RealTek)
  - 11-15-1116, "Trigger Frame Channel Access," Jinsoo Ahn (Yonsei Univ.)
  - 11-15-1120, "Buffer Status Report," Alfred Asterjadhi (Qualcomm)
  - 11-15-1121, "HE A-Control field," Alfred Asterjadhi (Qualcomm)
  - 11-15-1137, "Triggered OFDMA Random Access Observations," Russell Huang (MediaTek)
- **Multi-User (MU)** — 15 submissions
  - 11-15-1043, "Overall Protocol of UL MU BA for Multicast Transmission," Kazuyuki Sakoda (Sony)
  - 11-15-1047, "RU selection process upon TF-R reception," Stephane Baron (Canon)
  - 11-15-1053, "Multiuser Block ACK Request (MU-BAR)," Guoqing Li (Apple)
  - 11-15-1057, "Multiple Resource Unit Allocation for TGax OFDMA," Kome Oteri (InterDigital)
  - 11-15-1062, "NAV Consideration for UL MU Response to Trigger frame," Po-Kai Huang (Intel)
  - 11-15-1065, "11ax uplink Multi-TID aggregation," Chao-Chun Wang (MediaTek)
  - 11-15-1086, "Consideration on multi-STA BA frame indication," Jing Ma (NICT)
  - 11-15-1097, "Reducing Channel Sounding Protocol Overhead for 11ax," Narendar Madhavan (Toshiba)
  - 11-15-1102, "Fragmentation with MU Operation," Chittabrata Ghosh (Intel)
  - 11-15-1103, "DL Sounding Sequence with UL MU Feedback," Chittabrata Ghosh (Intel)
  - 11-15-1105, "UL OFDMA-based Random Access Procedure," Chittabrata Ghosh (Intel)
  - 11-15-1107, "Power Save with Random Access," Chittarata Ghosh (Intel)
  - 11-15-1117, "Regarding UL MU protection," Woojin Ahn (Yonei Univ.)
  - 11-15-1123, "Acknowledgement to DL MU," Liwen Chu (Marvell)
  - 11-15-1129, "Feedback overhead in DL-MU-MIMO," Filippo Tosato (Toshiba)
- **Spatial Reuse (SR)** — 12 submissions
  - 11-15-1045, "Dynamic CCA control and TPC Simulation Results with SS1-SS3," Takeshi Itagaki (Sony)
  - 11-15-1058, "CCA consideration for UL MU transmission," Kiseon Ryu (LG Electronics)
  - 11-15-1069, "Adaptive CCA and TPC," James Wang (MediaTek)
  - 11-15-1081, "Further consideration on receive behaviour based on the cascading structure and the BSS color scheme," Jing Ma (NICT)
  - 11-15-1082, "Analysis of BSS and ESS Structure During Concurrent SR Transmissions," Chuck Lukaszewski (Aruba/HP)
  - 11-15-1083, "Cost/Benefit Analysis of SR Techniques," Chuck Lukaszewski (Aruba/HP)
  - 11-15-1101, "DSC/DCCA Calibration with TGax Agreed Scenarios," Masahito Mori (Sony)
  - 11-15-1104, "TXOP Considerations for Spatial Reuse," Reza Hedayat (Newracom)
  - 11-15-1109, "OBSS NAV and PD Threshold Rule for Spatial Reuse," Rossi Jun Luo (Huawei)
  - 11-15-1110, "BSS TXOP," Amin Jafarian (Newracom)
  - 11-15-1118, "Discussions on Spatial Reuse Enhancement," Geonjung Ko (WILUS)

    - 11-15-1138, "To DSC or not to DSC," Filip Mestanov (Ericsson)
  - **Simulation, calibration, and other submissions** — 12 submissions
    - 11-15-1039, "Spatial Reuse Measurements," Chuck Lukaszewski (Aruba Networks, a HP company)
    - 11-15-1046, "MAC calibration results," Stephane Baron (Canon)
    - 11-15-1048, "On TGax Scenario 4 channel model," Marcin Filo (Univ. of Surrey)
    - 11-15-1049, "Implications of wrap-around for TGax Scenario 3 and Scenario 4," Marcin Filo (Univ. of Surrey)
    - 11-15-1056, "Clarifying Link Level Simulator Assumptions," Kome Oteri (InterDigital)
    - 11-15-1087, "MU BFee Interference channel feedback," Sigurd Schelstraete (Quantenna)
    - 11-15-1095, "OFDMA performance in 11ax," Suhwook Kim (LG Electronics)
    - 11-15-1099, "Power Save Simulation Results," Hyeyoung Choi (LG Electronics)
    - 11-15-1100, "Discussion on Deep and Shallow Sleep States," Chittabrata Ghosh (Intel)
    - 11-15-1113, "Box5 Calibration results," Vida Ferdowsi (Newracom)
    - 11-15-1134, "11ax Support for IoT," Shimi Shilo (Huawei)
    - 11-15-1135, "Results for SS6 calibration case for single BSS and OBSS," Esa Tuomaala (Nokia)

Goals for the November 2015 session

- Continue to advance TG documents based on submissions.
  - Priority to the TG Specification Framework document.
- Technical Presentations.

Teleconferences

Three teleconferences are scheduled after the November 2015 session.

Thursday	October 15th, 2015	10:00 - 12:00 (ET)

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July 2015 — Waikoloa, HI

TGax originally planned to have nine sessions during the week.
Two more sessions were added during the mid-week plenary session (marked red).
Four out of eleven sessions were ad hoc sessions.

	Monday	Tuesday		Wednesday		Thursday
AM1	**TGax** (full, ad hoc)					**TGax** (full)
AM2		**TGax** (PHY ad hoc)	**TGax** (MAC ad hoc)			**TGax** (full)
PM1	**TGax** (full)	**TGax** (MU ad hoc)	**TGax** (SR ad hoc)	**TGax** (PHY ad hoc)	**TGax** (MAC ad hoc)	**TGax** (full)
PM2				**TGax** (PHY ad hoc)	**TGax** (MU ad hoc)	**TGax** (full)
PM3		**TGax** (full)				

Main documents

The meeting agenda and minutes of the TGax and its subgroups, and the TGax closing report can be found here.

- TGax

- 11-15-0735-05, TGax July 2015 Meeting Agenda
- 11-15-0884-00, IEEE 802.11 TGax July 2015 Waikoloa Meeting Minutes
- 11-15-0963-00, TGax July 2015 Closing Report

- TGax PHY ad hoc group
  - 11-15-0898-03, TGax PHY Ad Hoc July 2015 Meeting Agenda
  - 11-15-0913-00, July 2015 Hawaii TGax PHY Ad hoc Meeting Minutes
- TGax MAC ad hoc group
  - 11-15-0888-02, TGax MAC Ad Hoc July 2015 Meeting Agenda
  - 11-15-922-01, July 2015 Hawaii TGax MAC Ad hoc Meeting Minutes
- TGax Multi-User (MU) ad hoc group
  - 11-15-0899-02, TGax MU Ad-hoc Agenda July 2015
  - 11-15-0949-01, July 2015 Hawaii TGax MU Ad Hoc Meeting Minutes
- TGax Spatial Reuse (SR) ad hoc group
  - 11-15-0911-01, TGax Spatial Reuse Ad Hoc July 2015 Agenda
  - 11-15-0971-01, Minutes of the IEEE 802.11ax Spatial Reuse ad hoc group meeting - Hawaii, July 2015

Achievements

1. **Passed a number of PHY, MAC and MU motions affecting the TGax Specification Framework**
   - PHY — SIG-A, SIG-B, Pilots, etc.
   - MAC — Trigger frame, etc.
   - Multi-User (MU) — Trigger frame for random access, MU CTS, etc.
2. **TG Documents**
   - Latest revision of the Specification Framework (rev. 7) is available.
     - https://mentor.ieee.org/802.11/dcn/15/11-15-0132-07-00ax-spec-framework.docx
   - Approved new revisions of the TGax Simulation Scenarios and Evaluation Methodology documents.
     - Simulation Scenarios (rev. 14)
     - Evaluation Methodology (rev. 10)
   - Other documents
     - TGax Channel Models
     - 802.11ax Functional Requirements
3. **Technical Presentations**

   More than 70 technical submissions have been covered during the week.

   A list of the submissions is here which is also contained in the agenda document.
   - **PHY** — 23 submissions
     - 11-15-0579, "preamble design and autodetection," Hongyuan Zhang (Marvell)
     - 11-15-0580, "11ax coding discussion," Hongyuan Zhang (Marvell)
     - 11-15-0602, "HE-LTF sequence for UL MU-MIMO," Qinghua Li (Intel)
     - 11-15-0805, "SIG-B field for HEW PPDU," Young Hoon Kwon (Newracom)
     - 11-15-0810, "HE PHY Padding and Packet Extension," Hongyuan Zhang (Marvell)
     - 11-15-0812, "Pilot Design for Data Section," Sameer Vermani (Qualcomm)
     - 11-15-0813, "CP Indication for UL MU Transmission," Zhigang Rong (Huawei)
     - 11-15-0816, "Interleaver and Tone Mapper for OFDMA," Yakun Sun (Marvell)
     - 11-15-0817, "P Matrix for HE-LTF," Yakun Sun (Marvell)
     - 11-15-0819, "11ax OFDMA Tone Plan Leftover Tones and Pilot Structure," Bin Tian (Qualcomm)
     - 11-15-0821, "HE SIG-B Structure," Joonsuk Kim (Apple)
     - 11-15-0822, "SIG-A Structure in 11ax Preamble," Jianhan Liu (MediaTek)
     - 11-15-0823, "Preamble Design and Auto-Detection for 11ax," Sungho Moon (Newracom)
     - 11-15-0824, "Pilot Design for 11ax Downlink Transmissions," Yujin Noh (Newracom)
     - 11-15-0826, "HE-SIG-A transmission for range extension," Jiayin Zhang (Huawei)
     - 11-15-0827, "Considerations on HE-SIG-A and B," Katsuo Yunoki (KDDI Labs)
     - 11-15-0832, "Performance evaluation of SU/MU MIMO in OFDMA," Jiayin Zhang (Huawei)
     - 11-15-0845, "LTF Design for Uplink MU-MIMO," Daewon Lee (Newracom)

- 11-15-0853, "Extensible Preamble Format Design," Leonardo Lanante (Kyushu Institute of Technology)
- 11-15-0865, "Discussion of ACI performance and ACI requirements for IEEE 802.11ax," Leif Wilhelmsson (Ericsson AB)
- 11-15-0868, "Impact of Frequency Selective Scheduling Feedback for OFDMA," Hakan Persson (Ericsson)
- 11-15-0873, "SIG-B Encoding Structure," Ron Porat (Broadcom)
- 11-15-0887, "Efficient padding for last OFDM symbol," Heejung Yu (Newracom)

◦ **MAC** — 14 submissions
- 11-15-0615, "DL OFDMA Bandwidth," Liwen Chu (Marvell)
- 11-15-0803, "Frame Collision Information Management," Peng Shao (NEC Communication Systems)
- 11-15-0831, "Broadcast and Unicast (Trigger) in DL MU," Liwen Chu (Marvell)
- 11-15-0841, "Cascading Structure," David Xun Yang (Huawei Technologies)
- 11-15-0851, "HE Trigger Frame Format," John Son (WILUS Institute)
- 11-15-0856, "Compressed Uplink Trigger Frame," Vida Ferdowsi (Newracom)
- 11-15-0871, "Efficiency enhancement for 802.11ax," Guido R. Hiertz (Ericsson)
- 11-15-0872, "802.11ai and 802.11ax," Guido R. Hiertz (Ericsson)
- 11-15-0874, "Minimal data rates management frame transmissions in 2.4 GHz," Guido R. Hiertz (Ericsson)
- 11-15-0876, "Duration and MAC Padding for MU PPDU," Simone Merlin (Qualcomm)
- 11-15-0877, "Trigger Frame Format," Simone Merlin (Qualcomm)
- 11-15-0878, "Issues on Trigger Frame Retransmission," Jinsoo Ahn (Yonsei Univ.)
- 11-15-0880, "Scheduled Trigger frames," Alfred Asterjadhi (Qualcomm)
- 11-15-0914, "Enlarged minimal contention window size," Guido R. Hiertz (Ericsson)

◦ **Multi-User (MU)** — 13 submissions
- 11-15-0800, "Multiplexing of Acknowledgements for Multicast Transmission," Yusuke Tanaka (Sony)
- 11-15-0806, "Protection for MU transmission," Young Hoon Kwon (Newracom)
- 11-15-0818, "Further Analysis of Feedback and Frequency Selective Scheduling (FSS) for TGax OFDMA," Kome Oteri (InterDigital Communication)
- 11-15-0829, "Uplink ACK and BA Multiplexing," Reza Hedayat (Newracom)
- 11-15-0843, "UL MU OFDMA analysis," Yonggang Fang (ZTE)
- 11-15-0852, "Transmission Interval of Trigger Frames," Leonardo Lanante (Kyushu Institute of Technology)
- 11-15-0854, "DL OFDMA Signalling," Tomoko Adachi (Toshiba)
- 11-15-0855, "How to collect STAs'f Tx demands for UL MU," Tomoko Adachi (Toshiba)
- 11-15-0858, "MU BFee Interference channel feedback," Sigurd Schelstraete (Quantenna)
- 11-15-0859, "A mechanism for incremental updates to MU precoding," Sigurd Schelstraete (Quantenna)
- 11-15-0867, "MU-RTS/CTS for DL MU," Po-kai Huang (Intel)
- 11-15-0875, "Random Access with Trigger Frames using OFDMA," Chittabrata Ghosh (Intel)
- 11-15-0881, "Regarding buffer status of UL-STAs in UL-OFDMA," Woojin Ahn (Yonsei Univ.)

◦ **Spatial Reuse (SR)** — 8 submissions
- 11-15-0797, "NAV Operation for Spatial Reuse," Yongho Seok (Newracom)
- 11-15-0801, "DCCA/DSC Reference Simulation Results," Masahito Mori (Sony)
- 11-15-0804, "Outdoor Enterprise Scenario and DSC," Graham Smith (SR Technologies)
- 11-15-0807, "DSC Summary," Graham Smith (SR Technologies)
- 11-15-0811, "Topics for Consideration for Spatial Reuse," Xiaofei Wang (InterDigital)
- 11-15-0882, "DSC leveraging uplink RTS/CTS control," M. Shahwaiz Afaqui (Technical University of Catalonia)
- 11-15-0883, "Follow Up Discussion on The Receiver Behavior," Yasuhiko Inoue (NTT)
- 11-15-0886, "DSC Calibration Results," Chinghwa Yu (MediaTek)

◦ **Simulation, calibration, and others** — 13 submissions
- 11-15-0754, "WLAN Packet traffic and efficiency analysis," Jim Lansford (CSR)
- 11-15-0781, "Summary of Power Save Calibration Results," Eric Wong (Apple)
- 11-15-0787, "Power Save Calibration Results," Eric Wong (Apple)
- 11-15-0788, "Box 1 and Box 2 calibration results," Takeshi Itagaki (Sony)
- 11-15-0789, "Proposed Changes to Evaluation Methodologies," Allan Jones (Activision)
- 11-15-0802, "Box5 Calibration Results of SS6," Jiyong Pang (Huawei)
- 11-15-0814, "Simulation Results for Box5 Calibration," Ke Yao (ZTE)
- 11-15-0833, "Calibration results for PSP and UAPSD for 20, 40 and 80MHz bands," Dmitry Akhmetov (Intel)
- 11-15-0680, "Reference Box5 Calibration Assumptions and Parameters," Jiyong Pang (Huawei)

- 11-15-0849, "Simulation Results for Box5 Calibration," Rongzhen Yang (Intel)
- 11-15-0869, "OFDMA and VoIP Capacity," Hakan Persson (Ericsson)
- 11-15-0870, "802.11ax in 2.4 GHz," Guido R. Hiertz (Ericsson)
- 11-15-0885, "Box 5 Calibration Results," ChingHwa Yu (MediaTek)

Goals for the September 2015 session

- Continue to advance TG documents based on submissions.
  - Priority to the TG Specification Framework document.
- Technical Presentations.

Teleconferences

Three teleconferences are planned before the September 2015 meeting.

Thursday	August 20th, 2015	10:00 - 12:00 (ET)

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May 2015 — Vancouver, BC, Canada

The TGax had 10 sessions during the week.
Six out of ten sessions were assigned to the ad hoc groups.

	Monday	Tuesday	Wednesday	Thursday
AM1				**TGax** (full)
AM2	**TGax** (full)	**TGax** (MU ad hoc) **TGax** (SR ad hoc)		
PM1	**TGax** (PHY ad hoc) **TGax** (MAC ad hoc)	**TGax** (PHY ad hoc) **TGax** (SR ad hoc)	**TGax** (PHY ad hoc) **TGax** (MU ad hoc)	**TGax** (full)
PM2			**TGax** (full)	
PM3	**TGax** (full)			

Main documents

The meeting agenda and minutes of the TGax and its subgroups, and the TGax closing report can be found here.

- TGax
  - 11-15-0500-08, TGax May 2015 Meeting Agenda
  - 11-15-0622-00, TGax May 2015 Vancouver Meeting Minutes
  - 11-15-0692-01, TGax May 2015 Closing Report

  - TGax PHY ad hoc group
    - 11-15-0640-04, TGax PHY Ad Hoc May 2015 Meeting Agenda
    - 11-15-0651-02, May 2015 Vancouver TGax PHY Ad hoc Meeting Minutes
  - TGax MAC ad hoc group
    - 11-15-0599-02, TGax MAC Ad Hoc May 2015 Meeting Agenda
    - 11-15-0637-00, May 2015 Vancouver TGax MAC Ad hoc Meeting Minutes
  - TGax Multi-User (MU) ad hoc group
    - 11-15-0645-01, TGax MU Ad-hoc Agenda May 2015

        - 11-15-0679-00, May 2015 Vancouver TGax MU Ad Hoc Meeting Minutes
    - TGax Spatial Reuse (SR) ad hoc group
        - 11-15-0650-02, TGax Spatial Reuse Ad Hoc May 2015 Agenda
        - 11-15-0662-01, Minutes of the IEEE 802.11ax Spatial Reuse ad hoc group meeting - Vancouver, May 2015

Achievements

1. **Passed a number of PHY, MAC and MU motions affecting the TGax Specification Framework**
    - PHY — SIG-A, SIG-B, Pilots, etc.
    - MAC — Trigger frame, etc.
    - Multi-User (MU) — Trigger frame for random access, MU CTS, etc.
2. **TG Documents**
    - Latest revision of the Specification Framework (rev. 7) is available.
        - https://mentor.ieee.org/802.11/dcn/15/11-15-0132-07-00ax-spec-framework.docx
    - Approved new revisions of the TGax Simulation Scenarios and Evaluation Methodology documents.
        - Simulation Scenarios (rev. 14)
        - Evaluation Methodology (rev. 10)
    - Other documents
        - TGax Channel Models
        - 802.11ax Functional Requirements
3. **Technical Presentations**

   More than 50 technical submissions have been covered during the week.

   A list of the submissions is here which is also contained in the agenda document.
    - **PHY** — 14 submissions
        - 11-15-0550, "L-preamble issues for UL-OFDMA," Katsuo Yunoki (KDDI Labs)
        - 11-15-0553, "Enhancing Performance of Hybrid-ARQ with Linear Constellation Precoding," Muhammad Mehboob Fareed (King Abdullah Univ. of Science and Technology)
        - 11-15-0569, "Performance of 1x, 2x, and 4x HE-LTF," Kome Oteri (InterDigital)
        - 11-15-0572, "Inefficiency of 256-FFT per 20MHz," Heejung Yu (Yeungnam Univ./Newracom)
        - 11-15-0574, "SIG structure for UL PPDU," Young Hoon Kwon (Newracom)
        - 11-15-0575, "Preamble Structure in 802.11ax," Yujin Noh (Newracom)
        - 11-15-0577, "Pilot Design for 11ax," Daewon Lee (Newracom)
        - 11-15-0579, "Preamble design and auto-detection," Hongyuan Zhang (Marvell)
        - 11-15-0580, "11ax coding discussion," Hongyuan Zhang (Marvell)
        - 11-15-0584, "Considerations on LTF Sequence Design," Sungho Moon (Newracom)
        - 11-15-0600, "Non Uniform Constellations for 1024QAM," Daniel Schneider (Sony)
        - 11-15-0602, "HE-LTF sequence for UL MU-MIMO," Qinghua Li (Intel)
        - 11-15-0621, "Design Principles for HE Preamble," John Son (WILUS)
        - 11-15-0381, "HE-STF Proposal," Yakun Sun (Marvell)
    - **MAC** — 6 submissions
        - 11-15-0567, "Multi-STA BA for SU Transmissions," Xiaofei Wang (InterDigital)
        - 11-15-0604, "Random Access with Trigger Frames using OFDMA," Chittabrata Ghosh (Intel)
        - 11-15-0611, "Multi-STA Block ACK Protection," Jinsoo Ahn (Yonsei Univ.)
        - 11-15-0615, "UL OFDMA Bandwidth," Liwen Chu (Marvell)
        - 11-15-0617, "Duration and MAC Padding for UL MU PPDUs," Gang Ding (Qualcomm)
        - 11-15-0626, "Further consideration for Multi-STA Block ACK frame," Jeongki Kim (LG)
        -
    - **Multi-User (MU)** — 7 submissions
        - 11-15-0378, "Channel Sensing in UL OFDMA," Reza Hedayat (Newracom)
        - 11-15-0568, "Frequency Selective Scheduling (FSS) for TGax OFDMA," Kome Oteri (InterDigital)
        - 11-15-0586, "Frequency Diversity Options in OFDMA," Reza Hedayat (Newracom)
        - 11-15-0587, "Uplink ACK and BA Multiplexing," Reza Hedayat (Newracom)
        - 11-15-0597, "Beamformed HE PPDU," Yongho Seok (Newracom)
        - 11-15-0608, "Regarding trigger frame in UL MU," Tomo Adachi (Toshiba)

    - 11-15-0612, "Multi Channel availability for UL-OFDMA," Woojin Ahn (Yonsei Univ.)
  - **Spatial Reuse (SR)** — 5 submissions
    - 11-15-0543, "Simulation Scenario changes for Frequency Re-use," Graham Smith (SR Technologies)
    - 11-15-0544, "Proposed text additions to 14/980 for frequency re-use," Graham Smith (SR Technologies)
    - 11-15-0548, "Enterprise Scenario and DSC," Graham Smith (SR Technologies)
    - 11-15-0588, "CCA revisited II," Amin Jafarian (Newracom)
    - 11-15-0595, "Discussion on The Receiver Behavior for CCAC/DSC with BSS Color," Yasuhiko Inoue (NTT)
  - **Simulation, calibration, and others** — 18 submissions
    - 11-15-0551, "OBSS Preamble Detection," Suhwook Kim (LG Electronics)
    - 11-15-0552, "IEEE 802.11 performance in dense, cellular-like, outdoor deployments," Richard Edgar (Imagination Technologies)
    - 11-15-0330, "OFDMA Numerology and Structure," Sharnaz Azizi (Intel)
    - 11-15-0583, "OBSS Preamble Error Probability," Jiyong Pan (Huawei)
    - 11-15-0590, "Traffic Model Updates to Evaluation Methodology," Phil Barber (Huawei)
    - 11-15-0674, "Joint submission for Box 5 Calibration," Suhwook Kin (LG Electronics)
    - 11-15-0581, "LSP Correlation Clarification for Scenario 4," Daewon Lee (Newracom)
    - 11-15-0582, "Clarifications to Box 2 MIMO simulation calibrations," Daewon Lee (Newracom)
    - 11-15-0373, "Mixed traffic configurations on simulation scenarios," Yingpei Lin (Huawei)
      - Not presented since the contents of this submission was merged into 11-15-0590.
    - 11-15-0610, "Simulation Results for Box 5 Calibration," Vida Ferdowsi (Newracom)
    - 11-15-0613, "Box 5 Calibration Result," Chinghwa Yu (MediaTek)
    - 11-15-0623, "TGax simulation scenario "Box 5" - calibration results," Guido Hiertz (Ericsson)
    - 11-15-0316, "Power Save Calibrations," Hyeyoung Choi (LG Electronic)
    - 11-15-0564, "802.11ax Calibration and Modeling Adjacent Channel Interference," Naveen Kakani (CSR)
    - 11-15-0576, "Latency and Power Consumption in State Transitions," Chittabrata Ghosh (Intel)
    - 11-15-0592, "More Power Save Calibration Results," Eric Wong (Apple)
    - 11-15-0598, "U-APSD Enhancement for HE," Jarkko Kneckt (Nokia)
    - 11-15-0603, "Calibration Results for PSP and U-APSD," Chittabrata Ghosh (Intel)

Goals for the July 2015 session

- Continue to advance TG documents based on submissions.
  - Expectation is more submissions affecting the TG specification framework document will be considered.
- Technical Presentations.

Teleconferences

Three teleconferences are planned before the July 2015 session.

Thursday	June 18th, 2015	10:00 - 12:00 (ET)

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March 2015 — Berlin, Germany

TGax originally planned nine sessions during the week.
However, one more session was added (Wednesday PM2).

	Monday	Tuesday	Wednesday		Thursday
AM1	**TGax** (full, ad hoc)		**TGax** (MU ad hoc)	**TGax** (SR ad hoc)	**TGax** (full)

	Monday	Tuesday	Wednesday	Thursday
AM2		**TGax** (PHY ad hoc) **TGax** (MAC ad hoc)		
PM1	**TGax** (full)	**TGax** (full)	**TGax** (full)	**TGax** (full)
PM2			**TGax** (full)	
PM3		**TGax** (full)		

Main documents

The meeting agenda, minutes, and closing report of the TGax can be found here.

- 11-15-0235-08, TGax March 2015 Meeting Agenda
- 11-15-0309-01, TGax March 2015 Berlin Meeting Minutes
- 11-15-0465-00, TGax March 2015 Closing Report

Achievements

1. **Passed a number of PHY, MAC and MU motions affecting the TGax Specification Framework**
   - PHY — LTF and SIG-B design.
   - MAC — Multi-User Block Ack and Multi-User procedures.
   - Multi-User (MU) — Ack multiplexing.
   - etc.
2. **TG Documents**
   - Approved new revisions of the TGax Simulation Scenarios and Evaluation Methodology documents.
     - Simulation Scenarios (rev. 9)
     - Evaluation Methodology (rev. 8)
   - Other documents
     - TGax Channel Models
     - 802.11ax Functional Requirements
3. **Technical Presentations**

   Following technical submissions have been covered during the week.
   - **PHY** — 12 submissions
     - 11-15-0305, "Effective Subcarrier Assignment for DL-OFDMA," Katsuo Yunoki (KDDI R&D Laboratories)
     - 11-15-0330, "OFDMA Numerology and Structure," Shahrnaz Azizi (Intel Corporation)
     - 11-15-0344, "SIG field design principle for 11ax," Young Hoon Kwon (Newracom)
     - 11-15-0349, "HE-LTF Proposal," Hongyuan Zhang (Marvell)
     - 11-15-0358, "Numerology for 11ax," Daewon Lee (Newracom)
     - 11-15-0360, "Preamble Auto-Detection for 802.11ax," Sungho Moon (NEWRACOM)
     - 11-15-0364, "11ax Preamble design: training sequence," Sigurd Schelstraete (Quantenna)
     - 11-15-0375, "Minimum Resource Granularity in OFDMA," John Son (WILUS Institute)
     - 11-15-0378, "Channel Sensing in UL OFDMA," Reza Hedayat (Newracom)
     - 11-15-0380, "Discussion on OFDMA scheduling for 802.11ax," Le Liu (Huawei Technologies)
     - 11-15-0381, "HE-STF Proposal," Yakun Sun (Marvell)
     - 11-15-0383, "Impact of number of sub-channels in OFDMA," Leif Wilhelmsson (Ericsson)
   - **MAC** — 6 submissions
     - 11-15-0320, "GCR-BA with Measurement Report Performance in OBSS," Yuichi Morioka (SONY)
     - 11-15-0336, "MAC Overhead Analysis of MU Transmissions," Xiaofei WANG (InterDigital)
     - 11-15-0362, "Beacon Transmission Issues," Yonggang Fang (ZTE)
     - 11-15-0365, "UL MU Procedure," Kiseon Ryu (LG Electronics)
     - 11-15-0366, "Multi-STA BA," Simone Merlin (Qualcomm)
     - 11-15-0376, "UL-MU MAC Throughput Under Non-Full Buffer Traffic," Tatsumi Uwai (Radrix Co. Ltd)
   - **Multi-User (MU)** — 9 submissions

- 11-15-0331, "Uplink Multi-User MIMO Protocol Design," Yongho Seok (NEWRACOM)
- 11-15-0333, "Throughput Comparison of Some Multi-user Schemes in 802.11ax," Kome Oteri (InterDigital)
- 11-15-0336, "MAC Overhead Analysis of MU Transmissions," Xiaofei WANG (InterDigital)
- 11-15-0353, "OFDMA Non-contiguous Channel Utilization," Jinsoo Ahn (Yonsei univ.)
- 11-15-0354, "Bandwidth granularity on UL-OFDMA data allocation," Woojin Ahn (Yonsei Univ.)
- 11-15-0363, "UL MU Synchronization Requirements," Yonggang Fang (ZTE)
- 11-15-0377, "Considerations on UL MU Resource Scheduling," Leonardo Lanante (Kyutech)
- 11-15-0379, "DL OFDMA Performance and ACK Aggregation," Reza Hedayat (Newracom)
- 11-15-0384, "Discussion on DL-OFDMA Sub-channel Indication Method," Yu Cai (Lenovo)

- **Spatial Reuse (SR)** — 7 submissions
  - 11-15-0300, "Potential of Modified Signal Detection Thresholds," Gustav Wikstrom (Ericsson AB)
  - 11-15-0318, "CCA Regime Evaluation Revisited," Amin Jafarian (Newracom Inc.)
  - 11-15-0319, "Impact of TPC coupled to DSC for legacy unfairness issue," Masahito Mori (Sony)
  - 11-15-0338, "Discussions on the Definition of CCA Threshold," Akira Kishida (NTT)
  - 11-15-0367, "OBSS preamble detection," Gwen Barriac (Qualcomm)
  - 11-15-0371, "Proposal and simulatin based evaluation of DSC-AP Algorithm," Eduard Garcia-Villegas (UPC)
  - 11-15-0374, "Further Considerations on Legacy Fairness with Enhanced CCA," John Son (WILUS Institute)
- **Simulation, calibration, and others** — 24 submissions
  - 11-14-1392, "Simulation results for Box-5 calibration," Suhwook Kim (LG Electronics)
  - 11-14-1434, "SLS Box4 Calibration Results," Russell Huang (MediaTek Inc.)
  - 11-15-0053, "Box5 Results of 11ac SS6," Jiyong Pang ⁄eHuawei)
  - 11-15-0072, "U-APSD power saving calibration results," Yanchun Li (Huawei)
  - 11-15-0125, "Box 1 and Box 2 Calibration Results," Ron Porat (Broadcom)
  - 11-15-0304, "Evaluating Power Save Performance," Joonsuk Kim (Apple)
  - 11-15-0306, "Power Save Mode Calibration Results," Eric Wong (Apple)
  - 11-15-0307, "MAC calibration results for Test 4," Ke Yao (ZTE Corp.)
  - 11-15-0308, "Simulation results for box 5," Ke Yao (ZTE Corp.)
  - 11-15-0314, "Sleep States in IEEE 802.11ax Simulation Scenarios," Chittabrata Ghosh (Intel)
  - 11-15-0316, "Power Save Calibration," Hyeyoung Choi (LG)
  - 11-15-0326, "U-APSD Enhancements for HE," Jarkko Kneckt (Nokia)
  - 11-15-0327, "Microsleep for HE STA," Jarkko Kneckt (Nokia)
  - 11-15-0343, "In Situ Frame Size Measurements," Chuck Lukaszewski (Aruba Networks)
  - 11-15-0351, "Empirical Measurements of Channel Degradation Under Load," Chuck Lukaszewski (Aruba Networks)
  - 11-15-0357, "Scenario 1 CCA Simulation," Knut Odman (Broadcom Corporation)
  - 11-15-0359, "Clarification of MIMO Box2 calibration," Jaehyun Ahn (Newracom)
  - 11-15-0368, "Box 5 results for Single BSS Calibration Case," Esa Tuomaala (Nokia)
  - 11-15-0369, "MAC calibration test 4 simulation results," Enrico-Henrik Rantala (Nokia)
  - 11-15-0370, "MAC Calibration Results," Guoqing Li (Apple)
  - 11-15-0372, "Corrections on Reference Traffic Profile for Scenario 2 in Simulation Scenarios Document," Yingpei Lin (Huawei)
  - 11-15-0373, "Mixed traffic configurations on simulation scenarios," Yingpei Lin (Huawei)
  - 11-15-0382, "MAC calibration test 4 simulation results," Yanchun Li (Huawei)
  - 11-15-0441, "Proposed text to TGax Simulation Scenarios MAC test 4," Enrico-Henrik Rantala (Nokia)

Goals for the May 2015 session

- Continue to advance TG documents based on submissions.
  - Expectation is more submissions affecting the TG specification framework document will be considered.
- Technical Presentations.

Teleconferences

Three teleconferences are planned before the May 2015 session.

Thursday	April 9th, 2015	10:00 - 12:00 (ET)
Thursday	April 30th, 2015	20:00 - 22:00 (ET)

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January 2015 — Atlanta, GA

The TGax planned to have 9 sessions during the week.
One session (Thursday PM2) was cancelled upon completion of the business.

	Monday	Tuesday	Wednesday	Thursday
AM1			**TGax** (full)	**TGax** (full)
AM2	**TGax** (full)	**TGax** (full)		
PM1	**TGax** (full)	**TGax** (full)	**TGax** (full)	**TGax** (Cancelled)
PM2				
PM3	**TGax** (full)			

Main documents

The meeting agenda, minutes, and closing report of the TGax can be found here.

- 11-14-1578-06, TGax January 2015 Meeting Agenda
- 11-15-0090-00, TGax January 2015 Atlanta Meeting Minutes
- 11-15-0186-00, TGax January 2015 Closing Report

Achievements

1. **TG Structure**
   Co-chairs for the ad hoc groups are elected.

MAC	PHY	Multi-User (MU)	Spatial Reuse (SR)
Eric Wong (Apple)	Bo Sun (ZTE)	Sigurd Schelstraete (Quantenna)	Laurent Cariou (Orange)
Reza Hedayat (Newracom)	Jianhan Liu (MediaTek)	Kiseon Ryu (LG Electronics)	Guido R. Hiertz (Ericsson)
Brian Hart (Cisco)	Yakun Sun (Marvell)	Kaushik Josiam (Samsung)	Jae Seung Lee (ETRI)

2. **TG Documents**
   - Passed a number of motions affecting the TG specification Framework.
   - Approved new revisions of Simulation Scenarios and Evaluation Methodology TG documents.
     - TGax Simularion Scenarios (11-14-0980-06)
     - TGax Evaluation Methodology (11-14-0571-07)
3. **Technical Presentations**
   Here is the list of the submissions that the TGax received during the week.
   - **DSC and CCA**
     - 11-15-0025, "DSC and Roaming," Graham Smith (SR Technologies)
     - 11-15-0027, "Simulation Based Evaluation DSC in residential scenario," M. Shahwaiz Afaqui (UPC)
     - 11-15-0045, "Performance Analysis of BSS Color and DSC," Masahito Mori (Sony)

- 11-15-0050, "Modeling components impacting throughput gain from CCAT adjustment," Yu Wang (Ericsson AB)
- 11-15-0085, "Legacy Fairness Issues of Enhanced CCA," John Son (WILUS Institute)
- 11-15-0105, "Dynamic CCA Management," Sean Coffey (RealTek)

◦ **OFDMA**
- 11-15-0034, "DL-OFDMA Map Frame," Katsuo Yunoki (KDDI Labs)
- 11-15-0066, "Downlink OFDMA Protocol Design," Yongho Seok (Newracom)
- 11-15-0079, "OFDM Numerology for 11ax," Daewon Lee (Newracom)
- 11-15-0091, "UL-OFDMA Procedure in IEEE 802.11ax," Woojin Ahn (Yonsei Univ.)
- 11-15-0092, "DL-OFDMA Procedure in IEEE 802.11ax," Jinsoo Ahn (Yonsei Univ.)

◦ **Multi-User (MU)**
- 11-15-0010, "draft for integrated UL DL MU MIMO Frame Format," Tae-Yoon Kim (Korea Univ.) - Not presented
- 11-15-0029, "Discussion on integrated UL/DL MU-MIMO," Tae-Yoon Kim (Korea Univ.) - Not presented
- 11-15-0040, "Discussion on integrated UL-DL MU-MIMO-MAC," TaeYoon Kim (Korea Univ.)
- 11-15-0064, "Consideration on UL-MU overheads," Tomoko Adachi (Toshiba)
- 11-15-0086, "Uplink MU Transmission and Legacy Coexistence," Reza Hedayat (NEWRACOM)
- 11-15-0089, "MAC Efficiency Gain of Uplink Multi-user Transmission," Leonardo Lanante Jr (Kyushu Inst. of Tech.)

◦ **MAC**
- 11-15-0035, "Scalable Channel Utilization," Katsuo Yunoki (KDDI R&D Laboratories)
- 11-15-0037, "Structural Format Change," Kyonggi University
- 11-15-0046, "11aa GCR-BA Performance in OBSS," Yuichi Morioka (Sony)
- 11-15-0059, "Uplink RTS/CTS Control," Sigurd Schelstraete (Quantenna)

◦ **PHY**
- 11-15-0048, "Non-Uniform Constellations for Higher Order QAMs," Daniel Schneider (Sony)
- 11-15-0068, "Support of outdoor environments," Young Hoon Kwon (NEWRACOM)
- 11-15-0079, "OFDM Numerology for 11ax," Daewon Lee (NEWRACOM)
- 11-15-0081, "Considerations on 11ax Auto-detection Methods," Jaeyoung Song (KAIST)
- 11-15-0082, "Considerations on 11ax OFDMA Frequency Granularity," Young-bin Kim (KAIST)
- 11-15-0097, "Performance Analysis of Frequency Selective Scheduling," Ningbo Zhang (BUPT)
- 11-15-0099, "Payload Symbol Size for 11ax," Sriram Venkateswaran (Broadcom)
- 11-15-0101, "Preamble structure for 11ax system," Jiayin Zhang (Huawei)

◦ **Simulation Scenarios and Evaluation Methodology**
- 11-14-1342, "MAC Calibration Results," Igor Kim (ETRI)
- 11-14-1343, "Multicast Scenarios for MAC Calibration," Igor Kim (ETRI)
- 11-14-1392, "Simulation Results for Box-5 Calibration," Suhwook Kim (LGE)
- 11-14-1523, "Offline Discussion Minutes of SLS Calibration," Jiyong Pang (Huawei)
- 11-14-1590, "Multi-wall penetration loss model for HEW system level simulation," Kejun Zhao et al. (National Engineering Research Center for Broadband Networks & Applications)
- 11-14-1597, "PHY abstraction and performance for outdoor channel models," Kejun Zhao et al. (National Engineering Research Center for Broadband Networks & Applications)
- 11-15-0022, "MAC Calibration Results," Xiaofei Wang (InterDigital)
- 11-15-0044, "Proposed Changes to Simulation Scenarios," Masahito Mori (Sony)
- 11-15-0051, "Box5 Calibration Results," Jiyong Pang (Huawei)
- 11-15-0052, "Box5 Results of One BSS Case," Jiyong Pang (Huawei)
- 11-15-0053, "Box5 Results of 11ac SS6," Jiyong Pang (Huawei)
- 11-15-0061, "FPS Network Traffic Model," Allan Jones (Activision)
- 11-15-0065, "11ax EMD Revision Straw Poll," Jiyong Pang (Huawei)
- 11-15-0071, "MAC calibration test 4 results," Yanchun Li (Huawei)
- 11-15-0072, "U-APSD power saving calibration results," Yanchun Li (Huawei)
- 11-15-0073, "Simulation Results of Box5," Ke Yao (ZTE)
- 11-15-0078, "Clarification on calibration test cases," Guoqing Li (Apple)
- 11-15-0080, "MAC Calibration Results," Geonjung Ko (WILUS Institute)
- 11-15-0093, "Text Update on PHY Abstraction and SP," Yakun Sun (Marvell)
- 11-15-0103, "Power Save Calibration," Yarkko Kneckt (Nokia)
- 11-15-0104, "SLS MAC Test 4 Results," Chinghwa Yu (MediaTek)

- **Others**
  - 11-15-0043, "In-band Full Duplex Radios and System Performance," Kapseok Chang (ETRI)
  - 11-15-0075, "Operating Rules for TGax Ad Hoc groups," Osama Aboul-Magd (TGax chair)
  - 11-15-0076, "Field Sample OBSS and Client Data," Carol Ansley (ARRIS Group)

Goals for the March 2015 session

- Continue to advance TG documents based on submissions.
  - Expectation is more submissions affecting the TG specification framework document will be considered.
- Technical Presentations.

Teleconferences

Three teleconferences are planned before the March 2015 session.

Thursday	February 26th, 2015	10:00 - 12:00 (ET)

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November 2014 — San Antonio, TX

The TGax originally planned to have 9 sessions during the week.
FourHowever, one session (Tuesday PM3) was cancelled.

	Monday	Tuesday	Wednesday	Thursday
AM1	**TGax** (ad hoc)			**TGax**
AM2		**TGax**		
PM1		**TGax**	**TGax**	**TGax**
PM2	**TGax**	**TGax**		
PM3		**TGax** (Cancelled)		

Main documents

The meeting agenda, minutes, and the closing report of TGax can be found here.

- 11-14-1319-07, TGax November 2014 Meeting Agenda
- 11-14-1460-00, TGax November 2014 San Antonio Meeting Minutes
- 11-14-1536-00, TGax November 2014 Closing Report

Achievements

1. **Discussions on the TG Structure**
   - The TG approved a motion to create four ad hoc groups.
     - PHY, MAC, Multi-User (MU) and Spatial Reuse (SR)
   - The TG approved a motion to have 3 co-chairs for each of the ad hocs.
   - Ad hoc chairs election is scheduled for January 2015 meeting on Tuesday.
   - Ad hoc meetings will start on March 2015
   - Robert Stacy (Intel) was appointed as the technical editor of the TGax.
2. **TG Documents — The group approved updated documents.**

- The group approved the first version of TGax Specification Framework document (11-14-1453-02).
- The group approved new revisions of the following documents.
  - TGax Simulation Scenarios (11-14-0980-05)
  - TGax Evaluation Methodology (11-14-0571-06).

3. **Technical Presentations**

Here is the list of the 44 submissions that the TGax received.

- **Evaluation Methodology**
  - 11-14-1388, "Consideration on PER Prediction for PHY Abstraction," Bo Sun (ZTE Corp)
  - 11-14-1418, "Further Study of Time Varying Interference and PHY Abstraction," Yakun Sun (Marvell)
  - 11-14-1420, "The Impact of Preamble Error on MAC System Performance," Po-Kai Huang (Intel)
  - 11-14-1424, "Proposed Changes to Evaluation Methodology and Simulation Scenario," Yuichi Morioka (Sony)
  - 11-14-1440, "A Few Corrections to Video Traffic Model," Guoqing Li (Apple)
- **Simulation Scenarios and Calibration**
  - 11-14-1177, "Discussion about Box5 Calibration," Jiyong Pang (Huawei)
  - 11-14-1342, "MAC Calibration Results," Igor Kim (ETRI)
  - 11-14-1343, "Multicast Scenarios for MAC Calibration," Igor Kim (ETRI)
  - 11-14-1392, "Simulation results for Box 5 calibration," Suhwook Kim (LG Electronics)
  - 11-14-1402, "Box1 and Box3 calibration results," Masahito Mori (Sony)
  - 11-14-1419, "SLS Box5 Calibration Results and Discussions," Yakun Sun (Marvell)
  - 11-14-1434, "TGax SLS Box4 Calibration Results," Russell Huang (MediaTek Inc.)
  - 11-14-1441, "Simulation Setting of Box5 Calibration," Jiyong Pang (Huawei)
  - 11-14-1444, "Energy Efficiency Evaluation and Simulation Model," Chinghwa Yu (MediaTek)
  - 11-14-1449, "MAC Calibration Results," Newracom
  - 11-14-1450, "Box 0 calibration results," Hongsup Lee (Newracom)
  - 11-14-1451, "Box 1 and Box 2 Calibration Results," Jaehyun Ahn (Newracom)
- **Technology/Other**
  - 11-14-1228, "Issues on 256-FFT per 20MHz," Heejung Yu (NEWRACOM/YU)
  - 11-14-1380, "Efficiency Measurement for RTS/CTS," Katsuo Yunoki (KDDI R&D Laboratories)
  - 11-14-1381, "Novel RTS/CTS Procedure," Katsuo Yunoki (KDDI R&D Laboratories)
  - 11-14-1382, "Responses to the comments on doc.1169," Katsuo Yunoki (KDDI R&D Laboratories)
  - 11-14-1397, "Discussion on Frame Structure for Future WLAN Systems with OFDMA," Myeong-Jin Kim (Korea University)
  - 11-14-1403, "Performance Analysis of BSS Color and DSC," Masahito Mori (Sony)
  - 11-14-1404, "11aa GCR-BA Performance in OBSS," Yuichi Morioka (Sony)
  - 11-14-1416, "Observed protocol violations caused by DSC with roaming STAs," Chuck Lukaszewski (Aruba Networks)
  - 11-14-1417, "HEW PPDU Transmission Discussion," Yongho Seok (NEWRACOM)
  - 11-14-1426, "DSC and legacy coexistence," Gustav Wikstrom et al. (Ericsson)
  - 11-14-1427, "DSC Performance," Gustav Wikstrom et al. (Ericsson)
  - 11-14-1428, "Clear Channel Assessment for OFDMA PHY," K. C. Chen (NTU) and D. J. Deng (NCUE)
  - 11-14-1431, "Issues on UL-OFDMA Transmission," Young Hoon Kwon (Newracom)
  - 11-14-1433, "Protocol and signaling framework for OFDMA," Sigurd Schelstraete (Quantenna)
  - 11-14-1435, "Considerations on OBSS Spatial Re-Use," Jianhan Liu (Mediatek Inc.)
  - 11-14-1436, "Overhead Analysis for Simultaneous Downlink Transmissions," Pengfei Xia (interdigita)
  - 11-14-1437, "Efficient Wider Bandwidth Operation in IEEE 802.11ax," Jinsoo Ahn (Yonsei Univ)
  - 11-14-1439, "Preamble Considerations in Large Channel Delay Spread Scenarios," Daewon Lee (Newracom)
  - 11-14-1442, "Considerations on DL OFDMA control mechanism," Woojin Ahn (Yonsei Univ.)
  - 11-14-1443, "Adapting CCA and Receiver Sensitivity," Esa Tuomaala (Nokia)
  - 11-14-1446, "Analysis of frequency and power requirements for UL-OFDM," Leif Wilhelmsson (Ericsson)
  - 11-14-1448, "Considerations for Adaptive CCA," Reza Hedayat (Newracom)
  - 11-14-1452, "Frequency selective scheduling in OFDMA," Leif Wilhelmsson (Ericsson)
- **Specification Framework**
  - 11-14-1429, "Proposed 802.11ax specification framework document," Minho Cheong (Newracom)
  - 11-14-1432, "Proposed 802.11ax specification framework - background," Minho Cheong (Newracom)

- 11-14-1447, "Proposed Spec Framework Document for 11ax considering potential tech features," John Son (WILUS Institute), Young Doo Kim (SK Telecom)
- 11-14-1453, "Spec Framework Proposal," Robert Stacey (Intel)

Goals for the January 2015 session

- Elect ad hoc chairs - 3 co-chairs/ad hoc group as agreed.
- Continue to advance TG documents.
- Technical Presentations.

Teleconferences

One teleconference is planned before the January 2015 session.

Thursday	December 4th, 2014,	10:00 - 12:00 (ET)

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September 2014 — Athens, Greece

The TGax had nine sessions during the week.

	Monday	Tuesday	Wednesday	Thursday
AM1				**TGax**
AM2	**TGax**	**TGax**		
PM1		**TGax**	**TGax**	**TGax**
PM2	**TGax**	**TGax**		
PM3	**TGax**			

Main documents

The meeting agenda, minutes, and the closing report of TGax can be found here.

- 11-14-1033-05, TGax September 2014 Meeting Agenda
- 11-14-1460-00, TGax November 2014 Athens Meeting Minutes
- 11-14-1304-00, TGax November 2014 Closing Report

Achievements

1. **The group elected two vice chairs and discussed about the TG structure.**
   Election of Vice Chairs took place during this meeting and two TG Vice Chairs are elected:
   - Simone Merlin (Qualcomm)
   - Ron Porat

   The group started discussion on the Ad Hoc groups. Discussion will be continued in future meetings.
2. **The group approved minutes from the July 2014 San Diego meeting.**
   - 11-14-0864-00, TGax July 2014 San Diego Meeting Minutes
3. **TG Documents**
   The group approved updated documents.
   - 11-14-0980-04, TGax Simulation Scenarios
   - 11-14-0571-05, TGax Evaluation Methodology

- 11-14-0882-04, TGax Channel Models
- 11-14-1009-02, TGax Functional Requirements

4. **Technical Presentations**

54 submissions were submitted to the group and 52 of them were covered during the week.

- **Functional Requirements**
  - 11-14-0636, "Discussion on Functional Requirements," David Xun Yang (Huawei Technologies)
  - 11-14-0920, "Considerations of Functional Requirements Documents," David Xun Yang (Huawei Technologies)
  - 11-14-1009, "Proposed 802.11ax Functional Requirements," Lei Wang (Marvell)
  - 11-14-1164, "Meaningful 11ax Functional Requirements," Joe Kwak (InterDigital)
  - 11-14-1167, "TGax Functional Requirement Discussion," Yonggang Fang (ZTE)
  - 11-14-1170, "Functional Requirements Discussions on Coex with Legacy STAs," Masahito Mori (Sony)
  - 11-14-1234, "Requirements Discussion," Joseph Levy (InterDigital)
- **Simulation Scenarios and Calibration**
  - 11-14-0800, "Box 1 and Box 2 Calibration Results," Nihae Jindal (Broadcom)
  - 11-14-1147, "MAC Simulator Calibration Results," Shoko Shinohara, Akira Kishida (NTT)
  - 11-14-1175, "MAC Calibration results," Suhwook Kim (LG Electronics)
  - 11-14-1177, "Discussion about Box5 Calibration," Jiyong Pang (Huawei Technologies)
  - 11-14-1187, "The Effect of Preamble Error Model on MAC Simulator," Po-Kai Huang (Intel)
  - 11-14-1191, "MAC calibration results," Zhou Lan (Huawei Technologies)
  - 11-14-1192, "MAC calibration results comparison," Zhou Lan (Huawei Technologies)
  - 11-14-1198, "Additional Test Cases for MAC calibration," Gwen Barriac (Qualcomm)
  - 11-14-1217, "MAC Calibration Results for Test 1 and 2," Esa Tuomaala (Nokia)
  - 11-14-1223, "Stadium Measurements," Brian Hart (Cisco Systems)
  - 11-14-1226, "SLS Box 1&2 Calibration Results," Russell Huang (MediaTek)
  - 11-14-1230, "MAC Calibration Result," Chinghwa Yu (MediaTek)
- **Evaluation Methodology**
  - 11-14-1161, "Parameters for Power Save Mechanisms," Eric Wong (Apple)
  - 11-14-1162, "Energy Efficiency Evaluation Methodology Follow Up," Eric Wong (Apple)
  - 11-14-1174, "PHY Abstraction with Time Varying Interference," Yakun Sun (Marvell)
  - 11-14-1176, "PHY abstraction tables for 11ax system level simulation," Jiayin Zhang (Huawei Technologies)
  - 11-14-1221, "Traffic Generator for OBSS Calibration Case," Chao-Chun Wang (MediaTek)
- **Channel Model**
  - 11-14-1214, "Impact of correlated shadowing in 802.11ax system evaluations," Leif Wilhelmsson (Ericsson AB)
  - 11-14-1222, "Doppler Effect Evaluation for 11ax," Jianhan Liu (MediaTek)
- **Technologies/Others**
  - 11-14-1106, "WLAN Frame Collision Information," Peng Shao (NEC Communication Systems)
  - 11-14-1148, "Consideration of asynchronous interference in OBSS environment," Koichi Ishihara (NTT)
  - 11-14-1168, "802.11 TGax PHY Frame Structure Discussion for Enabling New Contention Mechanism," Yonggang Fang (ZTE)
  - 11-14-1169, "DL-FDMA considerations," Katsuo Yunoki (KDDI R&D Labs.)
  - 11-14-1171, "DSC Simulation Results for Scenario 3," Masahiro Mori (Sony)
  - 11-14-1172, "Multicast Performance in OBSS," Yuichi Morioka (Sony)
  - 11-14-1178, "Inter-BSS interference in WLANs," Hyunduk Kang (ETRI)
  - 11-14-1179, "Considerations for Partial Band Interference between WLAN Systems," Gwangzeen Ko (ETRI)
  - 11-14-1180, "Discussions on Interference between TD-LTE & WLAN around 2.4GHz Band," Meng Yang (CATR)
  - 11-14-1181, "Measurements on A-MPDU performances under various channel conditions," John Sun (WILUS Institute)
  - 11-14-1186, "Comparisons of Simultaneous Downlink Transmissions," Pengfei Xia (InterDigital)
  - 11-14-1190, "Frame Exchange Control for Uplink Multi-user transmission," Kaying Lv (ZTE)
  - 11-14-1199, "Effect of CCA in residential scenario part 2," Gwen Barriac (Qualcomm)
  - 11-14-1207, "OBSS reuse mechanism which preserves fairness," Laurent Cariou (Orange)
  - 11-14-1208, "MAC considerations on 802.11ax OFDMA," Jinsoo Ahn (Yonsei Univ.)
  - 11-14-1209, "Multiple RF operation for 802.11ax OFDMA," Woojin Ahn (Yonsei Univ.)
  - 11-14-1210, "HEW PPDU Format for Supporting MIMO-OFDMA," Yongho Seok (NEWRACOM)
  - 11-14-1211, "ACK Procedure for OFDMA," Yongho Seok (NEWRACOM)

- 11-14-1216, "Consideration on Coexistence between LTE-U and 802.11 WLAN," Jae Seung Lee (ETRI)
- 11-14-1224, "Link-Aware CCA," Brian Hart (Cisco Systems)
- 11-14-1225, "Considerations on CCA for OBSS Opearation in 802.11ax," Luo Jun (Huawei Technologies)
- 11-14-1227, "OFDMA Performance Analysis," Tianyu Wu (MediaTek)
- 11-14-1228, "Issues on 256-FFT per 20MHz," Heejung Yu (NEWRACOM)
- 11-14-1229, "Dynamic OFDM Symbol Duration," Alan Jauh (MediaTek)
- 11-14-1232, "On MU Aggregation Mechanisms for 11ax," Reza Hedyat (NEWRACOM)
- 11-14-1233, "Adaptive CCA for 11ax," Reza Hedyat (NEWRACOM)

Goals for the November 2014 session

- Continue to advance TG documents.
- Technical Presentations.

Teleconferences

Three teleconferences are planned before the November 2014 session.

Thursday	October 9th, 2014	10:00 - 12:00 (ET)

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July 2014 — San Diego, CA

The TGax had 10 sessions during the week.

	Monday	Tuesday	Wednesday	Thursday
AM1	**TGax**		**TGax**	**TGax**
AM2		**TGax**		
PM1			**TGax**	**TGax**
PM2	**TGax**	**TGax**	**TGax**	
PM3		**TGax**		

Main documents

The meeting agenda, minutes, and the closing report of TGax can be found here.

- 11-14-0748-06, TGax July 2014 Meeting Agenda
- 11-14-0864-00, TGax July 2014 San Diego Meeting Minutes
- 11-14-0984-01, TGax July 2014 Closing Report

Achievements

1. **The group discussed on the TG structure.**
   - The group will have two vice chairs to be election during the initial meeting slot of TGax in September 2014.
     - Chair has sent out the call for nominations to the reflector.
   - The group will have some ad hoc groups in the future, however, the discussion on the ad hoc structure was deferred.
2. **The group approved minutes from the May 2014 Waikoloa meeting and Teleconference on July 2nd, 2014.**
   - 11-14-0655-03, May 2014 Waikoloa Meeting Minutes
   - 11-14-0788-02, Minutes from the teleconference on July 2nd, 2014

3. **TG Documents**

   The group discussed and approved following documents as current TG documents.

   - The group approved new version of the Simulation Scenarios Document (11-14-0980-01).
   - The group approved new version of the Evaluation Methodology Document (11-14-0571-03).
   - The group approved the initial version of the TGax Channel Model document (11-14-0882r3).
   - The group adopted the initial version of the TGax Selection Procedure (11-14-0938r4).
   - The group had discussion on the Functional Requirements document.

4. **Technical Presentations**

   More than 40 submissions were covered during the week.

   - **Simulation Scenarios and Calibration**
     - 11-14-0799, "Modifications to Simulation Scenarios and Calibration Process," Nihar Jindal (Broadcom)
     - 11-14-0800, "Box 1 and Box 2 Calibration Results," Nihar Jindal (Broadcom)
     - 11-14-0803, "Packet Length for Box 0 Calibration," Wookbong Lee (LG Electronics)
     - 11-14-0850, "Clarification for MAC Calibration," Gwen Barriac (Qualcomm)
     - 11-14-0851, "Proposed Rate Control for MAC Simulator," Gwen Barriac (Qualcomm)
     - 11-14-0859, "Proposing a Stadium Scenario," Hakan Persson (Ericsson)
     - 11-14-0860, "Text proposal of a Stadium scenario to ax," Hakan Persson (Ericsson)
     - 11-14-0869, "MAC calibration results," Zhou Lan (Huawei)
     - 11-14-0871, "Further Calibration Results towards Integrated System Level Simulation," Jiyong Pang (Huawei)
     - 11-14-0892, "MAC Calibration Text to Simulation Scenarios," Jarkko Kneckt (Nokia)
     - 11-14-0894, "Calibration of System Level Simulators," Sayantan Choudhury (Nokia)
     - 11-14-0895, "Calibration of MAC simulator with OBSS Network Scenario," Chao-CHun Wang (MediaTek)
   - **Evaluation Methodology**
     - 11-14-0571, "Evaluation Methodologies," Ron Porat (Broadcom)
     - 11-14-0810, "RBIR-based PHY Abstraction with Channel Estimation Error," Yukun Sun (Marvell)
     - 11-14-0811, "Overview on RBIR-based PHY Abstraction," Yukun Sun (Marvell)
     - 11-14-0827, "Energy Efficiency Evaluation Methodology," Eric Wong (Apple)
     - 11-14-0865, "ACI and AACI for 802.11ax System Simulations," Yu Cai (Huawei)
     - 11-14-0866, "Traffic modeling and system capacity performance measure," Johan Soder (Ericsson)
     - 11-14-0873, "PHY Abstraction Table for 11ax System Level Simulations," Jiayin Zhang (Huawei)
     - 11-14-0874, "Unified Traffic Model on Enterprise Scenario," Phillip Barber (Huawei)
     - 11-14-0875, "VoIP Traffic Model Content for 11ax TG Simulation Scenarios & Evaluation Methodology," Phillip Barber (Huawei)
   - **Channel Models**
     - 11-14-0882, "IEEE 802.11ax Channel Model Document," Jianhan Liu (Mediatek)
     - 11-14-0904, "In-Cabin WiFi Channel Channel: Preliminary Ray Tracing Simulations," Fan Bai (General Motors)
   - **Functional requirements**
     - 11-14-0567, "Proposed 802.11ax Functional Requirements," Lei Wang (Marvell)
     - 11-14-0818, "Synchronization Requirements," Yonggang Fang (ZTE)
     - 11-14-0821, "Coexistence Requirements of 802.11 WLAN and LTE in Unlicensed Spectrum," Alireza Babaei (CableLabs)
     - 11-14-0835, "Functional Requirements Discussion," Joe Kwak (InterDigital)
   - **Technologies/Others**
     - 11-14-0779, "Dynamic Sensitivity Control Practical Usage," Graham Smith (DSP Group)
     - 11-14-0801, "Envisioning 11ax PHY Structure - Part II," Dongguk Lim(LG Electronics)
     - 11-14-0802, "Consideration on UL MU transmission," Jinyoung Chun (LG Electronics)
     - 11-14-0804, "Envisioning 11ax PHY Structure - Part I," Jinsoo Choi (LG Electronics)
     - 11-14-0832, "Performance Evaluation of OBSS Densification," Po-Kai Huang (Intel)
     - 11-14-0833, "Residential Scenario Sensitivity and Transmit Power Control Simulation Results," Ron Murias (InterDigital)
     - 11-14-0838, "Discussion on dual-link STR in IEEE 802.11ax," Jinsoo Ahn (Yonsei Univ)
     - 11-14-0839, "Discussion on OFDMA in IEEE 802.11ax," Jinsoo Ahn (Yonsei Univ)
     - 11-14-0846, "Changing CCA in the Residential Environment," Gwen Barriac (Qualcomm)
     - 11-14-0847, "Further Considerations on Enhanced CCA for 11ax," John Son (WILUS Institute)
     - 11-14-0854, "DSC and Legacy Coexistence," Yuichi Morioka (SONY)
     - 11-15-0855, "Techniques for Short Downlink Frames," Brian Hart (Cisco Systems)

- 11-15-0856, "Evaluating Dynamic CCA/Receiver Sensitivity Algorithms," Brian Hart (Cisco Systems)
- 11-14-0858, "Analysis on Multiplexing Schemes exploiting frequency selectivity," Kaushik Josiam (Samsung)
- 11-14-0861, "Impact of CCA adaptation on spatial reuse in dense residential scenario," Sayantan Choudhury (Nokia)
- 11-14-0868, "UL & DL DSC and TPC MAC simulations," Johan Soder (Ericsson)
- 11-14-0872, "A Protocol Framework for Dynamic CCA," Sean Coffey (Realtek)
- 11-14-0880, "Increased Network Throughput with Channel Width Related CCA and Rules," James Wang (Mediatek)
- 11-14-0889, "Performance Gains from CCA Optimization," Nihar Jindal (Broadcom)

5. **Timeline**
   No change was made to the tGax initial timeline that was approved during the May 2014 Waikoloa session.

Current Timeline	
May 2014	**Start of TG**
November 2014	**Start to work on the specification framework**
July 2016	**Draft 1.0 to be ready**
March 2017	**Draft 2.0 to be ready**
1H 2019	**Publication of IEEE 802.11ax amendment**

Goals for the September 2014 session

- TG vice-chairs election.
- Continue to advance TG documents.
- Technical Presentations.

Teleconferences

Three teleconferences are planned before the September 2014 session.

Thursday	August 14th, 2014	10:00 - 12:00 (ET)

Chair had sent out call for submissions on the TGax reflector.

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May 2014 — Waikoloa, HI

The TGax had 10 sessions during the week.
Four out of ten sessions were assigned to the ad hoc groups.

	Monday	Tuesday	Wednesday	Thursday
AM1			**TGax**	**TGax**
AM2	**TGax**	**TGax**		
PM1				**Tgax**
PM2	**TGax**	**TGax**		
PM3	**TGax**	**TGax**		

Main documents

The meeting agenda, minutes, and the closing report of TGax can be found here.

- 11-14-0478-05, TGax May 2014 Meeting Agenda
- 11-14-0655-01, TGax May 2014 Waikoloa Meeting Minutes

- 11-14-0702-00, TGax May 2014 Closing Report

Achievements

1. **The group elected the chairperson and the secretary.**
   - **Chairperson: Osama Aboul-Magd (Huawei Technologies)**
   - **Secretary: Yasuhiko Inoue (NTT)**

   Other officer psitions and TG structure will be discussed in the July 2014 session.
2. **The group approved minutes from the March 2014 Beijing meeting and Teleconference on April 17th, 2014.**
   - 11-14-0380-01, HEW SG March 2014 Beijing Meeting Minutes
   - 11-14-0530-00, TGax teleconference minutes - 2014.04.17
3. **TG Documents**
   - The group approved initial version of the Simulation Scenarios (11-14-0621-04) and Evaluation Methodology (11-14-0571-02) documents.
   - The group started the discussion related to Functional Requirements document. Expectation is to approve the initial revision of the document in July.
   - Discussion related to Channel Model document is expected to start in July.
4. **Technical Presentations**

   40 submissions were covered during the week.
   - 11-14-0527, "PHY Abstraction for TGax System Level Simulations", Pengfei Xia (InterDigital)
   - 11-14-0546, "IEEE 802.11ax High Efficiency WLAN Packet measurements around Boulder Colorado", Jim Lansford (CSR)
   - 11-14-0567, "Proposed 802.11ax Functional Requirements", Lei Wang (Marvell)
   - 11-14-0571, "11ax Evaluation Methodologies", Ron Porat (Broadcom)
   - 11-14-0577, "Path Loss Model for Scenario 1," Nihar Jindal (Broadcom)
   - 11-14-0578, "Residential Scenario CCA/TPC Simulation Discussion," Frank La Sita (InterDigital)
   - 11-14-0581, "Further Discussions on PHY Abstraction," Yakun Sun (Marvell)
   - 11-14-0582, "Calibrating MAC Simulator Through Function Test," Jinjing Jiang (Marvell)
   - 11-14-0583, "Further Discussions on Instantaneous SINR Calibration for System Simulation," Yakun Sun (Marvell)
   - 11-14-0584, "System Level Simulations on Beamforming and Link Adaptation," Yan Zhang (Marvell)
   - 11-14-0585, "PHY Abstractions for and IEEE 11ax PHY System Simulation and Integrated System Level Simulation," Jianhan Liu (MediaTek)
   - 11-14-0586, "Automotive Considerations for the Simulation Scenarios," Igal Kotzer (General Motors)
   - 11-14-0594, "Insert Virtual Desktop Infrastructure (VDI) Traffic Model Content for HEW Simulation Scenarios," Yingpei Lin (Huawei)
   - 11-14-0595, "Edits on Some Traffic Content for HEW SG Simulation Scenarios," Yingpei Lin (Huawei)
   - 11-14-0598, "Uplink multi-user MAC protocol for 11ax," Tran Thi Thao Nguyen (Kyushu Inst. of Tech.)
   - 11-14-0600, "Proposed Calibration For MAC simulator," Gwen Barriac (Qualcomm)
   - 11-14-0604, "Modeling and Evaluating Variable Bit rate Video Streaming for 802.11ax," Chao-Chun Wang (MediaTek)
   - 11-14-0612, "Calibration Procedures towards Integrated System Level Simulation," Jiayin Zhang (Huawei)
   - 11-14-0613, "Discussions on adaptive frame length in MAC based on block ACK," Ningbo Zhang (BUPT)
   - 11-14-0614, "Joint Coding and Modulation Diversity with LRA MMSE VP by QR precoding MIMO," Ningbo Zhang (BUPT)
   - 11-14-0616, "CSMA/CA Enhancement Suggestion," Yonggang Fang (ZTE)
   - 11-14-0617, "Discussion on timeline for 802.11ax," Laurent Cariou (Orange)
   - 11-14-0620, "Link Adaptation for PHY SLS calibration," Jinyoung Chun (LG Electronics)
   - 11-14-0621, "TGax Simulation Scenarios," Simone Merlin (Qualcomm)
   - 11-14-0624, "Investigation on 1024 QAM feasibility in 11ax," Eunsung Park (LG Electronics)
   - 11-14-0625, "Multi-channel operation in Simulation scenarios," Suhwook Kim (LG Electronics)
   - 11-14-0626, "IEEE 802.11ax Functional Requirements," SangHyun Chang (Samsung)
   - 11-14-0627, "Outdoor Channel Models for System Level Simulations," Kaushik Josiam (Samsung)
   - 11-14-0628, "Measurements on CCA Thresholds in OBSS Environment," John Son (WILUS Institute), Young Doo Kim (SK Telecom)
   - 11-14-0634, "Consideration on MAC system calibration," Zhou Lan (Huawei)
   - 11-14-0635, "Dynamic Sensitivity Control Implementation," Graham Smith (DSP Group)
   - 11-14-0636, "Consideration on functional requirements," Zhou Lan (Huawei)

- 11-14-0637, "Spatial Reuse and Coexistence with Legacy Devices," James Wang (MediaTek)
- 11-14-0647, "PHY abstraction method comparison," Tianyu Wu (MediaTek)
- 11-14-0648, "Performance Observation of a Dense Campus Network," Chinghwa Yu (MediaTek)
- 11-14-0649, "802.11ax Timeline Scenarios," Rolf de Vegt (Qualcomm)
- 11-14-0656, "How to Describe 802.11ax Functional Requirements," Minho Cheong
- 11-14-0660, "802.11ax Timeline," Minho Cheong (NEWRACOM)
- 11-14-0677, "Comparison of Calibration Methodology for MAC Simulation," Chinghwa Yu (MediaTek)
- 11-14-0682, "In Situ Spectrum Reuse Measurements in Indoor 20,000 Seat Arena," Chuck Lukaszewski (Aruba Networks)

5. **Timeline**
   The group approved initial timeline.

Current Timeline	
May 2014	**Start of TG**
November 2014	**Start to work on the specification framework**
July 2016	**Draft 1.0 to be ready**
March 2017	**Draft 2.0 to be ready**
1H 2019	**Publication of IEEE 802.11ax amendment**

Goals for the July 2014 session

- Continue to advance simulation scenarios (11-14/0621) and Evaluation Methodologies (11-14/0571) documents.
- Approve an initial Functional Requirements document.
- Approve an initial Channel Model document.
- Discuss and approve TG structure and process.
- Technical Presentations.

Teleconferences

Three teleconferences are planned before the July 2014 meeting.

Wednesday	June 4th, 2014	10:00 - 12:00 (ET)
Wednesday	June 18th, 2014	20:00 - 22:00 (ET)
Wednesday	July 2nd, 2014	10:00 - 12:00 (ET)

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High Efficiency WLAN (HEW) Study Group

March 2014 — Beijing, China

The HEW SG had 7 sessions during the week.

	Monday	Tuesday	Wednesday	Thursday
AM1			**HEW**	**HEW**
AM2		**HEW**		
PM1				**HEW**

	Monday	Tuesday	Wednesday	Thursday
PM2	**HEW**	**HEW**		
PM3		**HEW**		

Main documents

The meeting agenda, minutes, and the closing report of HEW SG can be found here.

- 11-14-0219-04, HEW SG Maarch 2014 Meeting Agenda
- 11-14-0380-00, HEW SG March 2014 Beijing Meeting Minutes
- 11-14-0457-00, HEW SG March 2014 Closing Report

Achievements

1. **The group approved minutes from the January 2014 Los Angeles meeting and teleconferences on February 6th, 2014 and February 13th, 2014.**
   - 11-14-0199-00, January 2014 Los Angeles Meeting Minutes
   - 11-14-0229-02, Minutes from the teleconference on February 6th, 2014
   - 11-14-0242-00, Minutes from the teleconference on February 13th, 2014
2. **Addressed comments related to the PAR and CSD received from individuals and other IEEE 802 WGs. Resolutions of comments are contained in the following document:**
   - https://mentor.ieee.org/802.11/dcn/14/11-14-0424-00-0hew-hew-sg-par-and-csd-comments-and-resolutions.pptx
3. **Updated the PAR and the CSD documents based on received comments:**
   - https://mentor.ieee.org/802.11/dcn/14/11-14-0165-01-0hew-802-11-hew-sg-proposed-par.docx
   - https://mentor.ieee.org/802.11/dcn/14/11-14-0169-01-0hew-ieee-802-11-hew-sg-proposed-csd.docx
4. **The group passed motions to approve revised PAR and CSD documents, and SG extension.**

   Revised PAR (11-14/0165r1): Y/N/A = 94/0/1, Motion passes.
   Revised CSD (11-14/0169r1): Y/N/A = 97/0/1, Motion passes.
   SG extension: Y/N/A = 105/0/0, Motion passes.

   HEW SG has completed its work and the IEEE standard board approved 802.11ax project.

5. **The group received more than 30 submissions in the categories of simulation scenarios, evaluation methodologies, channel models, functional requirements, technologies and selection procedure.**
   Following submissions have been presented and discussed during the week.
   - 11-13-1359, "HEW-Evaluation-Methodology" Ron Porat (Broadcom)
   - 11-14-0112, "Wi-Fi interference measurements in Korea - part II", Minho Cheong (NEWRACOM)
   - 11-14-0113, "Modeling of additional channel loss in dense WLAN environments", Minho Cheong (NEWRACOM)
   - 11-14-0294, "DSC Channel Selection and Legacy Sharing" Graham Smith (DSP Group)
   - 11-14-0301, "Multicast Considerations for HEW", Eisuke Sakai (Sony Corporation)
   - 11-14-0306, "Discussions on HEW Functional Requirements", Lei Wang (Marvell)
   - 11-14-0307, "PHY Calibration Results", Nihar Jindal (Broadcom)
   - 11-14-0328, "Dense Apartment Complex Throughput Calculations", Graham Smith (DSP Group)
   - 11-14-0329, "Channel Models for different links in Simulations", Kaushik Josiam (Samsung)
   - 11-14-0330, "HEW PHY Abstraction", Sameer Vermani (Qualcomm)
   - 11-14-0335, "Instantaneous SINR Calibration for System Simulation", Yakun Sun (Marvell)
   - 11-14-0336, "Calibration of Long-Term SINR for System Simulator" Yakun Sun (Marvell)
   - 11-14-0339, "A simplified STR Mechanism", Raja Banerjea (CSR)
   - 11-14-0340, "A simplified STR Mechanism - MAC", Raja Banerjea (CSR)
   - 11-14-0342, "Short Packet Optimizations", Naveen Kakani (CSR, Inc)
   - 11-14-0345, "Joint Coding and Modulation Diversity with RBD pre-coding for next generation WLAN", Zhanji Wu (BUPT)
   - 11-14-0350, "Suggestion on Evaluation Methodology", Jinyoung Chun (LG Electronics)

- 11-14-0352, "Discussion on power save mode for real time traffic", Giwon Park (LG Electronics)
- 11-14-0353, "Suggestion on PHY Abstraction for Evaluation Methodology", Dongguk Lim (LG Electronics)
- 11-14-0355, "Simulation Scenario 1 Revised", Simone Merlin (Qualcomm)
- 11-14-0356, "Calibration of System Level Simulators", Jarkko Kneckt (Nokia)
- 11-14-0357, "Utilizing Unused Resources for Simultaneous Transmissions", Jarkko Kneckt (Nokia)
- 11-14-0365, "Extended Intra-Vehicle Channel Model", Igal Kotzer (General Motors)
- 11-14-0372, "System level simulations on increased spatial reuse", Liwen Chu (Marvell)
- 11-14-0373, "Energy Efficiency in HEW", Pingping Xu, Wei Wang (Southeast University)
- 11-14-0381, "Stadium scenario for HEW", Johan Soder, Filip Mestanov (Ericsson AB)
- 11-14-0383, "Considerations on evaluation methodology for candidate HEW PHY&MAC techniques", Le Liu (Huawei)
- 11-14-0385, "Simulation Methodology and Calibration", Gwen Barriac (Qualcomm)
- 11-14-0386, "Discussions on MCS selection" , Tianyu Wu (MediaTek)
- 11-14-0392, "Traffic Separation Scheme for Optimizing WLANs using PHY and MAC options", Takayuki Nishio (Kyoto University)
- 11-14-0393, "Possible Indoor Channel Models for HEW System Simulations", Leif Wilhelmsson (Ericsson AB)
- 11-14-0419, "802.11ax Spec Development Process Proposal", Rolf de Vegt (Qualcomm)

Goals for the May 2014 session

- Meet as a new TG and will have officer elections.
- Continue the work on simulation scenarios, evaluation methodologies, channel models, and function requirements.

Teleconferences

Three teleconferences are planned before the May 2014 meeting.

Thursday	April 174th, 2014	10:00 - 12:00 (ET)

Details to be announced.

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January 2014 — Los Angeles, CA

The HEW SG had 9 sessions during the week.

	Monday	Tuesday	Wednesday	Thursday
AM1				**HEW**
AM2	**HEW**	**HEW**		
PM1				**HEW**
PM2	**HEW**	**HEW**	**HEW**	
PM3	**HEW**	**HEW**		

Main documents

- 11-13-1506-05, HEW SG January 2014 Meeting Agenda
- 11-14-0199-00, HEW SG January 2014 Los Angeles Meeting Minutes
- 11-14-0187-00, HEW SG January 2014 Closing Report

Achievements

1. **The group approved minutes from the November 2013 Dallas meeting and teleconferences on December 4th, 2013, December 18th, 2013 and January 8th, 2014.**
    - 11-13-1465-01, November 2013 Dallas Meeting Minutes
    - 11-13-1495-00, Minutes from the teleconference on December 4th, 2013
    - 11-13-1532-01, Minutes from the teleconference on December 18th, 2013
    - 11-14-0024-01, Minutes from the teleconference on January 8th, 2014
2. **The group resolved open issues related to the PAR and CSD.**
3. **The group received 28 submissions that were categorized into (1) PAR and 5 Criteria related submissions, and (2) Best Effort submissions. Best Effort submissions basically related to simulation scenario and evaluation methodology.**
4. **The group passed motions to approve PAR and CSD.**
    - **PAR and 5 Criteria related submissions (high priority)**
        - 11-13-1410, "802.11 HEW Draft PAR and 5C", Osama Aboul-Magd and All
        - 11-13-1489, "Airport Capacity Analysis", Graham Smith (DSP Group)
        - 11-14-0026, "thoughts on hew par", Yong Liu (Apple)
        - 11-14-0045, "E-Education Analysis", Graham Smith (DSP Group)
        - 11-14-0058, "Pico Cell Use Case Analysis ", Graham Smith (DSP Group)
        - 11-14-0061, "Some findings from real world measurement", Katsuo Yunoki (KDDI Labs)
        - 11-14-0065, "Comments on Draft HEW PAR", Bill Carney (SONY)
        - 11-14-0101, "Comments on 802.11 HEW Draft PAR & 5C", Rakesh Taori (Samsung Electronics)
        - 11-14-0106, "Discussion on HEW PAR", Kiseon Ryu (LG Electronics)
        - 11-14-0119, "Suggested PAR Changes", James Yee (MediaTek)
        - 11-14-0163, "Raising the PAR", Mat Fischer (Broadcom)
    - **Best Effort submissions**
        - 11-14-0043, "PHY abstraction in system level simulation for HEW study", Fei Tong (Samsung)
        - 11-14-0051, "Wireless Office with Interference", David Xun Yang (Huawei)
        - 11-14-0053, "Further Considerations on Calibration of System Level Simulation", Jiayin Zhang (Huawei)
        - 11-14-0056, "Traffic Model on Virtual Desktop Infrastructure", Yingpei Lin (Huawei)
        - 11-14-0059, "Integrated System Level Simulation", Jun Luo (Huawei)
        - 11-14-0063, "Design Challenges for 802.11 HEW Radios", Yu Cai (Huawei)
        - 11-14-0070, "Joint MAC/PHY Evaluation Methodology", Kaushik Josiam (Samsung)
        - 11-14-0082, "Improved Spatial Reuse Feasibility - Part I", Ron Porat (Broadcom)
        - 11-14-0083, "Improved Spatial Reuse Feasibility - Part II", Ron Porat (Broadcom)
        - 11-14-0086, "Outdoor AP Measurement in Tokyo", Tsugu Aoki (Toshiba)
        - 11-14-0088, "Intra-Vehicular Channel Model", Igal Kotzer (General Motors)
        - 11-14-0095, "OFDM-IDMA Uplink Communication", Leonardo Lanante (Kyushu Inst. Of Tech)
        - 11-14-0107, "HEW Evaluation Metrics", Yonggang Fang (ZTETX)
        - 11-14-0116, "Long-Term SINR Calibration for System Level Simulation", Yakun Sun (Marvell)
        - 11-14-0117, "PHY Abstraction for HEW System Level Simulation", Yakun Sun (Marvell)
        - 11-14-0118, "Consideration on System Level Simulation", Jinsoo Chio (LG Electronics)
5. **The group passed motions to approve PAR and CSD**
    - 11-14-165-00, IEEE 802.11 HEW SG Proposed PAR
    - 11-14-169-00, IEEE 802.11 HEW SG Proposed CSD

Goals for the March 2014 session

- Resolve comments expected from EC members and other IEEE 802 WGs
- Continue with presentations relevant to the SG topics.
    - Simulation scenarios
    - Evaluation Methodologies
    - Channel Models
    - Technology
    - etc.

Teleconferences

The group agreed to have four teleconferences before the March 2014 session.

Thursday	February 6th, 2014	20:00 - 22:00 (ET)
Thursday	February 13th, 2014	10:00 - 12:00 (ET)
Thursday	February 20th, 2014	10:00 - 12:00 (ET)
Thursday	February 27th, 2014	20:00 - 22:00 (ET)

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November 2013 — Dallas, TX

The HEW SG had 10 sessions during the week.

	Monday	Tuesday	Wednesday	Thursday
AM1			**HEW**	**HEW**
AM2		**HEW**		
PM1		**HEW**	**HEW**	**HEW**
PM2	**HEW**	**HEW**	**HEW**	**HEW**
PM3				

Main documents

- 11-13-1263-05, HEW SG November 2013 Meeting Agenda
- 11-13-1465-01, HEW SG November 2013 Dallas Meeting Minutes
- 11-13-1476-01, HEW SG November 2013 Closing Report

Achievements

1. **The group approved minutes from the September 2013 Nanjing meeting and teleconferences on October 3rd and October 30th, 2013.**
   - 11-13-1117-01, September 2013 Nanjing Meeting Minutes
   - 11-13-1275-01, Minutes from the teleconference on October 3rd, 2013
   - 11-13-1303-00, Minutes from the teleconference on October 30th, 2013
2. **The group received more than 40 submissions that were categorized into three categories, i.e., (1) Channel Mode/Simulation Scenarios and Evaluation Methodologies, (2) MAC/PHY technologies and (3) PAR proposals.**
   Following submissions were presented during the week.
   - **Channel Models, Simulation Scenarios and Evaluation Methodologies**
     - 11-13-1001, "HEW SG Simulation Scenarios", Simone Merlin (Qualcomm)
     - 11-13-1305, "Simplification on HEW traffic models", Bill Carney (Sony)
     - 11-13-1334, 11-13-1335, "Video Traffic Modeling", Guiqing Li (Intel)
     - 11-13-1359, "HEW Evaluation Methodology", Ron Porat (Broadcom)
     - 11-13-1370, "LTE OOB Interference to 2.4 GHz Band", Yonggang Fang (ZTE TX)
     - 11-13-1376, "Discussions on Penetration Loss", Jianhan Liu (MediaTek)
     - 11-13-1380, "Outdoor Channel Model Simulation Follow-up", Hongyuan Zhang (Marvell)
     - 11-13-1383, "System Level Simulation Parameters", Wookbong Lee (LG Electronics)
     - 11-13-1387, "HEW channel modeling for system level simulation", Yan Zhang (Marvell)

        - 11-13-1390, "PHY Abstraction for HEW System Level Simulations", Yakun Sun (Marvell)
        - 11-13-1391, "About SINR conversion for PHY Abstraction", Yakun Sun (Marvell)
        - 11-13-1392, "Methodology of Calibrating System Level Simulation Results", Yakun Sun (Marvell)
        - 11-13-1401, "System Level Assessments for Outdoor HEW Deployments", Kaushik Josiam (Samsung)
        - 11-13-1406, "Traffic Modeling for HEW Simulations", Huai-Rong Shao (Samsung)
        - 11-13-1407, "Simulation based study of QoE", Chao-Chun Wang (MediaTek)
        - 11-13-1412, "How to use simulation scenarios in HEW", Minho Cheong (ETIR)
        - 11-13-1419, "Modifications to ITU Channel Model to Support 160MHz bandwidth of operation", Shahrnaz Azizi (Intel)
        - 11-13-1420, "HEW Considerations for the Vehicular Environment", Igal Kotzer (General Motors)
        - 11-13-1438, "Traffic Observation and Study on Virtual Desktop Infrastructure", Phillip Barber (Huawei Technologies)
        - 11-13-1456, "Considerations on WFA feedback", Simone Merlin (Qualcomm)
    - **MAC/PHY Technologies**
        - 11-13-1325, "IEEE 802.11ai overview", Hiroshi Mano (ATRD), chair of TGai
        - 11-13-1349, "Access Control Enhancement", Katsuo Yunoki (KDDI)
        - 11-13-1375, "Summary and Discussions of Proposals on Potential PHY Technologies in HEW", Jianhan Liu (MediaTek)
        - 11-13-1377, "DL efficiency enhancement in high density network", Kiseon Ryu (LG Electronics)
        - 11-13-1382, "Discussion on OFDMA in HEW", Jinsoo Choi (LG Electronics)
        - 11-13-1386, "Improving WLAN Efficiency and QoE - A Top Down Approach", Veli-Pekka Kentonen (7 Signals)
        - 11-13-1388, "UL MU-MIMO transmission", Jinyoung Chun (LG)
        - 11-13-1395, "Simultaneous Transmission Technologies for HEW", Koichi Ishihara (NTT)
        - 11-13-1409, "Dual Wi-Fi: Dual Channel Wi-Fi for Congested WLANs with Asymmetric Traffic Loads", Adriana Flores (Rice University)
        - 11-13-1421, "STR Radios and STR Media Access", Phillip Levis (Stanford University)
        - 11-13-1440, "Argos | Practical Masive-MIMO", Clayton Shepard (Rice University)
    - **PAR proposals**
        - 11-13-1331, "Proposed direction and priorities for HEW", Guido R. Hiertz (Ericsson)
        - 11-13-1333, "Power Efficiency PAR Requirements", Chris Hansen (Covariant)
        - 11-13-1361, "Discussion to derive HEW Functional Requirements", Yasunao Misawa (KDDI)
        - 11-13-1366, "Some propositions to progress towards the PAR definition", Laurent Cariou (Orange)
        - 11-13-1389, "Discussion on HEW PAR", HanGyu Cho (LG Electronics)
        - 11-13-1397, "Renewing 2.4 GHz", Brian Hart (Cisco Systems)
        - 11-13-1398, "Requirements for HEW", Akira Yamada (NTT DOCOMO)
        - 11-13-1404, "Some Thoughts on PAR", and
          11-13-1405, "HEW PAR", Eldad Perahia (Intel)
        - 11-13-1450, "Summary of PAR Discussions", Osama Aboul-Magd (HEW SG chair)
        - 11-13-1470 and 11-13-1471, "802.11 HEW proposed basis for PAR discussion", Laurent Cariou (Orange)
3. **Discussed the WFA feedback on prioritization of the usage cases and approved a liaison letter back to WFA.**
    - Feedback from the Wi-Fi Alliance:
        - 11-13-1443-00, Liaison from Wi-Fi Alliance - HEW Use Cases
    - Approved a liaison document to the Wi-Fi Alliance:
        - 11-13-1446-00, IEEE 802.11 Liaison to WFA on Prioritization of High Efficiency WLAN (HEW) Usage Scenarios
4. **Started the discussion on the PAR.**
5. **The group passed a motion to extend the study group by 136/0/2.**

Goals for the January 2014 session

- Progress the work on the PAR and 5C.

Teleconferences

Three teleconferences are planned before the March 2016 meeting.

Wednesday	December 4th, 2013	10:00 - 12:00 (ET)
Wednesday	December 18th, 2013	20:00 - 22:00 (ET)
Wednesday	January 8th, 2014	10:00 - 12:00 (ET)

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September 2013 — Nanjing, China

The HEW SG had 9 sessions during the week.

	Monday	Tuesday	Wednesday	Thursday
AM1				**HEW**
AM2		**HEW**		
PM1			**HEW**	**HEW**
PM2	**HEW**	**HEW**	**HEW**	
PM3	**HEW**	**HEW**		

Main documents

- 11-13-0951-07, HEW SG September 2013 Meeting Agenda
- 11-13-1117-01, HEW SG September 2013 Nanjing Meeting Minutes
- 11-13-1231-01, HEW SG September 2013 Closing Report

Achievements

1. **The group approved minutes from the Geneva meeting and teleconference on August 28th, 2013.**
   - 11-13-0861-01, Minutes from face-to-face meeting in Geneva, July 2013
   - 11-13-1003-00, Minutes from the teleconference on August 28th, 2013
2. **50 submissions in the following categories were received and presented during the week.**
   - **Channel Models**
     - 11-13-0996, "Outdoor Channel Model Candidates for HEW", Kaushik Josiam (Samsung)
     - 11-13-1113, "Channel Modeling for Dense Wi-Fi Environments", Minho Cheong (ETRI)
     - 11-13-1125, "HEW Outdoor Channel Model Discussions", Hongyuan Zhang (Marvell)
     - 11-13-1135, "Summary of HEW Channel Models", Jianhan Liu (MediaTek)
     - 11-13-1146, "Update on HEW Channel Model", Shahrnaz Azizi (Intel Corp)
   - **Simulation Scenarios/Simulation Methodologies**
     - 11-13-1000, "Simulation Scenarios", Simone Merlin (Qualcomm)
     - 11-13-1001, "Simulation Scenarios Document Template", Simone Merlin (Qualcomm)
     - 11-13-1079, "Outdoor Stadium Simulation Details Discussion", Joseph Levy (InterDigital)
     - 11-13-1080, "Markov Modeling of the Channel for HEW System Level Simulations", Joseph Levy (InterDigital)
     - 11-13-1081, "HEW Simulation Methodology", Sayantan Choudhury (Nokia)
     - 11-13-1083, "HEW SG Unified Simulation Scenarios", David Xun Yang (Huawei)
     - 11-13-1114, "Simulation Scenario for unplanned Wi-Fi Network", Jae Seung Lee (ETRI)
     - 11-13-1123, "Capacity Simulation of High Density Indoor WLAN Systems", Filip Mestanov (Ericsson AB)
     - 11-13-1133, "Virtual Desktop Infrastructure (VDI)", Yingpei Lin (Huawei Technologies)
     - 11-13-1153, "Simulation Scenario Proposal", Laurent Cariou (Orange)
     - 11-13-1159, "Video Performance Requirements and Simulation Parameters", Guoqing Li (Intel)
     - 11-13-1162, "Video Application Categories and Characteristics", Guoqing Li (Intel)
     - 11-13-1176, "Some Simulation Scenarios for HEW", Reza Hedayat (Cisco)

- **Evaluation Methodology**
  - 11-13-1051, "Evaluation Methodology", Ron Porat (Broadcom)
  - 11-13-1054, "HEW Evaluation Metrics Suggestions", Yonggang Fang (ZTETX)
  - 11-13-1059, "PHY Abstraction for HEW Evaluation Methodology", Dongguk Lim (LG Electronics)
  - 11-13-1131, "PHY Abstraction for HEW System Level Simulation", Jiayin Zhang (Huawei Technologies)
  - 11-13-1137, "The Definition of Performance Metrics for HEW", Haui-Rong Shao (Samsung)
  - 11-13-1144, "Simplified Traffic Model Based on Aggregated Network Statistics", William Carney (Sony)
  - 11-13-1158, "Video Traffic and Applications for HEW", William Carney (Sony)
- **Functional Requirements**
  - 11-13-1097, "Functional Requirements for HEW PAR", Minho Cheong (ETRI)
  - 11-13-1116, "Discussion on HEW Functional Requirements", Jinsoo Choi (LG Electronics)
- **MAC/PHY Technologies**
  - 11-13-1046, "Discussion for Massive MIMO for HEW", Zhigang Wen (BUPT)
  - 11-13-1056, "Enhancement on resource utilization in OBSS environment", Giwon Park (LG Electronics)
  - 11-13-1058, "Efficient wider bandwidth operation", Kiseon Ryu (LG Electronics)
  - 11-13-1061, "Multicast Transmission for HEW", Jeongki Kim (LG electronics)
  - 11-13-1073, "Access Control Enhancement", Katsuo Yunoki (KDDI Labs)
  - 11-13-1074, "Occupied air time calculation for doc.1073r0", Katsuo Yunoki (KDDI R&D Laboratories)
  - 11-13-1077, "EDCA Enhancements for HEW", Hui Zhao (BUPT)
  - 11-13-1089, "D2D Technology for HEW", Xiang Gao (BUPT)
  - 11-13-1090, "Non-linear pre-coding MIMO Scheme for next generation WLAN", Xiang Gao (BUPT)
  - 11-13-1105, "Discussion on Access Mechanism for HEW", Meng Yang (CATR)
  - 11-13-1122, "Considerations for In-Band Simultaneous Transmit and Receive (STR) feature in HEW", Rakesh Taori (Samsung Electronics)
  - 11-13-1126, "Beamforming under OBSS Interference", Hongyuan Zhang (Marvell)
  - 11-13-1154, "DL-MU-MIMO Transmission with Unequal Bandwidth", Yongming Huang (Southeast University)
  - 11-13-1155, "Space Division Multiplex for OBSS Interference Suppression", Yongming Huang (Southeast University)
  - 11-13-1156, "TXOP Redundancy NAV Clear", Yongming Huang (Southeast University)
  - 11-13-1157, "Feasibility of Coordination Transmission for HEW", Yunzhou Li (Tsunghua University)
  - 11-13-1168, "Requirements on WLAN Ad Push", Hui Tian (BUPT)
  - 11-13-1169, "WLAN Cellular Offload in High Speed Moving Environment", Hui Tian (BUPT)
- **General**
  - 11-13-1057, "Legacy support on HEW frame structure", Wookbong Lee (LG electronics)
  - 11-13-1100, "HEW SG Progress Review", Osama Aboul-Magd (HEW SG)
  - 11-13-1115, "Possible vision of the HEW-driven Wi-Fi 2020", Minho Cheong (ETRI)
  - 11-13-1163, "PAR and 5C: Comments based on 11n", Sean Coffey (RealTek)
  - 11-13-1164, "Some PAR and 5C Requirements", Paul Lambert (Marvell)

3. **Straw Polls**
   Several straw polls were conducted to sense the group consensus on topics related to simulation scenarios, evaluation methodologies and channel models.
4. **Timeline**
   The group reviewed the timeline. No changes.

Goals for the November 2013 session

- Hear presentations addressing SS/SM/EM/FR/CM/TECH
  - Attempt to consolidate documents related to the above areas of discussion.
  - Priority will be given to presentations with consolidated views
- Start discussion on PAR related issues
- Motion for SG extension
- WFA feedback on the usage cases

Teleconferences

Three teleconferences are planned before the November 2013 meeting.

Wednesday	October 9th, 2013	10:00 - 12:00 (ET)
Wednesday	October 17th, 2013	00:00 - 02:00 (ET)
Wednesday	October 30th, 2013	10:00 - 12:00 (ET)

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July 2013 — Geneva, Switzerland

The HEW SG had nine sessions during the week.

	Monday	Tuesday	Wednesday	Thursday
AM1			**HEW**	**HEW**
AM2		**HEW**		**HEW**
PM1			**HEW**	
PM2	**HEW**	**HEW**	**HEW**	**HEW**
PM3				

Main Documents

- 11-13-0664-05, HEW SG July 2013 Agenda
- 11-13-0861-00, HEW SG July 2013 Geneva Meeting Minutes
- 11-13-0922-00, HEW SG July 2013 Closing Report

Acheivements

1. **The group approved minutes from the face-to-face meeting in Waikoloa, HI and teleconferences held on June 5th and June 19th.**
   - 11-13-0560-02, HEW SG May 2013 Waikoloa meeting minutes
   - 11-13-0663-01, HEW SG Teleconference minutes 20130605
   - 11-13-0704-00, HEW SG Teleconference minutes 20130619
2. Technical Presentations
   The group received over 35 submissions in areas of (1) Usage Models/Use Cases, (2) Functional Requirements, (3) Simulation Scenarios and Evaluation Methodology, (4) MAC/PHY techniques as listed below.
   - Usage Models/Use Cases
     - 11-13-0657, "HEW SG usage models and requirements - Liaison with WFA" Laurent Cariou (Orange)
     - 11-13-0761, "Interference Control Use Case for HEW", Fang Xie (CMCC)
     - 11-13-0795, "HEW Usage Scenarios Categorization", Eldad Perahia (Intel)
     - 11-13-0802, "Proposed re-categorization of the HEW usage models", Yasuhiko Inoue (NTT)
     - 11-13-0836, "HEW Usage Models for Backhauls and Floor Automation", Minho Cheong (ETRI)
   - Functional Requirements
     - 11-13-0787, "Follow up requirements", Wu Tianyu (Huawei)
     - 11-13-0798, "Functional Requirements in HEW", Jinsoo Choi (LG Electronics)
     - 11-13-0840, "HEW Functional Requirements Follow-up (Preliminary Version for Study Group discussions)", Minho Cheong (ETRI)
     - 11-13-0850, "Quantitative QoE Requirements for HEW", Huai-Rong Shao (Samsung)
   - Simulation Scenarios and Evaluation Methodology
     - 11-13-0723, "HEW SG Evaluation Methodology Overview", Minyoung Park (Intel)
     - 11-13-0728, "Network Optimization for Expected HEW Traffic Patterns", Bill Carney (Sony)

        - 11-13-0756, "HEW Channel Model", Vinko Erceg (Broadcom)
        - 11-13-0757, "Evaluation Methodology and Simulation Scenarios" Nihar Jindal (Broadcom)
        - 11-13-0786, "Discussion on System Level Simulation Methodology" Wu Tianyu (Huawei)
        - 11-13-0800, "HEW Study Group Documentation", Hemanth Sampath (Qualcomm)
        - 11-13-0805, "On Definition of Dense Networks and Performance Metric", Jianhan Liu (MediaTek)
        - 11-13-0837, "Consideration for HEW Evaluation Methodology", Minho Cheong (ETRI)
        - 11-13-0847, "Evaluation Criteria and Simulation Scenarios" Klaus Doppler (Nokia)
        - 11-13-0858, "Enhanced Channel Model for HEW", Shahrnaz Azizi (Intel)
        - 11-13-0869, "Simulation scenarios and metrics for HEW", Thomas Derham (Orange)
        - 11-13-0872, "Clarifications on outdoor deployments", Laurent Cariou (Orange)
    - MAC/PHY Techniques
        - 11-13-0712, "A Brief Time of History", Larry Taylor (DTC)
        - 11-13-0758, "Possible Approaches for HEW", Katsuo Yunoki (KDDI Labs)
        - 11-13-0764, "Full-duplex Technology for HEW", Andre Bourdoux (IMEC)
        - 11-13-0765, "Full-duplex is an emerging radio paradigm that has the potential to improve the efficiency of future WLANs", Hongliang Bian (China Telecom)
        - 11-13-0768, "TD-uCSMA", Riccard Scopigno (ISMB)
        - 11-13-0801, "Issues of Low Rate Transmissions", Akira Kishida (NTT)
        - 11-13-0843, "Further Evaluation on outdoor Wi-Fi", Wookbong Lee (LG Electronics)
        - 11-13-0849, "New Techniques: Enabling Real World Improvement By Exposing Internal MAC state", Brian Hart (Cisco)
        - 11-13-0852, "Potential approach to improve WLAN BSS edge performance", Juho Pirskanen (Renesas Mobile)
        - 11-13-0854, "Consideration on Efficiency Enhancement", SangHyun Chang (Samsung)
        - 11-13-0865, "Video Data Rate for HEW", Huai-Rong Shao (Samsung)
        - 11-13-0871, "Discussion on Potential Techniques for HEW", Timo Koskela (Renesas Mobile)
        - 11-13-0877, "HEW Beamforming Enhancements", James Wang (MediaTek)
        - 11-13-0878, "Efficiency enhancement for dense WLAN environment", Jeongki Kim (LG Electronics)
3. HWE SG Initial Usage Models
   The group approved document 11-13-0657-06 as HEW SG initial draft of Usage Models and to send it to Wi-Fi Alliance asking for prioritization of the use cases and additional feedbacks.
4. Liaison to the Wi-Fi Alliance
   The group also approved a liaison letter to the Wi-Fi Alliance contained in the document 11-13-0902-01.
5. The group passed motion to extend the SG.
6. Timeline
   The group discusses the timeline.

TGax Initial Timeline	
May 2013	**Start of the HEW SG**
July 2013	**Presentations, SG extension**
September 2013	**Presentations**
November 2013	**Presentations, initial PAR and 5C, and SG extension**
January 2014	**Presentations, final PAR and 5C, WG approval**
March 2014	**Presentations, EC approval of PAR and 5C**
May - June, 2014	**NesCom approval of PAR and 5C**
July 2014	**Start of a new TG**

Goals for September 2013 session

During the September 2013 meeting, the HEW SG continues discussions on issues related to:

- Usage Models/Use Cases
- Functional Requirements
- Feasibility

- Scope and Process

Teleconferences

Two teleconferences are planned before the September 2013 session.

Wednesday	August 7th, 2013	10:00 - 12:00 (ET)
Wednesday	August 27th, 2013	20:00 - 22:00 (ET)

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May 2013 — Waikoloa, HI

HEW SG had six sessions during the week. The TGax had 10 sessions during the week.
Four out of ten sessions were assigned to the ad hoc groups.

	Monday	Tuesday	Wednesday	Thursday
AM1				**HEW**
AM2		**HEW**		**HEW**
PM1				
PM2	**HEW**		**HEW**	**HEW**
PM3				

Main Documents

- 11-13-0400-04, HEW SG May 2013 Agenda
- 11-13-0560-02, HEW SG May 2013 Waikoloa Meeting Minutes
- 11-13-0624-00, HEW SG May 2013 Closing Report

Acheivements

1. **The group decided leadership structure to have one chairperson and one secretary.**
   - Chair: Osama Aboul-Magd (Huawei Technologies)
   - Secretary: Yasuhiko Inoue (NTT)
2. **The group received 22 submissions as listed below.**
   - **Usage Models/Use Cases**
     - 11-13-0514, "HEW Usage Scenarios and Applications", Eldad Perahia (Intel)
     - 11-13-0538, "Dense apartment building use case for HEW", Klaus Doppler (Nokia)
     - 11-13-0554, "Use Cases", Minho Cheong (ETRI)
     - 11-13-0567, "Proposed HEW Usage Models", Yasuhiko Inoue (NTT)
     - 11-13-0527, "Usage Models for Next Generation", David Xun Yang (Huawei) and James Wang (MediaTek)
     - 11-13-0534, "Direction and Use Cases for HEW", HanGyu Cho (LG Electronics)
     - 11-13-0563-00, "D2D Technology for HEW", Zhanji Wu (BUPT) - not presented
   - **Problem Statements**
     - 11-13-0505, "MAC Efficiency Analysis for HEW SG", Minyoung Park (Intel)
     - 11-13-0545, "WLAN QoE, End User Perspective Opportunities to Improve", Veli-Pekka Ketonen (7 signals)
     - 11-13-0523, "Understanding Current Situation of Public Wi-Fi Usage - Possible Requirements for HEW -", Katsuo Yunoki (KDDI Labs)
     - 11-13-0539, "Efficient Frequency Spectrum Utilization", Yongho Seok (LG Electronics)
     - 11-13-0544, "Discussions on 11ac PHY efficiency", Jianhan Liu (MediaTek)

        - 11-13-0536-00, "HEW SG PHY Considerations For Outdoor Environment", Wookbong Lee (LG Electronics)
        - 11-13-0576, "Performance Evaluation for 11ac", Wu Tianyu (Huawei Technologies)
        - 11-13-0556, "Wi-Fi interference measurements in Korea - Part 1", Minho Cheong (ETRI)
        - 11-13-0549, "A perspective on what any High Efficiency Wireless TG should and should not do", Brian Hart (Cisco Systems)
    - **Requirements**
        - 11-13-0524, "HEW Finctional Requirements", Wu Tianyu (Huawei Technologies)
        - 11-13-0555, "Considerations on Functional Requirements for HEW", Minho Cheoung (ETRI)
    - **Scenarios and Metrics**
        - 11-13-0503, "Discussion on Basic Technical Aspects for HEW", Juho Pirskanen (Renesas Mobile)
        - 11-13-0542, "HEW Scenarios and Goals", Simone Merlin (Qualcomm)
        - 11-13-0486, "HEW - Metrics, Targets and Simulation Scenarios", Ron Porat (Broadcom)
        - 11-13-0520, "HEW scenarios and evaluation metrics", Thomas Derham (Orange)
    - **Technical Feasibility**
        - 11-13-0558, "Coexistence and Optimization of Wireless LAN: Time, Frequency, Space, Power, and Load", Jim Lansford (CSR)
3. **Liaison to the Wi-Fi Alliance**
    - The group agreed to ask the Wi-Fi Alliance for input about priority of the use cases.
    - Laurent Cariou (Orange) volunteers to develop the use case document.
4. **Project planning**
    - The group discussed about the project plan based on the submission 11-13-0616-02 by Phil Barber (Huawei)
    - Discussion to be continued in the July meeting.

Goals for July 2013 session

During July 2013 session, the HEW SG will continue discussions on:

- Use Cases,
- Functional Requirements,
- Feasibility,
- Scope and Process.

Teleconferences

Two teleconferences are planned before the July 2013 session.

Wednesday	June 5th, 2013	10:00 - 12:00 (ET)
Wednesday	June 19th, 2013	20:00 - 22:00 (ET)

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Related documents

Documents referenced in the motion that led to the creation of the study group

- https://mentor.ieee.org/802.11/dcn/13/11-13-0339-10-0wng-high-efficiency-wlan-straw-poll.ppt

Press release document

- https://mentor.ieee.org/802.11/dcn/13/11-13-0418-02-0000-proposed-edits-to-hew-press-release.doc

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Useful links to other web sites

IEEE P802.11 WLANs RELATED

- Home
- IEEE 802.11 Wiki
- E-mail Reflectors Archives (Members Only)

OTHER SITES

- IEEE P802 LAN/MAN Standards Committee (LMSC)

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Appendix D

802.11 Working Group Opening Report July 2014

Date: 2014-07-14

Authors:

Name	Company	Address	Phone	email
Adrian Stephens	Intel Corporation			adrian.p.stephens@intel.com

2015

Introduction

- This presentation, together with the topic reports cited on the next slide, forms the opening report of the IEEE 802.11 Working Group for May 2014.
- Subgroup status is reported in the “Snapshots” submission (see next slide for link). This is incorporated by reference into this opening report.
- “*Mx.y.z*” terminology indicates that the item was on the tentative agenda for the *M*onday 802.11 plenary, and was agenda item *x.y.z*.

M3.1 802.11 Working Group Session Documents

WG Session Reports	
WG Agenda	https://mentor.ieee.org/802.11/dcn/11-14-0736
Opening report	https://mentor.ieee.org/802.11/dcn/11-14-0737
Snapshots	https://mentor.ieee.org/802.11/dcn/11-14-0743
Supplementary Material	https://mentor.ieee.org/802.11/dcn/11-14-0738
Motions	https://mentor.ieee.org/802.11/dcn/11-14-0744
Closing report	https://mentor.ieee.org/802.11/dcn/11-14-0745
1st vice chair	https://mentor.ieee.org/802.11/dcn/11-14-0843
Treasurer	https://mentor.ieee.org/802.11/dcn/11-14-0844
2nd vice chair	https://mentor.ieee.org/802.11/dcn/11-14-0746

M4.1.1 Type of Groups

Type of Group	Description
WG	Working Group
SC	Standing Committee
TG	Task Group
SG	Study Group

2018

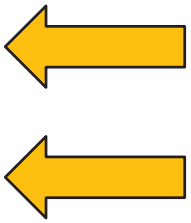
M4.1.1 Groups

Type	Group	Description
WG	WG11	The IEEE 802.11 Working Group
SC	ARC	Architecture
SC	REG	Regulatory
SC	PUB	Publicity
SC	WNG	Wireless Next Generation
802 SC	JTC1	ISO/IEC JTC1/SC6
TG	MC	Revision mc (REVmc)
TG	AH	Operation in 900 MHz bands (S1G)
TG	AI	Fast Initial Link Setup (FILS)
TG	AJ	China 60 GHz (CMMW)
TG	AQ	Pre-association Discovery (PAD)
TG	AK	General Link (GLK)
TG	AX	High Efficiency Wireless LAN (HEW)

2019

M4.1.2 PAR Expiration/Renewal Schedule

Project	PAR Expiration Date
AH	31-DEC-2014
AI	31-DEC-2014
MC	31-DEC-2016
AJ	31-DEC-2016
AK	31-DEC-2016
AQ	31-DEC-2016
AX	31-DEC-2018



July 2014 extension requests to 802 EC

http://www.ieee802.org/11/PARs/index.html

M4.1.3 802.11 Appointed positions

- WG Secretary – Stephen McCann
- Treasurer – Jon Rosdahl
- Publicity – Stephen McCann
- ANA Authority – Adrian Stephens
- WG Technical Editors – Adrian Stephens, Peter Ecclesine

2021

M4.1.3 Officers

Cat	Group	Chair	Vice Chair	Technical Editor	Secretary
WG		Adrian STEPHENS	Jon ROSDAHL Dorothy STANLEY	Adrian STEPHENS Peter ECCLESINE	Stephen MCCANN
SC	ARC	Mark HAMILTON	Joseph LEVY		
SC	REG	Richard KENNEDY			
SC	PUB	Stephen MCCANN			
SC	WNG	Clint CHAPLIN	Jim LANSFORD		
TG	MC	Dorothy STANLEY	Mark HAMILTON Jon ROSDAHL	Adrian Stephens, Sub-editors Emily Qi and Edward Au	Jon ROSDAHL
TG	AH	Yongho SEOK	Alfred ASTERJADHI Zander LEI	Yongho SEOK Alfred ASTERJADHI	Zander LEI
TG	AI	Hiroshi MANO	Marc EMMELMANN	Lee ARMSTRONG Ping FANG	Hitoshi MORIOKA
TG	AJ	Xiaoming PENG	Eldad PERAHIA Haiming WANG	Jiamin CHEN	HAO Peng
TG	AK	Donald EASTLAKE	Mark HAMILTON	Donald EASTLAKE Norm FINN	Filip MESTANOV
TG	AQ	Stephen McCann	Yunsong YANG	Dan GAL	Dapeng LIU
TG	AX	Osama Aboul-Magd			Yasuhiko Inoue

2022

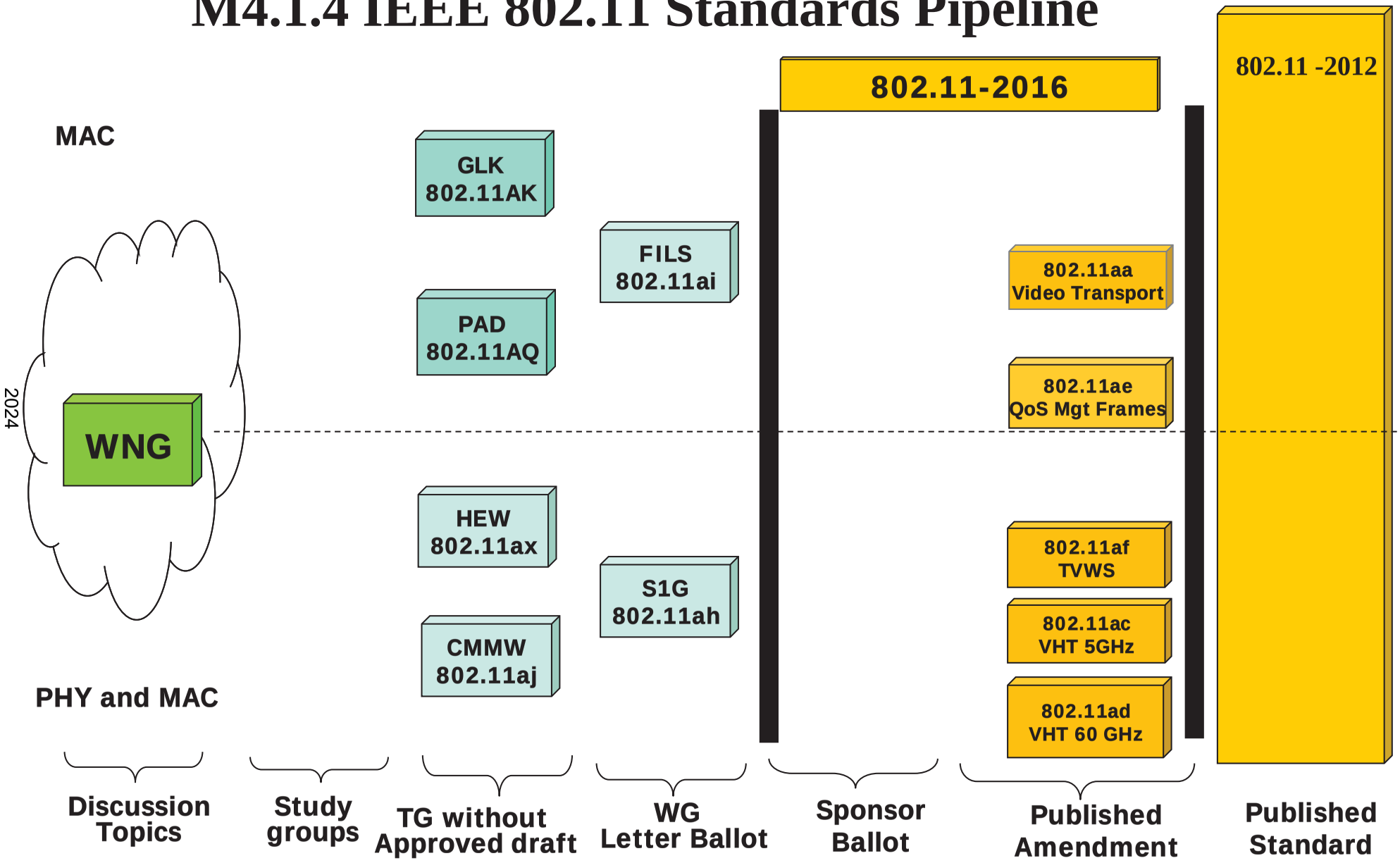
OPEN = Candidate Nominations are open

M4.1.3 Officers (this session)

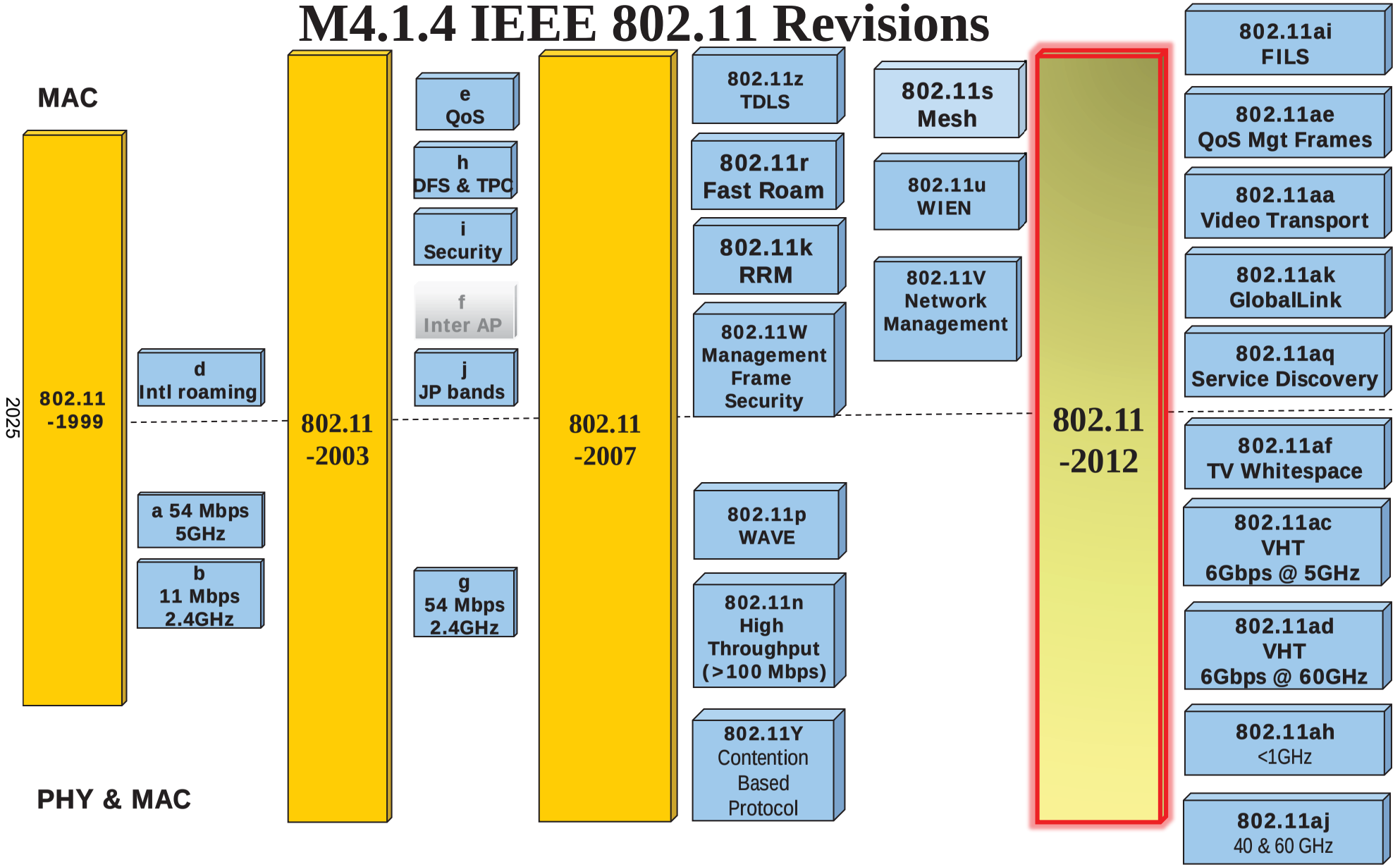
Cat	Group	Chair	Vice Chair	Technical Editor	Secretary
WG		Adrian STEPHENS	Jon ROSDAHL Dorothy STANLEY	Adrian STEPHENS Peter ECCLESINE	Stephen MCCANN
SC	ARC	Mark HAMILTON	Joseph LEVY		
SC	REG	Richard KENNEDY			
SC	PUB	Stephen MCCANN			
SC	WNG	Jim LANSFORD			
TG	MC	Dorothy STANLEY	Mark HAMILTON Jon ROSDAHL	Adrian Stephens, Sub-editors Emily Qi and Edward Au	Jon ROSDAHL
TG	AH	Yongho SEOK	Alfred ASTERJADHI Zander LEI	Yongho SEOK Alfred ASTERJADHI	Zander LEI
TG	AI	Hiroshi MANO	Marc EMMELMANN	Lee ARMSTRONG Ping FANG	Hitoshi MORIOKA
TG	AJ	Xiaoming PENG	Eldad PERAHIA Haiming WANG	Jiamin CHEN	HAO Peng
TG	AK	Donald EASTLAKE	Mark HAMILTON	Donald EASTLAKE Norm FINN	Filip MESTANOV
TG	AQ	Stephen McCann	Yunsong YANG	Dan GAL	Dapeng LIU
TG	AX	Osama Aboul-Magd			Yasuhiko Inoue

2023

M4.1.4 IEEE 802.11 Standards Pipeline



M4.1.4 IEEE 802.11 Revisions



M4.1.5 Summary of ballots and comment collections

Type	Label	Group	Opened	Dur (d)	# Comments	Pool	Approve	Disapprove	Abstain	Return %	Approve %	Result
LB	202	TGmc	Jun 3	20	775	325	219	24	19	81	90	P
LB	203	TGah	Jun 5	30	1214	330	204	43 +3	24	83	83	P
CC	19	TGaj	Jun 6	20	12							

M4.1.6 Current Membership Status

Status	Number
Aspirant	134
Potential Voter	69
Voter	321
Ex Officio Voter	9

Definitions:

Aspirant: a member who has attended 1 qualifying meeting

Potential Voter: a member who has attended 2 qualifying meetings and will become a voter at the start of the next plenary they attend

Ex Officio Voter: a voter who has voting rights by virtue of their membership of the 802 EC and has requested to be recorded as an ex officio voter in 802.11

- **Note – does not include effect of LB203ah**

Data as of 2014-05-16

2027

M4.1.6 “Ex Officio” voting members

- **According to the 802 P&P, 802 voting EC members have the right to vote in 802.11.**
- **The EC members have been asked to indicate if they are interested in exercising this right. Those interested are recorded as “Ex Officio” voters in 802.11.**
- **Ex Officio voters will appear in WG ballot pools.**

2028

M4.1.6 Recent voting member history

Date	Event	Gained	Lost	# Voters
2012-07-20	After July plenary	35	29	300
2012-08-20	LB189		5	295
2012-09-26	Inaugral China Interim	29		324
2012-10	Death of member		1	323
2012-11-16	After Nov plenary	24	23	324
2013-01-19	New Liaison added	1		325
2014-03-04	LB193		4	321
2014-03-22	After Mar plenary	18	16	323
2013-07-19	After July plenary	28	18	333
2013-09	Voting rights re-instated on appeal	1		334
2013-09-16	LB198		11	323
2013-11-10	LB200		16	307
2013-11-15	After Nov plenary	37	14	330
2013-03-18	7 Voters to Ex Officio		7	323
2013-03-21	After Mar plenary	35	30	328
2013-05-09	LB201		7	321

2029

M4.1.7 ANA Status

- **The latest database is 11-11/0270r22 (July 2014)**
- **Changes since last meeting:**
  - General Link subfield added to capabilities field

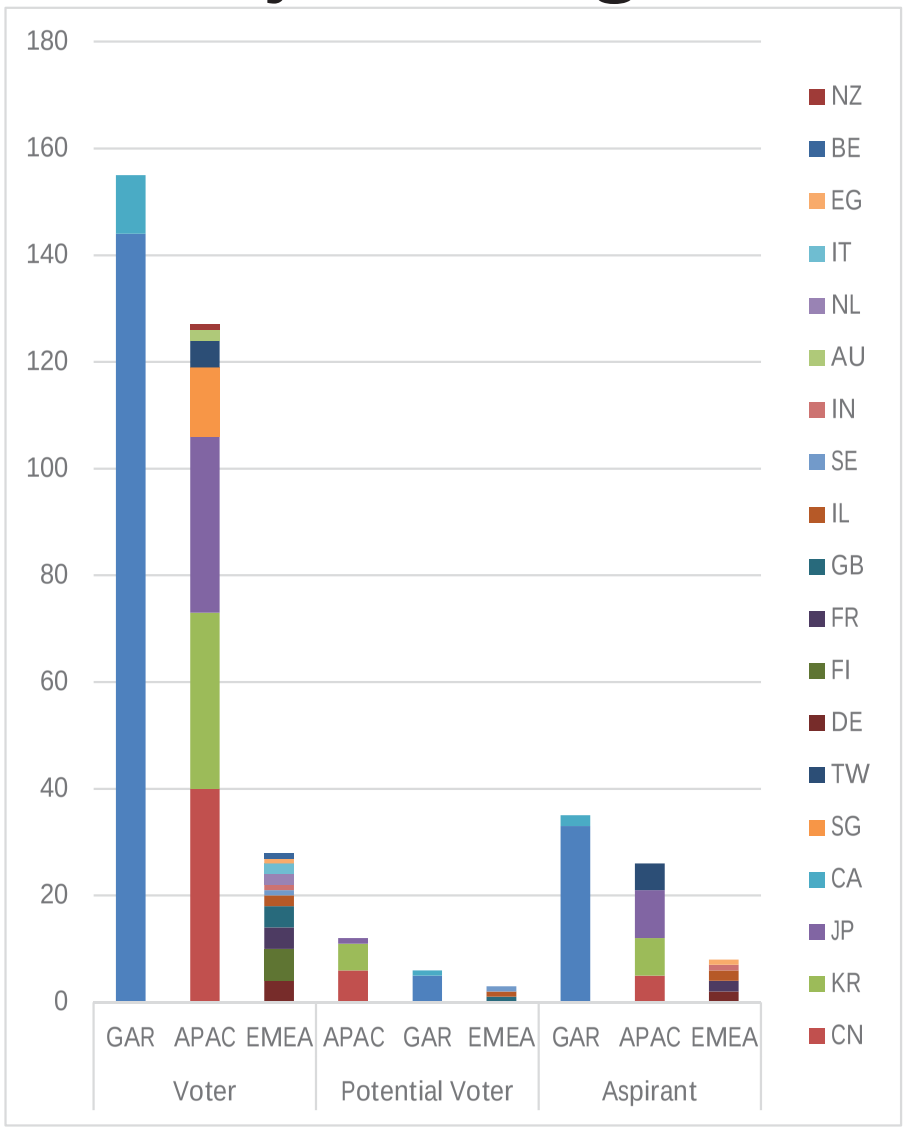
2030

2031

BACKGROUND DATA

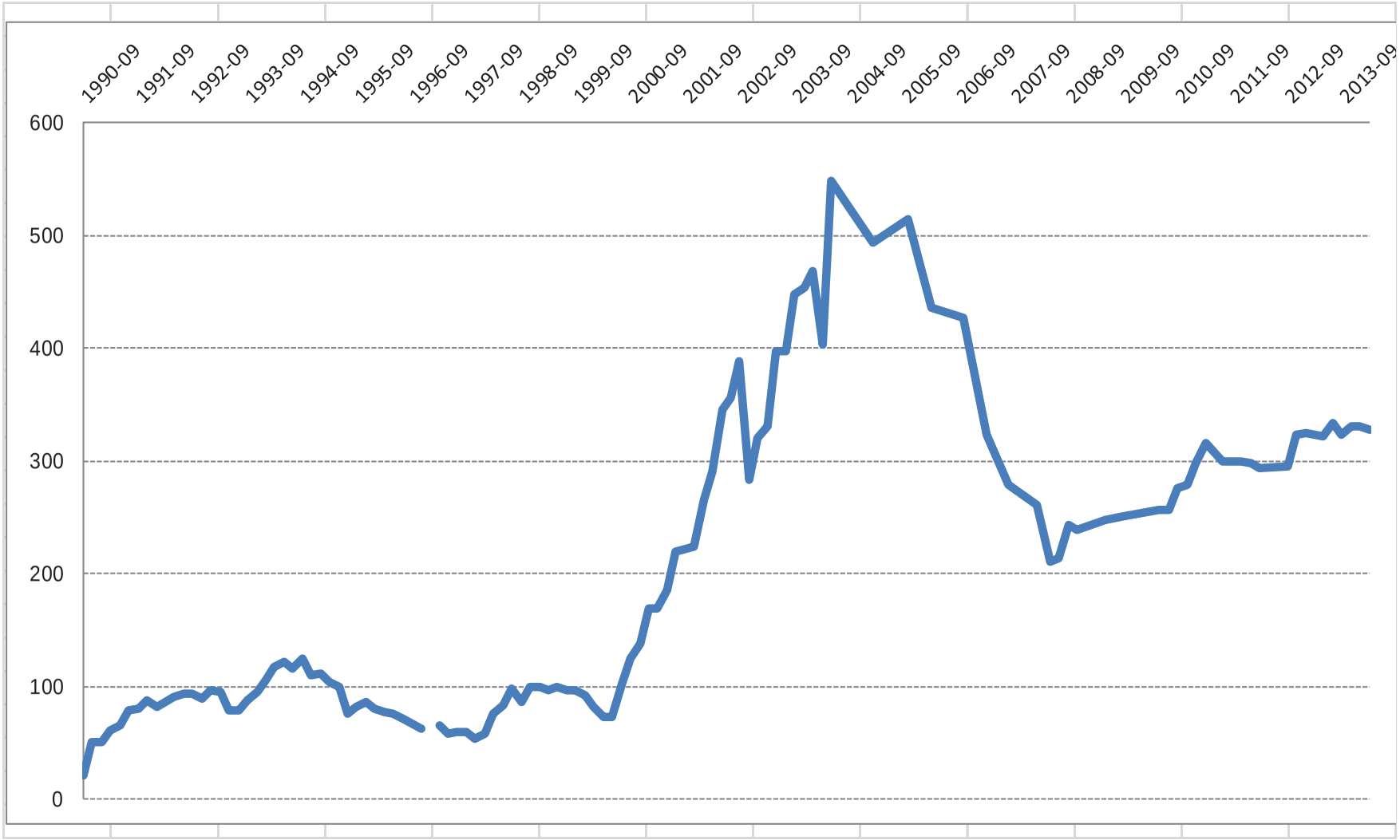
Membership by Country and Region

	Voter	Potential Voter	Aspirant	Grand Total
GAR	**155**	**6**	**35**	**196**
US	144	5	33	182
CA	11	1	2	14
APAC	**127**	**12**	**26**	**165**
CN	40	6	5	51
KR	33	5	7	45
JP	33	1	9	43
SG	13			13
TW	5		5	10
AU	2			2
NZ	1			1
EMEA	**28**	**3**	**8**	**39**
FI	6			6
FR	4		2	6
DE	4		2	6
IL	2	1	2	5
GB	4	1		5
NL	2			2
IT	2			2
SE	1	1		2
EG	1		1	2
IN	1		1	2
BE	1			1
Grand Total	**310**	**21**	**69**	**400**



2032

Membership – Historic Data



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Appendix E

The Wayback Machine - https://web.archive.org/web/20160120211329/https://mentor.ieee.org/802.11/docu...

Documents

Everything | All Years | All Groups

DCN, Title, Author or Affiliation

Created (ET) ▼	Year	DCN	Rev	Group	Title	Author (Affiliation)	Uploaded (ET)	Actions
20-Jan-2016 ET	2016	77	1	TGah	SB0-comment-resolutions-to-CIDs-8091, 8102, 8126, 8322, 8446, 8182	Kaiying Lv (ZTE Corp.)	20-Jan-2016 16:09:31 ET	Download
20-Jan-2016 ET	2015	1511	6	TGah	January 2016 Agenda	Yongho Seok (NEWRACOM)	20-Jan-2016 15:52:05 ET	Download
20-Jan-2016 ET	2016	168	0	TGah	11ah SB0 resolution to comments on frame control field	Zander Lei (I2R), Yongho Seok (NEWRACOM)	20-Jan-2016 15:41:14 ET	Download
20-Jan-2016 ET	2016	138	2	TGak	GLK-GCR Comments Resolutions (part-3)	Ganesh Venkatesan (Intel Corporation)	20-Jan-2016 15:34:23 ET	Download
20-Jan-2016 ET	2016	166	1	TGak	Revised 11ak Figures	Donald Eastlake (Huawei Technologies)	20-Jan-2016 15:31:34 ET	Download
20-Jan-2016 ET	2016	117	2	TGm	EIFS comment	Menzo Wentink (Qualcomm)	20-Jan-2016 15:28:23 ET	Download
20-Jan-2016 ET	2016	60	3	TGax	Recipient-aware Spatial Reuse	Reza Hedayat (Newracom)	20-Jan-2016 15:18:24 ET	Download
20-Jan-2016 ET	2016	136	2	TGaq	TGaq ANQP-SD to ANQP	Jouni Malinen (Qualcomm)	20-Jan-2016 15:12:02 ET	Download
20-Jan-2016 ET	2016	92	1	TGay	Multi-Beamforming in Polarized Channels for 11ay	Kyungtae Jo (LG Electronics)	20-Jan-2016 14:09:23 ET	Download
20-Jan-2016 ET	2016	134	3	TGaz	Accuracy and Coverage functional requirements	Ganesh Venkatesan (Intel Corporation)	20-Jan-2016 13:59:42 ET	Download
20-Jan-2016 ET	2016	167	0	TGah	SB Comment Resolutions Misc 8 CIDs	Qualcomm	20-Jan-2016 13:55:53 ET	Download
20-Jan-2016 ET	2016	60	2	TGax	Recipient-aware Spatial Reuse	Reza Hedayat (Newracom)	20-Jan-2016 13:44:51 ET	Download
20-Jan-2016 ET	2015	1466	2	TGaz	TGaz Jan 2016 Meeting Agenda	Jonathan Segev (Intel corporation)	20-Jan-2016 13:30:25 ET	Download
20-Jan-2016 ET	2016	166	0	TGak	Revised 11ak Figures	Donald Eastlake (Huawei Technologies)	20-Jan-2016 13:37:40 ET	Download
20-Jan-2016 ET	2015	1530	4	TGm	VHT160 operation signaling through non-zero CCFS1	Menzo Wentink (Qualcomm)	20-Jan-2016 13:24:58 ET	Download
20-Jan-2016 ET	2016	66	2	TGax	Views on UL-MU Features	Joonsuk Kim (Apple)	20-Jan-2016 13:23:51 ET	Download
20-Jan-2016 ET	2015	556	17	TGak	LB212 Working Group Ballot Comments	Donald Eastlake (Huawei Technologies)	20-Jan-2016 13:22:17 ET	Download
20-Jan-2016 ET	2016	117	1	TGm	EIFS comment	Menzo Wentink (Qualcomm)	20-Jan-2016 13:09:54 ET	Download
20-Jan-2016 ET	2016	138	1	TGak	GLK-GCR Comments Resolutions (part-3)	Ganesh Venkatesan (Intel Corporation)	20-Jan-2016 12:17:26 ET	Download

20-Jan-2016 ET	2015	828	5	TGm	SB0 Ecclesine Resolutions	Peter Ecclesine (Cisco Systems)	20-Jan-2016 11:53:04 ET	Download
20-Jan-2016 ET	2016	120	2	TGai	TGai comments assigned to me	Jouni Malinen (Qualcomm)	20-Jan-2016 11:52:49 ET	Download
20-Jan-2016 ET	2015	1485	3	802.11 WG	Jan 2016 WG Agenda	Adrian Stephens (Intel Corporation)	20-Jan-2016 11:40:36 ET	Download
20-Jan-2016 ET	2015	1473	7	TGak	January 2016 802.11ak Agenda	Donald Eastlake (Huawei Technologies)	20-Jan-2016 11:25:42 ET	Download
20-Jan-2016 ET	2015	1196	29	TGai	TGai Comments from 1st SB	Marc Emmelmann (self)	20-Jan-2016 11:03:23 ET	Download
20-Jan-2016 ET	2016	136	1	TGaq	TGaq ANQP-SD to ANQP	Jouni Malinen (Qualcomm)	20-Jan-2016 10:54:52 ET	Download
20-Jan-2016 ET	2015	1472	5	TGay	TG AY January 2016 Meeting Agenda	Edward Au (Huawei Technologies)	20-Jan-2016 10:47:25 ET	Download
20-Jan-2016 ET	2016	134	2	TGaz	Accuracy and Coverage functional requirements	Ganesh Venkatesan (Intel Corporation)	20-Jan-2016 10:39:27 ET	Download
20-Jan-2016 ET	2015	1537	1	802.11 WG	Current State of Affairs of IEEE 802.11 Regulatory	Rich Kennedy (Mediatek)	20-Jan-2016 10:38:04 ET	Download
20-Jan-2016 ET	2015	1468	2	802.11 WG	WG Motions regarding attendance and voting rights	Knut Odman (Broadcom)	20-Jan-2016 10:24:10 ET	Download
20-Jan-2016 ET	2016	8	2	TGaq	proposals for LB216 WG Comments for 11aq Draft 3.0	Stephen McCann (BlackBerry)	20-Jan-2016 10:21:47 ET	Download
20-Jan-2016 ET	2016	164	0	TGai	Clause 11 with CID 10049 changes.docx	Lee Armstrong (US DOT)	20-Jan-2016 10:19:09 ET	Download
20-Jan-2016 ET	2016	25	1	802.11 WG	WG attendance investigation re: 2015-11-motion	Dorothy Stanley (HPE)	20-Jan-2016 10:05:41 ET	Download
20-Jan-2016 ET	2016	71	1	TGax	Packet Extension Follow Up	Andrew Blanksby	20-Jan-2016 09:53:25 ET	Download
20-Jan-2016 ET	2016	59	1	TGax	Non-contiguous Channel Bonding in 11ax	Yunbo Li (Huawei)	20-Jan-2016 09:50:47 ET	Download
20-Jan-2016 ET	2016	89	1	TGax	Single Stream Pilots in UL MU MIMO	Sriram Venkateswaran (Broadcom)	20-Jan-2016 09:46:23 ET	Download
20-Jan-2016 ET	2016	163	0	802.11 WG	What is the status of the ETSI BRAN work on a revised version of EN 301 893?	Andrew Myles (Cisco)	20-Jan-2016 09:42:37 ET	Download
20-Jan-2016 ET	2016	80	2	TGax	1x/2x/4x OFDM Symbol in HE SU PPDU with BCC	Heejung Yu (YU/Newracom)	20-Jan-2016 09:32:23 ET	Download
20-Jan-2016 ET	2016	160	1	TGai	Mandatory Probe Request Max Channel Time	Peter Khoury (Ruckus Wireless)	20-Jan-2016 09:32:07 ET	Download
20-Jan-2016 ET	2016	154	1	TGaq	LB216 Clause 6 Comment Resolutions	Emily Qi (intel)	20-Jan-2016 09:28:43 ET	Download
20-Jan-2016 ET	2016	155	1	TGaq	LB216 AnnexCClause6 Comment Resolutions	Emily Qi (Intel)	20-Jan-2016 09:28:16 ET	Download
20-Jan-2016 ET	2016	161	0	REG SC	Closing Report on NGMN Ad-Hoc Meeting	Jeorge Hurtarte (Teradyne)	20-Jan-2016 09:34:44 ET	Download
20-Jan-2016 ET	2016	160	0	TGai	Mandatory Probe Request Max Channel Time	Peter Khoury (Ruckus Wireless)	20-Jan-2016 09:24:19 ET	Download

20-Jan-2016 ET	2015	1275	2	TGak	Address 1 filtering and GLK-GCR Scoreboarding	Ganesh Venkatesan (Intel Corporation)	20-Jan-2016 08:59:43 ET	Download
20-Jan-2016 ET	2016	109	2	TGax	MAC Ad-hoc January 2016 Meeting Agenda	Reza Hedayat (Newracom)	20-Jan-2016 08:41:39 ET	Download
20-Jan-2016 ET	2016	133	1	TGaq	architecture-figures	Stephen McCann (BlackBerry)	20-Jan-2016 08:36:43 ET	Download
20-Jan-2016 ET	2016	147	1	TGax	TGax MU Ad-hoc January 2016 Agenda	Sigurd Schelstraete (Quantenna)	20-Jan-2016 08:24:06 ET	Download
20-Jan-2016 ET	2016	159	0	TGah	TGah SB0 Relay Comments	Menzo Wentink (Qualcomm)	20-Jan-2016 08:08:23 ET	Download
20-Jan-2016 ET	2013	1186	37	TGai	TGai-Motion-deck	Hiroshi Mano (KDTI)	20-Jan-2016 07:58:22 ET	Download
20-Jan-2016 ET	2015	1489	2	802.11 WG	Register of LoA requests	Adrian Stephens (Intel Corporation)	20-Jan-2016 07:16:18 ET	Download
20-Jan-2016 ET	2015	1485	2	802.11 WG	Jan 2016 WG Agenda	Adrian Stephens (Intel Corporation)	20-Jan-2016 07:15:02 ET	Download
20-Jan-2016 ET	2016	156	0	802.11 WG	IMT-2020 Discussion Review and Straw Polls	Joseph LEVY (InterDigital)	20-Jan-2016 10:33:46 ET	Download
20-Jan-2016 ET	2016	155	0	TGaq	LB216 AnnexCClause6 Comment Resolutions	Emily Qi (Intel)	20-Jan-2016 01:04:00 ET	Download
20-Jan-2016 ET	2016	154	0	TGaq	LB216 Clause 6 Comment Resolutions	Emily Qi (intel)	20-Jan-2016 00:57:54 ET	Download
20-Jan-2016 ET	2016	128	1	WNG SC	IMT-2020 Way Forward and Straw Polls	Joseph LEVY (InterDigital)	20-Jan-2016 00:30:54 ET	Download
19-Jan-2016 ET	2015	1377	6	TGaq	LB216 WG Comments for 11aq Draft 3.0	Yunsong Yang (Huawei Technologies)	19-Jan-2016 23:50:50 ET	Download
19-Jan-2016 ET	2015	1472	4	TGay	TG AY January 2016 Meeting Agenda	Edward Au (Huawei Technologies)	19-Jan-2016 23:39:03 ET	Download
19-Jan-2016 ET	2016	67	1	TGax	MAC Padding in Trigger Frame	Liwen Chu (Marvell)	19-Jan-2016 22:36:45 ET	Download
19-Jan-2016 ET	2016	153	0	TGah	ah sb0 comment resolution 8.2.4	Liwen Chu (Marvell)	20-Jan-2016 15:50:15 ET	Download
19-Jan-2016 ET	2015	1196	28	TGai	TGai Comments from 1st SB	Marc Emmelmann (self)	19-Jan-2016 21:46:07 ET	Download
19-Jan-2016 ET	2016	12	7	TGai	Resolutions for assigned CIDs	Hitoshi Morioka (SRC Software)	19-Jan-2016 21:39:03 ET	Download
19-Jan-2016 ET	2016	21	6	TGai	Proposed Resolution for Authentication frame format	Hitoshi Morioka (SRC Software)	19-Jan-2016 21:38:37 ET	Download
19-Jan-2016 ET	2016	152	0	TGai	Resolutions-Kneckt	Jarkko Kneckt (Apple)	19-Jan-2016 21:00:34 ET	Download
19-Jan-2016 ET	2016	12	6	TGai	Resolutions for assigned CIDs	Hitoshi Morioka (SRC Software)	19-Jan-2016 20:35:12 ET	Download
19-Jan-2016 ET	2016	21	5	TGai	Proposed Resolution for Authentication frame format	Hitoshi Morioka (SRC Software)	19-Jan-2016 20:34:43 ET	Download
19-Jan-2016 ET	2016	151	0	ARC SC	Proposed Updates for REVmc to 5.1.5	Joseph LEVY (InterDigital)	20-Jan-2016 00:19:47 ET	Download
19-Jan-2016 ET	2016	85	1	TGax	Congestion control for UL MU random access	Woojin Ahn (Yonsei Univ.)	19-Jan-2016 20:03:26 ET	Download
19-Jan-2016 ET	2016	54	1	TGax	UL MU CCA Response	Kaiying Lv (ZTE Corp.)	19-Jan-2016 20:00:05 ET	Download
19-Jan-2016 ET	2016	91	2	TGax	Regarding HE NDPA frame	Narendar Madhavan	19-Jan-2016 19:46:38 ET	Download

					for DL Sounding Sequence	(Toshiba)		
19-Jan-2016 ET	2015	1275	1	TGak	Address 1 filtering and GLK-GCR Scoreboarding	Ganesh Venkatesan (Intel Corporation)	19-Jan-2016 19:45:54 ET	Download
19-Jan-2016 ET	2015	540	8	ARC SC	Updates to REVmc 5.1.5	Joseph Levy (InterDigital)	19-Jan-2016 19:44:07 ET	Download
19-Jan-2016 ET	2015	1519	3	ARC SC	ARC SC Agenda Jan 2016	Joseph Levy (InterDigital)	19-Jan-2016 19:42:45 ET	Download
19-Jan-2016 ET	2016	108	3	TGax	tgax-phy-ad-hoc-jan-2016-meeting-agenda	Bo Sun (ZTE Corporation)	19-Jan-2016 19:35:47 ET	Download
19-Jan-2016 ET	2016	150	0	TGax	TGax MU Ad hoc Meeting Minutes January 2016	Kaushik Josiam (Samsung)	20-Jan-2016 08:40:51 ET	Download
19-Jan-2016 ET	2016	12	5	TGai	Resolutions for assigned CIDs	Hitoshi Morioka (SRC Software)	19-Jan-2016 18:53:23 ET	Download
19-Jan-2016 ET	2016	21	4	TGai	Proposed Resolution for Authentication frame format	Hitoshi Morioka (SRC Software)	19-Jan-2016 18:52:45 ET	Download
19-Jan-2016 ET	2015	1196	27	TGai	TGai Comments from 1st SB	Marc Emmelmann (self)	19-Jan-2016 18:37:11 ET	Download
19-Jan-2016 ET	2016	63	1	TGah	LB215-TWT-CIDs-proposed-resolutions	Matthew Fischer (Broadcom)	19-Jan-2016 18:11:55 ET	Download
19-Jan-2016 ET	2015	1511	5	TGah	January 2016 Agenda	Yongho Seok (NEWRACOM)	19-Jan-2016 18:06:35 ET	Download
19-Jan-2016 ET	2015	1473	6	TGak	January 2016 802.11ak Agenda	Donald Eastlake (Huawei Technologies)	19-Jan-2016 17:47:52 ET	Download
19-Jan-2016 ET	2015	795	10	TGak	Addressing Comment Resolutions	David Kloper (Cisco)	19-Jan-2016 17:43:12 ET	Download
19-Jan-2016 ET	2016	7	2	TGaq	updated-text-for-annex-b-pics	Stephen McCann (BlackBerry)	19-Jan-2016 17:34:42 ET	Download
19-Jan-2016 ET	2016	148	1	TGaz	60 GHz Focus Area	Alecsander Eitan (Qualcomm)	19-Jan-2016 17:32:33 ET	Download
19-Jan-2016 ET	2016	8	1	TGaq	proposals for LB216 WG Comments for 11aq Draft 3.0	Stephen McCann (BlackBerry)	19-Jan-2016 17:27:02 ET	Download
19-Jan-2016 ET	2016	146	5	TGai	Resolutions for pending QC comments	Abhishek Patil (Qualcomm)	19-Jan-2016 17:21:47 ET	Download
19-Jan-2016 ET	2016	146	4	TGai	Resolutions for pending QC comments	Abhishek Patil (Qualcomm)	19-Jan-2016 17:10:20 ET	Download
19-Jan-2016 ET	2016	145	1	TGai	Resolution for CID-10747	Abhishek Patil (Qualcomm)	19-Jan-2016 17:09:49 ET	Download
19-Jan-2016 ET	2016	141	1	TGm	160 and 80+80 MHz channel width signaling	Menzo Wentink (Qualcomm)	19-Jan-2016 16:59:57 ET	Download
19-Jan-2016 ET	2015	1522	3	TGm	TGmc Agenda January 2016	Dorothy Stanley (HPE)	19-Jan-2016 17:00:16 ET	Download
19-Jan-2016 ET	2016	134	1	TGaz	Accuracy and Coverage functional requirements	Ganesh Venkatesan (Intel Corporation)	19-Jan-2016 16:52:27 ET	Download
19-Jan-2016 ET	2016	126	1	TGah	Misc. Clause 24 CIDs previously unassigned	Eugene Baik (Qualcomm)	19-Jan-2016 16:30:53 ET	Download
19-Jan-2016 ET	2016	146	3	TGai	Resolutions for pending QC comments	Abhishek Patil (Qualcomm)	19-Jan-2016 16:25:26 ET	Download
19-Jan-2016 ET	2016	148	0	TGaz	60 GHz Focus Area	Alecsander Eitan (Qualcomm)	19-Jan-2016 16:25:12 ET	Download
19-Jan-2016 ET	2016	147	0	TGax	TGax MU Ad-hoc January 2016 Agenda	Sigurd Schelstraete (Quantenna)	19-Jan-2016 16:17:13 ET	Download

19-Jan-2016 ET	2015	1502	1	TGm	REVmc - BRC Minutes for F2F Dec - IEEE-SA hosted - Piscataway	Jon Rosdahl (Qualcomm)	19-Jan-2016 16:38:10 ET	Download
19-Jan-2016 ET	2016	146	2	TGai	Resolutions for pending QC comments	Abhishek Patil (Qualcomm)	19-Jan-2016 16:05:10 ET	Download
19-Jan-2016 ET	2016	21	3	TGai	Proposed Resolution for Authentication frame format	Hitoshi Morioka (SRC Software)	19-Jan-2016 16:00:37 ET	Download
19-Jan-2016 ET	2016	12	4	TGai	Resolutions for assigned CIDs	Hitoshi Morioka (SRC Software)	19-Jan-2016 15:59:40 ET	Download
19-Jan-2016 ET	2015	1511	4	TGah	January 2016 Agenda	Yongho Seok (NEWRACOM)	19-Jan-2016 15:47:09 ET	Download
19-Jan-2016 ET	2016	109	1	TGax	MAC Ad-hoc January 2016 Meeting Agenda	Reza Hedayat (Newracom)	19-Jan-2016 15:39:21 ET	Download
19-Jan-2016 ET	2015	1530	3	TGm	VHT160 operation signaling through non-zero CCFS1	Menzo Wentink (Qualcomm)	19-Jan-2016 15:30:44 ET	Download

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Appendix F

IEEE P802.11
Wireless LANs

IEEE 802.11 TGax, MAC Ad hoc **Mar 2016 Macau TGax MAC Ad hoc Meeting Minutes**				
Date: 2016-03-14				
Author(s):				
Name	**Affiliation**	**Address**	**Phone**	**Email**
Brian Hart	Cisco Systems			brianh@cisco.com

Abstract

TGax, MAC Ad Hoc meeting minutes from the IEEE 802.11 Macau session, Mar 15th – 17th, 2016.

Tuesday, Mar 15th, 2016, AM2 TGax MAC Ad hoc Session (10:30am-12:30pm)

1. **The meeting called to order at 10:36pm by Eric Wong (Apple), the co-chair of the TGax MAC Ad hoc**
   1.1. About 55 people are in the room at this time.

2. **Announcement**
   2.1. Agenda doc is 11-16/0427r0 is on the server.
   2.2. Meeting Protocol: The Chair asked to state name and affiliation when speaking for the first time.
   2.3. Attendance reminder.
      2.3.1. The attendance server: https://imat.ieee.org/

3. **The chair reviewed the mandatory 5 slides of P&P.**
   3.1. Instructions from the WG Chair. [reviewed~~, did not review~~]
   3.2. Participants, Patents, and Duty to Inform [reviewed~~, did not review~~]
   3.3. Patent Related Links. [reviewed~~, did not review~~]
   3.4. Call for potentially essential patents.
      3.4.1. Chair asked if anyone is aware of potentially essential patents [Asked~~. Did not ask~~]
      3.4.2. Potentially essential patents [None reported~~. Reported as follows~~]
   3.5. Other Guidelines for IEEE WG Meetings. [reviewed~~, did not review~~]

4. **The Chair called for presentations**
   4.1. No requests for additional presentations or reordering of were made.

5. **The Chair asked for approval of the agenda**
   5.1. No objection raised

6. **Presentation of contributions**

Liwen Chu (Marvell) presented 11-16/0358r0, "Maximal A-MPDU size"

11-16/0358-SP1: Do you support adding the following text to 11ax SFD:
A HE STA can announce its maximum A-MPDU length limits to 2^{21}, 2^{22}?

Y29 N0 A13 – strawpoll [pre-motion] passes

Chitta Ghosh (Intel) presented 11-16/0362r0, "Multi-TID Aggregation Limit"

11-16/0362-SP1: Do you support to add to the 11ax SFD that the recipient indicates the maximum number of TIDs of the MPDUs that the originator can aggregate in a multi-TID A-MPDU in MU PPDU?

Y38 N0 A11 – strawpoll [pre-motion] passes

11-16/0362-SP2: Do you support to add to the 11ax SFD that within a single A-MPDU containing MPDUs with different value of TIDs, the MPDUs with the same TID value are not required to be in contiguous A-MPDU subframes?

Y33 N0 A10 – strawpoll [pre-motion] passes

Xiaofei Wang presented 11-16/0365r0, "Multi-STA BA Design"

11-16/0356-SP1: Do you agree to insert into the 802.11ax SFD
"4.2 The RA field of the Multi-STA BA with BA information for multiple AIDs may be set to a group address."

Y8 N9 A32 – strawpoll [pre-motion] fails

SP2 postponed for further discussion

Simone Merlin presented 11-16/0378r1, "Extended BA Bitmap"

11-16/078-SP1: Do you support to add to the SFD the definition of a variant of the Compressed BA frame format with a 256-bits BA Bitmap field?

Y42 N0 A7 – strawpoll [pre-motion] passes

11-16/078-SP2: Do you support to add to the SFD:
Reserved bit(s) in Fragment Number field are used to indicate the length of the BA Bitmap within the same BA Information field?

Y37 N1 A7 – strawpoll [pre-motion] passes

Mid session attendee count: **about 76 people in the room.**

Dengyu Qiao (Huawei) presented 11-16/404r0 "BlockAck-Bitmap"

11-16/404-SP1 Do you agree to add the following text into the SFD?
The spec shall define a length indication of Block Ack Bitmap subfield included in Fragment Number subfield of the Block Ack Starting Sequence Control field for a multi-STA BA frame, if the Block Ack Bitmap and the Block Ack Starting Sequence Control subfields are present.

Y36 N0 A5 – strawpoll [pre-motion] passes

Delayed strawpoll from Xiaofei Wang presented 11-16/0365r0

11-16/0356-SP2: Do you agree to insert into the 802.11ax SFD
"The RA field of a Multi-STA BA for a single STA should be set to the MAC address of that STA."

Y7 N0 A28 – strawpoll [pre-motion] passes

7. The Chair [recessed~~, did not recess~~] the MAC ad hoc session at 12:25 pm.
// recess = short break, adjournment = long break

Tuesday, Mar 15th, 2016, PM2 TGax MAC Ad hoc Session (4pm-6pm)

1. **The meeting called to order at 4:05pm by Eric Wong (Apple), the co-chair of the TGax MAC Ad hoc**
   1.1. About 55 people are in the room at this time.

2. Announcement

2.1. Agenda doc is 11-16/0427r1 is on the server.

2.2. Meeting Protocol: The Chair asked to state name and affiliation when speaking for the first time.

2.3. Attendance reminder.

2.3.1. The attendance server: https://imat.ieee.org/

3. The chair reviewed the mandatory 5 slides of P&P.

3.1. Instructions from the WG Chair. [reviewed~~, did not review~~]

3.2. Participants, Patents, and Duty to Inform [reviewed~~, did not review~~]

3.3. Patent Related Links. [reviewed~~, did not review~~]

3.4. Call for potentially essential patents.

3.4.1. Chair asked if anyone is aware of potentially essential patents
[Asked.~~ Did not ask~~]

3.4.2. Potentially essential patents
[None reported. ~~Reported as follows~~]

3.5. Other Guidelines for IEEE WG Meetings. [reviewed~~, did not review~~]

4. The Chair asked for approval of the agenda

4.1. No objection raised

5. Presentation of contributions

Evgeny Khorov (IITP RAS) presented 11-16/0399r1, "Considerations on Trigger Frame for Random Access Procedure"

11-16/0399-SP1: Do you agree to add the following text in SFD:
x.y.z. In case of unsuccessful transmission attempt triggered by a Trigger frame for random access, OFDMA Contention Window (OCW) is doubled (similar to CW in DCF) until it reaches OCWmax.

Y6 N9 A22– strawpoll [pre-motion] fails

Youbo Li (Huawei) presented 116-11/0383r0 "RU Signaling in Trigger Frame"

Do you support to add to SFD
9.3.1.23 Trigger frame
Use 8 bits to signal the RU allocation for each STA in per user info field of Trigger frame.
The first bit indicates the allocated RU is located in the primary or non-primary 80MHz.
The mapping of the subsequent 7 bits indices to the RU allocation is defined in the table below.

7 bits indices	Message	Number of entries

0000000 ~ 0100100	Possible 26 RU cases in 80MHz	37
0100101 ~ 0110100	Possible 52 RU cases in 80MHz	16
0110101 ~ 0111100	Possible 106 RU cases in 80MHz	8
0111101 ~ 1000000	Possible 242 RU cases in 80MHz	4
1000001 ~ 1000010	Possible 484 RU cases in 80MHz	2
1000011	996 RU cases in 80MHz	1
1000100	160MHz/80+80MHz case	1
Total		69

Y28 N0 A6– strawpoll [pre-motion] passes

Mid session attendee count: **about 64 people in the room.**

Matt Fischer (Broadcom) presented 11-16/0368r0, "MAC padding options for legacy trigger frame"

11-16/0368-SP1 Do you support to add to the SFD that the draft specification shall specify that when a Trigger needs to be padded to allow sufficient UL PPDU transmission preparation time, the padding shall be at the MAC layer and the padding shall not include an FCS?

Y44 N0 A10– strawpoll [pre-motion] passes

Matt Fischer (Broadcom) presented 11-16/0369r0, "M-BA aggregated trigger frame"

11-16/0369-SP1: Do you support to add to the SFD, that the draft specification shall specify that M-BA/BA/ACK may be aggregated with a trigger frame in an A-MPDU without accompanying Data?

Y48 N0 A2– strawpoll [pre-motion] passes

Jeongki Kim (LGE) presented 11-16/0361r0, "Ack Policy of UL MU frame"

11-16/0361-SP1: Do you agree to add to SFD?
The ACK Policy of the QoS data frame(s) sent in an HE trigger-based PPDU shall be set to 00 (Normal Ack or Implicit BAR) when the QoS data frame requires to be acknowledged (i.e., the Ack Policy cannot be set to 11 (Block Ack)).
Y37 N0 A7– strawpoll [pre-motion] passes

Jinsoo Ahm (Yonsei University) presented 11-16/0345r1, "Simultaneous NAK for MU GCR-BA"

11-16/0345-SP1: Do you agree to add to the TG Specification Frame work document?
4.7.X The spec shall define a mechanism to utilize a simultaneous NAK (TBD) for multicast operation
When AP allocates common RU for a simultaneous NAK, multicast destination STAs, which cannot successfully decode its multicast PPDU, transmit a simultaneous NAK frame (TBD) via the allocated common RU

Y9 N10 A40 – strawpoll [pre-motion] fails

6. The Chair [recessed~~, did not recess~~] the MAC ad hoc session at 5:57 pm.
// recess = short break, adjournment = long break

Wednesday, Mar 16th, 2016, PM1 TGax MAC Ad hoc Session (1:30pm-3:30pm)

1. **The meeting called to order at 1:35pm by Eric Wong (Apple), the co-chair of the TGax MAC Ad hoc**
   1.1. About 42 people are in the room at this time.

2. **Announcement**
   2.1. Agenda doc is 11-16/0427r2 is on the server.

3. **The chair reviewed the mandatory 5 slides of P&P.**
   3.1. Instructions from the WG Chair. [reviewed~~, did not review~~]
   3.2. Participants, Patents, and Duty to Inform [reviewed~~, did not review~~]
   3.3. Patent Related Links. [reviewed~~, did not review~~]
   3.4. Call for potentially essential patents.
      3.4.1. Chair asked if anyone is aware of potentially essential patents [Asked~~. Did not ask~~]
      3.4.2. Potentially essential patents [None reported.~~ Reported as follows~~]
   3.5. Other Guidelines for IEEE WG Meetings. [reviewed~~, did not review~~]

4. **The Chair asked for approval of the agenda**
   4.1. No objection raised

5. **Presentation of contributions**

Alfred Asterjadhi (Qualcomm) presented 11-16/347r0, "Fragmentation for MU frames-Follow up on parameters"

11-16/347-SP1: Do you support to add to the SFD:
An HE STA specifies the following parameters related to fragmentation:
- Minimum Fragment Size: The minimum payload size for the first fragment of an MSDU supported by the STA

  - Possible values: 128, 256, 512, Unspecified/No Limit
- Maximum Number of F-MSDUs: The maximum number of fragmented MSDUs/MMPDUs that can be concurrently received by the STA
  - Possible values: 1, 2, 8, 16, 32, Unspecified/No Limit
  - Note: Whether the counter is per <RA, TA> or per <RA, TA, TID> is currently TBD.

Y25 N0 A8– strawpoll [pre-motion] passes

Woojin Ahn (Yonsei University) presented 11-16/352r1, "Considerations on MU initial link setup"

11-16/352-SP1: Do you agree to add to the TG Specification Frame work document?
x.y.z the spec shall define a procedure for multiuser initial link setup (MU authentication, MU association)

Y13 N10 A26 – strawpoll [pre-motion] fails

Hanseul Hong (Yonsei Unicersity) presented 11-16/353r1, "MU-RTS/CTS for TWT Protection"

Mid session attendee count: **about 89 people in the room.**

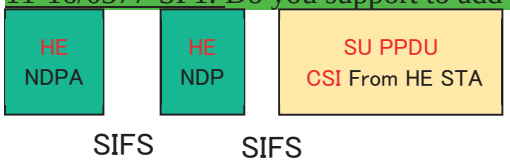
Liwen Chu (Marvell) presented 11-16/359r0, "Management Ack"

11-16/359-SP1: Do you support adding the following test to 11ax SFD:
A value of 15 in the TID subfield in the Per STA Info field of the M-BA frame indicate the successful acknowledgement of a MGMT frame that requires an immediate response and is carried in the soliciting A-MPDU?

Y40 N0 A9 – strawpoll [pre-motion] passes

Simone Merlin (Qualcomm) presented 11-16/0377r0 "Sounding Sequences Clarifications"

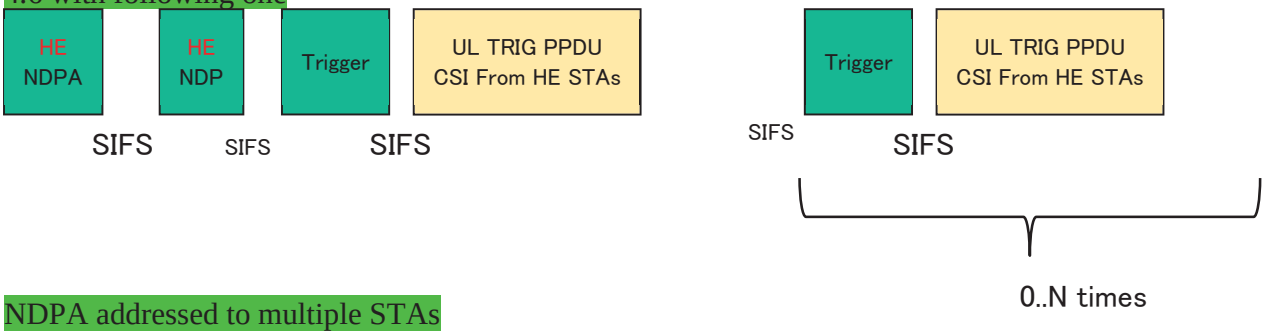
11-16/0377-SP1: Do you support to add to the SFD the following sounding sequence?



HE NDPA is addressed to 1 STA

Y46 N0 A4 – strawpoll [pre-motion] passes

11-16/0377-SP2: Do you support to replace the sounding sequence figure in SFD section 4.6 with following one



NDPA addressed to multiple STAs

Y42 N0 A3 – strawpoll [pre-motion] passes

Evgeny Khorov (IITP RAS) presented 11-16/0297r2 "Results for beacon collisions"

11-16/0297-SP1: Do you agree that TGax should address beacon collision problem?

Y9 N0 A33

The Chair [recessed~~, did not recess~~] the MAC ad hoc session at 3:30 pm.
// recess = short break, adjournment = long break

Wednesday, Mar 16th, 2016, PM2 TGax MAC Ad hoc Session (4pm-6pm)

1. **The meeting called to order at 4:05pm by Eric Wong (Apple), the co-chair of the TGax MAC Ad hoc**
   1.1. About 60 people are in the room at this time.

2. **Announcement**
   2.1. Agenda doc is 11-16/0427r3 is on the server.

3. **The chair reviewed the mandatory 5 slides of P&P.**
   3.1. Instructions from the WG Chair. [reviewed~~, did not review~~]
   3.2. Participants, Patents, and Duty to Inform [reviewed~~, did not review~~]
   3.3. Patent Related Links. [reviewed~~, did not review~~]
   3.4. Call for potentially essential patents.
      3.4.1. Chair asked if anyone is aware of potentially essential patents [Asked~~. Did not ask~~]
      3.4.2. Potentially essential patents [None reported~~. Reported as follows~~]
   3.5. Other Guidelines for IEEE WG Meetings. [reviewed~~, did not review~~]

4. The Chair asked for approval of the agenda
4.1. No objection raised

5. Presentation of contributions

Geonjung Ko (WILUS) presented 11-16/0396r0, "Issues on BSS Color Bits Collision"

Hanseul Hong (Yonsei University) polled:

11-16/353-SP1: Do you agree to add to the TG Specification Framework document? Spec shall define a mechanism to protect TWT SP.

- A TWT requesting STA sets the TWT Protection subfield to 1 in TWT Request frame to request the AP to provide protection of the set of TWT SPs using a NAV protection mechanism defined in 802.11ax (e.g. (MU)RTS/CTS or CTS-to-self, etc)

Y8 N2 A37 – strawpoll [pre-motion] passes

The Chair [adjourned] the MAC ad hoc session at 5:07 pm.
// recess = short break, adjournment = long break

Appendix G

IEEE P802.11ax™/D1.0, November 2016
(amendment to IEEE P802.11REVmc™/D8.0
as amended by IEEE P802.11ai™/D10.0,
IEEE P802.11ah™/D9.0,
IEEE P802.11aq™/D3.0,
IEEE P802.11ak™/D2.0,
and IEEE P802.11aj™/D3.0)

IEEE P802.11ax™/D1.0

Draft Standard for Information technology— Telecommunications and information exchange between systems Local and metropolitan area networks— Specific requirements

Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications

Amendment 6: Enhancements for High Efficiency WLAN

Prepared by the 802.11 Working Group of the

LAN/MAN Standards Committee
of the
IEEE Computer Society

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Abstract: This amendment defines modifications to both the IEEE 802.11 physical layer (PHY) and the medium access control (MAC) sublayer for high efficiency operation in frequency bands between 1 GHz and 6 GHz.

Keywords: high efficiency, PHY, physical layer, MAC, medium access control, OFDMA, orthogonal frequency division multiple access, wireless local area network, WLAN

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Introduction

This introduction is not part of IEEE P802.11ax /D1.0, November 2016, IEEE Standard for Information technology—Telecommunications and information exchange between systems—Local and metropolitan area network—Specific requirements—Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications—Amendment 6: Enhancements for High Efficiency WLAN.

This amendment defines modifications to both the IEEE 802.11 physical layer (PHY) and the medium access control (MAC) sublayer for high efficiency operation in frequency bands between 1 GHz and 6 GHz.

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Yasuhiko Inoue, *Secretary*
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IEEE P802.11ax™/D1.0

Draft STANDARD for Information Technology— Telecommunications and information exchange between systems— Local and metropolitan area networks— Specific requirements

Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications

Amendment 6: Enhancements for High Efficiency WLAN

[This amendment is based on IEEE P802.11REVmc/D8.0 amended by IEEE P802.11ai/D10.0, IEEE P802.11ah/D9.0, IEEE P802.11aq/D3.0, IEEE P802.11ak/D2.0 and IEEE P802.11aj/D3.0]

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Editor's Note: A cumulative status of the versions of this draft is shown below.

Table 1—Draft Status

Draft	Date	Status
D0.1	2016-03-03	Converted to FrameMaker from 16/0024r1 Proposed draft specification
D0.2	2016-06-06	Includes tentative resolutions for most editorials. Includes resolutions for technical comments motioned in May 2016 session.
D0.3	2016-08-11	Includes resolutions for technical comments motioned in July 2016 session.
D0.4	2016-08-26	Included motioned draft changes from July 2016 session and corrected errors
D0.5	2016-09-30	Included comment resolutions and other changes motioned at the September 2016 session
D1.0	2016-11-30	Includes all approved changes. Ready for WG ballot.

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3. Definitions, acronyms, and abbreviations

3.2 Definitions specific to IEEE 802.11

Change the following definitions:

20 MHz mask physical layer (PHY) protocol data unit (PPDU): One of the following PPDUs:

a) A Clause 17 (Orthogonal frequency division multiplexing (OFDM) PHY specification) PPDU transmitted using the 20 MHz transmit spectral mask defined in Clause 17 (Orthogonal frequency division multiplexing (OFDM) PHY specification).

b) A Clause 18 (Extended Rate PHY (ERP) specification) orthogonal frequency division multiplexing (OFDM) PPDU transmitted using the transmit spectral mask defined in Clause 18 (Extended Rate PHY (ERP) specification).

c) A high throughput (HT) PPDU with the TXVECTOR parameter CH_BANDWIDTH equal to HT_CBW20 and the CH_OFFSET parameter equal to CH_OFF_20 transmitted using the 20 MHz transmit spectral mask defined in Clause 19 (High Throughput (HT) PHY specification).

d) A very high throughput (VHT) PPDU with TXVECTOR parameter CH_BANDWIDTH equal to CBW20 transmitted using the 20 MHz transmit spectral mask defined in Clause 21 (Very High Throughput (VHT) PHY specification).

e) A Clause 17 (Orthogonal frequency division multiplexing (OFDM) PHY specification) PPDU transmitted by a VHT STA using the transmit spectral mask defined in Clause 21 (Very High Throughput (VHT) PHY specification).

f) An HT PPDU with the TXVECTOR parameter CH_BANDWIDTH equal to HT_CBW20 and the CH_OFFSET parameter equal to CH_OFF_20 transmitted by a VHT STA using the 20 MHz transmit spectral mask defined in Clause 21 (Very High Throughput (VHT) PHY specification).

g) An high efficiency (HE) PPDU with with TXVECTOR parameter CH_BANDWIDTH equal to CBW20 transmitted using the 20 MHz transmit spectral mask defined in Clause 28 (High Efficiency (HE) PHY specification).

20 MHz physical layer (PHY) protocol data unit (PPDU): A Clause 15 (DSSS PHY specification for the 2.4 GHz band designated for ISM applications) PPDU, Clause 17 (Orthogonal frequency division multiplexing (OFDM) PHY specification) PPDU (when using 20 MHz channel spacing), Clause 16 (High rate direct sequence spread spectrum (HR/DSSS) PHY specification) PPDU, Clause 18 (Extended Rate PHY (ERP) specification) orthogonal frequency division multiplexing (OFDM) PPDU, Clause 19 (High Throughput (HT) PHY specification) 20 MHz high throughput (HT) PPDU with the TXVECTOR parameter CH_BANDWIDTH equal to HT_CBW20, or Clause 21 (Very High Throughput (VHT) PHY specification(11ac)) 20 MHz very high throughput (VHT) PPDU with the TXVECTOR parameter CH_BANDWIDTH equal to CBW20, or Clause 28 (High Efficiency (HE) PHY specification) 20 MHz high efficiency (HE) PPDU with the TXVECTOR parameter CH_BANDWIDTH equal to CBW20.

40 MHz mask physical layer (PHY) protocol data unit (PPDU): One of the following PPDUs:

a) A 40 MHz high throughput (HT) PPDU (TXVECTOR parameter CH_BANDWIDTH equal to HT_CBW40) transmitted using the 40 MHz transmit spectral mask defined in Clause 19 (High Throughput (HT) PHY specification).

b) A 40 MHz non-HT duplicate PPDU (TXVECTOR parameter CH_BANDWIDTH equal to NON_HT_CBW40) transmitted by a non-very high throughput (non-VHT) STA using the 40 MHz transmit spectral mask defined in Clause 19 (High Throughput (HT) PHY specification).

c) A 40 MHz non-HT duplicate PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW40) transmitted by a very high throughput (VHT) STA using the 40 MHz transmit spectral mask defined in Clause 21 (Very High Throughput (VHT) PHY specification).

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d) A 20 MHz HT PPDU with the TXVECTOR parameter CH_BANDWIDTH equal to HT_CBW20 and the CH_OFFSET parameter equal to either CH_OFF_20U or CH_OFF_20L transmitted using the 40 MHz transmit spectral mask defined in Clause 19 (High Throughput (HT) PHY specification).

e) A 20 MHz VHT PPDU with the TXVECTOR parameter CH_BANDWIDTH equal to CBW20 transmitted using the 40 MHz transmit spectral mask defined in Clause 21 (Very High Throughput (VHT) PHY specification).

f) A 40 MHz VHT PPDU with the TXVECTOR parameter CH_BANDWIDTH equal to CBW40 transmitted using the 40 MHz transmit spectral mask defined in Clause 21 (Very High Throughput (VHT) PHY specification).

g) A 40 MHz HT PPDU (TXVECTOR parameter CH_BANDWIDTH equal to HT_CBW40) transmitted by a VHT STA using the 40 MHz transmit spectral mask defined in Clause 21 (Very High Throughput (VHT) PHY specification).

h) A 20 MHz non-HT PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW20) transmitted using the 40 MHz transmit spectral mask defined in Clause 19 (High Throughput (HT) PHY specification).

i) A 20 MHz non-HT PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW20) transmitted by a VHT STA using the 40 MHz transmit spectral mask defined in Clause 21 (Very High Throughput (VHT) PHY specification).

j) A 40 MHz high efficiency (HE) PPDU with with TXVECTOR parameter CH_BANDWIDTH equal to CBW40 transmitted using the 40 MHz transmit spectral mask defined in Clause 26 (High Efficiency (HE) PHY specification).

k) A 40 MHz HT PPDU (TXVECTOR parameter CH_BANDWIDTH equal to HT_CBW40) transmitted by a HE STA using the 40 MHz transmit spectral mask defined in Clause 28 (High Efficiency (HE) PHY specification).

l) A 40 MHz VHT PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW40) transmitted by a HE STA using the 40 MHz transmit spectral mask defined in Clause 28 (High Efficiency (HE) PHY specification).

m) A 40 MHz non-HT duplicate PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW40) transmitted by a HE (HE) STA using the 40 MHz transmit spectral mask defined in Clause 28 (High Efficiency (HE) PHY specification).

40 MHz physical layer (PHY) protocol data unit (PPDU): A 40 MHz high throughput (HT) PPDU (TXVECTOR parameter CH_BANDWIDTH equal to HT_CBW40) or a 40 MHz non-HT duplicate PPDU (TXVECTOR parameter CH_BANDWIDTH equal to NON_HT_CBW40 or TXVECTOR parameter CH_BANDWIDTH equal to CBW40), or a 40 MHz very high throughput (VHT) PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW40)), or Clause 28 (High Efficiency (HE) PHY specification) 40 MHz high efficiency (HE) PPDU with the TXVECTOR parameter CH_BANDWIDTH equal to CBW40.

80 MHz mask physical layer (PHY) protocol data unit (PPDU): ~~A PPDU that is transmitted using the 80 MHz transmit spectral mask defined in Clause 21 (Very High Throughput (VHT) PHY specification) and that is one~~ One of the following:

a) An 80 MHz very high throughput (VHT) PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW80) using the 80 MHz transmit spectral mask defined in Clause 21 (Very High Throughput (VHT) PHY specification)

b) An 80 MHz non-high throughput (non-HT) duplicate PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW80) using the 80 MHz transmit spectral mask defined in Clause 21 (Very High Throughput (VHT) PHY specification)

c) A 20 MHz non-HT, high throughput (HT), or VHT PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW20) using the 80 MHz transmit spectral mask defined in Clause 21 (Very High Throughput (VHT) PHY specification)

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d) A 40 MHz non-HT duplicate, HT, or VHT PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW40) using the 80 MHz transmit spectral mask defined in Clause 21 (Very High Throughput (VHT) PHY specification)

e) An 80 MHz high efficiency (HE) PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW80) using the 80 MHz transmit spectral mask defined in Clause 28 (High Efficiency (HE) PHY specification).

f) f) An 80 MHz very high throughput (VHT) PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW80) using the 80 MHz transmit spectral mask defined in Clause 28 (High Efficiency (HE) PHY specification).

g) g) An 80 MHz non-high throughput (non-HT) duplicate PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW80) using the 80 MHz transmit spectral mask defined in Clause 28 (High Efficiency (HE) PHY specification).

80 MHz physical layer (PHY) protocol data unit (PPDU): A Clause 21 (Very High Throughput (VHT) PHY specification) 80 MHz very high throughput (VHT) PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW80) or, a Clause 21 (Very High Throughput (VHT) PHY specification) 80 MHz non-high throughput (non-HT) duplicate PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW80), or Clause 28 (High Efficiency (HE) PHY specification) 80 MHz high efficiency (HE) PPDU with the TXVECTOR parameter CH_BANDWIDTH equal to CBW80.

160 MHz mask physical layer (PHY) protocol data unit (PPDU): ~~A PPDU that is transmitted using the 160 MHz transmit spectral mask defined in Clause 21 (Very High Throughput (VHT) PHY specification(11ac)) and that is one~~ One of the following:

a) A 160 MHz very high throughput (VHT) PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW160) using the 160 MHz transmit spectral mask defined in Clause 21 (Very High Throughput (VHT) PHY specification)

b) A 160 MHz non-high throughput (non-HT) duplicate PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW160) using the 160 MHz transmit spectral mask defined in Clause 21 (Very High Throughput (VHT) PHY specification)

c) A 20 MHz non-HT, high throughput (HT), or VHT PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW20) using the 160 MHz transmit spectral mask defined in Clause 21 (Very High Throughput (VHT) PHY specification)

d) A 40 MHz non-HT duplicate, HT, or VHT PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW40) using the 160 MHz transmit spectral mask defined in Clause 21 (Very High Throughput (VHT) PHY specification)

e) An 80 MHz non-HT duplicate or VHT PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW80) using the 160 MHz transmit spectral mask defined in Clause 21 (Very High Throughput (VHT) PHY specification)

f) A 160 MHz high efficiency (HE) PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW160) using the 160 MHz transmit spectral mask defined in Clause 28 (High Efficiency (HE) PHY specification)

g) A 160 MHz very high throughput (VHT) PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW160) using the 160 MHz transmit spectral mask defined in Clause 28 (High Efficiency (HE) PHY specification)

h) A 160 MHz non-high throughput (non-HT) duplicate PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW160) using the 160 MHz transmit spectral mask defined in Clause 28 (High Efficiency (HE) PHY specification)

160 MHz physical layer (PHY) protocol data unit (PPDU): A Clause 21 (Very High Throughput (VHT) PHY specification) 160 MHz very high throughput (VHT) PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW160) or, a Clause 21 (Very High Throughput (VHT) PHY specification)

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160 MHz non-high throughput (non-HT) duplicate PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW160) or Clause 28 (High Efficiency (HE) PHY specification) 160 MHz high efficiency (HE) PPDU with the (TXVECTOR parameter CH_BANDWIDTH equal to CBW160).

80+80 MHz mask physical layer (PHY) protocol data unit (PPDU): A ~~PPDU that is transmitted using the 80+80 MHz transmit spectral mask defined in Clause 21 (Very High Throughput (VHT) PHY specification) and that is one~~ One of the following:

a) An 80+80 MHz very high throughput (VHT) PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW80+80) using the 80+80 MHz transmit spectral mask defined in Clause 21 (Very High Throughput (VHT) PHY specification)

b) An 80+80 MHz non-high throughput (non-HT) duplicate PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW80+80) using the 80+80 MHz transmit spectral mask defined in Clause 21 (Very High Throughput (VHT) PHY specification)

c) An 80+80 MHz high efficiency (HE) PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW80+80) using the 80+80 MHz transmit spectral mask defined in Clause 28 (High Efficiency (HE) PHY specification)

d) An 80+80 MHz very high throughput (VHT) PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW80+80) using the 80+80 MHz transmit spectral mask defined in Clause 28 (High Efficiency (HE) PHY specification)

e) An 80+80 MHz non-high throughput (non-HT) duplicate PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW80+80) using the 80+80 MHz transmit spectral mask defined in Clause 28 (High Efficiency (HE) PHY specification)

80+80 MHz physical layer (PHY) protocol data unit (PPDU): A Clause 21 (Very High Throughput (VHT) PHY specification) 80+80 MHz very high throughput (VHT) PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW80+80) or, a Clause 21 (Very High Throughput (VHT) PHY specification) 80+80 MHz non-high throughput (non-HT) duplicate PPDU (TXVECTOR parameter CH_BANDWIDTH equal to CBW80+80)) or Clause 28 (High Efficiency (HE) PHY specification) 80+80 MHz high efficiency (HE) PPDU with the (TXVECTOR parameter CH_BANDWIDTH equal to CBW80+80).

bandwidth signaling transmitter address (TA): A TA that is used by a very high throughput (VHT) station (STA) or an high efficiency (HE) STA to indicate the presence of additional signaling related to the bandwidth to be used in subsequent transmission in an enhanced distributed channel access (EDCA) transmission opportunity (TXOP). It is represented by the IEEE medium access control (MAC) individual address of the transmitting VHT STA but with the Individual/Group bit set to 1.

Insert the following definitions maintaining alphabetical order:

high efficient (HE) dual beacon: A BSS transmits beacons in two PHY modes, in non-HE format and in HE extended range PHY format. The beacons transmitted in HE_EXT_SU PHY format enables BSS discoverability and BSS operating parameters distribution in the whole BSS coverage.

non-orthogonal frequency division multiple access (non-OFDMA): A full bandwidth HE transmission with 242-tone RU, 484-tone RU, 996-tone RU, 2×996-tone RU, or 2×996-tone RU allocated for 20 MHz, 40 MHz, 80 MHz, 160 MHz, or 80+80 MHz transmission, respectively.

target wake time (TWT) scheduling STA: A STA that schedules broadcast TWTs and provides these schedules in a broadcast TWT element.

target wake time (TWT) scheduled STA: A STA that follows the schedules provided in a broadcast TWT element.

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3.4 Abbreviations and acronyms

Insert the following acronym definitions (maintaining alphabetical order):

DCM	Dual carrier modulation
DL	Downlink
DL MU	Downlink multi-user
HE	High efficiency
OBO	Orthogonal frequency division multiple access (OFDMA) backoff
OCW	Orthogonal frequency division multiple access (OFDMA) contention window
OFDMA	Orthogonal frequency-division multiple access
OMI	Operation mode indication
PPE	PHY padding extension
MU-RTS	Multi-user request to send
UL	Uplink
UL MU	Uplink multi-user

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4. General description

4.3 Components of the IEEE Std 802.11 architecture

Insert a new subclause after subclause 4.3.12 as follows:

4.3.14a High efficiency (HE) STA

The IEEE 802.11 HE STA operates in frequency bands between 1 GHz and 6 GHz.

In the 5 GHz band, the following apply:

- An HE AP is also a VHT AP
- An HE non-AP STA supporting 20 MHz, 40 MHz, 80 MHz, 160 MHz and 80+80 MHz is also a VHT non-AP STA
- An HE non-AP STA shall support operation in 20 MHz channel bandwidth only

In the 2.4 GHz band, the following apply:

- An HE non-AP STA is also an HT non-AP STA
- An HE non-AP STA shall support operation in 20 MHz channel bandwidth only

The main PHY features in an HE STA that are not present in VHT STA or HT non-AP STA are the following:

- Mandatory support for DL and UL OFDMA
- Mandatory support for 26-, 52-, 106-, 242-tone RUs in a 20 MHz channel
- Mandatory support for 26-, 52-, 106-, 242- and 484-tone RUs in a 40 MHz channel
- Mandatory support for 26-, 52-, 106-, 242-, 484- and 996-tone RUs in an 80 MHz channel
- Mandatory support for 26-, 52-, 106-, 242-, 484-, 996- and 2x996-tone RUs in a 160 MHz channel
- Mandatory support for DL MU-MIMO by an HE AP that supports 4 or more spatial streams when MU-MIMO is done on the entire PPDU bandwidth
- Optional support for 1024-QAM on 242-, 484- and 996-tone RUs
- Optional support for the HE sounding protocol to support beamforming
- Optional support for HE-MCSs 10 and 11

The main MAC features in an HE STA that are not present in VHT STA or HT non-AP STA are the following:

- Mandatory support for the basic trigger frame.
- Mandatory support for dynamic fragmentation level 0
- Optional support for Multi-STA BlockAck
- Optional support for target wake up time (TWT) operation
- Optional support for OFDMA-based random access

An HE AP uses the Trigger frame to initiate MU OFDMA or MU-MIMO transmissions in the UL direction. The Trigger frame identifies non-AP STAs participating in the MU UL transmissions and assigns transmission resources. Multi-STA BlockAck frames are used by the AP to acknowledge the transmissions from multiple non-AP STAs. Scheduled Trigger frames are sent by the AP to allow for non-AP STA power save. The Trigger frames schedule may be set between the non-AP STA and the AP using TWT operation.

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6. Layer management

6.1 Overview of management model

6.2 Generic management primitives

6.3 MLME SAP interface

6.3.3 Scan

6.3.3.3 MLME-SCAN.confirm

6.3.3.3.2 Semantics of the service primitive

Insert the following rows at the end of the BSSDescription table:

Name	Type	Valid range	Description	IBSS adoption
HE Capabilities	As defined in frame format	As defined in 9.4.2.218 (HE Capabilities element)	Specifies the parameters within the HE Capabilities element that are supported by the STA. The parameter is present if dot11HEOptionImplemented is true; otherwise, this parameter is not present.	Do not adopt
HE Operation	As defined in frame format	As defined in 9.4.2.219 (HE Operation element)	Specifies the parameters within the HE Operation element that are supported by the AP. The parameter is present if dot11HEOptionImplemented is true.	Adopt

6.3.4 Synchronization

6.3.4.2 MLME-JOIN.request

6.3.4.2.2 Semantics of the service primitive

Change the primitive parameters as follows (note that not all existing parameters in the baseline are shown):

The primitive parameters are as follows:

MLME-JOIN.request(

...

AdvertisementProtocolInfo,

HE Capabilities,

VendorSpecificInfo

)

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Insert the following entry into the unnumbered table in this subclause:

Name	Type	Valid range	Description
HE Capabilities	As defined in HE Capabilities element.	As defined in 9.4.2.218 (HE Capabilities element)	Specifies the parameters within the HE Capabilities element that are supported by the STA. The parameter is present if dot11HEOptionImplemented is true; otherwise, this parameter is not present.

6.3.7 Associate

6.3.7.4 MLME-ASSOCIATE.indication

6.3.7.4.2 Semantics of the service primitive

Change the primitive parameters as follows (not all existing parameters in the baseline are shown):

The primitive parameters are as follows:

MLME-ASSOCIATE.indication(
...,
HE Capabilities,
VendorSpecificInfo
)

Insert the following entry into the unnumbered table in this subclause:

Name	Type	Valid range	Description
HE Capabilities	As defined in HE Capabilities element.	As defined in 9.4.2.218 (HE Capabilities element)	Specifies the parameters within the HE Capabilities element that are supported by the peer STA. The parameter is present if it is present in the Association Request frame received from the STA; otherwise, this parameter is not present.

6.3.8 Reassociate

6.3.8.4 MLME-REASSOCIATE.indication

6.3.8.4.2 Semantics of the service primitive

Change the primitive parameters as follows (not all existing parameters in the baseline are shown):

The primitive parameters are as follows:

MLME-REASSOCIATE.indication(
...
HE Capabilities,
VendorSpecificInfo
)

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Insert the following entry into the unnumbered table in this subclause:

Name	Type	Valid range	Description
HE Capabilities	As defined in HE Capabilities element.	As defined in 9.4.2.218 (HE Capabilities element)	Specifies the parameters within the HE Capabilities element that are supported by the peer STA. The parameter is present if it is present in the Reassociation Request frame received from the STA; otherwise, this parameter is not present.

6.3.11 Start

6.3.11.2 MLME-START.request

6.3.11.2.2 Semantics of the service primitive

Change the primitive parameters as follows (not all existing parameters in the baseline are shown):

MLME-START.request(

...,

HE Capabilities,

HE Operation,

VendorSpecificInfo

)

Insert the following entry into the unnumbered table in this subclause:

Name	Type	Valid range	Description
HE Capabilities	As defined in HE Capabilities element.	As defined in 9.4.2.218 (HE Capabilities element)	Specifies the parameters within the HE Capabilities element that are supported by the MAC entity. The parameter is present if dot11HEOptionImplemented is true; otherwise, this parameter is not present.
HE Operation	As defined in HE Operation element.	As defined in 9.4.2.219 (HE Operation element)	The additional HE capabilities to be advertised for the BSS. The parameter is present if dot11HEOptionImplemented is true; otherwise, this parameter is not present.

6.3.27 Management of direct links

6.3.27.4 6.3.27.4 MLME-DLS.indication

6.3.27.4.2 6.3.27.4.2 Semantics of the service primitive

Change the primitive parameters as follows (not all existing parameters in the baseline are shown):

MLME-DLS.indication(

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...,
HE Capabilities,
VendorSpecificInfo
)

Insert the following entry to the unnumbered table in this subclause:

Name	Type	Valid range	Description
HE Capabilities	As defined in HE Capabilities element.	As defined in 9.4.2.218 (HE Capabilities element)	Specifies the parameters within the HE Capabilities element that are supported by the MAC entity. The parameter is optionally present if dot11HEOptionImplemented is true; otherwise, not present.

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8. PHY service specification

8.3 Detailed PHY service specifications

8.3.5 PHY SAP detailed service specification

8.3.5.2 PHY-DATA.request

8.3.5.2.2 Semantics of the service primitive

Change the subclause as follows:

The primitive provides the following parameter:

PHY-DATA.request(
DATA
USER_INDEX
STA_INDEX
)

The DATA parameter is an octet of value X'00' to X'FF'.

The USER_INDEX parameter (typically identified as u for a VHT STA; see NOTE 1 at the end of Table 21-1 (TXVECTOR and RXVECTOR parameters)) is present for a VHT MU PPDU and indicates the index of the user in the TXVECTOR to which the accompanying DATA octet applies; otherwise, this parameter is not present.

The STA_INDEX parameter (obtained from STA_ID_LIST in Table 28-1 (TXVECTOR and RXVECTOR parameters) is present for an HE MU PPDU and indicates the index of the user in the TXVECTOR to which the accompanying DATA octet applies; otherwise, this parameter is not present.

8.3.5.3 PHY-DATA.indication

8.3.5.3.2 Semantics of the service primitive

Change the subclause as follows:

The primitive provides the following parameter:

PHY-DATA.request(
DATA
STA_INDEX
)

The DATA parameter is an octet of value X'00' to X'FF'.

The STA_INDEX parameter is present for an HE trigger-based PPDU and indicates the index of the user in the RXVECTOR to which the accompanying DATA octet applies; otherwise, this parameter is not present.

8.3.5.10 PHY-CCARESET.request

8.3.5.10.3 When generated

Insert the following after the 1st paragraph:

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This primitive is also generated by the MAC sublayer for the local PHY entity when the conditions are met to perform OBSS_PD-based spatial reuse operation as defined in 27.9.2 (OBSS_PD-based spatial reuse operation).

8.3.5.12 PHY-CCA.indication

8.3.5.12.2 Semantics of the service primitive

Change Table 8-5 (The channel-list parameter elements) as follows:

Table 8-5—The channel-list parameter elements

channel-list element	Meaning
primary	In an HT STA that is not a VHT STA, indicates that the primary 20 MHz channel is busy. In a VHT STA, indicates that the primary 20 MHz channel is busy according to the rules specified in 21.3.18.5.3 (CCA sensitivity for signals occupying the primary 20 MHz channel). In a TVHT STA, indicates that the primary channel is busy according to the rules specified in 22.3.18.6.3 (CCA sensitivity for signals occupying the primary channel). In an HE STA, indicates that the primary 20 MHz channel is busy according to the rules specified in 28.3.17.6.3 (CCA sensitivity for signals occupying the primary 20 MHz channel).
secondary	In an HT STA that is not a VHT STA, indicates that the secondary channel is busy. In a VHT STA, indicates that the secondary 20 MHz channel is busy according to the rules specified in 21.3.18.5.4 (CCA sensitivity for signals not occupying the primary 20 MHz channel). In a TVHT STA, indicates that the secondary channel is busy according to the rules specified in 22.3.18.6.4 (CCA sensitivity for signals not occupying the primary channel). In an HE STA, indicates that the secondary 20 MHz channel is busy according to the rules specified in 28.3.17.6.4 (CCA sensitivity for signals not occupying the primary 20 MHz channel).
secondary40	Indicates that the secondary 40 MHz channel is busy according to the rules specified in 21.3.18.5.4 (CCA sensitivity for signals not occupying the primary 20 MHz channel). In a TVHT STA, indicates that the secondary TVHT_2W channel is busy according to the rules specified in 22.3.18.6.4 (CCA sensitivity for signals not occupying the primary channel). In an HE STA, indicates that the secondary 40 MHz channel is busy according to the rules specified in 28.3.17.6.4 (CCA sensitivity for signals not occupying the primary 20 MHz channel).
secondary80	Indicates that the secondary 80 MHz channel is busy according to the rules specified in 21.3.18.5.4 (CCA sensitivity for signals not occupying the primary 20 MHz channel). In an HE STA, indicates that the secondary 80 MHz channel is busy according to the rules specified in 28.3.17.6.4 (CCA sensitivity for signals not occupying the primary 20 MHz channel).

8.3.5.12.3 When generated

Change the first paragraph as follows:

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For Clause 15 (DSSS PHY specification for the 2.4 GHz band designated for ISM applications) to Clause 20 (Directional multi-gigabit (DMG) PHY specification) PHYs, this primitive is generated within aCCATime of the occurrence of a change in the status of the primary channel from channel idle to channel busy or from channel busy to channel idle or when the elements of the channel-list parameter change. For Clause 21 (Very High Throughput (VHT) PHY specification(11ac)) ~~and,~~ Clause 22 (Television Very High Throughput (TVHT) PHY specification) and Clause 28 (High Efficiency (HE) PHY specification) PHYs, this primitive is generated when the status of the channel(s) changes from channel idle to channel busy or from channel busy to channel idle or when the elements of the channel-list parameter change. This includes the period of time when the PHY is receiving data. The timing of PHY-CCA.indication primitives related to transitions on secondary channel(s) is PHY specific. Refer to specific PHY clauses for details about CCA behavior for a given PHY.

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9. Frame formats

9.2 MAC frame formats

9.2.4 Frame fields

9.2.4.1 Frame Control field

9.2.4.1.3 Type and Subtype subfields

Change the row below and insert a new row immediately after it in Table 9-1 (Valid type and subtype combinations) as follows:

Table 9-1—Valid type and subtype combinations

Type value B3 B2	Type description	Subtype value B7 B6 B5 B4	Subtype description
01	Control	0000–~~0011~~<ANA>	Reserved
01	Control	<ANA>	Trigger

9.2.4.1.8 More Data subfield

Change the 4th and 5th paragraphs as follows:

An AP optionally sets the More Data subfield to 1 in Ack frames sent to a non-DMG non-HE STA and in Ack, BlockAck and Multi-STA BlockAck frames sent to an HE STA from which it has received a frame that contains a QoS Capability element in which the More Data Ack subfield is equal to 1 and that has one or more ACs that are delivery enabled and that is in PS mode to indicate that the AP has a pending transmission for the STA. An HE AP indicates that it can set the More Data subfield to 1 by setting the More Data Ack subfield to 1 in the QoS Info field of frames it transmits.

A TDLS peer STA optionally sets the More Data subfield to 1 in Ack frames sent to a non-HE STA and in Ack, BlockAck, and Multi-STA BlockAck frames sent to an HE STA that has TDLS peer PSM enabled and that has the More Data Ack subfield equal to 1 in the QoS Capability element of its transmitted TDLS Setup Request frame or TDLS Setup Response frame to indicate that it has a pending transmission for the STA. An HE TDLS peer STA indicates that it can set the More Data subfield to 1 by setting the More Data Ack subfield to 1 in the QoS Capability element it transmits.

9.2.4.1.10 +HTC/Order subfield

Change this subclause as follows:

The +HTC/Order subfield is 1 bit in length. It is used for two purposes:

— It is set to 1 in a non-QoS Data frame transmitted by a non-QoS STA to indicate that the frame contains an MSDU, or fragment thereof, that is being transferred using the StrictlyOrdered service class.

— It is set to 1 in a QoS Data or Management frame transmitted with a value of HT_GF, HT_MF, VHT, HE or S1G for the FORMAT parameter of the TXVECTOR to indicate that the frame contains an HT Control field.

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— It is set to 1 in an S1G RTS frame to indicate that the intended recipient of the frame has permission to extend the TXOP as described in 10.51.5.4 (Relay-shared TXOP protection mechanisms).

Otherwise, the +HTC/Order field is set to 0.

NOTE—The +HTC/Order field is always set to 0 for frames transmitted by a DMG STA.

9.2.4.5 QoS Control field

9.2.4.5.4 Ack Policy subfield

Change Table 9-9 (Ack Policy subfield in QoS Control field of QoS Data frames) as follows (only relevant row shown):

Table 9-9—Ack Policy subfield in QoS Control field of QoS Data frames

Bits in QoS Control field		Meaning
Bit 5	Bit 6	
0	1	No explicit acknowledgment, ~~or~~ PSMP Ack or MU Ack. When bit 6 of the Frame Control field (see 9.2.4.1.3 (Type and Subtype subfields)) is set to 1: There might be a response frame to the frame that is received, but it is neither the Ack frame nor any Data frame of subtype +CF-Ack. The Ack Policy subfield for QoS CF-Poll and QoS CF-Ack +CF-Poll Data frames is set to this value. When bit 6 of the Frame Control field (see 9.2.4.1.3 (Type and Subtype subfields)) is set to 0: The acknowledgment for a frame indicating PSMP Ack when it appears in a PSMP downlink transmission time (PSMP-DTT) is to be received in a later PSMP uplink transmission time (PSMP-UTT). The acknowledgment for a frame indicating PSMP Ack when it appears in a PSMP-UTT is to be received in a later PSMP-DTT. For a frame that is carried in a DL HE MU PPDU: The Ack Policy subfield for the frame that solicits an immediate response in an HE Trigger-based PPDU is set to this value (MU Ack). The addressed recipient returns an Ack, BlockAck, or Multi-STA BlockAck frame in the HE trigger-based PPDU format after a SIFS period, according to the procedures defined in 10.3.2.11.2 (Acknowledgement procedure for HE MU PPDU in MU format) and 27.5.2 (UL MU operation). NOTE—Bit 6 of the Frame Control field (see 9.2.4.1.3 (Type and Subtype subfields)) indicates the absence of a data Frame Body field. When equal to 1, the QoS Data frame contains no Frame Body field, and any response is generated in response to a QoS CF-Poll or QoS CF-Ack +CF-Poll frame, but does not signify an acknowledgment of data. When set to 0, the QoS Data frame contains a Frame Body field, which is acknowledged as described in 10.29.2.7 (PSMP acknowledgment rules).

9.2.4.5.6 Queue Size subfield

Change subclause 9.2.4.5.6 as follows:

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The Queue Size subfield is an 8-bit field that indicates the amount of buffered traffic for a given TC or TS at the STA sending this frame. A non-AP HE STA uses the Queue Size subfield to indicate the amount of buffered traffic intended for the STA identified by the receive address of the frame containing the QoS Control field. The Queue Size subfield is present in QoS Data and QoS Null frames sent by non-AP STAs with bit 4 of the QoS Control field equal to 1. The AP ~~might~~ can use information contained in the Queue Size subfield to determine the TXOP duration assigned to the STA or to determine the UL resources assigned to the HE STA (see 27.5.2 (UL MU operation)).

The queue size value is the total size, rounded up to the nearest multiple of 256 octets and expressed in units of 256 octets, of all MSDUs and A-MSDUs buffered at the STA (excluding the MSDU or A-MSDU of the present QoS Data frame sent by a non-HE STA and including the MSDUs or A-MSDUs contained in the present (A-)MPDU sent by an HE STA) in the delivery queue used for MSDUs and A-MSDUs with TID values equal to the value in the TID subfield of this QoS Control field. A queue size value of 0 is used solely to indicate the absence of any buffered traffic in the queue used for the specified TID. A queue size value of 254 is used for all sizes greater than 64 768 octets. A queue size value of 255 is used to indicate an unspecified or unknown size. If a QoS Data frame is fragmented and is not carried in an A-MPDU, the queue size value can remain constant in all fragments even if the amount of queued traffic changes as successive fragments are transmitted. If a QoS Data frame is fragmented and is carried in an A-MPDU, the queue size value is set as defined in 10.13.1 (A-MPDU contents).

9.2.4.6 HT Control field

9.2.4.6.1 General

Remove Figure 9-8 (HT Control field).

Insert Table 9-9a as follows:

Table 9-9a—HT Control field

Variant	Bit 0 (value)	Bit 1 (value)	Bit 2-29	Bit 30	Bit 31
HT variant	VHT (0)	HT Control Middle		AC Constraint	RDG/More PPDU
VHT variant	VHT (1)	HE (0)	VHT Control Middle	AC Constraint	RDG/More PPDU
HE variant	VHT (1)	HE (1)	Aggregated Control		

Change the paragraphs below of 9.2.4.6.1 as follows:

The HT Control field has ~~two~~ three forms~~;~~: the HT variant, ~~and~~ the VHT variant, and the HE variant. These forms differ in the values of the VHT and HE subfields and in their formats, which are shown in Table 9-9a (HT Control field). ~~The two forms differ in the format of the HT Control Middle subfield, described in 9.2.4.6.2 (HT variant) for the HT variant and in 9.2.4.6.3 (VHT variant) for the VHT variant and in the value of the VHT subfield.~~

The VHT subfield, which is B0 of the HT Control field, and the HE subfield, which is B1 of the HT Control field, indicate the variant of the HT Control field. The VHT subfield is set to 0 to indicate an HT variant HT Control field. The VHT subfield is set to 1 and the HE subfield is set to 0 to indicate a VHT variant HT Control field. The VHT subfield is set to 1 and the HE subfield is set to 1 to indicate an HE variant HT Control field.

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The HT Control Middle subfield is defined in 9.2.4.6.2 (HT variant) and the VHT Control Middle subfield is defined in 9.2.4.6.3 (VHT variant).

The Aggregated Control subfield is defined in 9.2.4.6.4 (A-Control).

~~The VHT subfield of the HT Control field indicates whether the HT Control Middle subfield is the VHT Variant or the HT Variant. The VHT subfield is set to 1 to indicate that the HT Control Middle subfield is the VHT Variant and is set to 0 to indicate that the HT Control Middle subfield is the HT Variant.~~

9.2.4.6.3 VHT variant

Change the paragraph below as follows:

The format of the VHT Control Middle subfield of the VHT variant HT Control field is shown in Figure 9-13 (VHT Control Middle subfield of the VHT variant HT Control field).

Change Figure 9-13 (VHT Control Middle subfield of the VHT variant HT Control field) as follows (remove Reserved field and change title):

	~~B1~~	B2	B3 B5	B6 B8	B9 B23	B24 B26	B27	B28	B29
	~~Reserved~~	MRQ	MSI/ STBC	MFSI/ GID-L	MFB	GID-H	Coding Type	FB Tx Type	Unsolicited MFB
Bits:	~~1~~	1	3	3	15	3	1	1	1

Figure 9-13—VHT Control Middle subfield of the VHT variant HT Control field

Insert a new subclause 9.2.4.6.4 following 9.2.4.6.3:

9.2.4.6.4 A-Control

9.2.4.6.4.1 General

The format of the Aggregated Control (A-Control) subfield of the HE variant HT Control field is shown in Figure 9-15a (Aggregated Control subfield of the HE variant HT Control field).

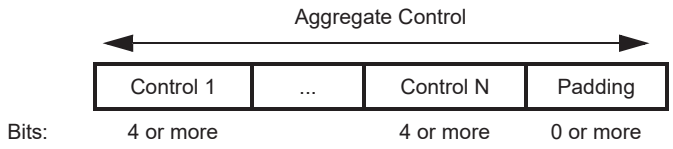

Figure 9-15a—Aggregated Control subfield of the HE variant HT Control field

The A-Control subfield contains a sequence of one or more Control subfields. The format of each Control subfield is defined in Figure 9-15b (Control subfield format). The Control subfield with Control ID subfield equal to 0, if present, is the first subfield of the sequence.

The Control ID subfield indicates the type of information carried in the Control Information subfield. The length of the Control Information subfield is fixed for each value of the Control ID subfield that is not

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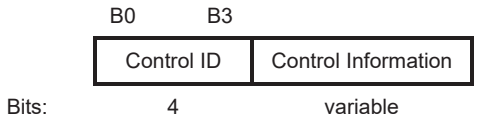

Figure 9-15b—Control subfield format

reserved. The values of the Control ID subfield and the associated length of the Control Information subfield are defined in Table 9-18a (Control ID subfield values).

Table 9-18a—Control ID subfield values

Control ID value	Meaning	Length of the Control Information subfield (bits)	Content of the Control Information subfield
0	UL MU response scheduling	26	See 9.2.4.6.4.2 (UL MU response scheduling)
1	Operating Mode	12	See 9.2.4.6.4.3 (Operating Mode)
2	HE link adaptation	16	See 9.2.4.6.4.4 (HE link adaptation)
3	Buffer Status Report (BSR)	26	See 9.2.4.6.4.5 (Buffer Status Report (BSR))
4	UL Power Headroom	8	See 9.2.4.6.4.6 (UL power headroom)
5	Bandwidth Query Report (BQR)	10	See 9.2.4.6.4.7 (Bandwidth Query Report (BQR))
6	Reverse Direction Protocol (RDP)	8	
7-15	Reserved		

The Padding subfield, if present, follows the last Control subfield and is set to a sequence of zeros so that the length of the A-Control subfield carried in the HT Control field is 30 bits.

9.2.4.6.4.2 UL MU response scheduling

If the Control ID subfield is 0, the Control Information subfield contains scheduling information for an HE trigger-based PPDU that carries an immediate acknowledgment and follows the HE MU PPDU containing the Control Information subfield (see 27.5.2.2 (Rules for soliciting UL MU frames)).

The format of the Control Information subfield is defined in Figure 9-15c (Control Information subfield format when Control ID subfield is 0).

The UL PPDU Length subfield indicates the length of the HE trigger-based PPDU response and is set to the number of OFDM symbols the Data field of the HE trigger-based PPDU minus 1. The duration of the HE trigger-based PPDU is calculated as defined in 28.4.2 (TXTIME and PSDU_LENGTH calculation).

The RU Allocation subfield indicates the resource unit (RU) assigned for transmitting the HE trigger-based PPDU response and is defined in 9.3.1.23 (Trigger frame format).

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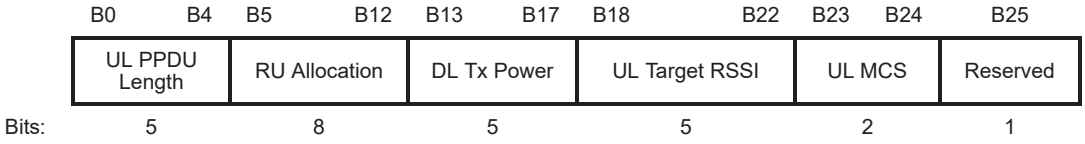

Figure 9-15c—Control Information subfield format when Control ID subfield is 0

The DL TX Power subfield indicates the AP transmit power, combined over all TX antennas and averaged in 20 MHz BW, used for the soliciting frame, in units of dBm. The transmit power, P_{TX}, is calculated as $P_{TX} = -20 + 2 \times F_{Val}$, where F_{Val} is the value of the DL TX Power subfield, except for the value 31, which is reserved.

The UL Target RSSI subfield indicates the AP target receive power, i.e., averaged RSSI over all AP's antennas, for the responding STA when transmitting the HE trigger-based PPDU, in units of dBm. The target receive power, TRSSI, is calculated as $T_{RSSI} = -90 + 2 \times F_{Val}$, except for the value 31 that indicates to the STA to transmit at maximum power for the assigned MCS.

NOTE—It is possible that a STA can not satisfy the target RSSI due to its hardware or regulatory limitation.

The UL MCS subfield indicates the MCS, from MCS0 to MCS3, to be used by the receiving STA for the HE trigger-based PPDU (see 28.5 (Parameters for HE-MCSs)).

9.2.4.6.4.3 Operating Mode

If the Control ID subfield is 1, the Control Information subfield contains information related to the operating mode change of the STA transmitting the frame containing this information (see 27.8 (Operating mode indication)).

The format of the Control Information subfield is defined in Figure 9-15d (Control Information subfield format when Control ID subfield is 1).

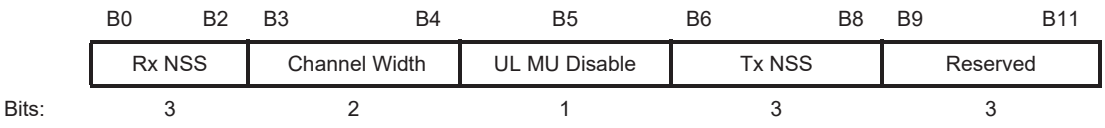

Figure 9-15d—Control Information subfield format when Control ID subfield is 1

The Rx NSS subfield indicates the maximum number of spatial streams, N_{SS}, that the STA can receive and is set to $N_{SS} - 1$.

The Channel Width subfield indicates the operating channel width supported by the STA in reception, and is set to 0 for 20 MHz, 1 for 40 MHz, 2 for 80 MHz, and 3 for 160 MHz and 80+80 MHz.

The UL MU Disable subfield indicates whether UL MU operation is suspended or resumed by the non-AP STA. The UL MU Disable subfield is set to 1 to indicate that UL MU operation is suspended; otherwise it is set to 0 to indicate that UL MU operation is resumed. An AP sets the UL MU Disable subfield to 0.

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The Tx NSS subfield indicates the maximum number of spatial streams, N_{SS}, that the STA can transmit and is set to $N_{SS} - 1$.

9.2.4.6.4.4 HE link adaptation

If the Control ID subfield is 2, the Control Information subfield contains information related to the HE link adaptation procedure (see 9.31.4 (Link adaptation using the HE variant HT Control field)).

The format of the Control Information subfield is defined in Figure 9-15e (Control Information subfield format when Control ID subfield is 2).

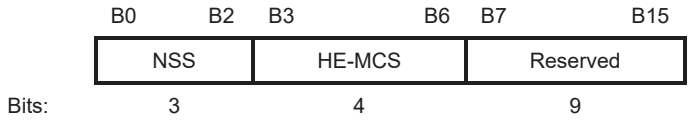

Figure 9-15e—Control Information subfield format when Control ID subfield is 2

The NSS subfield indicates the recommended number of spatial streams, N_{SS}, and is set to $N_{SS} - 1$.

The HE-MCS subfield indicates the recommended HE-MCS, and is set to the HE-MCS Index value (defined in 28.5 (Parameters for HE-MCSs)).

9.2.4.6.4.5 Buffer Status Report (BSR)

The Control Information subfield, when the Control ID subfield is 3, contains buffer status information used for UL MU operation (see 27.5.2.5 (HE buffer status feedback operation for UL MU)).

The format of the Control Information subfield is defined in Figure 9-15f (Control Information subfield format when Control ID subfield is 3).

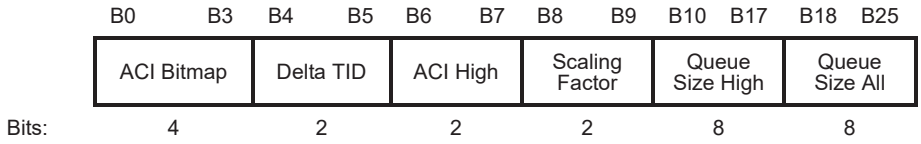

Figure 9-15f—Control Information subfield format when Control ID subfield is 3

The ACI Bitmap subfield indicates the access categories for which the buffer status is reported and its encoding is shown in Table 9-18b (ACI Bitmap subfield encoding). Each bit of the bitmap is set to 1 to

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indicate that the buffer status of the AC, which ACI is identified by the location of the bit in the ACI Bitmap subfield, is reported and set to 0 otherwise.

Table 9-18b—ACI Bitmap subfield encoding

B0	B1	B2	B3
AC_BE	AC_BK	AC_VI	AC_VO

The Delta TID subfield, together with the values of the AC Bitmap subfield, indicate the number of TIDs for which the STA is reporting the buffer status. The encoding of the Delta TID subfield is defined in Table 9-18c (Delta TID subfield encoding).

Table 9-18c—Delta TID subfield encoding

Number of bits in the ACI Bitmap subfield that are set to 1	Mapping of Delta TID subfield value and number of TIDs, N_{TID}
0	Values 0 to 2 are not applicable; Value 3 indicates 8 TIDs (i.e., all ACs have traffic)
1	Value 0 indicates 1 TID; Value 1 indicates 2 TIDs; Values 2 to 3 are not applicable;
2	Value 0 indicates 2 TID; Value 1 indicates 3 TIDs; Value 2 indicates 4 TIDs; Value 3 is not applicable;
3	Value 0 indicates 3 TID; Value 1 indicates 4 TIDs; Value 2 indicates 5 TIDs; Value 3 indicates 6 TIDs;
4	Value 0 indicates 4 TID; Value 1 indicates 5 TIDs; Value 2 indicates 6 TIDs; Value 3 indicates 7 TIDs;
NOTE—The number of TIDs can be obtained as $N_{TID} = N_{ones} + F_{Val}$, where N_{ones} is the number of bits set to one in the AC Bitmap subfield, and F_{Val} is the value of the Delta TID subfield except when N_{ones} is equal to 0 for which there is the $N_{TID} = 8$ case.	

The ACI High subfield indicates the ACI of the AC for which the BSR is indicated in the Queue Size High subfield.

The Scaling Factor subfield indicates the unit *SF*, in octets, of the Queue Size subfields. *SF* is equal to:

16 if the Scaling Factor subfield is 0

128 if the Scaling Factor subfield is 1

2 048 if the Scaling Factor subfield is 2

16 384 if the Scaling Factor subfield is 3

The Queue Size High subfield indicates the amount of buffered traffic, in units of *SF* octets, for the AC identified by the ACI High subfield.

The Queue Size All subfield indicates the amount of buffered traffic, in units of *SF* octets, for all the ACs identified by the ACI Bitmap subfield.

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The queue size values in the Queue Size High and Queue Size All subfields are the total sizes, rounded up to the nearest multiple of SF octets, of all MSDUs and A-MSDUs buffered at the STA (including the MSDUs or A-MSDUs contained in the present (A-)MPDU) in the delivery queues used for MSDUs and A-MSDUs with AC(s) that are specified in the ACI High and ACI Bitmap subfields, respectively. A queue size value of 254 is used for all sizes greater than 254 × *SF* octets. A queue size value of 255 is used to indicate an unspecified or unknown size. If a QoS Data frame is fragmented and is not carried in an A-MPDU, the queue size value can remain constant in all fragments even if the amount of queued traffic changes as successive fragments are transmitted. If a QoS Data frame is fragmented and is carried in an A-MPDU, the queue size values are set according to the rules in 10.9 (HT operation).

9.2.4.6.4.6 UL power headroom

The Control Information subfield, when the Control ID subfield is 4, contains the UL power headroom used for power pre-correction (see 26.3.13.2 (Power pre-correction).

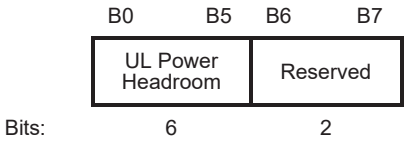

Figure 9-15g—Control Information subfield format when the Control ID subfield is 4

The 5 LSBs (B0-B4) of the UL Power Headroom subfield indicate the available power headroom in units of dB, for the current MCS. The resolution for the UL power headroom reported in UL Power Headroom subfield is 1 dB. The UL Power Headroom subfield carries a value 0 to 31 that maps to 0 dB to 31 dB. B5 of the UL Power Headroom subfield is set to 1 to indicate that the minimum transmit power for the current MCS is reached by the STA and set to 0 otherwise.

9.2.4.6.4.7 Bandwidth Query Report (BQR)

The Control Information subfield, when the Control ID subfield is 5, contains the Bandwidth Query Report used for Bandwidth Query report operation to assist HE DL HE MU transmission (see 27.5.1.3 (HE bandwidth query report operation for DL MU)).

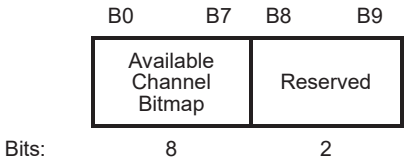

Figure 9-15h—Control Information subfield format when the Control ID subfield is 5

Bandwidth Query Report used for bandwidth query report operation to assist DL HE MU transmission (see 25.5.1.3. (Bandwidth query report operation).

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The Available Channel Bitmap subfield encoding is defined in Table 9-18d (Available Channel Bitmap subfield encoding).

Table 9-18d—Available Channel Bitmap subfield encoding

	B0	B1	B2	B3	B4	B5	B6	B7
20 MHz	Set to 1 if the channel is available, set to 0 otherwise	Set to 0	Set to 0	Set to 0	Set to 0	Set to 0	Set to 0	Set to 0
40 MHz	Set to 1 if the lower frequency 20 MHz channel is available and set to 0 otherwise	Set to 1 if the higher frequency 20 MHz channel is available and set to 0 otherwise	Set to 0	Set to 0	Set to 0	Set to 0	Set to 0	Set to 0
80 MHz	Set to 1 if the lowest frequency 20 MHz channel is available and set to 0 otherwise	Set to 1 if the second lowest frequency 20 MHz channel is available and set to 0 otherwise	Set to 1 if the third lowest frequency 20 MHz channel is available and set to 0 otherwise	Set to 1 if the fourth lowest frequency 20 MHz channel is available and set to 0 otherwise	Set to 0	Set to 0	Set to 0	Set to 0
160 MHz and 80+80 MHz	Set to 1 if the lowest frequency 20 MHz channel of the primary 80 MHz channel is available and set to 0 otherwise	Set to 1 if the second lowest frequency 20 MHz channel of the primary 80 MHz channel is available and set to 0 otherwise	Set to 1 if the third lowest frequency 20 MHz channel of the primary 80 MHz channel is available and set to 0 otherwise	Set to 1 if the fourth lowest frequency 20 MHz channel of the primary 80 MHz channel is available and set to 0 otherwise	Set to 1 if the lowest frequency 20 MHz channel of the secondary 80 MHz channel is available and set to 0 otherwise	Set to 1 if the second lowest frequency 20 MHz channel of the secondary 80 MHz channel is available and set to 0 otherwise	Set to 1 if the third lowest frequency 20 MHz channel of the secondary 80 MHz channel is available and set to 0 otherwise	Set to 1 if the fourth lowest frequency 20 MHz channel of the secondary 80 MHz channel is available and set to 0 otherwise

NOTE—The lowest frequency 20 MHz channel may not be the primary 20 MHz channel. Refer to Figure 8-1 and Figure 8-2 in section 8.3.5.12.2 for details.

9.2.4.6.4.8 Reverse direction protocol (RDP)

The Control Information subfield for the RDP Trigger frame is shown in Figure 9-15i (Control Information subfield format when the Control ID subfield is 6)

The AC Constraint subfield of the RDP field indicates whether the mapped AC of an RD Data frame is constrained to a single AC, and is defined in Table 9-10 (AC Constraint subfield values), except that a value

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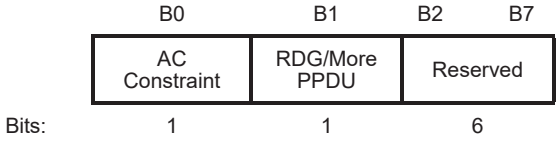

Figure 9-15i—Control Information subfield format when the Control ID subfield is 6

of 1 indicates that the response from an HE STA contains Data frames from the same AC or higher AC as defined in 10.28.4 (Rules for RD responder).

The RDG/More PPDU subfield is defined in Table 9-11 (RDG/More PPDU subfield values).

9.2.4.7 Frame Body field

9.2.4.7.1 General

Change as Table 9-19 (Maximum data unit sizes (in octets) and durations (in microseconds)) follows:

Table 9-19—Maximum data unit sizes (in octets) and durations (in microseconds)

	Non-HT non-VHT non-DMG PPDU and non-HT duplicate PPDU	HT PPDU	VHT PPDU	HE PPDU	DMG PPDU
MMPDU size	2304	2304	See NOTE 1	See NOTE 1	2304
MSDU size	2304	2304	2304	2304	7920
A-MSDU size	3839 or 4065 (see NOTE 2) (HT STA, see also Table 9-162 (Subfields of the HT Capability Information field)), or N/A (non-HT STA, see also 10.12 (A-MSDU operation))	3839 or 7935 (see also Table 9-162 (Subfields of the HT Capability Information field))	See NOTE 3	See NOTE 3	7935
MPDU size	See NOTE 4	See NOTE 5	3895 or 7991 or 11 454 (see also Table 9-249 (Subfields of the VHT Capabilities Information field))	3895 or 7991 or 11 454 (see also Table 9-249 (Subfields of the VHT Capabilities Information field))	See NOTE 5

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Table 9-19—Maximum data unit sizes (in octets) and durations (in microseconds) *(continued)*

	Non-HT non-VHT non-DMG PPDU and non-HT duplicate PPDU	HT PPDU	VHT PPDU	HE PPDU	DMG PPDU
PSDU size (see NOTE 7)	2^{12}–1 (see Table 15-5 (DSSS PHY characteristics), Table 16-4 (HR/DSSS PHY characteristics), Table 17-21 (OFDM PHY characteristics), Table 18-5 (ERP characteristics))	2^{16}–1 (see Table 19-25 (HT PHY characteristics))	4 692 480 (~$2^{22.16}$) (see Table 21-29 (VHT PHY characteristics))	6,500,631 (~$2^{22.63}$) (see Table 28-46 (HE PHY characteristics))	2^{18}–1 (see Table 20-32 (DMG PHY characteristics))
PPDU duration (see NOTE 7)	See NOTE 6	5484 (HT_MF; see 10.26.4 (L_LENGTH and L_DATARATE parameter values for HT-mixed format PPDUs)) or 10 000 (HT_GF; see Table 19-25 (HT PHY characteristics))	5484 (see Table 21-29 (VHT PHY characteristics))	5484 (see Table 21-29 (VHT PHY characteristics))	2000 (see Table 20-32 (DMG PHY characteristics))

NOTE 1—No direct constraint on the maximum MMPDU size; indirectly constrained by the maximum MPDU size (see 9.3.3.1 (Beacon frame format)).

NOTE 2—Indirect constraint from the maximum PSDU size: 2^{12}–1 octets minus the minimum QoS Data frame overhead (26 octets for the MAC header and 4 octets for the FCS).

NOTE 3—No direct constraint on the maximum A-MSDU size; indirectly constrained by the maximum MPDU size.

NOTE 4—No direct constraint on the maximum MPDU size; indirectly constrained by the maximum MSDU/MMPDU or (for HT STAs only) A-MSDU size.

NOTE 5—No direct constraint on the maximum MPDU size; indirectly constrained by the maximum A-MSDU size.

NOTE 6—No direct constraint on the maximum duration, but an L_LENGTH value above 2332 might not be supported by some receivers (see last NOTE in 10.26.4 (L_LENGTH and L_DATARATE parameter values for HT-mixed format PPDUs)).

NOTE 7—The values for maximum PSDU size and maximum PPDU duration are informative only. References to the normative requirements are provided.

9.2.5 Duration/ID field (QoS STA)

9.2.5.2 Setting for single and multiple protection under enhanced distributed channel access (EDCA)

Change item a) of the 2nd paragraph as follows:

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The Duration/ID field is determined as follows:

a) Single protection settings.

1) For an RTS frame that is not part of a dual clear-to-send (CTS) exchange and is not part of a BDT exchange, the Duration/ID field is set to the estimated time, in microseconds, required to transmit the pending frame, plus one CTS frame, plus one Ack or BlockAck frame if required, plus any NDPs required, plus explicit feedback if required, plus applicable IFSs.

1a) In an MU-RTS frame, the Duration/ID field is set to the estimated time, in microseconds, required for the pending frame, plus one CTS frame, plus the time for the solicited HE trigger-based PPDU if required, plus the time to transmit an acknowledgement frame for the solicited HE trigger-based PPDU if required, plus applicable IFSs.

...

3 In a BlockAckReq frame, the Duration/ID field is set to the estimated time required to transmit one Ack or BlockAck frame, as applicable, plus one SIFS.

3a In a MU-BAR frame, the Duration/ID field is set to the time required for the solicited HE trigger-based PPDU plus one SIFS.

...

6) In individually addressed QoS Data frames with the Ack Policy subfield equal to No Ack or Block Ack, for Action No Ack frames, and for group addressed frames, the Duration/ID field is set to one of the following:

i) i) If the frame is the final fragment of the TXOP, 0

ii) ii) Otherwise, the estimated time required for the transmission of the following frame and its response frame, if required (including appropriate IFSs)

7) In a Basic Trigger frame, the Duration/ID field is set to the estimated time required to transmit the solicited HE trigger-based PPDU, plus the estimated time required to transmit multiple BlockAck frames, Ack frames or a Multi-STA BlockAck frame, plus applicable SIFSs.

Change item b) of the 2nd paragraph as follows:

b) Multiple protection settings. The Duration/ID field is set to a value D as follows:

4) Else $T_{END-NAV} - T_{PPDU} \le D \le T_{TXOP-REMAINING} - T_{PPDU}$

where

$T_{SINGLE\text{-}MSDU}$ is the estimated time required for the transmission of the allowed frame exchange sequence defined in 10.22.2.8 (TXOP limits) (for a TXOP limit of 0), including applicable IFS durations

$T_{PENDING}$ is the estimated time required for the transmission of

—Pending MPDUs of the same AC

—Any associated immediate response frames

—Any HT NDP, VHT NDP, or Beamforming Report Poll frame transmissions and explicit feedback response frames

—Applicable IFSs

—Any RDG

—Any pending QoS Null frame exchanges by paged STAs

—Any pending PS-Poll or NDP PS-Poll frame exchanges by paged STAs

—Any DL MU PPDUs

—Any HE trigger-based PPDUs

—Any Trigger frames to solicit HE trigger-based PPDUs

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T_{TXOP} is the duration given by dot11EDCATableTXOPLimit (dot11QAPEDCATableTXOPLimit for the AP) for that AC

$T_{TXOP\text{-}REMAINING}$ is T_{TXOP} less the time already used time within the TXOP

$T_{END\text{-}NAV}$ is the remaining duration of any NAV set by the TXOP holder, or 0 if no NAV has been established

T_{PPDU} is the time required for transmission of the current PPDU

9.2.5.7 Setting for control response frames

Change as follows:

This subclause describes how to set the Duration/ID field for CTS, Ack, and BlockAck frames transmitted by a QoS STA.

In a CTS frame that is not part of a dual CTS sequence transmitted in response to an RTS frame, the Duration/ID field is set to the value obtained from the Duration/ID field of the RTS frame that elicited the response minus the time, in microseconds, between the end of the PPDU carrying the RTS frame and the end of the PPDU carrying the CTS frame.

In a CTS frame that is transmitted in response to an MU-RTS frame, the Duration/ID field is set to the value obtained from the Duration/ID field of the MU-RTS frame that elicited the CTS frame minus the time, in microseconds, between the end of the PPDU carrying the MU-RTS frame and the end of the PPDU carrying the CTS frame.

In an Ack frame, the Duration/ID field is set to the value obtained from the Duration/ID field of the frame that elicited the response minus the time, in microseconds between the end of the PPDU carrying the frame that elicited the response and the end of the PPDU carrying the Ack frame.

In a BlockAck frame transmitted in response to a BlockAckReq or MU-BAR frame or transmitted in response to a frame containing an implicit block ack request, the Duration/ID field is set to the value obtained from the Duration/ID field of the frame that elicited the response minus the time, in microseconds between the end of the PPDU carrying the frame that elicited the response and the end of the PPDU carrying the BlockAck frame.

In a BlockAck frame transmitted in response to a frame carried in HE trigger-based PPDU, the rule of setting Duration/ID field is described in 9.2.5.2 (Setting for single and multiple protection under enhanced distributed channel access (EDCA)).

9.3 Format of individual frame types

9.3.1 Control frames

9.3.1.2 RTS frame format

Change the 3rd paragraph as follows:

The TA field is the address of the STA transmitting the RTS frame or the bandwidth signaling TA of the STA transmitting the RTS frame. In an RTS frame transmitted by a VHT STA or an HE STA in a non-HT or non-HT duplicate format and where the scrambling sequence carries the TXVECTOR parameters CH_BANDWIDTH_IN_NON_HT and DYN_BANDWIDTH_IN_NON_HT (see 10.3.2.6 (VHT RTS procedure)), the TA field is a bandwidth signaling TA.

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9.3.1.3 CTS frame format

Change the 2nd paragraph of this subclause as follows:

When the CTS frame is a response to an RTS frame, the value of the RA field of the CTS frame is set to the address from the TA field of the RTS frame with the Individual/Group bit forced to the value 0. When the CTS frame is a response to an MU-RTS frame, the value of the RA field of the CTS frame is set to the address from the TA field of the MU-RTS frame.

9.3.1.5 PS-Poll frame format

Change the 2nd paragraph as follows:

The BSSID is the address of the STA contained in the AP. The TA field is the address of the STA transmitting the frame or a bandwidth signaling TA. In a PS-Poll frame transmitted by a VHT STA or a HE STA in a non-HT or non-HT duplicate format and where the scrambling sequence carries the TXVECTOR parameter CH_BANDWIDTH_IN_NON_HT, the TA field value is a bandwidth signaling TA. The ID field contains the AID value assigned to the STA transmitting the frame by the AP in the (Re)Association Response frame that established that STA's current association, with the two MSBs set to 1.

9.3.1.6 CF-End frame format

Change the last paragraph as follows:

When transmitted by a non-DMG STA, the BSSID (TA) field is the address of the STA contained in the AP except that the Individual/Group bit of the BSSID (TA) field is set to 1 in a CF-End frame transmitted by a VHT STA to a VHT AP or an HE STA to an HE AP in a non-HT or non-HT duplicate format to indicate that the scrambling sequence carries the TXVECTOR parameter CH_BANDWIDTH_IN_NON_HT. When transmitted by a DMG STA, the TA field is the MAC address of the STA transmitting the frame.

9.3.1.8 BlockAckReq frame format

9.3.1.8.1 Overview

Change the 4th paragraph as follows:

The TA field value is the address of the STA transmitting the BlockAckReq frame or a bandwidth signaling TA. In a BlockAckReq frame transmitted by a VHT STA or an HE STA in a non-HT or non-HT duplicate format and where the scrambling sequence carries the TXVECTOR parameter CH_BANDWIDTH_IN_NON_HT, the TA field value is a bandwidth signaling TA.

9.3.1.8.2 Basic BlockAckReq variant

Change Figure 9-28 as follows:

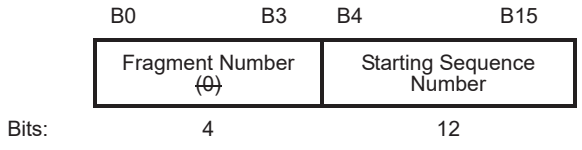

Figure 9-28—Block Ack Starting Sequence Control subfield

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9.3.1.9 BlockAck frame format

9.3.1.9.1 Overview

Change Figure 9-33 as follows:

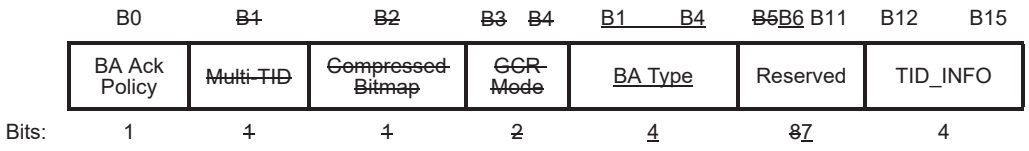

Figure 9-33—BA Control field

Change the 3rd paragraph as follows:

The RA field of the BlockAck frame that is not a Multi-STA BlockAck variant is ~~the address of the recipient STA that requested the Block Ack~~ set to the TA field of the soliciting frame or the address of the recipient STA whose data/management frames are acknowledged. An HE AP that transmits a Multi-STA BlockAck frame with different values of the AID subfield in Per STA Info subfields sets the RA field to the broadcast address. An HE AP that transmits a Multi-STA BlockAck frame with a single AID subfield or with the same values of the AID subfield in Per STA Info subfields sets the RA field to the address of the recipient STA that requested the Block Ack or to the broadcast address. An HE non-AP STA transmits a Multi-STA BlockAck frame with a single AID subfield or with the same values of the AID subfield in Per STA Info subfields and sets the RA field to the TA field of the soliciting frame or the address of the recipient STA whose data/management frames are acknowledged.

Change the 4th paragraph as follows:

The TA field value is the address of the STA transmitting the BlockAck frame or a bandwidth signaling TA in the context of HT-delayed Block Ack. In a BlockAck frame transmitted in the context of HT-delayed Block Ack by a VHT STA or an HE STA in a non-HT or non-HT duplicate format and where the scrambling sequence carries the TXVECTOR parameter CH_BANDWIDTH_IN_NON_HT, the TA field value is a bandwidth signaling TA.

Change the 6th paragraph of this subclause as follows:

For BlockAck frames sent under Delayed and HT-delayed agreements, the BA Ack Policy subfield of the BA Control field has the meaning shown in Table 9-23 (BA Ack Policy subfield). For BlockAck frames sent under other types of agreement, the BA Ack Policy subfield is reserved. An HE STA does not send a Multi-STA BlockAck frame under Delayed and HT-delayed agreements.

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Change Table 9-24 as follows:

Table 9-24—BlockAck frame variant encoding

~~Multi-TID subfield value~~	~~Compressed Bitmap subfield value~~	~~GCR subfield value~~	BA Type (B1 B2 B3 B4)	BlockAck frame variant
~~0~~	~~0~~	~~00~~	0000	Basic BlockAck
		~~01~~	0001	Reserved
		~~10~~	0010	Reserved
		~~11~~	0011	Reserved
~~0~~	~~1~~	~~00~~	0100	Compressed BlockAck
		~~01~~	0101	GLK-GCR BlockAck
		~~10~~	0110	GCR BlockAck
		~~11~~	0111	Reserved
~~1~~	~~0~~	~~00~~	1000	Extended Compressed BlockAck
		~~01~~	1001	Reserved
		~~10~~	1010	Reserved
		~~11~~	1011	Reserved
~~1~~	~~1~~	~~00~~	1100	Multi-TID BlockAck
		~~01~~	1101	~~Reserved~~ Multi-STA BlockAck
		~~10~~	1110	Reserved
		~~11~~	1111	Reserved

Change the 7th paragraph of this subclause as follows:

The ~~values of the Multi-TID, Compressed Bitmap, and GCR~~ BA Type subfield~~s~~ of the BA Control field determine~~s~~ which of the BlockAck frame variants is represented, as indicated in the Table 9-24 (BlockAck frame variant encoding).

9.3.1.9.3 Compressed BlockAck variant

Change subclause 9.3.1.9.3 (including Figure 9-34) as follows:

The TID_INFO subfield of the BA Control field of the Compressed BlockAck frame contains the TID for which this BlockAck frame is sent.

The BA Information field of the Compressed BlockAck frame comprises the Block Ack Starting Sequence Control subfield and the Block Ack Bitmap subfield, as shown in Figure 9-35 (BA Information field (Compressed BlockAck)). The Starting Sequence Number subfield of the Block Ack Starting Sequence Control subfield contains the sequence number of the first MSDU or A-MSDU for which this BlockAck frame is sent. The value of this subfield is defined in 10.24.7.5 (Generation and transmission of BlockAck

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frames by an HT STA or DMG STA). ~~The Fragment Number subfield of the Block Ack Starting Sequence Control subfield is set to 0.~~

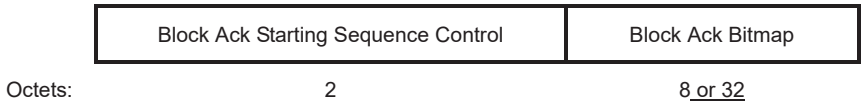

Figure 9-34—BA Information field (Compressed BlockAck)

The Fragment Number subfield is set as defined in Table 9-24a (Fragment Number subfield encoding for the Compressed BlockAck variant)

Insert the following table:

Table 9-24a—Fragment Number subfield encoding for the Compressed BlockAck variant

Fragment Number subfield			Fragmentation Level 3 (ON/ OFF)	Block Ack Bitmap subfield length (octets)	Maximum number of MSDUs/A-MSDUs that can be acknowledged
B3	B2-B1	B0			
0	0	0	OFF	8 octets	64
0	1	0		Reserved	Reserved
0	2	0		32 octets	256
0	3	0		Reserved	Reserved
0	0	1	ON	8 octets	16
0	1	1		Reserved	Reserved
0	2	1		32 octets	64
0	3	1		Reserved	Reserved
1	Any	Any		Reserved	Reserved

NOTE—A Compressed BlockAck frame with B0 of the Fragment Number subfield set to 1 can only be sent to an HE STA whose HE Fragmentation Support subfield in the HE Capabilities element it transmits is 3 (see 27.3 (Fragmentation)).

Change the remainder of 9.3.1.9.3 as follows:

When B0 of the Fragment Number subfield is 0, the Block Ack Bitmap subfield of the BA Information field of the Compressed BlockAck frame is used to indicate the receive status of up to 64 or 256 MSDUs and A-MSDUs depending upon the value of B2-B1 in the Fragment Number subfield as shown in Table 9-24a (Fragment Number subfield encoding for the Compressed BlockAck variant).~~The Block Ack Bitmap subfield of the BA Information field of the Compressed BlockAck frame is 8 octets in length and is used to indicate the received status of up to 64 MSDUs and A-MSDUs.~~ Each bit that is equal to 1 in the compressed Block Ack Bitmap subfield acknowledges the successful reception of a single MSDU or A-MSDU in the order of sequence number, with the first bit of the Block Ack Bitmap subfield corresponding to the MSDU or A-MSDU with the sequence number that matches the value of the Starting Sequence Number subfield of the Block Ack Starting Sequence Control subfield.

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When B0 of the Fragment Number subfield is 1, the Block Ack Bitmap subfield of the BA Information field of the Compressed BlockAck frame is used to indicate the receive status of up to 16 or 64 MSDUs and A-MSDUs depending upon the value B2-B1 in the Fragment Number subfield as shown in Table 9-24a (Fragment Number subfield encoding for the Compressed BlockAck variant). If bit position *n* of the Block Ack Bitmap subfield is 1, it acknowledges receipt of an MPDU with sequence number value *SN* and fragment number value *FN* with $n = 4 \times (SN - SSN) + FN$, where *SSN* is the value of the Starting Sequence Number subfield of the Block Ack Starting Sequence Control subfield and the operations on the sequence numbers are performed modulo 4096. If bit position *n* of the Block Ack Bitmap subfield is 0, it indicates that the MPDU has not been received.

NOTE—When the B0 of the Fragment Number subfield is equal to 1 then the Block Ack Bitmap subfield is split into (Block Ack Bitmap subfield length)/4 subbitmaps, each of which indicates receive status for up to 4 fragments of each of the MSDUs as indicated in Table 9-24a (Fragment Number subfield encoding for the Compressed BlockAck variant). For an A-MSDU, only the first bit of the subbitmap is used, as fragmentation is not allowed in an A-MSDU.

Insert a new subclause after 9.3.1.9.6:

9.3.1.9.7 Multi-STA BlockAck variant

The format defined below is used for multi-STA multi-TID, and multi-STA single TID BlockAck variant. Multi-STA BlockAck frames shall be supported if either UL MU or multi-TID A-MPDU operation is supported.

The TID_INFO subfield of the BA Control field of the Multi-STA BlockAck frame is reserved.

The BA Information field of the Multi-STA BlockAck frame comprises one or more Per STA Info subfields. The Per STA Info subfield is shown in Figure 9-38a (Per STA Info subfield format).

	Per AID TID Info	Block Ack Starting Sequence Control	Block Ack Bitmap
Octets:	2	0 or 2	0, 4, 8, 16 or 32

Figure 9-38a—Per STA Info subfield format

The Per AID TID Info subfield is shown in Figure 9-38b (Per AID TID Info subfield format).

	B0 – B10	B11	B12 – B15
	AID	Ack Type	TID
Bits:	11	1	4

Figure 9-38b—Per AID TID Info subfield format

When Multi-STA BlockAck variant is intended for a non-AP STA, the AID subfield carries the AID of the non-AP STA for which the Per STA Info subfield is intended. When the Multi-STA BlockAck variant is intended for an AP, the AID subfield is set to 0.

NOTE—One or more Per STA Info subfields with same value of the AID subfield and different values of the TID subfields can be present in the Multi-STA BlockAck frame.

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The TID subfield contains the TID for which the acknowledgment or block acknowledgment contained in the Per AID TID Info subfield applies.

NOTE—When a Multi-STA BlockAck frame is used to acknowledge a management frame, the TID value is set to 15.

If the Ack Type subfield is 1 and the TID value of the Per AID TID Info subfield is less than 8 or equal to 15, then the Block Ack Starting Sequence Control and Block Ack Bitmap subfields are not present and the Per STA Info subfield acknowledges successful reception of a single MPDU indicated by the TID of the Per AID TID Info subfield. If the Ack Type subfield is 1 and the TID subfield of the Per AID TID Info field is 14, then the Block Ack Starting Sequence Control and Block Ack Bitmap are not present and the Per STA Info field acknowledges successful reception of all the MPDUs carried in the eliciting A-MPDU. The Ack Type field is not set to 1 when responding to a BlockAckReq frame or an MU-BAR frame. If the Ack Type subfield is 0, then the Block Ack Starting Sequence Control and Block Ack Bitmap subfields are present.

The context and the presence of each optional subfields in a Per STA Info subfield in a Multi-STA BlockAck frame is as defined in Table 9-24b (Context of the Per STA Info subfield and presence of optional subfields).

Table 9-24b—Context of the Per STA Info subfield and presence of optional subfields

Ack Type subfield value	TID subfield values	Presence of optional subfields in the Per STA Info field		Context of a Per STA Info field in a Multi-STA BlockAck frame
0	0-7	Block Ack Starting Sequence Control	Present	Block acknowledgment context: Sent as a response to an A-MPDU that solicits an immediate block acknowledgement or to a BAR frame
		Block Ack Bitmap	Present	
1	0-7	Block Ack Starting Sequence Control	Not present	Acknowledgment context: Sent as a response to an MPDU or VHT Single MPDU that solicits an immediate acknowledgment
		Block Ack Bitmap	Not present	
0 or 1	8 to 13	N/A	N/A	Reserved
0	14	N/A	N/A	Reserved
1	14	Block Ack Starting Sequence Control	Not present	All block acknowledgment context: Sent as a response to an A-MPDU that solicits an immediate response and all MPDUs contained in the A-MPDU are received successfully
		Block Ack Bitmap	Not present	
0	15	N/A	N/A	Reserved
1	15	Block Ack Starting Sequence Control	Not present	Action Ack frame acknowledgment context: Sent as a response to an Action Ack frame carried in an A-MPDU that solicits an immediate acknowledgment
		N/A	Not present	

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If the Ack Type field is 0, the Fragment Number subfield encoding is defined in Table 9-24c (Fragment Number subfield encoding for the Multi-STA BlockAck variant).

Table 9-24c—Fragment Number subfield encoding for the Multi-STA BlockAck variant

Fragment Number subfield			Fragmentation Level 3 (ON/OFF)	Block Ack Bitmap subfield length (octets)	Maximum number of MSDUs/A-MSDUs that can be acknowledged
B3	B2-B1	B0			
0	0	0	OFF	8 octets	64
0	1	0		16 octets	128
0	2	0		32 octets	256
0	3	0		4 octets	32
0	0	1	ON	8 octets	16
0	1	1		16 octets	32
0	2	1		32 octets	64
0	3	1		4 octets	8
1	Any	Any		Reserved	Reserved

NOTE—A Multi-STA BlockAck frame with B0 of the Fragment Number subfield set to 1 can only be sent to an HE STA whose HE Fragmentation Support subfield in the HE Capabilities element it transmits is 3 (see 27.3 (Fragmentation)).

When B0 of the Fragment Number subfield of the Block Ack Starting Sequence Control subfield is 0, the Block Ack Starting Sequence Control subfield is as defined in Figure 9-28. The BA Information field of the Multi-STA BlockAck frame contains an 8-octet, 16-octet, 32-octet or 4-octet Block Ack Bitmap subfield depending on B2-B1 of the Fragment Number subfield as defined in the Table 9-24c (Fragment Number subfield encoding for the Multi-STA BlockAck variant). Each bit that is equal to 1 in the Block Ack Bitmap subfield acknowledges the successful reception of a single MSDU or A-MSDU in the order of sequence number with the first bit of the Block Ack Bitmap subfield corresponding to the MSDU or A-MSDU with the sequence number that matches the value of the Starting Sequence Number subfield of the Block Ack Starting Sequence Control subfield.

When B0 of the Fragment Number subfield of the Block Ack Starting Sequence Control subfield is 1, the Block Ack Bitmap subfield of the BA Information field of the Multi-STA Block Ack frame is used to indicate the receive status of up to 16, 32, 64 or 8 MSDUs and A-MSDUs depending on B2-B1 of the Fragment Number subfield as shown in the Table 9-24c (Fragment Number subfield encoding for the Multi-STA BlockAck variant). If bit position n of the Block Ack Bitmap subfield is 1, it acknowledges receipt of an MPDU with sequence number value SN and fragment number value FN with $n = 4 \times (SN - SSN) + FN$, where SSN is the value of the Starting Sequence Number subfield of the Block Ack Starting Sequence Control subfield and the operations on the sequence numbers are performed modulo 4096. If bit position n of the Block Ack Bitmap subfield is 0, it indicates that the MPDU has not been received.

NOTE—When B0 of the Fragment Number subfield is 1 then the Block Ack Bitmap field is split into Block Ack Bitmap field length/4 subbitmaps, each of which indicates receive status for 4 fragments of each of the MSDUs as indicated in Table 9-24c (Fragment Number subfield encoding for the Multi-STA BlockAck variant). For an A-MSDU, only the first bit of the subbitmap is used, as fragmentation is not allowed in an A-MSDU.

Change the title of 9.3.1.20 as follows:

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9.3.1.20 VHT/HE NDP Announcement frame format

Insert the following at the end of 9.3.1.20:

The HE NDP Announcement uses the same Frame Control Type as the VHT NDP Announcement. The frame format of the HE NDP Announcement frame with multiple STA info field is shown in Figure 9-51a (HE NDP Announcement frame format).

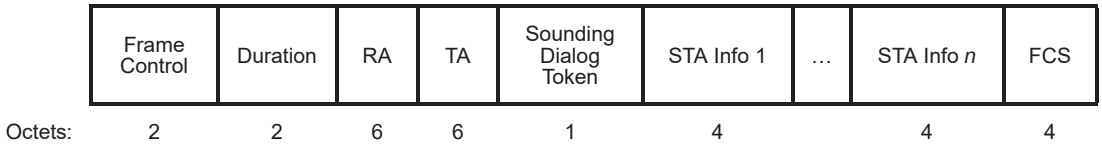

Figure 9-51a—HE NDP Announcement frame format

Bit 1 of the Sounding Dialog Token is set to 1 to indicate an HE NDP Announcement frame.

The format of the STA Info subfield in an HE NDP Announcement Frame is defined in Figure 9-51b (STA Info subfield format in an HE NDP Announcement frame).

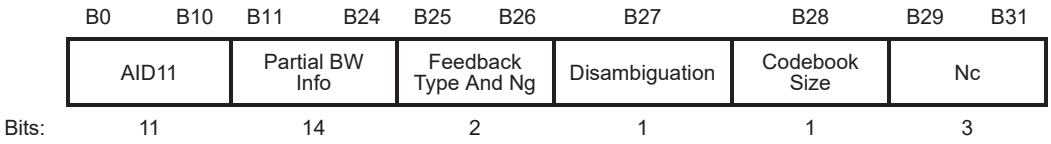

Figure 9-51b—STA Info subfield format in an HE NDP Announcement frame

The Partial BW Info subfield is defined in Figure 9-51c (Partial BW Info subfield).

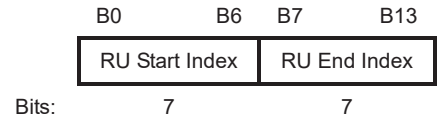

Figure 9-51c—Partial BW Info subfield

The RU Start Index subfield of the Partial BW subfield indicates the first 26-tone RU for which the HE beamformer is requesting feedback. The RU End Index subfield of the Partial BW subfield indicates the last 26-tone RU for which the HE beamformer is requesting feedback.

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The Feedback Type And Ng and Codebook Size subfields are defined inTable 9-25a (Feedback Type And Ng subfield and Codebook Size subfield encoding)

Table 9-25a—Feedback Type And Ng subfield and Codebook Size subfield encoding

Feedback Type + Ng + codebook size	Description
000	SU, Ng4, quantization resolution (ϕ, ψ) = {4, 2}
001	SU, Ng4, quantization resolution (ϕ, ψ) = {6, 4}
010	SU, Ng16, quantization resolution (ϕ, ψ) = {4, 2}
011	SU, Ng16, quantization resolution (ϕ, ψ) = {6, 4}
100	MU+Ng4, quantization resolution (ϕ, ψ) = {7, 5}
101	MU+Ng4, quantization resolution (ϕ, ψ) = {9, 7}
110	CQI only feedback
111	MU+Ng16, quantization resolution (ϕ, ψ) = {9, 7}

The Disambiguation subfield is set to 1 to prevent a VHT STA from wrongly determining it's AID in the HE STA Info.

Insert a new subclause after 9.3.1.22:

9.3.1.23 Trigger frame format

The Trigger frame solicits and allocates resources for UL MU transmissions a SIFS after the PPDU that carries the Trigger frame. The Trigger frame also carries other information required by the responding STA to send an HE trigger-based PPDU.

The frame format for the Trigger frame is as defined in Figure 9-52c (Trigger frame).

	Frame Control	Duration	(RA)	TA	Common Info	User Info	...	User Info	Padding	FCS
Octets:	2	2	6	6	8 or more	5 or more		5 or more	variable	4

Figure 9-52c—Trigger frame

The Duration field is set as defined in 9.2.5 (Duration/ID field (QoS STA)).

The RA field of the Trigger frame is the address of the recipient STA.If the Trigger frame has one User Info field then the RA of the Trigger frame is the STA's MAC Address. If the Trigger frame has multiple User Info fields then the RA of the Trigger Frame is the broadcast address.If the Trigger Type field is GCR MU-BAR, the RA field is set to the MAC address of the group for which reception status is being requested.

The TA field value is the address of the STA transmitting the Trigger frame.

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The Common Info field is defined in Figure 9-52d (Common Info field).

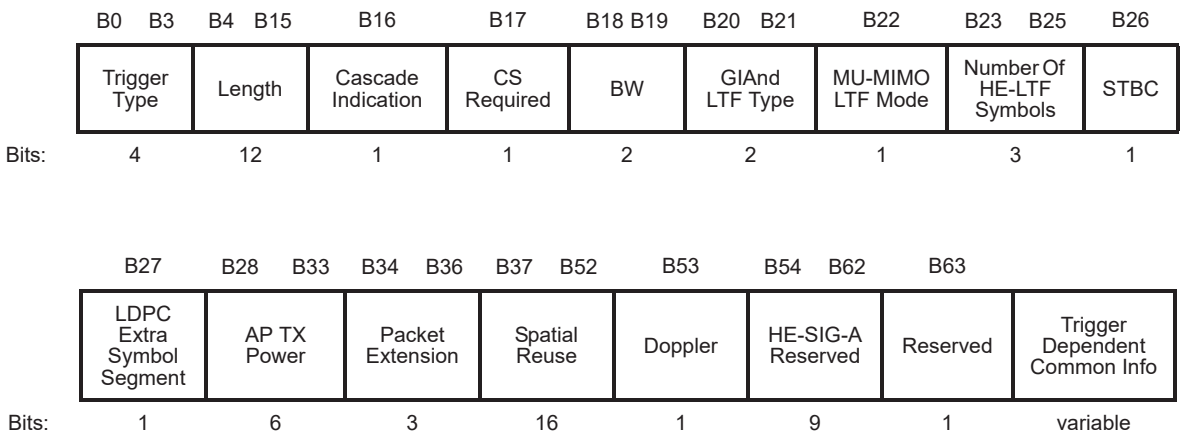

Figure 9-52d—Common Info field

The Trigger Type subfield indicates the type of the Trigger frame. The Trigger frame can include an optional Trigger Dependent Common Info field and optional Trigger Dependent User Info field. The Trigger Type subfield encoding is defined in Table 9-25a (Trigger Type subfield encoding).

Table 9-25a—Trigger Type subfield encoding

Trigger Type field value	Description
0	Basic Trigger
1	Beamforming Report Poll
2	MU-BAR
3	MU-RTS
4	Buffer Status Report Poll (BSRP)
5	GCR MU-BAR
6	Bandwidth Query Report Poll (BQRP)
7-15	Reserved

The Length subfield of the Common Info field indicates the value of the L-SIG Length field of the HE trigger-based PPDU that is the response to the Trigger frame.

If the Cascade Indication subfield is 1, then a subsequent Trigger frame as defined in 27.7 (TWT operation) and in 27.14.2 (Power save with UL OFDMA-based random access) follows the current Trigger frame. Otherwise the Cascade Indication subfield is 0.

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The CS Required subfield is set to 1 to indicate that the STAs identified in the User Info fields are required to use ED to sense the medium and to consider the medium state and the NAV in determining whether or not to respond. The CS Required subfield is set to 0 to indicate that the STAs identified in the User Info fields are not required to consider the medium state or the NAV in determining whether or not to respond.

The BW subfield indicates the bandwidth in the HE-SIG-A of the HE trigger-based PPDU and is defined in Table 9-25b (BW subfield encoding).

Table 9-25b—BW subfield encoding

BW subfield value	Description
0	20 MHz
1	40 MHz
2	80 MHz
3	80+80 MHz or 160 MHz

The GI And LTF Type subfield of the Common Info field indicates the GI and HE-LTF type of the HE trigger-based PPDU response. The GI And LTF Type subfield encoding is defined in Table 9-25c (GI And LTF Type subfield encoding).

Table 9-25c—GI And LTF Type subfield encoding

GI And LTF field value	Description
0	1x LTF + 1.6 μs GI
1	2x LTF + 0.8 μs GI
2	2x LTF + 1.6 μs GI
3	4x LTF + 3.2 μs GI

The MU-MIMO LTF Mode subfield of the Common Info field indicates the LTF mode of the UL MU-MIMO HE trigger-based PPDU response. The AP shall set the MU-MIMO LTF Mode subfield to Single

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Stream pilot if the triggered UL PPDU contains partial or full UL OFDMA allocation. The MU-MIMO LTF Mode subfield encoding is defined in Table 9-25d (MU-MIMO LTF Mode subfield encoding).

Table 9-25d—MU-MIMO LTF Mode subfield encoding

MU-MIMO LTF subfield value	Description
0	Single stream pilots
1	Mask LTF sequence of each spatial stream by a distinct orthogonal code

The Number Of HE-LTF Symbols subfield of the Common Info field indicates the number of HE-LTF symbols present in the HE trigger-based PPDU response. The number of HE-LTF symbols is a function of the total number of space-time streams. For non-OFDMA PPDUs, the encoding of the Number Of HE-LTF Symbols subfield is defined in Table 22-13. For OFDMA PPDUs, the number of HE-LTFs is greater than or equal to the maximum across RUs of the total number of space time streams. The encoding of the Number Of HE-LTF Symbols subfield is the same as the Number of HE-LTF Symbols in HE-SIG-A2, which is defined in Table 28-18 (HE-SIG-A field of an HE trigger-based PPDU).

The STBC subfield of the Common Info field indicates the status of STBC encoding of the HE trigger-based PPDU response. It is set to 1 if STBC encoding is used and set to 0 otherwise.

The LDPC Extra Symbol Segment subfield of the Common Info field indicates the status of LDPC extra symbol segment. It is set to 1 when LDPC extra symbol segment is present and set to 0 otherwise.

The AP Tx Power subfield of the Common Info field indicates the combined average power per 20 MHz bandwidth of all transmit antennas used to transmit the trigger frame at the HE AP. The resolution for the transmit power reported in the Common Info field is 1 dB. The AP Tx Power subfield encoding is defined in Table 9-25e (AP Tx Power subfield encoding).

Table 9-25e—AP Tx Power subfield encoding

AP Tx Power subfield value	Description
0-60	Values 0 to 61 maps to −20 dBm to 40 dBm
61-63	Reserved

The Packet Extension subfield of the Common Info field indicates the packet extension duration of the trigger-based PPDU response. The first two bits indicate the pre-FEC padding factor and the third bit indicates the PE-Disambiguity.

The Spatial Reuse subfield carries the value for the Spatial Reuse field in the HE-SIG-A field of the HE trigger-based PPDU transmitted as a response to the Trigger frame. For HE trigger-based PPDU, four SR fields are signaled:

— For 20 MHz one SR field corresponding to entire 20 MHz (other 3 fields indicate identical values)

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— For 40 MHz two SR fields for each 20 MHz (other 2 fields indicate identical values)
— For 80 MHz four SR fields for each 20 MHz
— For 160 MHz four SR fields for each 40 MHz

When operating 40 MHz in 2.4GHz band, two SR fields, SR field 1 and SR field 2, are set to same values. When operating 80+80 MHz, SR field 3 is set to same value as SR field 1, and SR field 4 is set to the same value as SR field 2.

The Doppler subfield indicates a high doppler mode of transmission.

The HE-SIG-A Reserved subfield indicate the values of the reserved bits in HE-SIG-A2 of the HE trigger-based PPDU transmitted as a response to the Trigger frame. Bits B54 to B62 in the Trigger frame are set to 1 and correspond to the bits B7 to B15 in the HE-SIG-A2 of the HE trigger-based PPDU with B54 in the Trigger frame corresponding to B7 in the HE-SIG-A2 of the HE trigger-based PPDU and so on.

The User Info field is defined in Figure 9-52e (User Info field).

	B0 B11	B12 B19	B20	B21 B24	B25	B26 B31	B32 B38	B39	
	AID12	RU Allocation	Coding Type	MCS	DCM	SS Allocation	Target RSSI	Reserved	Trigger Dependent User Info
Bits:	12	8	1	4	1	6	7	1	variable

Figure 9-52e—User Info field

The AID12 subfield of the User Info field carries the least significant 12 bits of the AID of the STA for which the User Info field is intended. An AID12 subfield that is 0 indicates that the User Info field identifies an RU for random access.User Info fields with AID = 0 shall be allocated only after User Info fields with AID not equals to 0, if any, and before the MAC padding field, if present.

The RU Allocation subfield of the User Info field indicates the RU used by the HE trigger-based PPDU of the STA identified by the AID12 subfield. The RU Allocation subfield is 8 bits in length. The first bit, B12, indicates the allocated RU is located in the primary or non-primary 80 MHz (zero for primary and one for

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non-primary). The mapping of the subsequent 7 bits, B19-B13, indices to the RU allocation is defined in Table 9-25f (The encoding of B19-B13 of the RU Allocation subfield).

Table 9-25f—The encoding of B19-B13 of the RU Allocation subfield

B19-B13	Description	Number of entries
0000000 - 0100100	Possible 26-tone RU cases in 80 MHz	37
0100101 - 0110100	Possible 52-tone RU cases in 80 MHz	16
0110101 - 0111100	Possible 106-tone RU cases in 80 MHz	8
0111101 - 1000000	Possible 242-tone RU cases in 80 MHz	4
1000001 - 1000010	Possible 484-tone RU cases in 80 MHz	2
1000011	996-tone RU cases in 80 MHz	1
1000100	2×996-tone RU case	1
Total		69

B12 is set to 0 for a 20 MHz, 40 MHz and 80 MHz PPDU. For the 2×996-tone RU case, B12 is set to 1. The mapping of subsequent 7 bits indices B19-B13 to RU index in each row depends on the BW bits in Common Info field:

— For a 20 MHz PPDU, the mapping of B19-B13 to RU allocation follows the RU index in Table 28-3 (Subcarrier indices for RUs in a 20 MHz HE PPDU) in an increasing order. B19-B13 are 0000000 indicates 26-tone RU1 [–121: –96], 0001000 indicates 26-tone RU9 [96: 121], and 0001001-0100100 are not used. B19-B13 are 0100101 indicates 52-tone RU1 [–121: –70], 0101000 indicates 52-tone RU4 [70: 121], and 0101001-0110100 are not used. B19-B13 are 0110101 indicates 106-tone RU1 [–122: –17], 0110110 indicates 106-tone RU2 [17: 122], and 0110111-0111100 are not used. B19-B13 are 0111101 indicates 242-tone RU1 [–122: –2, 2:122], and 0111110-1000000 are not used.

— For a 40 MHz PPDU, the mapping of B19-B13 to RU allocation follows the RU index in Table 28-4 (Subcarrier indices for RUs in a 40 MHz HE PPDU) in an increasing order. B19-B13 are 0000000 indicates 26-tone RU1 [–243: –218], 0010001 indicates 26-tone RU18 [218: 243], and 0010010-0100100 are not used. B19-B13 are 0100101 indicates 52-tone RU1 [–243: –192], 0101100 indicates 52-tone RU8 [192: 243], and 0101101-0110100 are not used. Similar ordering is followed for 106-tone RU, 242-tone RU and 484-tone RU.

— For an 80 MHz, 160 MHz and 80+80 MHz PPDU, the mapping of B19-B13 to RU allocation follows the RU index in Table 28-5 (Subcarrier indices for RUs in an 80 MHz HE PPDU) in an increasing order. B19-B13 are 0000000 indicates 26-tone RU1 [–499: –474], and 0100100 indicates 26-tone RU37 [474: 499]. B19-B13 are 0100101 indicates 52-tone RU1 [–499: –448], and 0110100 indicates 52-tone RU16 [448: 499]. Similar ordering is followed for 106-tone RU, 242-tone RU, 484-tone RU and 996-tone RU. For a 160 MHz and 80+80 MHz PPDU, B19-B13 are 1000100 indicates 2×996-tone RU.

The Coding Type subfield of the User Info field indicates the code type of the HE trigger-based PPDU response of the STA identified by the AID12 subfield. Set to 0 for BCC and set to 1 for LDPC.

The MCS subfield of the User Info field indicates the MCS of the HE trigger-based PPDU response of the STA identified by the AID12 subfield. The encoding of the MCS field is as defined in 28.3.7 (HE modulation and coding schemes (HE-MCSs)).

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The DCM subfield of the User Info field indicates dual carrier modulation of the HE trigger-based PPDU response of the STA identified by the AID12 subfield. A value of 1 indicates that the HE trigger-based PPDU response shall use DCM as defined in 28.3.11.15 (Dual carrier modulation). A value 0 indicates that DCM is not be used.

The SS Allocation subfield of the User Info field indicates the spatial streams of the HE trigger-based PPDU response of the STA identified by the AID12 subfield. The format of the SS Allocation subfield is defined in Figure 9-52f (SS Allocation subfield format).

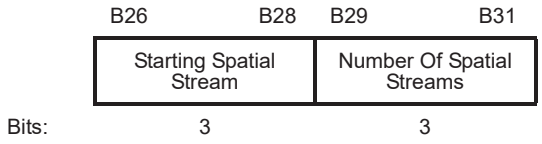

Figure 9-52f—SS Allocation subfield format

The Target RSSI subfield of the User Info field indicates the target received signal power of the HE trigger-based PPDU response. The resolution for the Target RSSI subfield in the User Info field is 1 dB. The Target RSSI subfield encoding is defined in Table 9-25g (Target RSSI subfield encoding).

Table 9-25g—Target RSSI subfield encoding

Target RSSI subfield	Description
0-90	Values 0 to 90 map to –100 dBm to –20 dBm
91-126	Reserved
127	Indicates to the STA to transmit an HE trigger-based PPDU response at its maximum transmit power for the assigned MCS

The Padding field extends the frame length to give the recipient STAs more time to prepare a response. The Padding field of the Trigger frame, if present, is an integer number of octets ≥ 2: Padding field starts with special STAID[11:0] as 0xFFF and the rest bits of the Padding field are all set to one. 0xFFF is reserved as the special value to indicate the start of the MAC padding. The length of the Padding field is in units of octets and is set as defined in the following formulas.

For a non-HT PPDU, HT PPDU and VHT PPDU the length of the Padding field is given by Equation (9-ax1).

$$L_{PAD,\,MAC} = \left\lceil \frac{N_{DBPS} m_{PAD}}{8} \right\rceil \text{ octets} \qquad \text{(9-ax1)}$$

where

$$m_{PAD} = \begin{cases} 0, \text{ max TF MAC Padding Duration among receiving STAs} = 0\ \mu s \\ 2, \text{ max TF MAC Padding Duration among receiving STAs} = 8\ \mu s \\ 4, \text{ max TF MAC Padding Duration among receiving STAs} = 16\ \mu s \end{cases}$$

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For an HE PPDU, the length of the Padding field is given by Equation (9-ax2).

$$L_{PAD,\,MAC} = \left\lceil \frac{N_{DBPS,\,SHORT} m_{PAD}}{8} \right\rceil \text{ octets} \qquad \text{(9-ax2)}$$

where

$$m_{PAD} = \begin{cases} 0, \text{ max TF MAC Padding Duration among receiving STAs} = 0\ \mu s \\ 2, \text{ max TF MAC Padding Duration among receiving STAs} = 8\ \mu s \\ 4, \text{ max TF MAC Padding Duration among receiving STAs} = 16\ \mu s \end{cases}$$

STBC is disallowed for Trigger Frame transmission.

9.3.1.23.1 Basic Trigger variant

If the Trigger frame is a Basic Trigger variant, the Trigger Dependent Common Info field is not present and the Trigger Dependent User Info field is defined in Figure 9-52g (Trigger Dependent User Info field for the Basic Trigger variant).

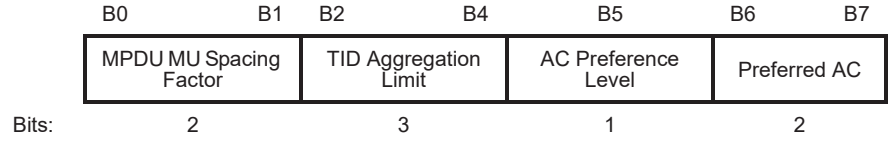

Figure 9-52g—Trigger Dependent User Info field for the Basic Trigger variant

The MPDU MU Spacing Factor subfield indicates the value by which the minimum MPDU start spacing defined in Table 8-159 is multiplied. The MPDU MU Spacing Factor subfield encoding is defined in Table 9-25h (MPDU MU Spacing Factor subfield encoding).

Table 9-25h—MPDU MU Spacing Factor subfield encoding

Value	Description
0	Multiplier = 1
1	Multiplier = 2
2	Multiplier = 4
3	Multiplier = 8

The TID Aggregation Limit subfield indicates the maximum number of TIDs that can be aggregated by a STA in a multi-TID A-MPDU carried in the responding HE trigger-based PPDU.

NOTE–A value of 7 in the TID Aggregation Limit subfield indicates to the STA that it can aggregate QoS Data frames from any number of different TID values in the multi-TID A-MPDU.

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The value in the TID Aggregation Limit subfield in Trigger frame is less than or equal to the value indicated in the Multi-TID Aggregation Support field in the HE Capabilities element (see 9.4.2.218 (HE Capabilities element)).

The AC Preference Level subfield is set to 1 to indicate that MPDUs with TIDs that correspond to the AC indicated in the Preferred AC subfield are recommended with respect to TIDs from other ACs. The AC Preference Level subfield is set to 0 if the AP does not have a recommendation.

The Preferred AC subfield indicates the AC that is recommended for aggregation of MPDUs of ACs belonging to the same AC as indicated or higher priority AC(s) within a multi-TID A-MPDU sent as a response to the Trigger frame (see 9.3.1.23 (Trigger frame format)). The encoding of the Preferred AC subfield is shown in Table 9-25i (Preferred AC subfield encoding).

Table 9-25i—Preferred AC subfield encoding

Value	Description
0	AC_VO
1	AC_VI
2	AC_BE
3	AC_BK

9.3.1.23.2 Beamforming Report Poll variant

If the Trigger frame is a Beamforming Report Poll variant, the Trigger Dependent Common Info field is not present and the Trigger Dependent User Info field is defined in Figure 9-52h (Trigger Dependent User Info field for the Beamforming Report Poll variant).

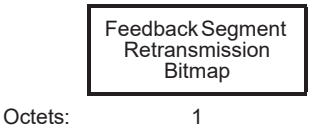

Figure 9-52h—Trigger Dependent User Info field for the Beamforming Report Poll variant

The Feedback Segment Retransmission Bitmap subfield indicates the requested feedback segments of an HE Compressed Beamforming report. If the bit in position *n* (*n* = 0 for LSB and *n* = 7 for MSB) is 1, then the feedback segment with the Remaining Feedback Segments subfield in the HE MIMO Control field equal to *n* is requested. If the bit in position *n* is 0, then the feedback segment with the Remaining Feedback Segments subfield in the HE MIMO Control field equal to n is not requested.

9.3.1.23.3 MU-BAR variant

The Trigger Dependent Common Info field is not present in the MU-BAR variant Trigger frame. The Trigger Dependent User Info field of the MU-BAR variant Trigger frame is defined in Figure 9-52i (Trigger Dependent User Info field for the MU-BAR variant).

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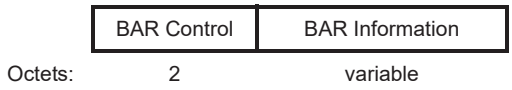

Figure 9-52i—Trigger Dependent User Info field for the MU-BAR variant

The BAR Control subfield is defined in 9.3.1.8 (BlockAckReq frame format).

The BAR Information subfield is defined in 9.3.1.8 (BlockAckReq frame format). The Fragment number field is set accordingly to Table 9-24a (Fragment Number subfield encoding for the Compressed BlockAck variant) for a compressed BAR variant and Table 9-24c (Fragment Number subfield encoding for the Multi-STA BlockAck variant) for a Multi-TID BAR variant.

9.3.1.23.4 MU-RTS variant

The MU-RTS frame format is a variant of Trigger frame format as shown in Figure 9-52c (Trigger frame).

The RA field of the MU-RTS frame is set to the broadcast address.

NOTE—The TA field value is the address of the STA transmitting the MU-RTS frame.

The Common Info field is defined in Figure 9-52d (Common Info field).

The Trigger Type subfield is set to 3 to indicate MU-RTS variant.

The BW subfield indicates the total PPDU bandwidth, and is defined in Table 9-25b (BW subfield encoding).

The Length, GI And LTF Type, MU MIMO LTF Mode, Number of LTFs, STBC, LDPC Extra Symbol Segment, AP TX Power, Packet Extension, Spatial Reuse and HE-SIG-A Reserved fields are reserved.

NOTE—The Trigger Dependent Common Info field is not present in the MU-RTS frame.

The User Info field is defined in Figure 9-52e (User Info field).

The MCS, Coding Type, DCM, SS Allocation and Target RSSI fields are reserved.

The RU Allocation subfield in the User Info field addressed to the STA follows the same definition as described in 9.3.1.23 (Trigger frame format) and indicates whether the CTS frame is transmitted on the primary 20 MHz channel, primary 40 MHz channel, primary 80 MHz channel, 160 MHz channel, or 80+80 MHz channel.

B12 of the RU Allocation subfield is set to 0 for indication of primary 20 MHz/40 MHz/80 MHz. For 160 MHz/80+80 MHz indication, B12 of the RU Allocation subfield is set to 1. The mapping of B19-B13 to RU Allocation subfield follows the RU index in Table 28-3 (Subcarrier indices for RUs in a 20 MHz HE PPDU) in an increasing order.

If the BW subfield indicates 20 MHz, then the 242-tone RU entry 0111101 for B19-B13 indicates primary 20 MHz channel.

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If the BW subfield indicates 40 MHz, then the 242-tone RU entry for B19-B13 corresponding to the primary 20 MHz channel indicates primary 20 MHz; the 484-tone RU entry 1000001 for B19-B13 indicates the primary 40 MHz channel.

If the BW subfield indicates 80 MHz or 80+80 MHz or 160 MHz, then the 242-tone RU entry for B19-B13 corresponding to the primary 20 MHz indicates the primary 20 MHz channel, the 484-tone RU entry for B19-B13 corresponding to the primary 40 MHz indicates the primary 40 MHz channel and the 996-tone RU entry 1000011 for B19-B13 indicates the primary 80 MHz channel.

If the Bandwidth field indicates 80+80 MHz or 160 MHz, then the entry 1000100 for B19-B13 indicates primary and secondary 80 MHz.

NOTE—The Trigger Dependent User Info field is not present in the MU-RTS frame.

9.3.1.23.5 BSRP variant

The BSRP variant Trigger frame format is as defined in Figure 9-52c (Trigger frame).

The Common Info field of the BSRP variant Trigger frame is defined in Figure 9-52d (Common Info field) and the Trigger Dependent Common Info field is not present.

The User Info field of the BSRP variant Trigger frame is defined in Figure 9-52e (User Info field) and the Trigger Dependent User Info field is not present.

9.3.1.23.6 GCR MU-BAR variant

The Trigger Dependent Common Info field of the GCR MU-BAR variant Trigger frame is defined in Figure 9-52j (Trigger Dependent Common Info field for the GCR MU-BAR variant). GCR MU-BAR frame does not have a Trigger Dependent User Info field.

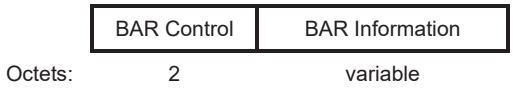

Figure 9-52j—Trigger Dependent Common Info field for the GCR MU-BAR variant

The BAR Control subfield is defined in 9.3.1.8 (BlockAckReq frame format).

The BAR Information subfield is defined in 9.3.1.8 (BlockAckReq frame format). The Fragment number field is set according to Table 9-24a (Fragment Number subfield encoding for the Compressed BlockAck variant) for a compressed BAR variant and Table 9-24c (Fragment Number subfield encoding for the Multi-STA BlockAck variant) for a Multi-TID BAR variant.

9.3.1.23.7 Bandwidth Query Report Poll variant

The Bandwidth Query Report Poll (BQRP) variant Trigger frame format is as defined in Figure 9-52c (Trigger frame).

The Common Info field of the BQRP variant Trigger frame is defined in Figure 9-52d (Common Info field) and the Trigger Dependent Common Info field is not present.

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The User Info field of the BQRP variant Trigger frame is defined in Figure 9-52e (User Info field) and the Trigger Dependent User Info field is not present.

The CS Required subfield is set to 1.

9.3.2 Data frames

9.3.3 Management frames

9.3.3.1 Beacon frame format

Editor's Note: Order: 11ai adds 66-69, 11ah adds none, 11aq adds 70-71, 11ak adds 67 (appears to be out of date), 11aj adds none.

Insert the following new rows (header row shown for convenience) into Table 9-27 (Beacon frame body):

Table 9-27—Beacon frame body

Order	Information	Notes
73	HE Capabilities	The HE Capabilities element is present when dot11HEOptionImplemented is true; otherwise it is not present.
74	HE Operation	The HE Operation element is present when dot11HEOptionImplemented is true; otherwise it is not present.
75	TWT	The TWT element is optionally present when dot11TWTOptionActivated is true; otherwise it is not present.
76	RAPS	The RAPS element is optionally present when dot11OFDMARandomAccessOptionImlemented is true; otherwise it is not present.
77	BSS Color Change Announcement	The BSS Color Change Announcement element is optionally present when dot11HEOptionImplemented is true; otherwise it is not pre-sent.

9.3.3.5 Association Request frame format

Editor's Note: Order: 11ai adds 24-28, 11ah adds 29-38, 11ak adds 24 (appears to be out of date), 11aj adds two (numbers unassigned)

Insert the following new row (header row shown for convenience) into Table 9-29 (Association Request frame body):

Table 9-29—Association Request frame body

Order	Information	Notes
43	HE Capabilities	The HE Capabilities element is present when dot11HEOptionImplemented is true; otherwise it is not present.

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9.3.3.6 Association Response frame format

Editor's Note: Order: 11ai adds 31-36, 11ah adds 37-49, 11aq adds none, 11ak adds 30-31 (appears to be out of date), 11aj adds three (numbers unassigned)

Change Table 9-30 (Association Response frame body) as follows maintaining numeric order (only rows with changes are shown):

Table 9-30—Association Response frame body

Order	Information	Notes
29	TWT	~~The TWT element is optionally present if dot11TWTOptionActivated is true; otherwise not present.~~ The TWT element is present if dot11TWTOptionActivated is true and the TWT element is present in the Association Request frame that elicited this Association Response frame. The TWT element is optionally present if dot11TWTOptionActivated is true and the TWT Requester Supported field in the HE Capabilities in the Association Request frame that elicited this Association Response frame is one.
54	HE Capabilities	The HE Capabilities element is present when dot11HEOptionImplemented is true; otherwise it is not present.
55	HE Operation	The HE Operation element is present when dot11HEOptionImplemented is true; otherwise it is not present.
56	BSS Color Change Announcement	The BSS Color Change Announcement element is optionally present when dot11HEOptionImplemented is true; otherwise it is not pre-sent.

9.3.3.7 Reassociation Request frame format

Editor's Note: Order: 11ai adds 29-33, 11ah adds 34-43, 11aq adds none, 11ak adds 29 (appears to be out of date), 11aj adds two (numbers unassigned)

Insert the following row in Table 9-31 (Reassociation Request frame body) (header shown for convenience):

Table 9-31—Reassociation Request frame body

Order	Information	Notes
47	HE Capabilities	The HE Capabilities element is present when dot11HEOptionImplemented is true; otherwise it is not present.

9.3.3.8 Reassociation Response frame format

Editor's Note: Order: 11ai adds 35-49, 11ah adds 41-52, 11aq adds none, 11ak adds 34 and 30 (appears to be an error), 11aj adds three (numbers unassigned)

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Change Table 9-32 (Reassociation Response frame body) as follows maintaining numeric order (only rows with changes are shown):

Table 9-32—Reassociation Response frame body

Order	Information	Notes
42	TWT	~~The TWT element is optionally present if dot11TWTOptionActivated is true; otherwise not present.~~ The TWT element is present if dot11TWTOptionActivated is true and the TWT element is present in the Reassociation Request frame that elicited this Reassociation Response frame. The TWT element is optionally present if dot11TWTOptionActivated is true and the TWT Requester Supported field in the HE Capabilities in the Reassociation Request frame that elicited this Association Response frame is one.
55	HE Capabilities	The HE Capabilities element is present when dot11HEOptionImplemented is true; otherwise it is not present.
56	HE Operation	The HE Operation element is present when dot11HEOptionImplemented is true; otherwise it is not present.
57	BSS Color Change Announcement	The BSS Color Change Announcement element is optionally present when dot11HEOptionImplemented is true; otherwise it is not pre-sent.

9.3.3.10 Probe Request frame format

Editor's Note: Order: 11ai adds 20-21, 11ah adds 22-27, 11aq adds none, 11ak adds 20 (appears to be out of date), 11aj adds three (numbers unassigned)

Insert the following new row (header row shown for convenience) into Table 9-33 (Probe Request frame body):

Table 9-33—Probe Request frame body

Order	Information	Notes
32	HE Capabilities	The HE Capabilities element is present when dot11HEOptionImplemented is true; otherwise it is not present.

9.3.3.11 Probe Response frame format

Editor's Note: Order: 11ai adds 70-73, 11ah adds 74-84, 11aq adds 85-86, 11ak adds 70 (appears to be out of date), 11aj adds four (numbers unassigned)

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Insert the following new rows into Table 9-34 (Probe Response frame body) (header shown for convenience):

Table 9-34—Probe Response frame body

Order	Information	Notes
92	HE Capabilities	The HE Capabilities element is present when dot11HEOptionImplemented is true; otherwise it is not present.
93	HE Operation	The HE Operation element is present when dot11HEOptionImplemented is true; otherwise it is not present.
94	TWT	The TWT element is optionally present when dot11TWTOptionActivated and dot11HEOptionImplemented is true; otherwise it is not present.
95	RAPS	The RAPS element is optionally present when dot11OFDMARandomAccessOptionImlemented is true; otherwise it is not present.
96	BSS Color Change Announcement	The BSS Color Change Announcement element is optionally present when dot11HEOptionImplemented is true; otherwise it is not pre-sent.

9.4 Management and Extension frame body components

9.4.1 Fields that are not elements

9.4.1.11 Action field

Change Table 9-47 as follows (insert new row and updated reserved row):

Table 9-47—Category values

Code	Meaning	See subclause	Robust	Group addressed privacy
	...			
<ANA>	HE	9.6.28 (HE Action frame details)	No	No
<ANA>	Quiet Time Period	9.6.23a (Quiet Time Period Action frame details)	No	No
~~21~~<ANA>–125	Reserved	—	—	—
	...			

Insert the following subclauses after 9.4.1.61:

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9.4.1.62 HE MIMO Control field

The HE MIMO Control field is included in every HE Compressed Beamforming frame (see 9.4.1.63 (HE Compressed Beamforming Report field)). The HE MIMO Control field is defined in Figure 9-121a (HE MIMO Control field).

B0 B2	B3 B5	B6 B7	B8	B9	B10 B11	B12 B14	B15	B16 B22	B23 B29	B30 B35	B36 B39
Nc Index	Nr Index	BW	Grouping	Codebook Information	Feedback Type	Remaining Feedback Segments	First Feedback Segment	RU Start Index	RU End Index	Sounding Dialog Token Number	Reserved
Bits: 3	3	2	1	1	2	3	1	7	7	6	4

Figure 9-121a—HE MIMO Control field

The subfields for the HE MIMO Control Fields are defined in Table 9-76a (HE MIMO Control field encoding).

Table 9-76a—HE MIMO Control field encoding

Subfield	Description
Nc Index	Indicates the number of columns, *Nc*, in the compressed beamforming feedback matrix minus 1: Set to 0 for *Nc* = 1 Set to 1 for *Nc* = 2 … Set to 7 for *Nc* = 8
Nr Index	Indicates the number of rows, *Nr*, in the compressed beamforming feedback matrix minus 1: Set to 0 for *Nr* = 1 Set to 1 for *Nr* = 2 … Set to 7 for *Nr* = 8
BW	Indicates the channel width used to determine the starting and ending subcarrier indexes when interpreting the RU Start Index and RU End Index subfields. Set to 0 for 20 MHz Set to 1 for 40 MHz Set to 2 for 80 MHz Set to 3 for 160 MHz and 80+80 MHz
Grouping	Indicates the subcarrier grouping, *Ng*, used for the compressed beamforming feedback matrix: Set to 0 for *Ng* = 4 Set to 1 for *Ng* = 16

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Table 9-76a—HE MIMO Control field encoding *(continued)*

Codebook Information	Indicates the size of codebook entries: If Feedback Type is SU: Set to 0 for 2 bits for ψ, 4 bits for ϕ Set to 1 for 4 bits for ψ, 6 bits for ϕ If Feedback Type is MU: Set to 0 for 5 bits for ψ, 7 bits for ϕ Set to 1 for 7 bits for ψ, 9 bits for ϕ NOTE—The codebook size for MU Feedback with *Ng* = 16 is limited to (ϕ, ψ) = {9, 7}
Feedback Type	Indicates the feedback type: Set to 0 for SU Set to 1 for MU Set to 2 for CQI feedback 3 is reserved
Remaining Feedback Segments	Indicates the number of remaining feedback segments for the associated VHT Compressed Beamforming frame: Set to 0 for the last feedback segment of a segmented report or the only feedback segment of an unsegmented report. Set to a value between 1 and 6 for a feedback segment that is neither the first nor the last of a segmented report. Set to a value between 1 and 7 for a feedback segment that is not the last feedback segment of a segmented report. In a retransmitted feedback segment, the field is set to the same value associated with the feedback segment in the original transmission.
First Feedback Segment	Set to 1 for the first feedback segment of a segmented report or the only feedback segment of an unsegmented report. Set to 0 if not the first feedback segment or if the VHT Compressed Beamforming Report field and MU Exclusive Beamforming Report field are not present in the frame. In a retransmitted feedback segment, the field is set to the same value associated with the feedback segment in the original transmission.
RU Start Index	The starting RU index indicates the first 26-tone RU for which the HE beamformer is requesting feedback.
RU End Index	The ending RU index indicates the last 26-tone RU for which the HE beamformer is requesting feedback.
Sounding Dialog Token Number	The ending RU index indicates the last RU26 for which the HE beamformer is requesting feedback.

In an HE Compressed Beamforming frame not carrying all or part of an HE Compressed Beamforming report, the Nc Index, Nr Index, Channel Width, Grouping, Codebook Information, Feedback Type and Sounding Dialog Token Number subfields are reserved, the First Feedback Segment subfield is set to 0 and the Remaining Feedback Segments subfield is set to 7.

9.4.1.63 HE Compressed Beamforming Report field

The HE Compressed Beamforming Report field is used in the HE Compressed Beamforming And CQI frame (see 9.6.28.2 (HE Compressed Beamforming And CQI frame format)) to carry average SNR of each space-time stream and compressed beamforming feedback matrices *V* for use by a transmit beamformer to determine steering matrices *Q*, as described in 10.32.3 (Explicit feedback beamforming) and 19.3.12.3 (Explicit feedback beamforming).

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The size of the HE Compressed Beamforming Report field depends on the values in the HE MIMO Control field. The HE Compressed Beamforming Report field contains HE Compressed Beamforming Report information or successive (possibly zero-length) portions thereof in the case of segmented HE Compressed Beamforming and CQI feedback (see 27.6 (HE sounding protocol)). HE Compressed Beamforming Report information is included in the HE Compressed Beamforming and CQI feedback if an SU feedback type or an MU feedback type is indicated in the Feedback Type field in the HE MIMO Control field.

The HE Compressed Beamforming Report information contains the channel matrix elements indexed, first, by matrix angles in order shown in Table 9-67 (Order of angles in the Compressed Beamforming Feedback Matrix subfield), and second, by data and pilot subcarrier index from lowest frequency to highest frequency. The explanation on how these angles are generated from the beamforming feedback matrix *V* is given in 19.3.12.3.6 (Compressed beamforming feedback matrix) in Table 9-67 (Order of angles in the Compressed Beamforming Feedback Matrix subfield), *Nc* is the number of columns in a compressed beamforming feedback matrix determined by the Nc Index field of the HE MIMO Control field, *Nr* is the number of rows in a compressed beamforming feedback matrix determined by the Nr Index field of the HE MIMO Control field.

The beamforming feedback matrix *V* is formed by the beamformee as follows. The beamformer transmits an NDP with $N_{STS,NDP}$ space-time streams, where $N_{STS,NDP}$ may take a value between 2 and 8. Based on this NDP, the beamformee estimates the $N_{RX,BFEE} \times N_{STS,NDP}$ channel, and based on that channel it determines a $Nr \times Nc$ orthogonal matrix *V*, where *Nr* and *Nc* satisfy Equation (8-1).

Further restrictions on *Nc* are described in 28.2 (HE PHY service interface). The angles are quantized as defined in Table 9-68 (Quantization of angles).

The HE Compressed Beamforming Report information has the same structure and order defined in Table 9-76b (HE Compressed Beamforming Report information).

Table 9-76b—HE Compressed Beamforming Report information

Field	Size (bits)	Meaning
Average SNR of Space-Time Stream 1	8	Signal-to-noise ratio at the beamformee for space-time stream 1 averaged over all data subcarriers. See Table 9-71 (Average SNR of Space-Time Stream i subfield).
...		...
Average SNR of Space-Time Stream Nc	8	Signal-to-noise ratio at the beamformee for space-time stream Nc averaged over all data subcarriers. See Table 9-71 (Average SNR of Space-Time Stream i subfield).
Compressed Beamforming Feedback Matrix *V* for subcarrier $k = scidx(0)$	$Na \times (b_\psi + b_\phi)/2$	Compressed beamforming feedback matrix defined in Table 9-67 (Order of angles in the Compressed Beamforming Feedback Matrix subfield).
Compressed Beamforming Feedback Matrix *V* for subcarrier $k = scidx(1)$	$Na \times (b_\psi + b_\phi)/2$	Compressed beamforming feedback matrix defined in Table 9-67 (Order of angles in the Compressed Beamforming Feedback Matrix subfield).

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Table 9-76b—HE Compressed Beamforming Report information *(continued)*

Compressed Beamforming Feedback Matrix *V* for subcarrier $k = scidx(2)$	$Na \times (b_\psi + b_\phi)/2$	Compressed beamforming feedback matrix defined in Table 9-67 (Order of angles in the Compressed Beamforming Feedback Matrix subfield).
...		...
Compressed Beamforming Feedback Matrix *V* for subcarrier $k = scidx(Ns - 1)$	$Na \times (b_\psi + b_\phi)/2$	Compressed beamforming feedback matrix defined in Table 9-67 (Order of angles in the Compressed Beamforming Feedback Matrix subfield).

In Table 9-76b (HE Compressed Beamforming Report information), *Ns* is the number of subcarriers for which the Compressed Beamforming Feedback Matrix subfield is sent back to the beamformer. A beamformee may choose to reduce Ns by using a method referred to as grouping, in which only a single Compressed Beamforming Feedback Matrix is reported for each group of *Ng* adjacent subcarriers. For HE Compressed Beamforming Report, *Ns* is a function of the RU Start Index, RU End Index and Grouping subfields in the HE MIMO Control field (see 9.4.1.62 (HE MIMO Control field)). Subcarriers *scidx(0)* and *scidx(Ns – 1)* represent the S (Start)-tone corresponding to the RU Start Index and E (End)-tone corresponding to the RU End Index, respectively.

For 40 MHz and 80 MHz, when the aforementioned S-tone and E-tone indices lie on the same side of DC, $scidx(i) = scidx(i - 1) + Ng$, where $1 \le i \le Ns - 2$. However, when the S-tone and E-tone indices lie on different sides of DC, the following relationships hold separately for the two sides of DC.

For the left of DC, $scidx(i) = scidx(i - 1) + Ng$, where $1 \le i \le L$ and $scidx(L) = -4$.

For the right of DC, $scidx(i) = scidx(i - 1) + Ng$, where $L + 2 \le i \le Ns - 2$ and $scidx(L + 1) = 4$.

The S-tone and E-tone corresponding to the possible RU indices are listed in Table 9-76c (Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for Ng = 4) for $Ng = 4$ and Table 9-76d (Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for Ng = 16) for $Ng = 16$. For 160 MHz, to determine the S-tone and E-tone, RUs 37 to 73 occupying the higher 80 MHz use the same entries in Table 9-76c (Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for Ng = 4) and Table 9-76d (Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for Ng = 16) as RUs 0 to 36 occupying the lower 80 MHz. For 20 MHz, $scidx(i)$, where $1 \le i \le Ns - 2$, includes all subcarrier indices between the S-tone and the E-tone subcarrier indices described in Table 9-76e (Feedback subcarrier indices for 20 MHz bandwidth for Ng = 4 and Ng = 16) for $Ng = 4$ and $Ng = 16$.

Table 9-76c—Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for *Ng* = 4

80 MHz 26-tone RU Index	80 MHz (S, E) FB tone	40 MHz 26-tone RU Index	40 MHz (S, E) FB tone	20 MHz 26-tone RU Index	20 MHz (S, E) FB tone

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Table 9-76c—Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for *Ng* = 4 *(continued)*

0	–500, –472	0	= (S, E) for 80 MHz + 256		
1	–476, –448	1			
2	–448, –420	2			
3	–420, –392	3			
4	–392, –364	4			
5	–368, –340	5			
6	–340, –312	6			
7	–312, –284	7			
8	–288, –260	8			
9	–260, –232				
10	–232, –204				
11	–204, –176				
12	–180, –152				
13	–152, –124				
14	–124, –96			0	–122, –96
15	–100, –72			1	= (S, E) for 80 MHz + 4
16	–72, –44			2	
17	–44, –16			3	= (S, E) for 80 MHz
18	–16, 16			4	
19	16, 44			5	
20	44, 72			6	= (S, E) for 80 MHz – 4
21	72, 100			7	
22	96, 124			8	
23	124, 152				
24	152, 180				
25	176, 204				
26	204, 232				

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Table 9-76c—Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for *Ng* = 4 *(continued)*

27	232, 260				
28	260, 288	9	= (S, E) for 80 MHz – 256		
29	284, 312	10			
30	312, 340	11			
31	340, 368	12			
32	364, 392	13			
33	392, 420	14			
34	420, 448	15			
35	448, 476	16			
36	472, 500	17			

Table 9-76d—Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for *Ng* = 16

80 MHz 26-tone RU index	80 MHz (S, E) FB tone	40 MHz 26-tone RU index	40 MHz (S, E) FB tone	20 MHz 26-tone RU index	20 MHz (S, E) FB tone
0	–500, –468	0	= (S, E) for 80 MHz + 256		
1	–484, –436	1			
2	–452, –420	2			
3	–420, –388	3			
4	–404, –356	4			
5	–372, –340	5			
6	–340, –308	6			
7	–324, –276	7			
8	–292, –260	8			
9	–260, –228				
10	–244, –196				
11	–212, –164				
12	–180, –148				

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Table 9-76d—Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for *Ng* = 16 *(continued)*

13	–164, –116				
14	–132, –84			0	–122, –96
15	–100, –68			1	= (S, E) for 80 MHz + 4
16	–84, –36			2	
17	–52, –4			3	= (S, E) for 80 MHz
18	–20, 20			4	
19	4, 52			5	
20	36, 84			6	= (S, E) for 80 MHz – 4
21	68, 100			7	
22	84, 132			8	
23	116, 164				
24	148, 180				
25	164, 212				
26	196, 244				
27	228, 260				
28	260, 292	9	= (S, E) for 80 MHz – 256		
29	276, 324	10			
30	308, 340	11			
31	340, 372	12			
32	356, 404	13			
33	388, 420	14			
34	420, 452	15			
35	436, 484	16			
36	468, 500	17			

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Table 9-76e—Feedback subcarrier indices for 20 MHz bandwidth for *Ng* = 4 and *Ng* = 16

Ng	Subcarrier indeces
4	−122, −120, −116, −112, −108, −104, −100, −96, −92, −88, −84, −80, −76, −72, −68, −64, −60, −56, −52, −48, −44, −40, −36, −32, −28, −24, −20, −16, −12, −8, −4, −2, 2, 4, 8, 12, 16, 20, 24, 28, 32, 36, 40, 44, 48, 52, 56, 60, 64, 68, 72, 76, 80, 84, 88, 92, 96, 100, 104, 108, 112, 116, 120, 122
16	−122, −116, −100, −84, −68, −52, −36, −20, −4, −2, 2, 4, 20, 36, 52, 68, 84, 100, 116, 122

The Average SNR of Space-Time Stream *i* subfield in Table 9-76b (HE Compressed Beamforming Report information) is an 8-bit twos complement integer defined in Table 9-71 (Average SNR of Space-Time Stream i subfield).

The $AvgSNR_i$ in Table 9-71 (Average SNR of Space-Time Stream i subfield) is found by computing the SNR per subcarrier in decibels for the subcarriers identified in Table 9-76c (Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for Ng = 4) for *Ng* = 4 and Table 9-76d (Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for Ng = 16) for *Ng* = 16, and then computing the arithmetic mean of those values. Each SNR value per subcarrier in stream *i* (before being averaged) corresponds to the SNR associated with the column *i* of the beamforming feedback matrix *V* determined at the beamformee. Each SNR corresponds to the predicted SNR at the beamformee when the beamformer applies all columns of the matrix *V*.

For HE beamformee, supporting *Ng* = 16 in the HE Compressed Beamforming Report field is optional for both SU and MU feedback types. A beamformer shall not request *Ng* = 16 in an HE NDP Announcement frame if the beamformee does not indicate support for *Ng* = 16 in the HE Capabilities element it transmits (see 9.4.2.218 (HE Capabilities element)).

For an HE beamformee, supporting the codebook size $(\phi, \psi) = \{4, 2\}$ in the HE Compressed Beamforming Report field is optional for SU feedback type. A beamformer shall not request codebook size $(\phi, \psi) = \{4, 2\}$ in an HE NDP Announcement frame if the beamformee does not indicate support for the codebook size $(\phi, \psi) = \{4, 2\}$ in the HE Capabilities element it transmits (see 9.4.2.218 (HE Capabilities element)).

For an HE beamformee, supporting codebook size $(\phi, \psi) = \{7, 5\}$ in the HE Compressed Beamforming Report field is optional for MU feedback type. A beamformer shall not request the codebook size $(\phi, \psi) = \{7, 5\}$ in an HE NDP Announcement frame if the beamformee does not indicate support for the codebook size $(\phi, \psi) = \{7, 5\}$ in the HE Capabilities element it transmits (see 9.4.2.218 (HE Capabilities element)).

9.4.1.64 HE MU Exclusive Beamforming Report field

The MU Exclusive Beamforming Report field is used by the HE Compressed Beamforming And CQI frame (see 9.6.28.2 (HE Compressed Beamforming And CQI frame format)) to carry explicit feedback in the form of delta SNRs. The information in the HE Compressed Beamforming Report field and the HE MU Exclusive Beamforming Report field can be used by the transmit MU beamformer to determine the steering matrices *Q*, as described in 28.3.3.8 (DL MU-MIMO).

The size of the HE MU Exclusive Beamforming Report field depends on the values in the HE MIMO Control field. The HE MU Exclusive Beamforming Report field contains HE MU Exclusive Beamforming Report information or successive (possibly zero-length) portions thereof in the case of segmented HE Compressed Beamforming and CQI feedback (see 27.6 (HE sounding protocol)). HE Compressed

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Beamforming Report information and HE MU Exclusive Beamforming Report information are included in the HE Compressed Beamforming and CQI feedback if the MU feedback type is indicated in the Feedback Type field in the HE MIMO Control field.

The HE MU Exclusive Beamforming Report information consists of Delta SNR subfields for each of the space-time stream (1 to *Nc*) of a subset of subcarriers typically spaced *Ng* apart, where *Ng* is signaled in the Grouping subfield of the HE MIMO Control field. Starting from the lowest frequency subcarrier and continuing to the highest frequency subcarrier. Specifically, the locations of the feedback subcarriers for delta SNR subfield shall be identical to the subcarrier locations of the compressed *V* matrices feedback.

No padding is present between $\Delta SNR_{k,i}$, in the HE MU Exclusive Beamforming Report field, even if they correspond to different subcarriers. The subset of subcarriers included is determined by the values of the RU Start Index, RU End Index, and Grouping subfield of the HE MIMO Control field. For each subcarrier included, the deviation in dB of the SNR of that subcarrier for each column of *V* relative to the average SNR of the corresponding space-time stream is computed using Equation (9-2).

The HE MU Exclusive Beamforming Report information has the same structure and order Table 9-76f (HE MU Exclusive Beamforming Report information).

Table 9-76f—HE MU Exclusive Beamforming Report information

Field	Size (bits)	Meaning
Delta SNR for space-time stream 1 for subcarrier $k = scidx(0)$	4	$\Delta SNR_{scidx(0),1}$ as defined in Equation (9-2).
...		...
Delta SNR for space-time stream *Nc* for subcarrier $k = scidx(0)$	4	$\Delta SNR_{scidx(0),Nc}$ as defined in Equation (9-2).
Delta SNR for space-time stream 1 for subcarrier $k = scidx(1)$	4	$\Delta SNR_{scidx(1),1}$ as defined in Equation (9-2).
...		...
Delta SNR for space-time stream *Nc* for subcarrier $k = scidx(1)$	4	$\Delta SNR_{scidx(1),Nc}$ as defined in Equation (9-2).
...		...
Delta SNR for space-time stream 1 for subcarrier $k = scidx(Ns - 1)$		$\Delta SNR_{scidx(Ns-1),1}$ as defined in Equation (9-2).
...		...
Delta SNR for space-time stream *Nc* for subcarrier $k = scidx(Ns - 1)$		$\Delta SNR_{scidx(Ns-1),Nc}$ as defined in Equation (9-2).

In Table 9-76f (HE MU Exclusive Beamforming Report information), *Ns* and *scidx()* are defined in 9.4.1.63 (HE Compressed Beamforming Report field).

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9.4.1.65 HE CQI-only Report field

The HE CQI-only Report field is used by the HE Compressed Beamforming And CQI frame (see 9.6.28.2 (HE Compressed Beamforming And CQI frame format)) to carry the per-RU average SNRs of each space-time stream, where each per-RU average SNR is the arithmetic mean of the SNR in decibels over a 26-tone RU for which the feedback is being requested.

The size of the HE Compressed Beamforming Report field depends on the values in the HE MIMO Control field. The HE Compressed Beamforming Report field contains HE CQI-only Report information or successive (possibly zero-length) portions thereof in the case of segmented HE Compressed Beamforming and CQI feedback (see 27.6 (HE sounding protocol)). HE CQI-only Report information is included in the HE Compressed Beamforming and CQI feedback if the CQI-only feedback type is indicated in the Feedback Type field of the HE MIMO Control field. The structure of the HE CQI-only Report field is shown in Table 9-76g (HE CQI-only Report information).

Table 9-76g—HE CQI-only Report information

Field	Size (bits)	Meaning
Average SNR for space-time stream 1 for RU index $k = ruidx(0)$	6	SNR at the beamformee for space-time stream 1 averaged over 26-tone RU. See Table 9-76h (Average SNR of RU index k for space-time stream i subfield).
...		
Average SNR for space-time stream *Nc* for RU index $k = ruidx(0)$	6	SNR at the beamformee for space-time stream *Nc* averaged over 26-tone RU. See Table 9-76h (Average SNR of RU index k for space-time stream i subfield).
Average SNR for space-time stream 1 for RU index $k = ruidx(1)$	6	SNR at the beamformee for space-time stream 1 averaged over 26-tone RU. See Table 9-76h (Average SNR of RU index k for space-time stream i subfield).
...		
Average SNR for space-time stream *Nc* for RU index $k = ruidx(1)$	6	SNR at the beamformee for space-time stream *Nc* averaged over 26-tone RU. See Table 9-76h (Average SNR of RU index k for space-time stream i subfield).
...		
Average SNR for space-time stream 1 for RU index $k = ruidx(Ncqi - 1)$	6	SNR at the beamformee for space-time stream 1 averaged over 26-tone RU. See Table 9-76h (Average SNR of RU index k for space-time stream i subfield).
...		
Average SNR for space-time stream *Nc* for RU index $k = ruidx(Ncqi - 1)$	6	SNR at the beamformee for space-time stream *Nc* averaged over 26-tone RU. See Table 9-76h (Average SNR of RU index k for space-time stream i subfield).

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Ncqi is the number of RU indices for which the CQI-only report is sent back to the beamformer. *Ncqi* is a function of the RU Start Index and RU End Index subfields in the HE MIMO Control field. The RU indices *ruidx*(0) and *ruidx*(*Ncqi* − 1) correspond to the RU Start Index and RU End Index subfields, respectively. The RU index *ruidx*(*i*) = *ruidx*(*i* − 1) + 1, where $1 \le i \le Ncqi - 2$.

The Average SNR of space-time stream *i* for the RU index *k* subfield in the Table 9-76g (HE CQI-only Report information) is an 6-bit twos complement integer whose definition is shown in Table 9-76h (Average SNR of RU index k for space-time stream i subfield).

Table 9-76h—Average SNR of RU index *k* for space-time stream *i* subfield

Average SNR of RU index *k* for space-time stream *i*	$AvgSNR_{k,i}$ (dB)
−32	≤ −10
−31	−9
−30	−8
...	
30	52
31	≥ 53

The $AvgSNR_{k,i}$ in Table 9-76h (Average SNR of RU index k for space-time stream i subfield) is found by computing the arithmetic mean of the SNR per subcarrier in decibels for space-time stream *i* over the subcarriers in RU index *k* for which the feedback is being requested.

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9.4.2 Elements

9.4.2.1 General

Insert the following new rows into Table 9-77 (Element IDs) (header row shown for convenience):

Table 9-77—Element IDs

Element	Element ID	Element ID Extension	Extensible
HE Capabilities (see 9.4.2.213 (HE Capabilities element))	<ANA>	N/A	Yes
HE Operation (see 9.4.2.214 (HE Operation element))	<ANA>	N/A	Yes
RAPS element (see 9.4.2.220 (OFDMA-based Random Access Parameter Set (RAPS) element))	255	<ANA>	Yes
MU EDCA Parameter Set (see 9.4.2.221 (MU EDCA Parameter Set element))	255	<ANA>	Yes

9.4.2.3 Supported Rates and BSS Membership Selectors element

Insert a new last row in Table 9-78 (BSS membership selector value encoding) as follows:

Table 9-78—BSS membership selector value encoding

Value	Feature	Interpretation
125	HE PHY	Support for the mandatory features of Clause 28 (High Efficiency (HE) PHY specification) is required in order to join the BSS that was the source of the Supported Rates and BSS Membership Selectors element or Extended Supported Rates and BSS Membership Selectors element containing this value.

9.4.2.6 TIM element

Insert the following at the end of the subclause:

When included in TIM frames and FILS discovery frames at the beginning of a broadcast TWT SP by an HE AP:

— The DTIM count field is reserved

— The DTIM period is reserved

— Bit number *N* in the traffic indication virtual bitmap that corresponds to an HE non-AP STA with AID *N* is determined as follows:

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- Bit number *N* in the traffic indication virtual bitmap is 0 if the AP does not intend to transmit to the STA or to trigger the STA for an UL MU transmission during the TWT SP and before the next TWT SP.
- Otherwise, bit number *N* in the traffic indication virtual bitmap is 1.

9.4.2.27 Extended Capabilities element

Insert the following rows into Table 9-135 (Extended Capabilities element) (header row shown for convenience):

Table 9-135—Extended Capabilities element

Bit	Information	Notes
<ANA>	TWT Requester Support	A STA sets the TWT Requester Support field to 1 when dot11TWTOptionActivated is true, and sets it to 0 otherwise. See 11.11.9.9 (TWT section).
<ANA>	TWT Responder Support	A STA sets the TWT Responder Support field to 1 when dot11TWTOptionActivated is true, and sets it to 0 otherwise. See 11.11.9.9 (TWT section).

9.4.2.139 ADDBA Extension element

Change Figure 9-531 (ADDBA Capabilities field format) as follows:

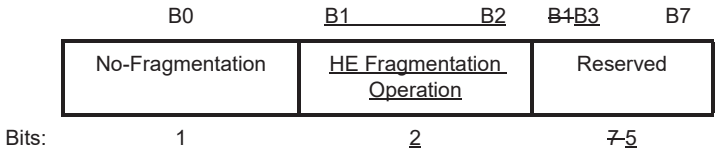

Figure 9-531—ADDBA Capabilities field format

Change the last paragraph as follows:

The No-Fragmentation subfield determines whether a fragmented MSDU can be carried in the MPDU sent under the block ack agreement. When this subfield set to 1 in the ADDBA Request frame, it indicates that the non-HE originator is not fragmenting sent MSDUs. When this subfield set to 1 in the ADDBA Response frame, it indicates that the non-HE recipient is not capable of receiving fragmented MSDUs. The No-Fragmentation subfield is reserved when transmitted by an HE STA.

Insert the following as the new last paragraph:

The HE fragmentation Operation subfield is reserved when transmitted by a non-HE STA. The HE fragmentation operation subfield when transmitted by an HE STA indicates the level of dynamic fragmentation that is supported as a recipient for the TID which is defined in the ADDBA frame as follows:

— A value of 0 in the ADDBA Request frame indicates that the originator does not intend to send fragmented MSDUs for the TID specified in the Block Ack Parameter Set field of the ADDBA Request frame.

— When this subfield set to 1 in the ADDBA Request frame, it indicates that the originator intends to send fragmented MSDUs under fragmentation level 1 (see 27.3.3.2 (Level 1 dynamic

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fragmentation)) for the TID specified in the Block Ack Parameter Set field of the ADDBA Request frame.

— When this subfield set to 2 in the ADDBA Request frame, it indicates that the originator intends to send fragmented MSDUs under fragmentation level 2 (see 27.3.3.3 (Level 2 dynamic fragmentation)) for the TID specified in the Block Ack Parameter Set field of the ADDBA Request frame.

— When this subfield set to 0 in the ADDBA Response frame, it indicates that the recipient is not capable of receiving fragmented MSDUs for the TID specified in the Block Ack Parameter Set field of the ADDBA Response frame.

— When this subfield set to 1 in the ADDBA Response frame, it indicates that the recipient is capable of receiving fragmented MSDUs under fragmentation level 1 only for the TID specified in the Block Ack Parameter Set field of the ADDBA Response frame.

— When this subfield set to 2 in the ADDBA Response frame, it indicates that the recipient is capable of receiving fragmented MSDUs under fragmentation levels 1 and 2 for the TID specified in the Block Ack Parameter Set field of the ADDBA Response frame.

9.4.2.200 TWT element

Change Figure 9-589av (TWT element format) as follows (add arrow and associated text):

Repeat for each TWT parameter set when the Broadcast field is 1

	Element ID	Length	Control	Request Type	Target Wake Time	TWT Group Assignment	Nominal Minimum TWT Wake Duration	TWT Wake Interval Mantissa	Broadcast TWT ID	TWT Channel	NDP Paging (optional)
Octets:	1	1	1	2	8 or 0	9 or 3 or 0	1	2	0 or 1	1	0 or 4

Figure 9-589av—TWT element format

Change Figure 9-589aw (Control field format) as follows.

	B1	B2	B3	B4	~~B3~~B5 B8
	NDP Paging Indicator	Responder PM Mode	Broadcast	Wake TBTT Negotiation	Reserved
Bits:	1	1	1	1	~~6~~4

Figure 9-589aw—Control field format

Insert the following two paragraphs after the 5th paragraph ("The Responder PM Mode subfield..."):

The Broadcast field indicates if the TWT SP(s) indicated by the TWT element are for broadcast or individual TWT(s) as defined in 10.43 (Target wake time (TWT)). The Broadcast field is 1 to indicate that the TWT SP(s) defined by the TWT element are associated with broadcast TWT(s). The Broadcast field is 0, otherwise.When the Broadcast field is 1 then one or more TWT parameter sets are contained in the TWT element where the TWT parameter set is the set of subfields that occur after the Control subfield. Otherwise, only one TWT parameter set is contained in the TWT element. An S1G STA sets the Broadcast field to 0.

The Wake TBTT Negotiation subfield indicates that the scheduled STA transmitting the TWT element is indicating a value for the next wake TBTT for a broadcast TWT in the Target Wake Time field and is

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indicating a value for a wake interval between Beacon frames in the TWT Wake Interval Mantissa and TWT Wake Interval Exponent fields as described in 27.7.3.4 (Negotiation of wake TBTT and listen interval). The Wake TBTT Negotiation subfield is set to 0 in TWT elements transmitted by a responding STA and by a scheduling STA.

Change Figure 9-589ax (Request Type field format) as follows (B4 from "Reserved" to "Trigger").

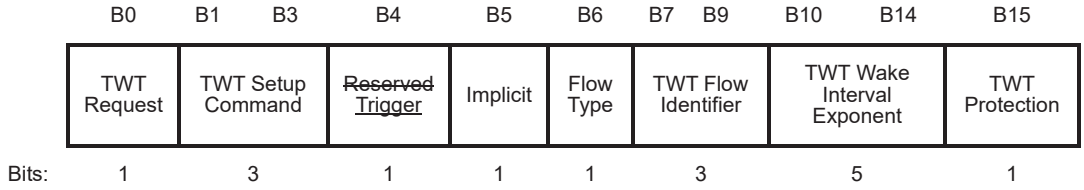

Figure 9-589ax—Request Type field format

Change Table 9-257l (TWT Setup Command field values) as follows:

Table 9-262k—TWT Setup Command field values

TWT Setup Command field value	Command name	Description when transmitted by a TWT requesting STA, Wake TBTT Negotiation subfield = 0	Description when transmitted by a TWT responding STA, Wake TBTT Negotiation subfield = 0	Description when transmitted by a TWT scheduled STA, Wake TBTT Negotiation subfield = 1	Description when transmitted by a TWT scheduling STA, Wake TBTT Negotiation subfield = 1
0	Request TWT	The Target Wake Time field of the TWT element contains 0s as the TWT responding STA specifies the target wake time value for this case, other TWT parameters* are suggested by the TWT requesting STA in the TWT request.	N/A	N/A	N/A
1	Suggest TWT	TWT requesting STA includes a set of TWT parameters such that if the requested target wake time value and/or other TWT parameters cannot be accommodated, then the TWT setup might still be accepted.	N/A	The Target Wake Time field of the TWT element contains 0s as the TWT scheduling STA specifies the target wake time value for this case, other TWT parameters are suggested by the TWT scheduled STA in the TWT request.	N/A

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Table 9-262k—TWT Setup Command field values *(continued)*

2	Demand TWT	TWT requesting STA includes a set of TWT parameters such that if the requested target wake time value and/or other TWT parameters cannot be accommodated, then the TWT setup will be rejected.	N/A	The Target Wake Time field of the TWT element contains 0s as the TWT scheduling STA specifies the target wake time value for this case, other TWT parameters are demanded by the TWT scheduled STA in the TWT request.	N/A
3	TWT Grouping	N/A	TWT responding STA suggests TWT group parameters that are different from the suggested or demanded TWT parameters of the TWT requesting STA	N/A	N/A
4	Accept TWT	N/A	TWT responding STA accepts the TWT request with the TWT parameters (See NOTE) indicated in the TWT element transmitted by the responding STA	N/A	TWT scheduling STA accepts the TWT request with the TWT parameters (see NOTE) indicated in the TWT element transmtted by the TWT scheduled STA.
5	Alternate TWT	N/A	TWT responding STA suggests TWT parameters that are different from TWT requesting STA suggested or demanded TWT parameters	N/A	N/A

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Table 9-262k—TWT Setup Command field values *(continued)*

6	Dictate TWT	N/A	TWT responding STA demands TWT parameters that are different from TWT requesting STA TWT suggested or demanded parameters	N/A	N/A
7	Reject TWT	N/A	TWT responding STA rejects TWT setup	N/A	TWT scheduling STA rejects TWT setup

NOTE—TWT Parameters are: TWT, Nominal Minimum Wake Duration, TWT Wake Interval and TWT Channel subfield values indicated in the element. The Trigger subfield value indicated in the element is also a TWT parameter for an HE STA.

Insert the following paragraph after the 8th paragraph ("The TWT Setup Command subfield values..."):

The Trigger field indicates if the TWT SP indicated by the TWT element includes Trigger frames as defined in 10.43 (Target wake time (TWT)). The Trigger field is set to 1 to indicate that at least one Trigger frame is transmitted during the TWT SP. The Trigger field is set to 0 otherwise.

Change the 9th paragraph as follows:

The TWT Flow Identifier subfield contains a 3-bit value which identifies the specific information for this TWT request uniquely from other requests made between the same TWT requesting STA and TWT responding STA pair. For a TWT SP that is indicated in a TWT response transmission that is a broadcast TWT SP, the TWT Flow Identifier subfield contains a value that indicates recommendations on the types of frames that are transmitted by scheduled STAs during the broadcast TWT SP, encoded according to Table 9-262k1 (TWT Flow Identifier field for a broadcast TWT element).

Insert a new table as follows:

Table 9-262k1—TWT Flow Identifier field for a broadcast TWT element

TWT Flow Identifier field value	Description when transmitted in a broadcast TWT element
0	No constraints on the frames transmitted during a broadcast TWT SP.

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Table 9-262k1—TWT Flow Identifier field for a broadcast TWT element

1	Frames transmitted during a broadcast TWT SP by a TWT scheduled STA are recommended to be limited to: — Frames with reduced payload sizes that deliver control feedback: • PS-Poll and QoS Null frames • Feedback can be contained is the QoS Control field or in the HE variant HT Control field of the frame, whichever is present (see 27.5.1 (HE DL MU operation), 27.5.2 (UL MU operation), 27.8 (Operating mode indication), 25.14 (Link adaptation using the HE variant HT Control field), etc.) — Frames that are sent as part of a sounding feedback exchange (see 27.6 (HE sounding protocol)) — Management frames • Action, or Action No Ack frames There are no restrictions on the frames transmitted by the scheduling STA of the broadcast TWT SP. Trigger frames transmitted by the AP during the broadcast TWT SP will not contain RUs for random access (see 27.7.3.2 (Rules for TWT scheduling STA)).
2	Frames transmitted during a broadcast TWT SP by a TWT scheduled STAT are recommended to be limited to: — Frames with reduced payload sizes that deliver control feedback: • PS-Poll and QoS Null frames • Feedback can be contained is the QoS Control field or in the HE variant HT Control field of the frame, whichever is present (see 27.5.1 (HE DL MU operation), 27.5.2 (UL MU operation), 27.8 (Operating mode indication), 25.14 (Link adaptation using the HE variant HT Control field), etc.) — Frames that are sent as part of a sounding feedback exchange (see 27.6 (HE sounding protocol)) — Management frames • Action, Action No Ack frames or (Re-)Association Request frames There are no restrictions on the frames transmitted by the scheduling STA of the broadcast TWT SP. Trigger frames transmitted by the AP during the broadcast TWT SP will contain at least one RU for random access (see 27.7.3.2 (Rules for TWT scheduling STA)).
3	No constraints on the frames transmitted during a broadcast TWT SP. The AP transmits a TIM frame or a FILS discovery frame including a TIM element at the beginning of the TWT SP.
4-7	Reserved

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Change the 10th paragraph as follows:

In a TWT element transmitted by a TWT requesting or scheduled STA, the TWT wake interval is equal to the average time that the TWT requesting STA expects to elapse between successive TWT SPs. In a TWT element transmitted by a TWT responding or scheduling STA, the TWT wake interval is equal to the average time that the TWT responding STA expects to elapse between successive TWT SPs. In a TWT element contained in a TWT request that is sent by the scheduled STA to negotiate the wake intervals for Beacon frames that contain a TWT element that indicates a broadcast TWT, the TWT wake interval indicates the value of the listen interval (see 10.44.3.4 (Negotiation of TBTT and listen interval)). The TWT Wake Interval Exponent subfield is set to the value of the exponent of the TWT wake interval value in microseconds, base 2. The TWT wake interval of the requesting STA is equal to (TWT Wake Interval Mantissa) × $2^{(\text{TWT Wake Interval Exponent})}$.

Change the 11th paragraph as follows:

When transmitted by a TWT requesting STA or a TWT scheduled STA, the Target Wake Time field contains a positive integer which corresponds to a TSF time at which the STA requests to wake, or a value of zero when the TWT Setup Command subfield contains the value corresponding to the command "Request TWT". The Target Wake Time field is 8 octets when the Broadcast field is 0; otherwise it is 2 octets with the lowest bit of the 2 octets corresponding to bit 4 of the relevant TSF value. When a TWT responding STA or a TWT scheduling STA with dot11TWTGroupingSupport equal to 0 transmits a TWT element to the TWT requesting STA, the TWT element contains a value in the Target Wake Time field which corresponds to a TSF time at which the TWT responding STA requests the TWT requesting STA or TWT scheduled STA to wake for the corresponding TWT SP and it does not contain the TWT Group Assignment field.

Insert the following paragraph after paragraph 21 ("The TWT Wake Interval Mantissa..."):

The Broadcast TWT ID subfield is present if the Broadcast subfield in the Control subfield has a value of 1, otherwise the Broadcast TWT ID subfield is not present. Within a TWT element that includes a TWT setup command value of Request TWT, Suggest TWT or Demand TWT, the Broadcast TWT ID, if present, indicates a specific Broadcast TWT in which the transmitting STA is requesting to participate. Within a TWT element that includes a TWT setup command value of Accept TWT, Alternate TWT, Dictate TWT or Reject TWT, the Broadcast TWT ID, if present, indicates a specific Broadcast TWT for which the transmitting STA is providing TWT parameters. Within a TWT element that includes a TWT setup command value of TWT Grouping, the Broadcast subfield is 0 and the Broadcast TWT ID, is not present. The value 0 in the Broadcast TWT ID subfield indicates the special broadcast TWT whose membership corresponds to all STAs that are members of the BSS corresponding to the BSSID of the management frame carrying the TWT element.

Change the 22nd and subsequent two paragraphs as follows:

When transmitted by a TWT requesting STA, the TWT Channel field contains a bitmap indicating which channel the STA requests to use as a temporary primary channel during a TWT SP. When transmitted by a TWT responding STA, the TWT Channel field contains a bitmap indicating which channel the TWT requesting STA is allowed to use as a temporary channel during the TWT SP. Each bit in the bitmap corresponds to one minimum width channel for the band in which the TWT responding STA's associated BSS is currently operating, with the least significant bit corresponding to the lowest numbered channel of the operating channels of the BSS.The minimum width channel is equal to the SST Channel Unit field of the SST Operation element if such an element has been previously received or is equal to 1 MHz for a BSS with a BSS primary channel width of 1 MHz and 2 MHz for a BSS with a BSS primary channel width of 2 MHz if no such element has been previously received from the AP to which the SST STA is associated. A value of 1 in a bit position in the bitmap transmitted by a TWT requesting STA means that operation with that channel as the primary channel is requested during a TWT SP. A value of 1 in a bit position in the bitmap

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transmitted by a TWT responding STA means that operation with that channel as the primary channel is allowed during the TWT SP. The TWT Channel field is not present when the TWT Broadcast field has the value 1.

~~A TWT requesting STA sets the TWT Protection subfield to 1 to request the TWT responding STA to provide protection of the set of TWT SPs corresponding to the requested TWT flow identifier by allocating RAW(s) that restrict access to the medium during the TWT SP(s) for that(those) TWTs. A TWT requesting STA sets the TWT Protection subfield to 0 if TWT protection by RAW allocation is not requested for the corresponding TWT(s).~~

A TWT requesting STA sets the TWT Protection subfield to 1 to request the TWT responding STA to provide protection of the set of TWT SPs corresponding to the requested TWT flow identifier by:

— Allocating RAW(s) that restrict access to the medium during the TWT SP(s) for that (those) TWTs that are set up within an S1G BSS

— Enabling NAV protection during the TWT SP(s) for that (those) TWTs that are set up within an HE BSS

A TWT requesting STA sets the TWT Protection subfield to 0 if TWT protection by RAW allocation is not requested for the corresponding TWT(s).

A TWT scheduled STA sets the TWT Protection subfield to 0.

~~When transmitted by a TWT responding STA that is an AP, the TWT Protection subfield indicates whether the TWT SP(s) identified in the TWT element will be protected. A TWT responding STA sets the TWT Protection subfield to 1 to indicate that the TWT SP(s) corresponding to the TWT flow identifier(s) of the TWT element will be protected by allocating RAW(s) that restrict access to the medium during the TWT SP(s) for that(those) TWT(s). A TWT responding STA sets the TWT Protection subfield to 0 to indicate that the TWT SP(s) identified in the TWT element might not be protected from TIM STAs by allocating RAW(s).~~

When transmitted by a TWT responding STA or TWT scheduling STA that is an AP, the TWT Protection subfield indicates whether the TWT SP(s) identified in the TWT element will be protected. A TWT responding STA or TWT scheduling STA sets the TWT Protection subfield to 1 to indicate that the TWT SP(s) corresponding to the TWT flow identifier(s) of the TWT element will be protected by:

— Allocating RAW(s) that restrict access to the medium during the TWT SP(s) for that (those) TWT(s) when the responding STA or scheduling STA is an S1G STA.

— Enabling NAV protection during the TWT(s) for that (those) TWTs when the responding STA or scheduling STA is not an S1G STA

A TWT responding STA or TWT scheduling STA sets the TWT Protection subfield to 0 to indicate that the TWT SP(s) identified in the TWT element might not be protected.

Insert the following new subclauses after the last subclause in 9.4.2:

9.4.2.218 HE Capabilities element

9.4.2.218.1 General

An HE STA declares that it is an HE STA by transmitting the HE Capabilities element.

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The HE Capabilities element contains a number of fields that are used to advertise the HE capabilities of an HE STA. The HE Capabilities element is defined in Figure 9-589cj (HE Capabilities element format)..

	Element ID	Length	HE MAC Capabilities Information	HE PHY Capabilities Information	Tx Rx HE MCS NSS Support	PPE Thresholds (optional)
Octets:	1	1	5	9	2 or more	variable

Figure 9-589cj—HE Capabilities element format

The Element ID and Length fields are defined in 9.4.2.1 (General).

The HE MAC Capabilities Information, HE PHY Capabilities Information, Tx Rx HE MCS NSS Support, and PPE Thresholds fields are defined in the subclauses below.

9.4.2.218.2 HE MAC Capabilities Information field

The format of the HE MAC Capabilities Information field is defined in Figure 9-589ck (HE MAC Capabilities Information field format).

	B0	B1	B2	B3 B4	B5 B7	B8 B9	B10 B11	B12 B14
	+HTC HE Support	TWT Requester Support	TWT Responder Support	Fragmentation Support	Maximum Number of Fragmented MSDUs	Minimum Fragment Size	Trigger Frame MAC Padding Duration	Multi-TID Aggregation Support
Bits:	1	1	1	2	3	2	2	3

	B15 B16	B17	B18	B19	B20	B21	B22	B23	B24
	HE Link Adaptation	All Ack Support	UL MU Response Scheduling Support	A-BSR Support	Broadcast TWT Support	32-bit BA Bitmap Support	MU Cascade Support	Ack-Enabled Multi-TID Aggregation Support	Group Addressed Multi-STA BlockAck In DL MU Support
Bits:	2	1	1	1	1	1	1	1	4

	B25	B26	B27 B28	B29	B30	B31	B32
	OMI A-Control Support	OFDMA RA Support	Maximum A-MPDU Length Exponent	A-MSDU Fragmentation Support	Flexible TWT Schedule Support	Rx Control Frame to MultiBSS	BSRP A-MPDU Aggregation
Bits:	1	1	2	1	1	1	1

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Figure 9-589ck—HE MAC Capabilities Information field format

The subfields of the HE MAC Capabilities Information field are defined in Table 9-262z (Subfields of the HE MAC Capabilities Information field).

Table 9-262z—Subfields of the HE MAC Capabilities Information field

Subfield	Definition	Encoding
+HTC-HE Support	Indicates if the STA supports the reception of an HE variant HT Control field carried in a QoS Data, QoS Null, or Management frame.	Set to 1 if the STA supports reception of an HE variant HT Control field. Set to 0 otherwise.
TWT Requester Support	Indicates support by an HE STA for the role of TWT requesting STA as described in 10.44 (Target wake time (TWT)).	Set to 1 if dot11TWTOptionActivated is true and the STA supports TWT requester STA functionality (see 10.44 (Target wake time (TWT))). Set to 0 otherwise.
TWT Responder Support	Indicates support by an HE STA for the role of TWT responder STA as described in 10.44 (Target wake time (TWT)).	Set to 1 if dot11TWTOptionActivated is true and the STA supports TWT responder STA functionality (see 10.44 (Target wake time (TWT))). Set to 0 otherwise.
Fragmentation Support	Indicates the level of dynamic fragmentation that is supported by a STA as a recipient.	Set to 0 for no support for dynamic fragmentation. Set to 1 for support for dynamic fragments that are contained within a S-MPDU, no support for dynamic fragments within an A-MPDU that is not a S-MPDU. Set to 2 for support for dynamic fragments that are contained within a Single MPDU and support for up to one dynamic fragment for each MSDU and each MMPDU within an A-MPDU or multi-TID A-MPDU that is not a Single MPDU. Set to 3 for support for dynamic fragments that are contained within a Single MPDU and support for multiple dynamic fragments for each MSDU within an A-MPDU or multi-TID AMPDU and up to one dynamic fragment for each MMPDU in a multi-TID A-MPDU that is not a Single MPDU.
Maximum Number of Fragmented MSDUs	Indicates the maximum number of fragmented MSDUs that can be concurrently received by a STA.	The maximum number of fragmented MSDUs, N_{max}, defined by this field is $N_{max} = 2^{\text{Maximum Number Of F-MPDUs}}$, except for a value of the Maximum Number of Fragmented MSDUs equal to 7 which indicates that there is no restriction.

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Table 9-262z—Subfields of the HE MAC Capabilities Information field

Minimum Fragment Size	Indicates the minimum payload size in octets of the first fragment of an MSDU that is supported by the STA.	Set to 0 to indicate no restriction on the minimum payload size. Set to 1 to indicate a minimum payload size of 128 octets. Set to 2 to indicate a minimum payload size of 256 octets. Set to 3 to indicate a minimum payload size of 512 octets.
Trigger Frame MAC Padding Duration	Indicates the additional amount of time defined as *MinTrigProcTime*, in microseconds, needed for a non-AP STA to process a received Trigger frame.	Set to 0 to indicate no additional processing time. Set to 1 to indicate 8 us of processing time. Set to 2 to indicate 16 us of processing time. Remaining values are reserved.
Multi-TID Aggregation Support	Indicates the number of TIDs minus 1 of QoS Data frames that an HE STA can aggregate in a multi-TID A-MPDU as described in 27.10.4 (A-MPDU with multiple TIDs).	Set to the number of TIDs minus 1 of QoS Data frames that an HE STA can aggregate in a multi-TID A-MPDU.
HE Link Adaptation Capable	Indicates whether the STA supports link adaptation using the HE variant HT Control field.	If +HTC-HE Support is 1: Set to 0 (No Feedback) if the STA does not provide HE MFB. Set to 2 (Unsolicited) if the STA provides only unsolicited HE MFB. Set to 3 (Both) if the STA can provide HE MFB in response to HE MRQ and if the STA provides unsolicited HE MFB. The value 1 is reserved. Reserved if +HTC-HE Support is 0.
All ACK Support	Indicates whether the STA supports reception of a Multi-STA Block-Ack frame under the all ack context (see 25.4.2)	Set to 1 is the STA supports reception of a Multi-STA BlockAck frame under the all ack context. Set to 0 otherwise.
UL MU Response Scheduling Support	Indicates support for receiving an MPDU that contains an UL MU Response Scheduling A-Control field.	If +HTC-HE Support is 1: Set to 1 if the STA supports reception of the UL MU Response Scheduling A-Control field. Set to 0 otherwise. Reserved if +HTC-HE Support is 0.
A-BSR Support	Indicates support by an AP for receiving an (A-)MPDU that contains a BSR in the A-Control subfield and support by a non-AP STA for generating an (A-)MPDU that contains a BSR in the A-Control subfield.	If +HTC-HE Support is 1: Set to 1 if the STA supports the BSR A-Control field functionality. Set to 0 otherwise. Reserved if +HTC-HE Support is 0.
Broadcast TWT Supported	Indicates support by an HE non-AP STA for the role of TWT scheduled STA and by an AP for the role of TWT scheduling STA as described in 27.7.3 (Broadcast TWT operation).	Set to 1 when the STA supports broadcast TWT functionality. Set to 0 otherwise.

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Table 9-262z—Subfields of the HE MAC Capabilities Information field

32-bit BA Bitmap Support	Indicates whether the STA supports reception of a Multi-STA BlockAck frame that has a 32-bit Block Ack Bitmap subfield intended to it.	Set to 1 if the STA supports reception of a Multi-STA BlockAck frame that has a 32-bit Block Ack Bitmap subfield intended to it. Set to 0 otherwise.
MU Cascading Supported	Indicates whether the STA supports participating in an MU Cascading sequence (see 27.5.3 (HE MU cascading operation)).	Set to 1 if the STA supports MU cascading operation. Set to 0 otherwise.
Ack-enabled Multi-TID Aggregation Support	Indicates support by a STA to receive a multi-TID A-MPDU that can solicit either Ack or BlockAck, or both, as described in 27.10.4 (A-MPDU with multiple TIDs).	Set to 1 when the STA supports reception of this multi-TID A-MPDU format. Set to 0 otherwise.
Group Addressed Multi-STA BlockAck In DL MU Support	Indicates support by a non-AP STA for the reception of a group-addressed Multi-STA BlockAck frame that is sent in a DL MU PPDU in a non-broadcast RU.	Set to 1 when the STA supports its reception. Set to 0 otherwise.
OMI A-Control Support	Indicates support for receiving an MPDU that contains an OMI A-Control field.	If +HTC-HE Support is 1: Set to 1 if the STA supports reception of the OMI A-Control field. Set to 0 otherwise. Reserved if +HTC-HE Support is 0.
OFDMA RA Supports	Indicates support for a non-AP STA to follow the OFDMA random access procedure and for an AP to send Trigger frames that allocate random RUs (see 27.5.2.6 (UL OFDMA-based random access)).	Set to 1 if supported. Set to 0 otherwise.
Maximum A-MPDU Length Exponent		
A-MSDU Fragmentation Support	The A-MSDU Fragmentation Support subfield indicates support for the reception of fragmented A-MSDUs.	Set to 1 to indicate support for the receipt of fragmented A-MSDUs. Set to 0 to indicate that reception of fragmented A-MSDUs is not supported.
Flexible TWT Schedule Support	Indicates support for the reception of TWT Information frames with any nonzero value in the Next TWT field.	Set to 1 if the STA supports reception of a TWT Information frame with a nonzero value in the Next TWT field. Set to 0 otherwise.
Rx Control Frame to MultiBSS	Indicates whether the non-AP STA when associated with a BSS corresponding to a nontransmitted BSSID supports reception of a control frame with TA equal to the transmitted BSSID	Set to 1 if supported. Set to 0 otherwise.

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Table 9-262z—Subfields of the HE MAC Capabilities Information field

BSRP A-MPDU Aggregation	Indicates whether or not the STA accepts a BSRP Trigger frame that is aggregated with other control, data and management frames in an A-MPDU destined to the STA	Set to 1 if supported. Set to 0 otherwise.
QTP Support	The QTP Support field indicates support by an HE STA for Quiet Time Period (QTP) operation as described in 11.47 (Quieting HE STAs in a HE BSS).	If the field is set to 1, the HE STA supports QTP functionality. Otherwise, set to 0.
A-BQR Support	Indicates support by an AP for receiving an (A-)MPDU that contains a BQR in the A-Control subfield and support by a non-AP STA for generating an (A-)MPDU that contains a BQR in the A-Control subfield.	If +HTC-HE Support is 1: Set to 1 if the STA supports the BQR A-Control field functionality. Set to 0 otherwise. Reserved if +HTC-HE Support is 0.

If the HE STA includes a VHT Capabilities element, the Maximum A-MPDU Length Exponent subfield in HE Capabilities element combined with the Maximum A-MPDU Length Exponent subfield in VHT Capabilities element indicate the maximum length of A-MPDU that the STA can Receive where EOF padding is not included in this limit. When Maximum A-MPDU Length Exponent subfield in HE Capabilities element is 0, the value in Maximum A-MPDU Length Exponent subfield in VHT Capabilities element indicates the maximum length of A-MPDU that the STA can Receive which follows the definition in 9.4.2.158.2 (VHT Capabilities Info field). When Maximum A-MPDU Length Exponent subfield in HE Capabilities element is 1 or 2, the value in Maximum A-MPDU Length Exponent subfield in VHT Capabilities element is 7 and the length defined by the field is $2^{(20+\text{ Maximum A-MPDU Length Exponent subfield in HE Capabilities element})}-1$. The value 3 in Maximum A-MPDU Length Exponent subfield in HE Capabilities element is reserved.

If the HE STA does not include VHT Capabilities element, the Maximum A-MPDU Length Exponent subfield in HE Capabilities element combined with the Maximum A-MPDU Length Exponent subfield in HT Capabilities element indicate the maximum length of A-MPDU that the STA can Receive where EOF padding is not included in this limit. When Maximum A-MPDU Length Exponent subfield in HE Capabilities element is 0, the value in Maximum A-MPDU Length Exponent subfield in HT Capabilities element indicates the the maximum length of A-MPDU that the STA can Receive which follows the definition in 9.4.2.56.3 (HT Capabilities Info field). When Maximum A-MPDU Length Exponent subfield in HE Capabilities element is 1 or 2, the value in Maximum A-MPDU Length Exponent subfield in HT Capabilities element is 7 and the length defined by the field is $2^{(16+\text{ Maximum A-MPDU Length Exponent subfield in HE Capabilities element})} - 1$. The value 3 in Maximum A-MPDU Length Exponent subfield in HE Capabilities element is reserved.

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9.4.2.218.3 HE PHY Capabilities Information field

The format of the HE PHY Capabilities Information field is defined in Figure 9-589cl (HE PHY Capabilities Information field format).

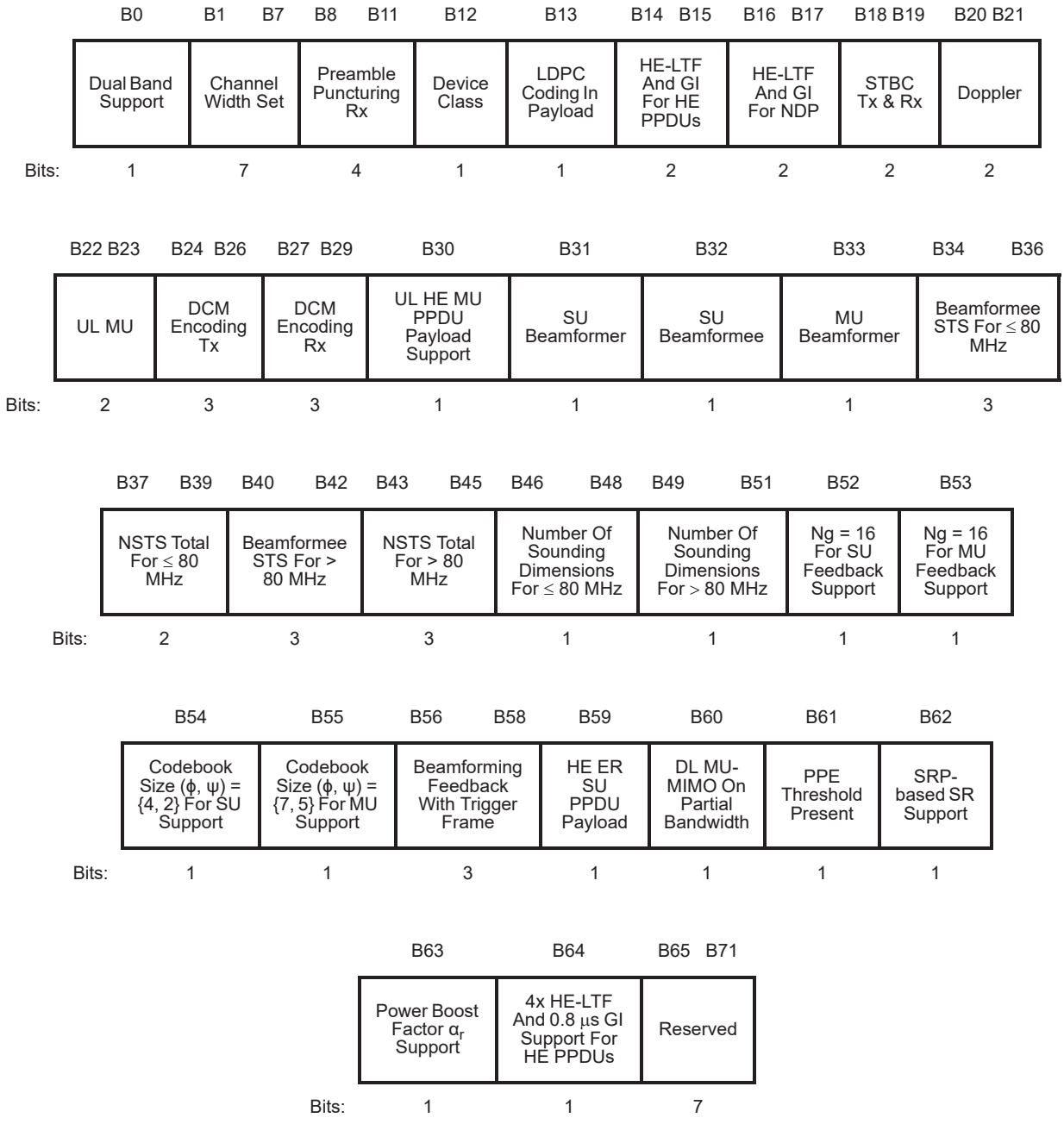

Figure 9-589cl—HE PHY Capabilities Information field format

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The subfields of the HE PHY Capabilities Information field are defined in Table 9-262aa (Subfields of the HE PHY Capabilities Information field).

Table 9-262aa—Subfields of the HE PHY Capabilities Information field

Subfield	Definition	Encoding
Dual Band Support	Indicates support of both 2.4 GHz and 5 GHz frequency bands	Set to 0 if not supported. Set to 1 if supported.
Channel Width Set	B1: Indicates STA support 40 MHz channel width in 2.4 GHz B2: Indicates STA support 40 MHz and 80 MHz channel width in 5 GHz B3: Indicates STA supports 160 MHz channel width in 5 GHz B4: Indicates STA supports 160/80+80 MHz channel width in 5 GHz B5: If B1 is set to 0, then B5 indicates support of 242/106/52/26-tone RU mapping in 40 MHz channel width in 2.4 GHz. Otherwise Reserved. B6: If B2, B3, and B4 are set to 0, then B6 indicates support of 242-tone RU mapping in 40 MHz and 80 MHz channel width in 5 GHz. Otherwise Reserved. B7: Reserved	B1 set to 0 if not supported. B1 set to 1 if supported. B2 set to 0 if not supported, i.e., it indicates 20 MHz only device in 5 GHz. B2 set to 1 if supported. Note AP always sets B2 to 1. B3 set to 0 if not supported. B3 set to 1 if supported. If B3 set to 1 then B2 is set to 1. B4 set to 0 if not supported. B4 set to 1 if supported. If B4 set to 1 then B3 is set to 1. B5 set to 0 if not supported. B5 set to 1 if supported. B6 set to 0 if not supported. B6 set to 1 if supported. NOTE: B1 and B5 are only applicable to 2.4 GHz and ignored at the receiver when HE PHY capabilities advertised on 5 GHz. B2, B3, B4, and B6 are only applicable to 5 GHz and ignored at the receiver when HE PHY capabilities advertised of 2.4 GHz.
Preamble Puncturing Rx	B8: Indicates STA supports reception of preamble puncturing in 80 MHz, where in the preamble only the secondary 20 MHz is punctured B9: Indicates STA supports reception of preamble puncturing in 80 MHz, where in the preamble only one of the two 20 MHz sub-channels in the secondary 40 MHz is punctured B10: Indicates STA supports reception of preamble puncturing in 160 MHz or 80+80 MHz, where in the primary 80 MHz of the preamble only the secondary 20 MHz is punctured B11: Indicates STA supports reception of preamble puncturing in 160 MHz or 80+80 MHz, where in the primary 80 MHz of the preamble, the primary 40 MHz is present	B8 set to 0 if not supported. B8 set to 1 if supported. B9 set to 0 if not supported. B9 set to 1 if supported. B10 set to 0 if not supported. B10 set to 1 if supported. B11 set to 0 if not supported. B11 set to 1 if supported.

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Table 9-262aa—Subfields of the HE PHY Capabilities Information field

Subfield	Definition	Encoding
Device Class	Indicates transmitting STA is a Class A or a Class B device.	Set to 1 to indicate STA is a Class A device. Set to 0 to indicate STA is a Class B device. Note: This field is reserved when transmitting STA is an AP STA.
LDPC Coding In Payload	Indicates support of transmission and reception of LDPC encoded packets	Set to 1 if supported by the STA. Set to 0 otherwise.
HE-LTF And GI For HE PPDUs	B14: Indicates support of reception of 1x LTF and 0.8 us guard interval duration for HE SU PPDUs. B15: Indicates support of reception of 1x LTF and 1.6 us guard interval duration for HE Trigger-based PPDUs.	Set to 1 if supported by the STA. Set to 0 otherwise.
HE-LTF And GI For NDP	B16: For a transmitting STA acting as beamformer, it indicates support of NDP transmission using 4x LTF and 3.2 us guard interval duration B17: For a transmitting STA acting as beamformee, it indicates support of NDP reception using 4x LTF and 3.2 us guard interval duration	If the SU Beamformer Capable field is set to 1 then B16 set to 1 if supported by the STA. Set B16 to 0 otherwise. If SU Beamformer Capable field is set to 0 then B16 is reserved. If the SU Beamformee Capable field is set to 1 the B17 set to 1 if supported by the STA.Set B17 to 0 otherwise.
STBC Tx And Rx	B18 indicates support for the transmission of HE PPDUs using STBC with one spatial stream B19 indicates support for the reception of HE PPDUs using STBC with one spatial stream	B18 set to 1 if supported by the STA. Set to 0 otherwise. B19 set to 1 if supported by the STA. Set to 0 otherwise.
Doppler	B20 indicates transmitting STA supports transmitting HE PPDUs with Doppler procedure B21 indicates transmitting STA supports receiving HE PPDUs with Doppler procedure	B20 set to 1 if supported by the STA. Set to 0 otherwise. B21 set to 1 if supported by the STA. Set to 0 otherwise.
UL MU	If the transmitting STA is an AP: B22 indicates STA supports of reception of full bandwidth UL MU-MIMO transmission. B23 indicates STA supports of reception of UL MU-MIMO transmission on an RU in an HE MU PPDU where the RU does not span the entire PPDU bandwidth. If the transmitting STA is a non-AP STA: B22 indicates STA supports of transmission of full bandwidth UL MU-MIMO transmission. B23 indicates STA supports of transmission of UL MU-MIMO transmission on an RU in an HE MU PPDU where the RU does not span the entire PPDU bandwidth.	B22 set to 1 if supported by the STA. Set to 0 otherwise. B23 set to 1 if supported by the STA. Set to 0 otherwise. NOTE—If the non-AP STA sets B23 (Uplink MU-MIMO on Partial Bandwidth) to 0, it shall support transmitting SU RU within an HE MU PPDU where some other RU is employing UL MU-MIMO

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Table 9-262aa—Subfields of the HE PHY Capabilities Information field

Subfield	Definition	Encoding
DCM encoding at Tx and Rx	B24 - B26 Signals support of Tx of (i) packet payload with dual sub-carrier modulation at a STA and (ii) DCM encoded HE-SIG-B in an HE MU PPDU at a STA. The signaling includes maximum constellation and the maximum number of spatial streams that are supported with DCM. B27 - B29 Signals support of reception of (i) packet payload with dual sub-carrier modulation at a STA and (ii) DCM encoded HE-SIG-B in an HE MU PPDU at a STA. The signaling includes maximum constellation and the maximum number of spatial streams that are supported with DCM.	B25:B24 signals Maximum Constellation 00: Does not support DCM, 01: BPSK , 10: QPSK, 11: 16-QAM B26 signals maximum number of spatial streams with DCM 0: 1 spatial stream, 1: 2 spatial streams. B28:B27 signals Maximum Constellation 00: Does not support DCM, 01: BPSK, 10: QPSK, 11: 16-QAM B29 signals maximum number of spatial streams with DCM 0: 1 spatial stream, 1: 2 spatial streams
UL HE MU PPDU Payload Support	Indicates that the STA supports the reception of an HE MU PPDU payload over full bandwidth and partial bandwidth (106-tone RU within 20 MHz).	Set to 0 if not supported. Set to 1 if supported. This field is reserved for a non-AP STA.
SU Beamformer	Indicates support for operation as an SU beamformer.	Set to 0 if not supported. Set to 1 if supported. Set to 1 if sent by an HE AP with support for 4 or more spatial streams
SU Beamformee	Indicates support for operation as an SU beamformee.	Set to 0 if not supported. Set to 1 if supported. Set to 1 if sent by a non-AP STA.
MU Beamformer	Indicates support for operation as an MU Beamformer.	Set to 0 if not supported. Set to 0 if the SU Beamformer subfield is 0. Set to 0 if sent by a non-AP STA. Set to 1 if supported. Set to 1 if SU Beamformer subfield is set to 1. Set to 1 if sent by an AP.
Beamformee STS For ≤ 80 MHz	The maximum number of space-time streams that the STA can receive in an HE NDP	If SU beamformee capable, set to maximum number of space-time streams that the STA can receive in an HE NDP minus 1. The minimum value of this field is 3. Otherwise, reserved.
NSTS Total For ≤ 80 MHz	The maximum value for $N_{STS,total}$ that can be sent to the STA in a DL MU-MIMO transmission on full or partial bandwidth	If SU beamformee capable, set to maximum number of total space-time streams that the STA can receive minus 1. The minimum value of this field is 3. Otherwise reserved.

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Table 9-262aa—Subfields of the HE PHY Capabilities Information field

Subfield	Definition	Encoding
Beamformee STS For > 80 MHz	The maximum number of space-time streams that the STA can receive in an HE NDP	If SU beamformee capable, set to maximum number of space-time streams that the STA can receive in an HE NDP minus 1. The minimum value of this field is 3. Otherwise, reserved.
NSTS Total For > 80 MHz	The maximum value for $N_{STS,total}$ that can be sent to the STA in an DL MU-MIMO transmission on full or partial bandwidth	If SU beamformee capable, set to maximum number of total space-time streams that the STA can receive minus 1. The minimum value of this field is 3. Otherwise reserved.
Number Of Sounding Dimensions For ≤ 80 MHz	Beamformer's capability indicating the maximum value of the TXVECTOR parameter NUM_STS for an HE NDP	If SU beamformer capable, set to the maximum supported value of the TXVECTOR parameter NUM_STS minus 1. Otherwise, reserved
Number Of Sounding Dimensions For > 80 MHz	Beamformer's capability indicating the maximum value of the TXVECTOR parameter NUM_STS for an HE NDP	If SU beamformer capable, set to the maximum supported value of the TXVECTOR parameter NUM_STS minus 1. Otherwise, reserved
Ng = 16 For SU Feedback Support	Indicates if the HE beamformee is capable of feedback with tone grouping of 16 in the HE Compressed Beamforming Report field for a SU-type feedback.	Set to 1 if supported. Set to 0 otherwise.
Ng = 16 For MU Feedback Support	Indicates if the HE beamformee is capable of feedback with tone grouping of 16 in the HE Compressed Beamforming Report field for a MU-type feedback	Set to 1 if supported. Set to 0 otherwise.
Codebook Size (ϕ, ψ) = {4, 2} For SU Support	Indicates if the HE beamformee is capable of feedback with codebook size (ϕ, ψ) = {4, 2} in the HE Compressed Beamforming Report field for a SU-type feedback.	Set to 1 if supported. Set to 0 otherwise.
Codebook Size (ϕ, ψ) = {7, 5} For MU Support	Indicates if HE beamformee is capable of feedback with codebook size (ϕ, ψ) = {7, 5} in the HE Compressed Beamforming Report field for a MU-type feedback.	Set to 1 if supported. Set to 0 otherwise.
Tx Beamforming Feedback With Trigger Frame	If the transmitting STA is an AP STA: B56: indicates support of reception of SU-Type partial and full bandwidth feedback B57: indicates support of reception of MU-Type partial bandwidth feedback B58 indicates support of reception of CQI-Only partial and full bandwidth feedback If the transmitting STA is a non-AP STA: B56: indicates support of transmission of SU-Type partial and full bandwidth feedback B57: indicates support of transmission of MU-Type partial bandwidth feedback B58: indicates support of transmission of CQI-Only partial and full bandwidth feedback	Set B56 to 1 if SU-Type partial and full bandwidth feedback supported by the STA. Set to 0 otherwise. Set B57 to 1 if MU-Type partial bandwidth feedback supported by the STA. Set to 0 otherwise. Set B58 to 1 if CQI-Only partial and full bandwidth feedback supported by the STA. Set to 0 otherwise.

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Table 9-262aa—Subfields of the HE PHY Capabilities Information field

Subfield	Definition	Encoding
HE ER SU Payload	Indicates the support of transmission and reception of an HE extended range SU PPDU payload transmitted over the right 106-tone RU within primary 20 MHz channel.	Set to 1 if supported. Set to 0 otherwise.
DL MU-MIMO on Partial BW	Indicates that the non-AP STA supports reception of a DL MU-MIMO transmission on an RU in an HE MU PPDU where the RU does not span the entire PPDU bandwidth.	Set to 1 if supported by the non-AP STA. Set to 0 if not supported by the non-AP STA. This field is reserved for an AP.
PPE Threshold Present	Indicates whether or not the PPE Threshold field is present.	Set to 1 if PPE Threshold field is present. Set to 0, otherwise
SRP-based SR Support	Indicates that the STA supports SRP-based SR operation	Set to 1 if supported. Set to 0 otherwise.
Power Boost Factor α_r Support	Indicates that the STA supports a power boost factor α_r for the *r*-th RU in the range [0.5, 2]	Set to 1 if supported. Set to 0 otherwise.
4x HE-LTF And 0.8 μs GI Support For HE PPDUs	Indicates support for the reception of 4x LTF and 0.8 μs guard interval duration for HE SU PPDUs.	Set to 1 if supported. Set to 0 otherwise.

A STA that declares support for HE trigger-based PPDUs shall also declare whether they belong to class A or class B. Class A STAs are high capability devices and class B STAs are low capability devices.

9.4.2.218.4 Tx Rx HE MCS Support field

The Tx Rx HE MCS Support field format is defined in Figure 9-589cm (Tx Rx HE MCS Support field format).

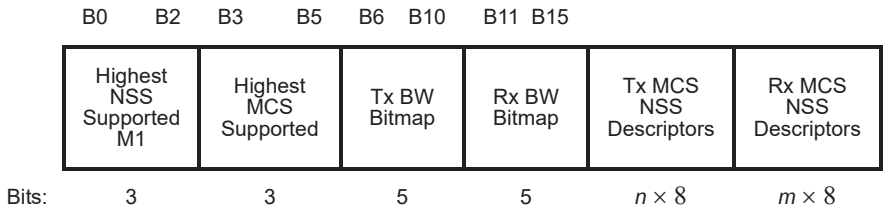

Figure 9-589cm—Tx Rx HE MCS Support field format

The Highest NSS Supported M1 subfield indicates the highest NSS value minus 1, supported by the STA that transmitted this subfield. The Highest NSS Supported M1 value is applicable to both transmissions and receptions but does not necessarily apply to all combinations of PPDU bandwidth and MCS. The PPDU bandwidth and MCS values that do not support the NSS value indicated in this subfield are described in the Tx MCS NSS Descriptors and Rx MCS NSS Descriptors subfields, if present. If no Tx MCS NSS Descriptors subfield is present, then the STA supports transmission of all combinations of PPDU bandwidth identified by the Channel Bandwidth Set field at each NSS and MCS indicated in the Highest NSS Supported M1 and Highest MCS Supported subfields. If no Rx MCS NSS Descriptors subfield is present, then the STA supports reception of all combinations of PPDU bandwidth identified by the Channel Bandwidth Set field at each NSS and MCS indicated in the Highest NSS Supported M1 and Highest MCS Supported subfields.

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The Highest MCS Supported subfield indicates whether the STA transmitting this subfield supports the optional MCS values of MCS8, MCS9, MCS10, MCS11. The encoding of this field is defined in Table 9-262ab (Highest MCS Supported subfield encoding). The Highest MCS Supported value is applicable to both

Table 9-262ab—Highest MCS Supported subfield encoding

Highest MCS Supported subfield value	Highest supported MCS of the transmitting STA
0	MCS7
1	MCS8
2	MCS9
3	MCS10
4	MCS11
5-7	Reserved

transmissions and receptions but does not necessarily apply to all combinations of PPDU bandwidth and NSS. The PPDU bandwidth and NSS values that do not support the MCS value indicated in this subfield are described in the Tx MCS NSS Descriptors and Rx MCS NSS Descriptors subfields, if present. If no Tx MCS NSS Descriptors subfield is present, then the STA supports transmission of all combinations of PPDU bandwidth identified by the Channel Bandwidth Set field at each NSS and MCS indicated in the Highest NSS Supported M1 and Highest MCS Supported subfields. If no Rx MCS NSS Descriptors subfield is present, then the STA supports reception of all combinations of PPDU bandwidth identified by the Channel Bandwidth Set field at each NSS and MCS indicated in the Highest NSS Supported M1 and Highest MCS Supported subfields.

Each bit of the Tx BW Bitmap indicates whether a set of TX MCS NSS Descriptor field(s) are present for a specific PPDU bandwidth. The bits correspond to the ordered set of PPDU bandwidth values of 20 MHz, 40 MHz, 80 MHz, 80+80 and 160 MHz with the bit in the lowest numbered bit position corresponding to 20 MHz. A bit in the Tx BW Bitmap is set to 1 to indicate that the corresponding Tx MCS NSS Descriptor for that bandwidth is present; otherwise the bit is set to 0.

Each bit of the Rx BW Bitmap indicates whether a set of RX MCS NSS Descriptor field(s) are present for a specific bandwidth of operation. The bits correspond to the ordered set of PPDU values of 20 MHz, 40 MHz, 80 MHz, 80+80 and 160 MHz with the bit in the lowest numbered bit position corresponding to 20 MHz. A bit in the Rx BW Bitmap is set to 1 to indicate that the corresponding Rx MCS NSS Descriptor for that bandwidth is present; otherwise the bit is set to 0.

If all of the bits of the Tx BW Bitmap subfield and all of the bits of the Rx BW Bitmap subfield are zero, then none of the subfields of the Tx Rx HE MCS Support field beyond Highest MCS Supported need to be present. If either the Tx BW Bitmap subfield or the Rx BW Bitmap subfield has at least one bit set to 1, then both the Tx BW Bitmap subfield and the Rx BW Bitmap subfield are present, even if one of these subfields has the value of all zeros.

Each Tx MCS NSS Descriptor indicates the value of the highest supported NSS for the indicated MCS for a specific bandwidth of operation and for all MCS that are higher than the indicated MCS up to but not

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including the next MCS in the set for this bandwidth. MCS values that are lower than the lowest specified MCS within a set of Tx MCS NSS Descriptor fields implicitly support transmission of PPDUs using the highest NSS value indicated in the Highest NSS Supported subfield.

Each Rx MCS NSS Descriptor indicates the value of the highest supported NSS for the indicated MCS for a specific bandwidth of operation and for all MCS that are higher than the indicated MCS up to but not including the next MCS in the set for this bandwidth. MCS values that are lower than the lowest specified MCS within a set of Rx MCS NSS Descriptor fields implicitly support reception of PPDUs using the highest NSS value indicated in the Highest NSS Supported subfield.

The Tx MCS NSS Descriptor and Rx MCS NSS Descriptor subfield format is defined in Figure 9-589cn (Tx MCS NSS Descriptor and Rx MCS NSS Descriptor subfield format).

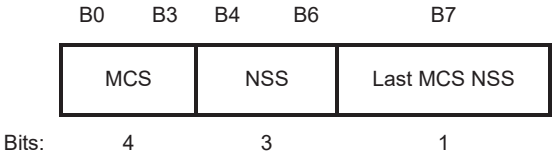

Figure 9-589cn—Tx MCS NSS Descriptor and Rx MCS NSS Descriptor subfield format

The MCS subfield of the Tx MCS NSS Descriptor and Rx MCS NSS Descriptor subfields indicates an MCS value encoded as an unsigned integer.

The NSS subfield of the Tx MCS NSS Descriptor and Rx MCS NSS Descriptor subfields indicates an NSS value encoded as an unsigned integer. The NSS indicated by the field corresponds to the MCS value in the same Tx MCS NSS Descriptor or Rx MCS NSS Descriptor subfield. The value 0 indicates that there is no support for this combination of PPDU bandwidth and this MCS and higher.

The Last MCS NSS subfield indicates the last Tx MCS NSS Descriptor or Rx MCS NSS Descriptor for a set of Tx MCS NSS Descriptors or Rx MCS NSS Descriptors corresponding to a single PPDU bandwidth value. The Last MCS NSS subfield is set to 1 to indicate that the current Tx MCS NSS Descriptor or Rx MCS NSS Descriptor is the last descriptor for the corresponding PPDU bandwidth. Otherwise the subfield is set to 0.

9.4.2.218.5 PPE Thresholds field

The format of the PPE Thresholds field is defined in Figure 9-589co (PPE Thresholds field format).

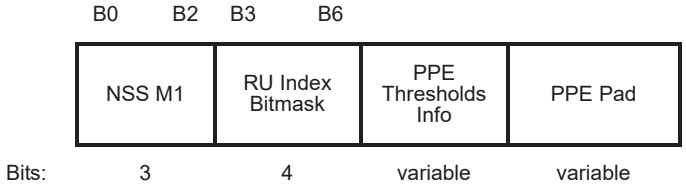

Figure 9-589co—PPE Thresholds field format

The NSS M1 subfield contains an unsigned integer that is equal to the number of NSS values minus one for which PPE threshold values are included in the PPE Thresholds Info field.

The RU Index Bitmask subfield contains a bitmask that indicates whether PPE threshold values are present for each of four RU allocation sizes according to their RU Allocation Index values. For example, when B3 is set to 1, PPE threshold values are present for the RU allocation corresponding to RU allocation index 0 and

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when B3 is set to 0, PPE threshold values are not present for the RU allocation corresponding to RU allocation index 0.

The PPE Thresholds Info field is (NSS M1 + 1) × Number of bits set to 1 in the RU Index Bitmask subfield × 6 bits in length. The format of the PPE Thresholds Info field is defined in Figure 9-589cp (PPE Thresholds Info field format).

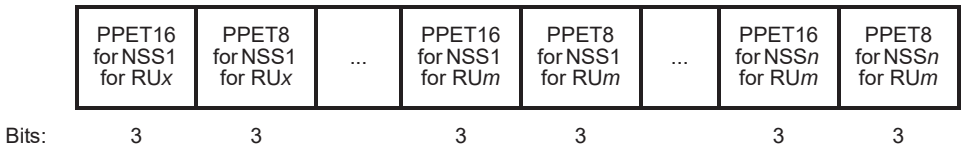

Figure 9-589cp—PPE Thresholds Info field format

PPE threshold values appear in increasing NSS value and increasing RU index value order, where lower-numbered PPE Thresholds Info field bits contain PPE threshold values corresponding to lower numbered NSS values and within a set of PPE Threshold subfields corresponding to a single value of NSS, lower-numbered PPE Thresholds Info field bits contain PPE threshold values corresponding to lower numbered RU index values. Subfields PPET16 for NSS*n* for RU*b* and PPET8 for NSS*n* for RU*b* are present for all values of *n* and *b* where:

$1 \le n \le (\text{NSS M1} + 1)$

$b = [x, \ldots, m]$

where [*x*, …, *m*] is the set of integers equal to the ordered list of bit positions of all bits that are set to 1 in the RU Index Bitmask subfield, with *x* being the lowest value.

Each PPET8 for NSS*n* for RU*b* subfield and PPET16 for NSS*n* for RU*b* subfield contains an integer that corresponds to a constellation index value related to the transmission constellation of an HE PPDU as defined in Table 9-262ac (Constellation index)..

Table 9-262ac—Constellation index

Constellation Index	Corresponding Transmission Constellation
0	BPSK
1	QPSK
2	16-QAM
3	64-QAM
4	256-QAM
5	1024-QAM
6	Reserved
7	None

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The PPET8 for NSS*n* for RU*b* subfield and PPET16 for NSS*n* for RU*b* subfield values are combined to determine the Maximum PE value for HE PPDUs that are transmitted to the STA sending this field and using NSS = *n* and an RU allocation corresponding to RU Allocation Index *b*, for each value of NSS and RU specified by the field. For all values of n and b for which PPET8 and PPET16 are not present, the Maximum PE value is 0 for HE PPDUs that are transmitted to the STA using NSS = *n* and an RU allocation corresponding to RU Allocation Index *b*. The value for each PPET8 for NSS*n* for RU*m* is always less than the value of PPET16 for NSS*n* for RU*m*. The encoding is described in Table 9-262ad (PPET8 and PPET16 encoding).

Table 9-262ad—PPET8 and PPET16 encoding

Result of comparison of the constellation index *x* of an HE PPDU with NSS value *n* and RU value Allocation size that corresponds to the RU Allocation index = (*b* + DCM) to the value in the PPET8 for NSS*n* for RU*m* subfield	**Result of comparison of the constellation index of an HE PPDU with NSS value *n* and RU value Allocation size that corresponds to the RU Allocation index = value (*b* + DCM) to the value in the PPET16 for NSS*n* for RU*m* subfield**	**Maximum PE value for an HE PPDU transmitted to this STA using the constellation index = *x*, NSS = *n* and RU Allocation size that corresponds to the RU Allocation index = (*b* + DCM)**
x greater than or equal to PPET8	*x* less than PPET16 or PPET16 equal to None	8 µs
x greater than PPET8 or PPET8 equal to None	*x* greater than equal to PPET16	16 µs
All other combinations not otherwise listed in this table		0
NOTE—DCM = 1 when the HE PPDU uses DCM; DCM = 0 otherwise.		

The RU Allocation Index encoding is indicated in Table 9-262ae (RU Allocation Index encoding).

Table 9-262ae—RU Allocation Index encoding

RU Allocation Index value	**RU allocation size**
0	242
1	484
2	996
3	2×996

The PPE Pad field contains all zeros. The number of bits in the PPE Pad field is the number of bits required to round the length of the PPE Thresholds Info field up to the next integer number of octets.

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9.4.2.219 HE Operation element

The operation of HE STAs in an HE BSS is controlled by the HT Operation element, the VHT Operation element and the HE Operation element. The format of the HE Operation element is defined in Figure 9-589cq (HE Operation element format).

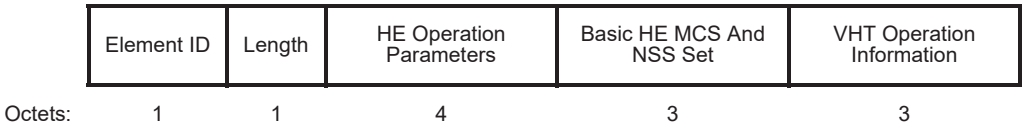

Figure 9-589cq—HE Operation element format

The Element ID and Length fields are defined in 9.4.2.1 (General).

The format of the HE Operation Parameters field is defined in Figure 9-589cr (HE Operation Parameters field format).

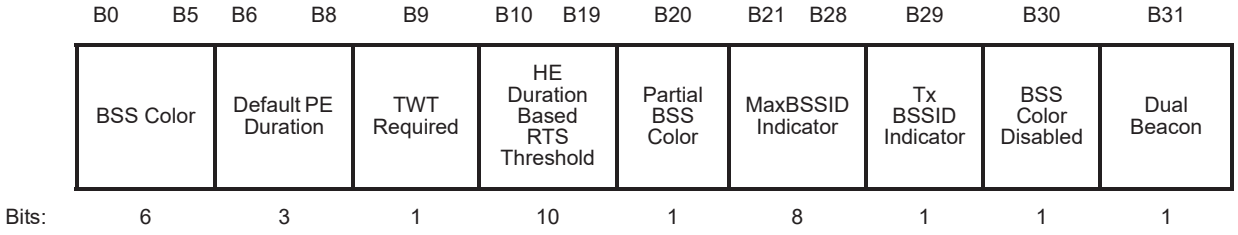

Figure 9-589cr—HE Operation Parameters field format

The BSS Color field is an unsigned integer whose value is the BSS color of the BSS corresponding to the AP which transmitted this element, except that a value of 0 in this field indicates that there is no BSS color for this BSS.

The BSS Color field is an unsigned integer whose value is the BSS Color of the BSS corresponding to the AP, IBSS STA, mesh STA or TDLS STA that transmitted this element, except that a value of 0 in this field is used if one or more intended recipient STAs of an HE PPDU is not a member of a transmitting STA's BSS.

The Default PE Duration subfield indicates the PE duration in units of 4 μs, for an HE trigger-based PPDU that is solicited with UL MU Response Scheduling in the A-Control subfield. Values 5-7 of the Default PE Duration subfield are reserved.

The TWT Required subfield is set to 1 to indicate that the AP requires the non-AP HE STAs to operate in the role of either TWT requesting STA, as described 27.7.2 (Individual TWT agreements), or TWT scheduled STA, as described in 27.7.3 (Broadcast TWT operation) and set to 0 otherwise.

The HE Duration Based RTS Threshold field enables an HE AP to manage RTS/CTS usage by HE non-AP STAs that are associated with it. The HE Duration Based RTS Threshold field contains the duration based RTS threshold in units of 32 μs, which enables the use of RTS/CTS except for values 0 and 1023. The value 0 indicates that RTS/CTS must be used for all frame exchanges. The value 1023 indicates that HE duration-based RTS is disabled.

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The Partial BSS Color field indicates whether or not the BSS applies an AID assignment rule using the partial BSS color bits. If the Partial BSS Color field is set to 1, then the 4 least significant bits of BSS color are used in AID assignment. If the Partial BSS Color field is set to 0, no partial BSS color bits are used in the AID assignment.

An HE AP corresponds to a nontransmitted BSSID if the AP's BSSID can be derived from Multiple BSSID element present in the Beacon or Probe Response frame transmitted by another AP (i.e., the AP identified by the Transmitted BSSID). The Tx BSSID Indicator indicates whether an HE AP corresponds to transmitted BSSID. The definition of MaxBSSID Indicator is same as the MaxBSSID Indicator in Multiple BSSID element. An HE AP corresponding to a nontransmitted BSSID sets Tx BSSID Indicator to 0. An HE AP corresponding to a transmitted BSSID sets Tx BSSID Indicator to 1. An HE AP corresponding to Nontransmitted BSSID or a transmitted BSSID sets the MaxBSSID Indicator field to non-zero value.An AP corresponding to neither a nontransmitted BSSID nor a transmitted BSSID sets both MaxBSSID Indicator and Tx BSSID Indicator to 0.

The BSS Color Disabled subfield indicates whether the transmitting AP recommends the associated STAs to disable the use of BSS Color parameter when making decisions related to Intra-PPDU power save and setting Intra BSS NAV. An HE AP sets the BSS Color Disabled subfield to 1 if the HE AP decides to disable the use of the BSS color for the BSS that it serves, for example, after detecting a BSS Color overlap in the neighborhood as described in 27.11.4 (BSS_COLOR); otherwise the HE AP sets the BSS Color Disabled subfield to 0.

If a HE non-AP STA receives from associated AP a BSS Color Disabled subfield value equal to 1 in the HE Operation element the HE non-AP STA should not exclusively use BSS Color parameter in making decision related to Intra-PPDU power save and for setting Intra BSS NAV. Instead, the non-AP STA should use the MAC header to make such decisions (see 27.11.4 (BSS_COLOR)). HE non-AP STA may (re)enable BSS Color related features once it receives from the associated AP a BSS Color Disabled subfield equal to 0 in an HE Operation element.

The Dual Beacon subfield indicates whether the HE AP transmits beacons using two PHY formats, one in a non-HE format and other in an HE_EXT_SU PHY format. The Dual Beacon subfield also indicates the TBTT offset of Beacon frame in HE extended range SU PPDU in 11.1.3.10 (Beacon generation in an HE BSS). The subfield is set to 0, if the HE AP transmits beacons in one PHY format. The subfield is set to 1 if the HE AP transmits beacons in an HE extended range SU PPDU and a non-HE PPDU.

The Basic HE MCS And NSS Set field indicates the HE-MCSs for each number of spatial streams in HE PPDUs that are supported by all HE STAs in the BSS (including IBSS and MBSS). The Basic HE MCS And NSS Set field is a bitmap of size 24 bits. Each 3 bit pair in the bitmap indicates the supported HE-MCS set for NSS from 1 to 8. The Basic HE-MCS And NSS Set field is defined in Figure 9-589cs (Basic HE-MCS And NSS Set field format).

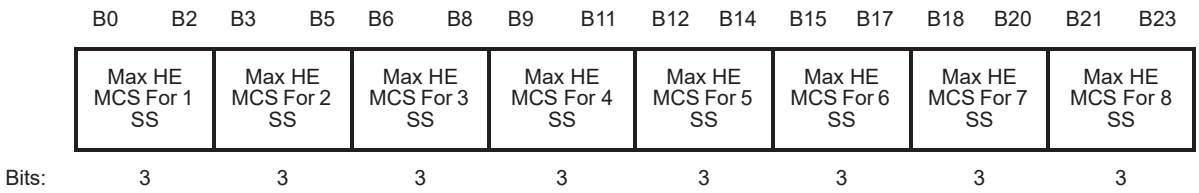

Figure 9-589cs—Basic HE-MCS And NSS Set field format

The Max HE MCS For n SS subfield (where n = 1, ..., 8) is encoded as follows:

— 0 indicates support for HE-MCS 0-7 for n spatial streams

— 1 indicates support for HE-MCS 0-8 for n spatial streams

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— 2 indicates support for HE-MCS 0-9 for *n* spatial streams

— 3 indicates support for HE-MCS 0-10 for *n* spatial streams

— 4 indicates support for HE-MCS 0-11 for *n* spatial streams

— 5-7 are reserved

The structure of the VHT Operation Information field is defined in Figure 9-564 (VHT Operation Information field) and its subfields are defined in Table 9-252 (VHT Operation Information subfields).

9.4.2.220 OFDMA-based Random Access Parameter Set (RAPS) element

The metrics of the OFDMA-based random access mechanism (see 27.5.2.6 (UL OFDMA-based random access)) are signaled in the RAPS element. The format of the RAPS element is defined in Figure 9-589ct (RAPS element format).

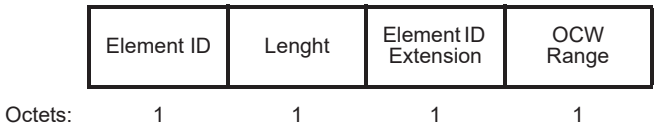

Figure 9-589ct—RAPS element format

The Element ID, Length, Element ID Extension fields are defined in 9.4.2.1 (General).

The OCW Range field indicates the minimum and maximum values of the OCW (OFDMA contention window) derived from the fields defined in Figure 9-589cu (OCW Range field format).

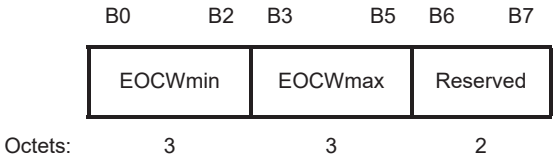

Figure 9-589cu—OCW Range field format

The EOCWmin field indicates the minimum value of OCW for the initial HE trigger-based PPDU transmission using UL OFDMA-based random access. The OCWmin parameter is used by a STA either for an initial transmission or following a successful HE trigger-based PPDU transmission and is derived from the value in the EOCWmin field as

$$OCWmin = 2^{EOCWmin} - 1$$

The EOCW_max field indicates the maximum value of OCW for UL OFDMA-based random access. The OCW_max parameter used by a STA for its retransmission attempts of UL OFDMA-based random access is derived from the value in the EOCWmax field as

$$OCWmax = 2^{EOCWmax} - 1$$

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9.4.2.221 MU EDCA Parameter Set element

The MU EDCA Parameter Set element provides information needed by non-AP STAs that are UL MU capable for proper operation of the QoS facility during the CP. The format of the MU EDCA Parameter Set element is defined in Figure 9-589cv (MU EDCA Parameter Set element).

	Element ID	Length	Element ID Extension	MU QoS Info	MU AC_BE Parameter Record	MU AC_BK Parameter Record	MU AC_VI Parameter Record	MU AC_VO Parameter Record
Octets:	1	1	1	1	3	3	3	3

Figure 9-589cv—MU EDCA Parameter Set element

The Element ID, Length, and Element ID Extension fields are defined in 9.4.2.1 (General).

For an infrastructure BSS, the MU EDCA Parameter Set element is used by the AP to establish policy (by changing default MIB attribute values), to change policies when accepting new STAs or new traffic, or to adapt to changes in offered load. The most recent MU EDCA Parameter Set element received by a STA is used to update the appropriate MIB values.

The format of the MU QoS Info field is the same as the field defined in 9.4.1.17 (QoS Info field). The MU QoS Info field contains the EDCA Parameter Set Update Count subfield, which is initially set to 0 and is incremented each time any of the MU AC parameters changes. This subfield is used by non-AP STAs to determine whether the MU EDCA parameter set has changed and requires updating the appropriate MIB attributes.

The formats of MU AC_BE, MU AC_BK, MU AC_VI, and MU AC_VO Parameters fields are identical and are illustrated in Figure 9-589cw (MU AC Parameter Record field format).

	ACI/AIFSN	ECWmin/ ECWmax	MU EDCA Timer
Octets:	1	1	1

Figure 9-589cw—MU AC Parameter Record field format

The format of the ACI/AIFSN field is illustrated in Figure 9-262 (ACI/AIFSN field) and the encoding of its subfields is as defined in 9.4.2.29 (EDCA Parameter Set element), except that a value 0 of the AIFSN field indicates that the AIFS is equal to the value of the MU EDCA Timer, i.e. EDCA is disabled for the duration specified by the MUEDCATimer for the corresponding AC.

The format of the ECWmin/ECWmax field is illustrated in Figure 9-263 (ECWmin and ECWmax fields) and the encoding of its subfields is as defined in 9.4.2.29 (EDCA Parameter Set element).

The MU EDCA Timer field indicates the duration of time, in units of 8 TUs, for which the provided MU EDCA parameters are used by an HE STA after reception of a Basic variant Trigger frame for the corresponding AC.

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9.4.2.222 BSS Color Change Announcement element

The BSS Color Change Announcement element is used by an HE AP to advertise a BSS Color change and the value of the new BSS color. The format of the BSS Color Change Announcement element is shown in Figure 9-589cx (BSS Color Change Announcement element format).

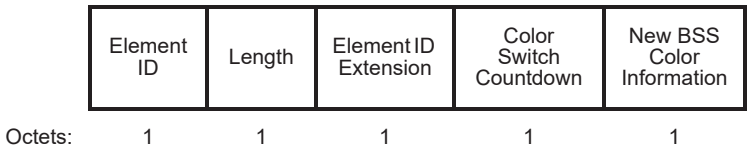

Figure 9-589cx—BSS Color Change Announcement element format

The Element ID, Length, and Element ID Extension fields are defined in 9.4.2.1 (General).

The Color Switch Countdown field is set to the number of TBTTs that remain until the STA sending the BSS Color Change Announcement element switches to the new BSS Color. A value of 0 indicates that the switch occurs at the current TBTT if the element is carried in a Beacon frame or the next TBTT following the frame that carried the element if the frame is not a Beacon.

The format of the New BSS Color Information field is as defined in Figure 9-589cy (New BSS Color field format). The New BSS Color sub-field is set to the new BSS Color value that the HE AP intends to use starting from the TBTT at which the Color Switch Countdown reaches 0.

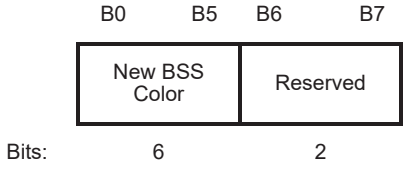

Figure 9-589cy—New BSS Color field format

The BSS Color Change Announcement element can be included in HE BSS Color Change Announce-ment frame, Beacon, Probe Response, and (Re-)Association Response frames. The use of BSS Color Change Announcement elements and frames is described in 27.16.2 (Selecting and advertising new BSS Color).

9.4.2.223 Quiet Time Period Setup element

The Quiet Time Period Setup element defines a period for an STA-to-STA operation (see 11.47 (Quieting HE STAs in a HE BSS)).

This quiet time period may be used to improve the probability of channel access for HE STAs participating in the STA-2-STA operation.

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The Quiet Time Period Setup element is shown Figure 9-589cz (Quiet Time Period Setup element).

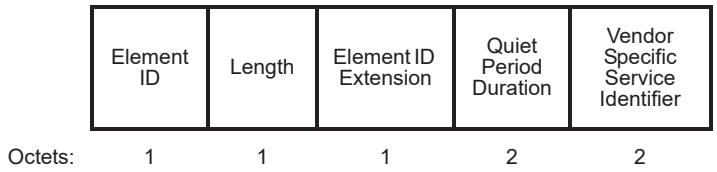

Figure 9-589cz—Quiet Time Period Setup element

The Element ID and Length fields are defined in 9.4.2.1 (General).

The Quiet Duration field is set to duration, expressed in TUs, no larger than the value indicated in the Quiet Period Duration field of the Quiet Time Period Request element sent by the requester HE STA.

The Vendor Specific Service ID field indicates a specified operation, and the HE STA supporting it can transmit frames. The Vendor Specific Service ID field contains a public unique identifier assigned by the IEEE.

9.4.2.224 Quiet Time Period Request element

The Quiet Time Period Request element defines a periodic sequence of quiet periods that the requester HE STA requests the responder AP to schedule. The format of the Quiet Time Period Request element is shown in Figure 9-589da (Quiet Time Period Request element).

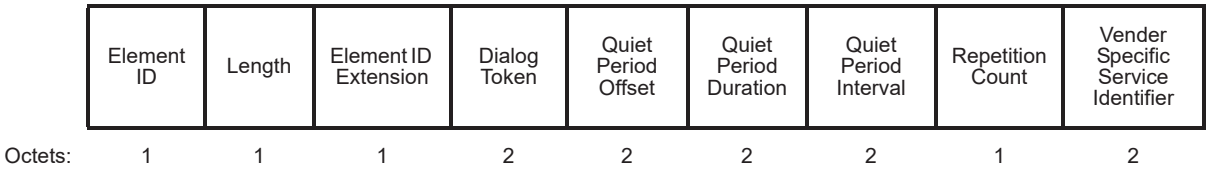

Figure 9-589da—Quiet Time Period Request element

The Element ID and Length fields are defined in 9.4.2.1 (General).

The Dialog Token field is used to identify the Quiet Time Period request and response dialog.

The Quiet Period Offset field is set to the offset of the start of the first quiet period from the Quiet Time Period Request frame that contains this element, expressed in TUs. The reference time is the start of the preamble of the PPDU that contains this element.

The Quiet Period Interval field is set to the spacing between the start of two consecutive quiet time periods, expressed in TUs.

The Quiet Duration field is set to duration of the Quiet Period, expressed in TUs.

The Repetition Count field is set to the number of requested quiet periods.

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The Vendor Specific Service Identifier field indicates a specified operation, and the HE STA supporting it can transmit frames. The Vendor Specific Service Identifier field contains a public unique identifier assigned by the IEEE.

9.4.2.225 Quiet Time Period Response element

The Quiet Period Response element defines the feedback information from the AP that received the Quiet Period Request element. The format of the Quiet Period Response element is shown in Figure 9-589db (Quiet Time Period Response element).

	Element ID	Length	Element ID Extension	Dialog Token	Quiet Period Offset	Quiet Period Duration	Quiet Period Interval	Repetition Count	Vender Specific Service Identifier	Status Code
Octets:	1	1	1	2	2	2	2	1	2	2

Figure 9-589db—Quiet Time Period Response element

The Element ID and Length fields are defined in 9.4.2.1 (General).

The Dialog Token field is used to identify the Quiet Time Period request and response dialog.

The Quiet Period Offset field is set to the offset of the start of the first quiet period from the Quiet Time Period Request frame that contains this element, expressed in TUs. The reference time is the start of the preamble of the PPDU that contains this element.

The Quiet Period Interval field is set to the spacing between the start of two consecutive quiet time periods, expressed in TUs.

The Quiet Duration field is set to duration of the Quiet Period, expressed in TUs.

The Repetition Count field is set to the number of requested quiet periods.

The Vendor Specific Service ID field indicates a specified operation, and the HE STA supporting it can transmit frames. The Vendor Specific Service ID field contains a public unique identifier assigned by the IEEE.

The Status Code field is used in a response Management frame to indicate the success or failure of a requested operation.

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9.6 Action frame format details

9.6.4 DLS Action frame details

9.6.4.2 DLS Request frame format

Insert the following new rows (header row shown for convenience) into Table 9-299 (DLS Request frame Action field format) after the row for Order 11:

Table 9-299—DLS Request frame Action field format

Order	Information	Notes
12	HE Capabilities	The HE Capabilities element is present when dot11HEOption-Implemented is true; otherwise it is not present.
13	HE Operation	The HE Operation element is present when dot11HEOptionImplemented is true; otherwise it is not present.

9.6.4.3 DLS Response frame format

Insert the following new row (header row shown for convenience) into Table 9-300 (DLS Response frame Action field format) after the row for Order 11:

Table 9-300—DLS Response frame Action field format

Order	Information	Notes
12	HE Capabilities	The HE Capabilities element is present when dot11HEOption-Implemented is true; otherwise it is not present.

9.6.5 Block Ack Action frame details

9.6.5.1 General

Change Table 9-302 (Block Ack Action field values) as follows:

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Table 9-302—Block Ack Action field values

Block Ack Action field values	Meaning
0	ADDBA Request
1	ADDBA Response
2	DELBA
3	L3 FRAG ADDBA Request
4	L3 FRAG ADDBA Response
5	L3 FRAG DELBA
~~36~~–255	Reserved

9.6.8 Public Action details

9.6.8.16 TDLS Discovery Response frame format

Insert the following new rows (header row shown for convenience) into Table 9-317 (TDLS Discovery Response Action field format) after the row for Order 17:

Table 9-317—TDLS Discovery Response Action field format

Order	Information	Notes
18	HE Capabilities	The HE Capabilities element is present when dot11HEOption-Implemented is true; otherwise it is not present, The HE Capabilities element is defined in 9.4.2.218 (HE Capabilities element)

9.6.8.36 FILS Discovery frame format

Change Table 9-325a (FILS Discovery frame format) as follows (only modified rows are shown):

Table 9-325a—FILS Discovery frame format

Order	Information	Notes
~~6~~	~~Vendor Specific element~~	~~One or more Vendor Specific elements are optionally present.~~
7	TIM element	The TIM element is optionally present when dot11TWTOption-Activated and dot11HEOptionImplemented are true, otherwise it is not present.

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Insert the following at the end of the subclause:

The FILS Discovery frame may include a TIM element, which is defined in 9.4.2.6 (TIM element), for operation as defined in 27.14.3 (Opportunistic power save in congested environment).

9.6.13 TDLS Action field formats

9.6.13.2 TDLS Setup Request Action field format

Insert the following new rows (header row shown for convenience) into Table 9-343 (Information for TDLS Setup Request Action field) after the row for Order 20:

Table 9-343—Information for TDLS Setup Request Action field

Order	Information	Notes
21	HE Capabilities	The HE Capabilities element is present when dot11HEOptionImplemented is true; otherwise it is not present. The HE Capabilities element is defined in 9.4.2.218 (HE Capabilities element)

9.6.13.3 TDLS Setup Request Action field format

Insert the following new row (header row shown for convenience) into Table 9-344 (Information for TDLS Setup Response Action field) after the row for Order 22:

Table 9-344—Information for TDLS Setup Response Action field

Order	Information	Notes
23	HE Capabilities	The HE Capabilities element is present when dot11HEOptionImplemented is true and the Status Code is SUCCESS; otherwise it is not present. The HE Capabilities element is defined in 9.4.2.218 (HE Capabilities element)

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9.6.13.4 TDLS Setup Confirm Action field format

Insert the following new row (header row shown for convenience) into Table 9-345 (Information for TDLS Setup Confirm Action field) after the row for Order 12:

Table 9-345—Information for TDLS Setup Confirm Action field

Order	Information	Notes
13	HE Operation	The HE Operation element is present when dot11HEOptionImplemented is true, the TDLS Setup Response frame contained an HE Capabilities element and the Status Code is SUCCESS; otherwise it is not present. The HE Operation element is defined in 9.4.2.219 (HE Operation element).

9.6.16 Self-protected Action frame details

9.6.16.2 Mesh Peering Open frame format

9.6.16.2.2 Mesh Peering Open frame details

Insert the following new row (header row shown for convenience) into Table 9-365 (Mesh Peering Open frame Action field format) after the row for Order 21:

Table 9-365—Mesh Peering Open frame Action field format

Order	Information	Notes
22	HE Capabilities	The HE Capabilities element is present when dot11HEOptionImplemented is true; otherwise it is not present.
23	HE Operation	The HE Operation element is present when dot11HEOptionImplemented is true; otherwise it is not present.

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9.6.16.3 Mesh Peering Confirm frame format

9.6.16.3.2 Mesh Peering Confirm frame details

Insert the following new row (header row shown for convenience) into Table 9-366 (Mesh Peering Open frame Action field format) after the row for Order 17:

Table 9-366—Mesh Peering Open frame Action field format

Order	Information	Notes
18	HE Capabilities	The HE Capabilities element is present when dot11HEOption-Implemented is true; otherwise it is not present.
19	HE Operation	The HE Operation element is present when dot11HEOptionImplemented is true; otherwise it is not present.

9.6.28 HE Action frame details

9.6.28.1 HE Action field

An HE Action field, in the octet immediately after the Category field, differentiates the HE Action frame formats. The HE Action field values associated with each frame format within the HE category are defined in Table 9-421z (HE Action field values).

Table 9-421z—HE Action field values

Value	Meaning
0	HE Compressed Beamforming And CQI
1	HE BSS Color Change Announcement
2-255	Reserved

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9.6.28.2 HE Compressed Beamforming And CQI frame format

The HE Compressed Beamforming And CQI frame is an Action No Ack frame of category HE. The Action field of an HE Compressed Beamforming And CQI frame contains the information shown in Table 9-421aa (HE Compressed Beamforming And CQI frame Action field format).

Table 9-421aa—HE Compressed Beamforming And CQI frame Action field format

Order	Information
1	Category
2	HE Action
3	HE MIMO Control
4	HE Compressed Beamforming Report (see 9.4.1.63 (HE Compressed Beamforming Report field))
5	HE MU Exclusive Beamforming Report (see 9.4.1.64 (HE MU Exclusive Beamforming Report field))
6	HE CQI-only Report (see 9.4.1.65 (HE CQI-only Report field))

The Category field is defined in Table 9-47 (Category values).

The HE Action field is defined in Table 9-421z (HE Action field values).

The HE MIMO Control field is always present in the frame. The presence and contents of the HE Compressed Beamforming Report field, HE MU Exclusive Beamforming Report field and HE CQI-only Report field are dependent on the values of Feedback Type subfield of HE MIMO Control field.

No vendor-specific elements are present in HE Compressed Beamforming and CQI frame.

9.6.28.3 HE BSS Color Change Announcement frame format

The HE BSS Color Change Announcement frame is an Action or Action No ACK frame of category HE. The Action field of a HE BSS Color Change Announcement frame contains the information shown in Table 9-421ab (HE BSS Color Change Announcement frame Action field format).

Table 9-421ab—HE BSS Color Change Announcement frame Action field format

Order	Information
1	Category
2	HE Action
3	BSS Color Change Announcement

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The Category field is defined in Table 9-47 (Category values).

The HE Action field is defined in Table 9-421z (HE Action field values).

The BSS Color Change Announcement element as defined in 9.4.2.222 (BSS Color Change Announcement element) is always present in the frame.

No Vendor-Specific elements are present in HE BSS Color Change Announcement frame.

9.6.29 Quiet Time Period Action frame details

9.6.29.1 Quiet Time Period Action field

Several Action frame formats are defined to support Quiet Time Period functionality for STA-to-STA operation. A Quiet Time Period Action field, in the octet immediately after the Category field, differentiates the Quiet Time Period Action frame formats. The Quiet Time Period Action field values associated with each frame format within the Quiet Time Period category are defined in Table 9-421ac (Quiet Time Period Action field values).

Table 9-421ac—Quiet Time Period Action field values

Value	Meaning
0	Quiet Time Period Setup
1	Quiet Time Period Request
2	Quiet Time Period Response
3-255	Reserved

9.6.29.2 Quiet Time Period Setup frame format

The Quiet Time Period Setup frame is an Action No Ack frame of category Quiet Time Period. It is sent by AP to set up a quiet period for the operation indicated by Quiet Time Period Setup element. The Action field of a Quiet Time Period Setup frame contains the information shown in TTable 9-421ad (Quiet Time Period Setup frame Action field format).

Table 9-421ad—Quiet Time Period Setup frame Action field format

Order	Information
1	Category
2	Quiet Time Period Action
3	Quiet Time Period Setup element (see 9.4.2.223 (Quiet Time Period Setup element))

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9.6.29.3 Quiet Time Period Request frame format

The Quiet Time Period Request frame is an Action frame of category Quiet Time Period. It is sent by HE STA to request a quiet period for the operation indicated by Quiet Time Period Request element. The Action field of a Quiet Time Period Setup frame contains the information shown in Table 9-421ae (Quiet Time Period Request frame Action field format).

Table 9-421ae—Quiet Time Period Request frame Action field format

Order	Information
1	Category
2	Quiet Time Period Action
3	Quiet Time Period Request element (see 9.4.2.224 (Quiet Time Period Request element))

9.6.29.4 Quiet Time Period Response frame format

The Quiet Time Period Request frame is an Action frame of category Quiet Time Period. It is sent by HE STA to request a quiet period for the operation indicated by Quiet Time Period Request element. The Action field of a Quiet Time Period Setup frame contains the information shown in Table 9-421af (Quiet Time Period Response frame Action field format).

Table 9-421af—Quiet Time Period Response frame Action field format

Order	Information
1	Category
2	Quiet Time Period Action
3	Quiet Time Period Response element (see 9.4.2.225 (Quiet Time Period Response element))

9.7 Aggregate MPDU (A-MPDU)

9.7.1 A-MPDU format

Change the 4th paragraph as follows:

The EOF Padding field is shown in Figure 9-739 (EOF Padding field format). This is present only in a VHT or HE PPDU.

Change the 6th and subsequent paragraphs as follows:

In a VHT or HE PPDU, the following padding is present, as determined by the rules in 10.13.6 (A-MPDU padding for VHT PPDU):

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— 0–3 octets in the Padding subfield of the final A-MPDU subframe (see Figure 9-740 (A-MPDU subframe format)) before any EOF padding subframes. The content of these octets is unspecified.

— Zero or more EOF padding subframes in the EOF Padding Subframes subfield.

— 0–3 octets in the EOF Padding Octets subfield. The content of these octets is unspecified.

An A-MPDU pre-EOF padding refers to the contents of the A-MPDU up to, but not including, the EOF Padding field.

NOTE—A-MPDU pre-EOF padding includes any A-MPDU subframes with 0 in the MPDU Length field and 0 in the EOF field inserted in order to meet the minimum MPDU start spacing requirement.

The maximum length of an A-MPDU in an HT PPDU is 65 535 octets. The maximum length of an A-MPDU in a DMG PPDU is 262 143 octets. The maximum length of an A-MPDU pre-EOF padding in a VHT PPDU is 1 048 575 octets. The maximum length of an A-MPDU pre-EOF padding in an HE PPDU is 4 194 303 octets. The length of an A-MPDU addressed to a particular STA can be further constrained as described in 10.13.2 (A-MPDU length limit rules).

Change Table 9-422 as follows:

Table 9-422— MPDU delimiter fields (non-DMG)

Field	Size (bits)	Description
EOF	1	End of frame indication. Set to 1 in an A-MPDU subframe that has 0 in the MPDU Length field and that is used to pad the A-MPDU in a VHT or HE PPDU as described in 10.13.6 (A-MPDU padding for VHT PPDU). Set to 1 in the MPDU delimiter of a S-MPDU as described in 10.13.7 (Setting the EOF field of the MPDU delimiter). Set to 0 otherwise.
Reserved	1	
MPDU Length	14	Length of the MPDU in octets. Set to 0 if no MPDU is present. An A-MPDU subframe with 0 in the MPDU Length field is used as defined in 10.13.3 (Minimum MPDU Start Spacing field) to meet the minimum MPDU start spacing requirement and also to pad the A-MPDU to fill the available octets in a VHT or HE PPDU as defined in 10.13.6 (A-MPDU padding for VHT PPDU).
CRC	8	8-bit CRC of the preceding 16 bits
Delimiter Signature	8	Pattern that may be used to detect an MPDU delimiter when scanning for an MPDU delimiter. The unique pattern is 0x4E (see NOTE below).
NOTE—The ASCII value of the character 'N' was chosen as the unique pattern for the value in the Delimiter Signature field.		

Change the 12th and 13th paragraph as follows:

The format of the MPDU Length field when transmitted by a non-DMG STA is shown in Figure 9-743. The MPDU Length Low subfield contains the 12 low order bits of the MPDU length. In a VHT or HE PPDU, the MPDU Length High subfield contains the two high order bits of the MPDU length. In an HT PPDU, the MPDU Length High subfield is reserved.

The MPDU length value is derived from the MPDU Length field subfields as follows:

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$$L_{MPDU} = \begin{cases} L_{low} + L_{high} \times 4096, & \text{VHT PPDU} \\ L_{low}, & \text{HT PPDU} \\ L, & \text{DMG PPDU} \end{cases} \quad (9\text{-}5)$$

where

L_{low} is the value of the MPDU Length Low subfield

L_{high} is the value of the MPDU Length High subfield

L is the value of the MPDU Length field

NOTE—The format of the MPDU Length field maintains a common encoding structure for ~~both~~ HE, VHT and HT PPDUs. For HT PPDUs, only the MPDU Length Low subfield is used, while for VHT PPDUs, both subfields are used.

9.7.3 A-MPDU contents

Change the 1st paragraph of this subclause as follows:

In a non-DMG PPDU, an A-MPDU is a sequence of A-MPDU subframes carried in a single PPDU with one of the following combinations of RXVECTOR or TXVECTOR parameter values:

— The FORMAT parameter set to VHT

— The FORMAT parameter set to HT_MF or HT_GF and the AGGREGATION parameter set to 1

— The FORMAT parameter set to S1G, S1G_DUP_1M, or S1G_DUP_2M and the AGGREGATION parameter set to 1

— The FORMAT parameter set to HE_SU, HE_MU, HE_TRIG or HE_EXT

Insert the following paragraph:

An A-MPDU carried in an HE SU PPDU, HE extended range SU PPDU, HE trigger-based PPDU and HE MU PPDU can include MPDUs with different values of the TID field as described in 27.10.4 (A-MPDU with multiple TIDs).

Change the 3rd paragraph as follows:

All of the MPDUs within an A-MPDU are addressed to the same RA. All of the MPDUs within an A-MPDU have the same TA. All QoS Data frames within an A-MPDU that have a TID for which an HT-immediate block ack agreement exists have the same value for the Ack Policy subfield of the QoS Control field.

Change the 5th paragraph as follows:

The Duration/ID fields in the MAC headers of all MPDUs in an A-MPDU carry the same value. The Duration/ID fields in the MAC headers of MPDUs in A-MPDUs carried in the same VHT MU PPDU, the same HE MU PPDU or all HE trigger-based PPDUs addressed to the same AP ~~all~~ carry the same value.

NOTE 1—The reference point for the Duration/ID field is the end of the PPDU carrying the MPDU. Setting the Duration/ID field to the same value in the case of A-MPDU aggregation means that each MPDU consistently specifies the same NAV setting.

Change the 7th and 8th paragraph as follows:

An A-MPDU is transmitted in one of the contexts specified in Table 9-424 (A-MPDU contexts) as defined by the description in the "Definition of context" column~~, independently of whether the A-MPDU is contained in a VHT MU PPDU or an SU PPDU~~. The further restrictions of A-MPDU content are defined in

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the conditions of various contexts. Ordering of MPDUs within an A-MPDU is not constrained, except where noted in these tables. See 10.13.1 (A-MPDU contents).

A VHT MU PPDU does not carry more than one A-MPDU that contains one or more MPDUs soliciting an immediate response. An HE MU PPDU does not carry more than one A-MPDU that contains one or more MPDUs soliciting an immediate response that is not carried in an HE trigger-based PPDU.

NOTE 2—The TIDs present in a data enabled A-MPDU context are also constrained by the channel access rules (for a TXOP holder; see 10.22.2 (HCF contention based channel access (EDCA)) and 10.22.3 (HCF controlled channel access (HCCA))) and the RD response rules (for an RD responder, see 10.28.4 (Rules for RD responder)). This is not shown in these tables.

NOTE 3—If a STA supports A-MSDUs of 7935 octets (indicated by the Maximum A-MSDU Length field in the HT Capabilities element), A-MSDUs transmitted by that STA within an A-MPDU carried in a PPDU with FORMAT HT_MF or HT_GF are constrained so that the length of the QoS Data frame carrying the A-MSDU is no more than 4095 octets. The 4095-octet MPDU length limit does not apply to A-MPDUs carried in VHT or DMG PPDUs. The use of A-MSDU within A-MPDU might be further constrained as described in 9.4.1.14 (Block Ack Parameter Set field) through the operation of the A-MSDU Supported field.

Change Table 9-424 (A-MPDU Contexts) as follows:

Table 9-424—A-MPDU Contexts

Name of Context	Definition of Context	Table defining permitted contents
Data Enabled Immediate Response	The A-MPDU is transmitted outside a PSMP sequence by a TXOP holder, TXOP responder or an RD responder including potential immediate responses.	Table 9-425 (A-MPDU contents in the data enabled immediate response context)
Data Enabled No Immediate Response	The A-MPDU is transmitted outside a PSMP sequence by a TXOP holder, TXOP responder that does not include or solicit an immediate response. See NOTE.	Table 9-426 (A-MPDU contents in the data enabled no immediate response context)
PSMP	The A-MPDU is transmitted within a PSMP sequence.	Table 9-427 (A-MPDU contents in the PSMP context)
Control Response	The A-MPDU is transmitted by a STA that is neither a TXOP holder nor an RD responder or the A-MPDU is transmitted by AP in an HE BSS that also needs to transmit one of the following immediate response frames: Ack BlockAck frame with a TID for which an HT-immediate block ack agreement exists Multi-STA BA for acknowledging multi-TID A-MPDU	Table 9-428 (A-MPDU contents MPDUs in the control response context)
S-MPDU context	The A-MPDU is transmitted within a VHT PPDU or an HE PPDU and contains an S-MPDU.	Table 9-429 (A-MPDU contents in the S-MPDU context)
NOTE—This context includes cases when no response is generated or when a response is generated later by the operation of the delayed block ack rules.		

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Change Table 9-425 (A-MPDU contents in the data enabled immediate response context) as follows:

Table 9-425—A-MPDU contents in the data enabled immediate response context

MPDU Description	Conditions	
Ack	If the preceding PPDU contains an MPDU that requires an Ack frame response, a single Ack frame at the start of the A-MPDU.	In a non-DMG STA other than an HE STA: at most one of ~~these~~ Ack and HT-immediate BlockAck MPDUs is present. In an HE STA: at most one of these MPDUs is present. In a DMG STA: at most one Ack frame is present, and zero or more HT-immediate BlockAck frames are present.
HT-immediate BlockAck	In a non-DMG STA: if the preceding PPDU contains an implicit or explicit block ack request for a TID for which an HT-immediate block ack agreement exists, at most one BlockAck frame for this TID, in which case it occurs at the start of the A-MPDU. In a DMG STA: if the preceding PPDU contains an implicit or explicit block ack request for a TID for which an HT-immediate block ack agreement exists, one or more copies of the same BlockAck for this TID.	
Multi-STA BlockAck	In an HE STA: If the preceding PPDU that carried a multiple-TID A-MPDU contains implicit or explicit block ack requests for multiple TIDs for which HT-immediate block ack agreement exist, at most one Multi-STA BA frame, in which case it occurs at the start of the A-MPDU.	
Delayed BlockAcks	BlockAck frames with the BA Ack Policy subfield equal to No Acknowledgment with a TID for which an HT-delayed block ack agreement exists.	
Delayed block ack data	QoS Data frames with a TID that corresponds to a Delayed or HT-delayed block ack agreement. These have the Ack Policy field equal to Block Ack.	
Action No Ack	Action No Ack frames.	
Delayed BlockAckReqs	BlockAckReq frames with a TID that corresponds to an HT-delayed block ack agreement in which the BA Ack Policy subfield is equal to No Acknowledgment.	

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Table 9-425—A-MPDU contents in the data enabled immediate response context *(continued)*

MPDU Description	Conditions	
Data frames without HT-immediate block ack agreement	QoS Data frames with multiple TIDs which have no HT-immediate block ack agreement See NOTE 1.	Of these, at most one of the following is present in a non-DMG BSS except HE BSS: — One or more QoS Data frames with the Ack Policy field equal to Implicit Block Ack Request — A BlockAckReq frame Of these, at most one of the following is present in a DMG BSS: — One or more QoS Data frames with the Ack Policy field equal to Implicit Block Ack Request — QoS Null MPDU with Ack Policy set to No Ack — A BlockAckReq frame with an optional QoS Null MPDU with Ack Policy set to No Ack Of these, at most one of the following is present between two HE STAs: — One or more QoS Data frames from multiple TIDs with the Ack Policy field equal to Implicit Block Ack Request/MU Ack/ AckRequest, at most one Action, optional QoS Null with Ack Policy set to No Ack, Basic Trigger frame or BSRP Trigger frame only when AP transmits the A-MPDU — QoS Null MPDU with Ack Policy set to No Ack — One of BolckAckReq and Multi-TID BlockAckReq frame — Basic Trigger frame or BSRP Trigger frame only when AP transmits the A-MPDU
Data frames sent under an HT-immediate block ack agreement	QoS Data frames with the same TID, which corresponds to an HT-immediate block ack agreement. QoS Data frames with multiple TIDs, which correspond to multiple HT-immediate block ack agreements. See NOTE 1.	
QoS Null MPDUs with Ack Policy set to No Ack	In a DMG BSS, QoS Null MPDUs with Ack Policy set to No Ack. In an HE BSS, QoS Null MPDUs with Ack Policy set to No Ack.	
Immediate BlockAckReq	At most one BlockAckReq frame with a TID that corresponds to an HT-immediate block ack agreement. This is the last MPDU in the A-MPDU. It is not present if any QoS Data frames for that TID are present. At most one of the following cases: — Multi-TID BlockAckReq frame with TIDs that correspond to an HT-immediate block ack agreement. This is after data and management frames in the A-MPDU. — This is the last MPDU in the A-MPDU	
Action	At most one Action frame	
Trigger	One or more Trigger frames where the Trigger Type field is Basic Trigger, MU-BAR, or BSRP. See NOTE 2	

NOTE 1—~~These~~ The MPDUs from the same TID all have the Ack Policy field equal to the same value, which is either Implicit Block Ack Request (Ack Request), MU Ack or Block Ack.
NOTE 2—An AP including a Trigger frame and BlockAck frame is not required to include QoS Data in that A-MPDU

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Change Table 9-426 (A-MPDU contents in the data enabled no immediate response context) as follows:

Table 9-426—A-MPDU contents in the data enabled no immediate response context

MPDU Description	Conditions
Delayed BlockAcks	BlockAck frames for a TID for which an HT-delayed block ack agreement exists with the BA Ack Policy subfield equal to No Acknowledgment.
Delayed Block Ack data	QoS Data frames with a TID that corresponds to a Delayed or HT-delayed block ack agreement. These have the Ack Policy field equal to Block Ack.
Data without a block ack agreement	QoS Data frames with a TID that does not correspond to a block ack agreement. These have the Ack Policy field equal to No Ack and the A-MSDU Present subfield equal to 0.
Action No Ack	Action No Ack frames.
Delayed BlockAckReqs	BlockAckReq frames with the BA Ack Policy subfield equal to No Acknowledgment and with a TID that corresponds to an HT-delayed block ack agreement.
Trigger	If the A-MPDU is transmitted by an AP, one or more Trigger frames where the Trigger Type field is Basic Trigger or BSRP. See NOTE 1.
QoS Null frame with Ack Policy field set to No Acknowledgment	Zero of more QoS Null MPDUs with Ack Policy field set to No Acknowledgment sent by an HE STA.
NOTE 1—An AP including Trigger frame and BlockAck is not required to include QoS Data in that A-MPDU.	

Change Table 9-428 (A-MPDU contents MPDUs in the control response context) as follows:

Table 9-428—A-MPDU contents MPDUs in the control response context

MPDU	Conditions	
Ack	Ack frame transmitted in response to an MPDU that requires an Ack frame.	One Ack and BlockAck frame is present at the start of the A-MPDU in a BSS that is not an HE BSS. One of these is present at the start of the A-MPDU between two HE STAs.
BlockAck	BlockAck frame with a TID that corresponds to an HT-immediate block ack agreement.	
Multi-STA BlockAck	If the preceding PPDU that carried multi-TID A-MPDU contains implicit or explicit block ack requests for multiple TIDs for which HT-immediate block ack agreement exist, at most one Multi-STA BlockAck frame.	
Action No Ack	+HTC Action No Ack frames carrying a Management Action Body containing an explicit feedback response or BRP frame.	
QoS Null frame with Ack Policy field set to No Acknowledgment	Zero of more QoS Null MPDUs with Ack Policy field set to No Acknowledgment sent by an HE STA.	

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10. MAC sublayer functional description

10.2 MAC architecture

10.2.4 Hybrid coordination function (HCF)

10.2.4.2 HCF contention based channel access (EDCA)

Insert the following after the 4th paragraph (the 4th paragraph begins "The QoS AP shall announce the EDCA parameters..."):

In addition, an HE AP may change the EDCA access parameters for HE non-AP STAs that are UL MU capable, by including an MU EDCA Parameter Set element in the Beacon frame, Probe Response frame, and (Re-)Association Response frame. An HE non-AP STA that receives an MU EDCA Parameter Set element from its associated AP follows the rules defined in 27.2.3 (Obtaining an EDCA TXOP for UL MU capable STAs).

10.3 DCF

10.3.1 General

Change the 6th paragraph as follows:

The virtual CS mechanism is achieved by distributing reservation information announcing the impending use of the medium. The exchange of RTS and CTS frames prior to the actual Data frame is one means of distribution of this medium reservation information. The RTS and CTS frames contain a Duration field that defines the period of time that the medium is to be reserved to transmit the actual Data frame and the returning Ack frame. A STA receiving either the RTS frame (sent by the originating STA) or the CTS frame (sent by the destination STA) shall process the medium reservation. Thus, a STA might be unable to receive from the originating STA and yet still know about the impending use of the medium to transmit a Data frame. The exchange of MU-RTS and simultaneous CTS responses by HE STAs prior to the actual Data frames is another means of distribution of this medium reservation information.

Change the 12th paragraph as follows:

~~The~~ When HE duration-based RTS is disabled, the use of the RTS/CTS mechanism is under control of dot11RTSThreshold. This attribute may be set on a per-STA basis. This mechanism allows STAs to be configured to initiate RTS/CTS either always, never, or only on frames longer than a specified length.

When HE duration-based RTS is enabled, the use of the RTS/CTS mechanism is under control of dot11DurationRTSThreshold. This mechanism requires STAs to use an RTS/CTS exchange for individually addressed frames when the duration of the TXOP is greater than the duration threshold indicated by dot11DurationRTSThreshold.

NOTE 1—A STA configured not to initiate the RTS/CTS mechanism updates its virtual CS mechanism with the duration information contained in a received RTS or CTS frame, and responds to an RTS frame addressed to it with a CTS frame if permitted by medium access rules.

10.3.2 Procedures common to the DCF and EDCAF

10.3.2.1 CS mechanism

Change the 3rd and 4th paragraph of the subclause as follows:

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A first virtual CS mechanism shall be provided by all MAC entities, and an additional second virtual CS mechanism shall be provided by an S1G MAC entity. The first mechanism is referred to as the NAV. The NAV maintains a prediction of future traffic on the medium based on duration information that is announced in RTS/CTS frames by non-DMG STAs, MU-RTS/CTS by HE STAs as defined in 10.3.2.8a, and RTS/ DMG CTS frames by DMG STAs prior to the actual exchange of data. The duration information is also available in the MAC headers of all frames sent during the CP other than PV1 MAC frames and PS-Poll frames and during the BTI, the A-BFT, the ATI, the CBAP, and the SP. The duration information may also be available in the RXVECTOR parameter TXOP_DURATION when an HE PPDU is received.

The CS mechanism combines the NAV state and the STA's transmitter status with physical CS to determine the busy/idle state of the medium. The NAV may be thought of as a counter, which counts down to 0 at a uniform rate. When the counter is 0, the virtual CS indication is that the medium is idle; when the counter is nonzero, the indication is busy. The virtual CS indication of medium for HE STAs with two NAVs is described in 27.2.2 (Updating two NAVs). If a DMG STA supports multiple NAVs as defined in 10.36.10 (Updating multiple NAV) and all counters are 0, the virtual CS indication is that the medium is idle; when at least one of the counters is nonzero, the indication is busy. The medium shall be determined to be busy when the STA is transmitting.

10.3.2.3 IFS

10.3.2.3.7 EIFS

Change the 2nd paragraph of 10.3.2.3.7 as follows:

EIFS shall not be invoked if the NAV is updated by the frame that would have caused an EIFS. EIFS shall not be invoked for an A-MPDU if one or more of its frames are received correctly. EIFS shall not be invoked if a valid TXOP_DURATION parameter is present in the RXVECTOR of a received HE PPDU.

10.3.2.4 Setting and resetting the NAV

Change the 1st four paragraph as follows (the 2nd paragraph is broken into three paragraphs):

This subclause describes the setting and resetting of the NAV for non-DMG STAs and DMG STAs that support a single NAV. DMG STAs that support multiple NAVs shall update their NAVs according to the procedures described in 10.36.10 (Updating multiple NAV). HE STAs with two NAV timers shall update their NAV timers according to the procedures described in 27.2.2 (Updating two NAVs).

A STA that receives at least one valid frame in a PSDU can update its NAV with the information from any valid Duration field in the PSDU. If the STA is not an HE STA and ~~When~~ the received frame's RA is equal to the STA's own MAC address, the STA shall not update its NAV. If the STA is an HE STA and the STA is solicited for an immediate response by the PPDU carrying the received frame, the STA shall not update its NAV. If the STA is an HE STA, the STA is a TXOP holder, and the frame is solicited by the STA, then the STA shall not update its NAV. Further, when the received frame is a DMG CTS frame and its TA is equal to the STA's own MAC address, the STA shall not update its NAV. For all other received frames the STA shall update its NAV when the received Duration is greater than the STA's current NAV value. Upon receipt of a PS-Poll frame, a STA shall update its NAV settings as appropriate under the data rate selection rules using a duration value equal to the time, in microseconds, required to transmit one Ack frame plus one SIFS, but only when the new NAV value is greater than the current NAV value. If the calculated duration includes a fractional microsecond, that value is rounded up to the next higher integer.

A STA shall update the NAV with the duration information indicated by the RXVECTOR parameter TXOP_DURATION if and only if all the following conditions are met:

— The RXVECTOR parameter TXOP_DURATION is not all 1s.

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- The STA does not receive a frame with the duration information indicated by a Duration field in the PSDU of the PPDU carrying the RXVECTOR parameter TXOP_DURATION
- The duration information indicated by the RXVECTOR parameter TXOP_DURATION is greater than the STA's current NAV value
- The PPDU that carried information of the RXVECTOR parameter is not HE trigger-based PPDU triggered by the STA

Various additional conditions may set or reset the NAV, as described in 10.4.3.3 (NAV operation during the CFP). When the NAV is reset, a PHY-CCARESET.request primitive shall be issued. The exact time of updating the NAV is described as follows. This NAV update operation is performed when the PHY-RXEND.indication primitive is received, except when the PHYRXEND.indication primitive is received before the end of the PPDU, in this case, this NAV update operation is performed at the expected end of the PPDU.

Figure 10-5 (RTS/CTS/data/Ack and NAV setting) indicates the NAV for STAs that might receive the RTS frame, while other STAs might receive only the CTS frame, resulting in the lower NAV bar as shown (with the exception of the STA to which the RTS frame was addressed).

A STA that used information from an RTS or MU-RTS frame as the most recent basis to update its NAV setting is permitted to reset its NAV if no PHY-RXSTART.indication primitive is received from the PHY during a NAVTimeout period starting when the MAC receives a PHY-RXEND.indication primitive corresponding to the detection of the RTS or MU-RTS frame.

Insert the following at the end of 10.3.2.4:

An HE AP may use the HE duration-based RTS threshold to configure the use of RTS/CTS initiated by a non-AP HE STA.

Insert a new subclause following 10.3.2.4:

10.3.2.4a Duration-based RTS/CTS

In dense environments, managing RTS usage by an AP can help the overall interference situation since the AP may have better view of the network situation. To improve spectrum utilization, RTS usage should be duration-based, rather than length-based.

Insert a new subclause following 10.3.2.8:

10.3.2.8a MU-RTS/CTS procedure

10.3.2.8a.1 General

The MU-RTS/CTS procedure allows an AP to protect an MU transmission. An HE AP may transmit an MU-RTS frame to solicit simultaneous CTS responses from one or more HE STAs.

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Figure 10-9a (Example of MU-RTS/CTS/DL MU PPDU/Acknowledgement Response and NAV setting) shows an example of the exchange of MU-RTS and simultaneous CTS responses to protect DL MU PPDU and acknowledgement responses..

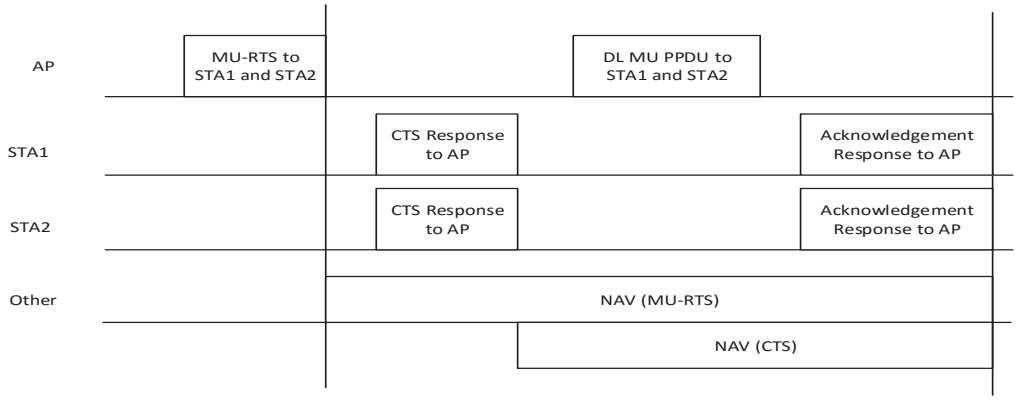

Figure 10-9a—Example of MU-RTS/CTS/DL MU PPDU/Acknowledgement Response and NAV setting

Figure 10-9b (Example of MU-RTS/CTS/Trigger/HE trigger-based PPDU/Multi-STA BlockAck and NAV setting) shows an example of the exchange of MU-RTS and simultaneous CTS responses to protect the scheduled HE trigger-based PPDU and Multi-STA BlockAck frame.

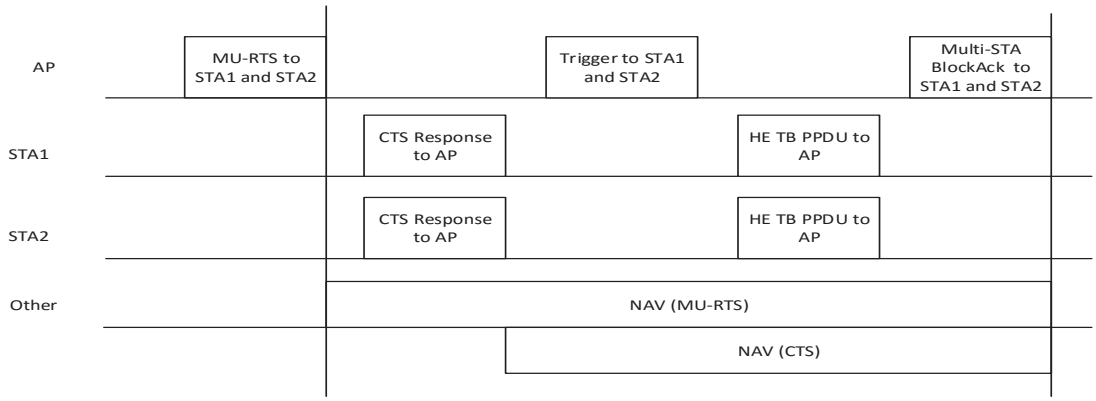

Figure 10-9b—Example of MU-RTS/CTS/Trigger/HE trigger-based PPDU/Multi-STA BlockAck and NAV setting

10.3.2.8a.2 MU-RTS procedure

The transmitter of an MU-RTS frame shall not request a STA to send a CTS frame response in a 20 MHz channel that is not occupied by the PPDU that contains the MU-RTS frame. In each 20 MHz channel occupied by the PPDU that contains an MU-RTS frame, the transmitter of the MU-RTS frame shall request at least one STA to send a CTS frame response that occupies the 20 MHz channel.

After transmitting an MU-RTS frame, the STA shall wait for a CTSTimeout interval with a value of aSIFSTime + aSlotTime + aRxPHYStartDelay. This interval begins when the MAC receives a PHY-TXEND.confirm primitive. If a PHY-RXSTART.indication primitive does not occur during the CTSTimeout interval, the STA shall conclude that the transmission of the MU-RTS frame has failed, and this STA

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shall invoke its backoff procedure upon expiration of the CTSTimeout interval. If a PHY-RXSTART.indication primitive does occur during the CTSTimeout interval, the STA shall wait for the corresponding PHY-RXEND.indication primitive to determine whether the MU-RTS frame transmission was successful. The recognition of a valid CTS frame sent by the recipient of the MU-RTS frame, corresponding to this PHY-RXEND.indication primitive, shall be interpreted as successful response, permitting the frame exchange sequence to continue. The recognition of anything else, including any other valid frame, shall be interpreted as failure of the MU-RTS frame transmission.

An MU-RTS frame shall not be carried in an HE MU PPDU.

10.3.2.8a.3 CTS response to MU-RTS

If an HE STA receives an MU-RTS frame, the HE STA shall commence the transmission of a CTS frame response at the SIFS time boundary after the end of a received PPDU when all the following conditions are met:

— The MU-RTS frame has one of the User Info fields addressed to the STA.

— The UL MU CS condition described in 27.5.2.4 (UL MU CS mechanism) indicates the medium is idle. The ED-based CCA during the SIFS after receiving an MU-RTS frame and virtual CS functions are used to determine the state of the medium to respond to an MU-RTS frame.

— The RU Allocation subfield in the User Info field addressed to the STA indicates either the primary 20 MHz channel, primary 40 MHz channel, primary 80 MHz channel, 160 MHz channel, or 80+80 MHz channel.

— The MU-RTS frame is sent by the AP with which the STA is associated and the value of the basic NAV is 0.

The CTS frame sent in response to an MU-RTS frame shall be carried in a non-HT or non-HT duplicate PPDU.

An HE non-AP STA transmitting a CTS frame in response to an MU-RTS frame shall set the TXVECTOR parameter SCRAMBLER_INITIAL_STATE to the same value as the RXVECTOR parameter SCRAMBLER_INITIAL_STATE of the received MU-RTS frame. The data rate to be used for the non-HT PPDU response shall be 6 Mb/s (see 17.1.1 General).

A CTS frame sent in response to an MU-RTS frame shall be transmitted on the 20 MHz channels indicated in the RU Allocation subfield of the User Info field of the MU-RTS frame when the indicated 20 MHz channels are all idle. If any 20 MHz channel indicated in the RU Allocation subfield of the User Info field is busy, the CTS frame response shall not be transmitted.

Figure 10-9c (An example of an MU-RTS frame soliciting CTS frame responses on the primary 40 MHz channel) shows an example of the exchange of MU-RTS and simultaneous CTS frame responses on the primary 40 MHz channel. In this example, MU-RTS is transmitted in a 40 MHz non-HT duplicate PPDU on the primary 40 MHz channel. Further, the MU-RTS frame requests STA1 to transmit a CTS frame response

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in a non-HT PPDU on the primary 20 MHz channel and STA2 to transmit a CTS frame response in a 40 MHz non-HT duplicate PPDU on the primary 40 MHz channel.

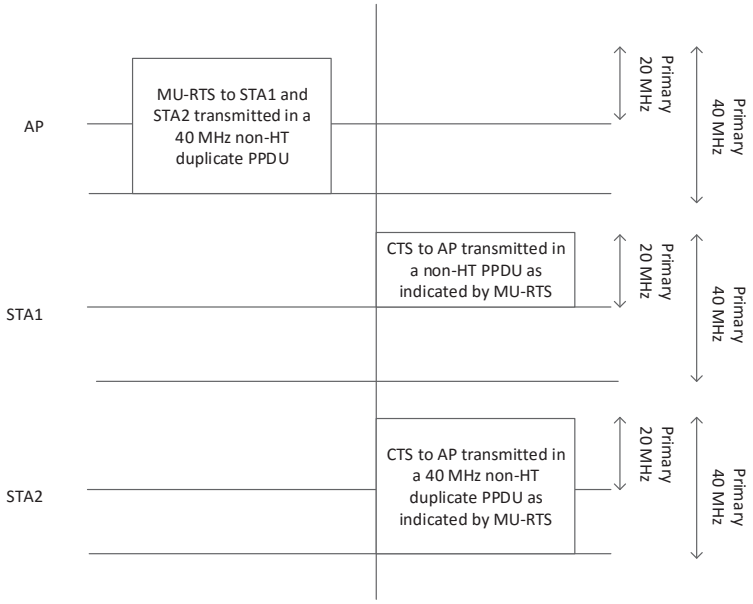

Figure 10-9c—An example of an MU-RTS frame soliciting CTS frame responses on the primary 40 MHz channel

A STA that transmits a CTS frame in response to an MU-RTS frame shall follow the synchronization requirement as defined in 17.3.9.10 (Pre-correction accuracy requirements).

10.3.2.10 MU acknowledgement procedure

Insert a new subclause heading before the first paragraph as follows:

10.3.2.10.1 Acknowledgement procedure for DL MU PPDU in SU format

Change the subclause as follows:

The acknowledgment procedure performed by a STA that receives MPDUs that were transmitted within a VHT MU PPDU or an HE MU PPDU for DL transmission is the same as the acknowledgment procedure for MPDUs that were not transmitted within a VHT MU PPDU or an HE MU PPDU for DL transmission.

NOTE–All MPDUs transmitted within a VHT MU PPDU or an HE MU PPDU for DL transmission are contained within A-MPDUs, and the rules specified in 9.7.3 (A-MPDU contents) prevent an immediate response carried in SU format to more than one of the A-MPDUs.

Responses to A-MPDUs within a VHT MU PPDU or an HE MU PPDU for DL transmissionthat are not immediate responses to the VHT MU PPDU or the HE MU PPDU for DL transmission are transmitted in response to explicit BlockAckReq frames by the AP. Examples of VHT MU PPDU frame exchange sequences are shown in Figure 10-11 (An example of a TXOP containing a VHT MU PPDU transmission with an immediate acknowledgment to the VHT MU PPDU) and Figure 10-12 (An example of a TXOP containing a VHT MU PPDU transmission with no immediate acknowledgment to the VHT MU PPDU).

Recovery within the TXOP that contains a VHT MU PPDU or an HE MU PPDUfor DL transmission can be performed according to the rules of 10.22.2.7 (Multiple frame transmission in an EDCA TXOP). BlockAck-

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Request frames related to A-MPDUs within a VHT MU PPDU or an HE MU PPDU for DL transmission can be transmitted in a TXOP separate from the one that contained the VHT MU PPDU or the HE MU PPDU for DL transmission.

NOTE 1—A BlockAck frame or an Ack frame is sent in immediate response to the BlockAckReq frame for HT-immediate or HT-delayed Block Ack, respectively. An Ack frame might be sent in immediate response carried in SU format to a Single MPDU in the VHT MU PPDU or the HE MU PPDU for DL transmission. A Multi-STA Block Ack frame is sent in immediate response to the BlockAckReq frame with multi-TID BAR variant or MU-BAR frame with multi-TID BAR variant.

NOTE 2—A BlockAckRequest frame would typically not be sent to a STA in the case where the A-MPDU to the STA contained no MPDUs requiring acknowledgment. It could be sent if MPDUs in a previous A-MPDU remain unacknowledged.

Insert a new subclauses 10.3.2.10.2 and 10.3.2.10.3 as follows:

10.3.2.10.2 Acknowledgement procedure for DL MU PPDU in MU format

A non-AP STA that is the recipient, within an HE MU PPDU, of a QoS Data frame or QoS Null frame that solicits an immediate response with Ack Policy equal to MU Ack in the QoS Control field, of an MU-BAR frame, or of an MMPDU that solicits an immediate response, shall send the immediate response according to the scheduling information defined by the UL trigger information that is carried either in the Trigger frame(s) or UL MU Response Scheduling A-Control field. If no valid Trigger frame(s) (see 9.3.1.23 (Trigger frame format)) or UL MU Response Scheduling A-Control field (see 9.2.4.6.4.2 (UL MU response scheduling)) is received, then the STA shall not respond. An example of UL OFDMA acknowledgement to an HE MU PPDU is shown in Figure 10-12a (An example of an HE MU PPDU transmission with an immediate UL OFDMA acknowledgement).

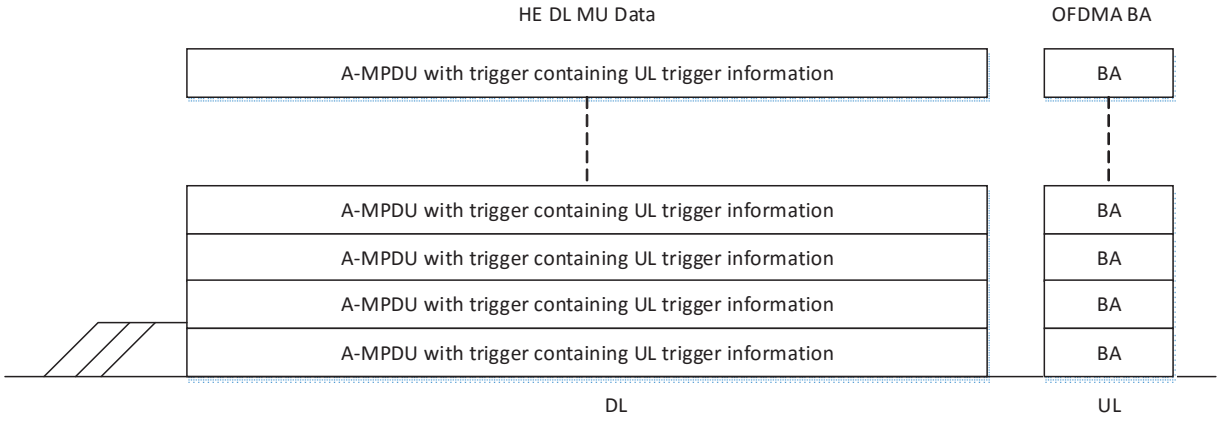

Figure 10-12a—An example of an HE MU PPDU transmission with an immediate UL OFDMA acknowledgement

An AP may use an MU-BAR variant Trigger frame to solicit acknowledgment frames from multiple HE STAs to which the AP has sent QoS Data frame(s) with the Ack Policy subfield equal to Block Ack or from which the AP has not received immediate acknowledgement frames after sending QoS Data frame(s) with the Ack Policy subfield equal to MU Ack in an HE MU PPDU.

10.3.2.10.3 Acknowledgement procedure for an UL MU transmission

When receiving frames from more than one STA that are part of an UL MU transmission (see 9.42.2) and that require an immediate acknowledgement (i.e., the Ack Policy subfield of the eliciting QoS Data frame is

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equal to Normal Ack or Implicit BAR), an AP may send either multiple BlockAck frames (or Ack frames) in an HE MU PPDU, or a Multi-STA BlockAck frame (see 27.4 (Block acknowledgement)). Multi-STA BlockAck frame transmissions are allowed in a non-HT Duplicate PPDU, HT PPDU, VHT PPDU, HE SU PPDU, HE extended range SU PPDU and OFDMA HE MU PPDU. After a successful reception of an UL frame requiring acknowledgment, transmission of the DL acknowledgement shall commence after a SIFS, without regard to the busy/idle state of the medium.Specifically, when an AP transmits an immediate acknowledgement in HE MU PPDU in response to (A-)MPDU sent in HE trigger-based PPDU, the AP should send it within the 20 MHz channel(s) where the pre-HE modulated fields of the HE trigger-based PPDU sent by the STA are located. The immediate acknowledgement is either a BlockAck frame, Ack frame or Multi-STA Block Ack frame.

An example of a DL OFDMA BA is shown in Figure 10-12b (An example of an UL MU transmission with an immediate DL MU transmission containing individually addressed BlockAck frames acknowledging the frames received from the respective STAs).

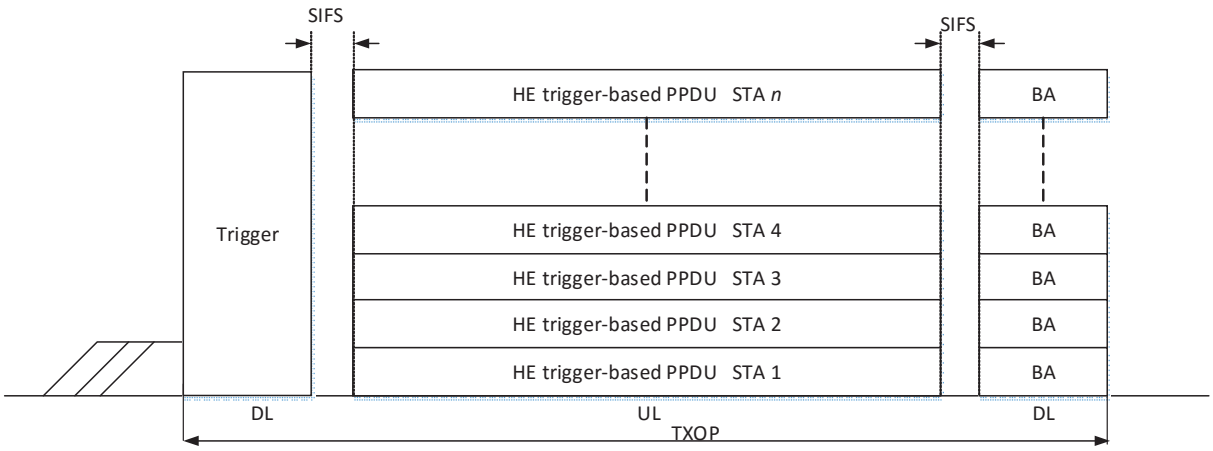

Figure 10-12b—An example of an UL MU transmission with an immediate DL MU transmission containing individually addressed BlockAck frames acknowledging the frames received from the respective STAs

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An example of a Multi-STA BlockAck frame acknowledgement in a non-HT, HT, VHT or HE SU PPDU is given in Figure 10-12c (An example of UL MU transmissions with an immediate Multi-STA BlockAck frame acknowledging the MPDUs).

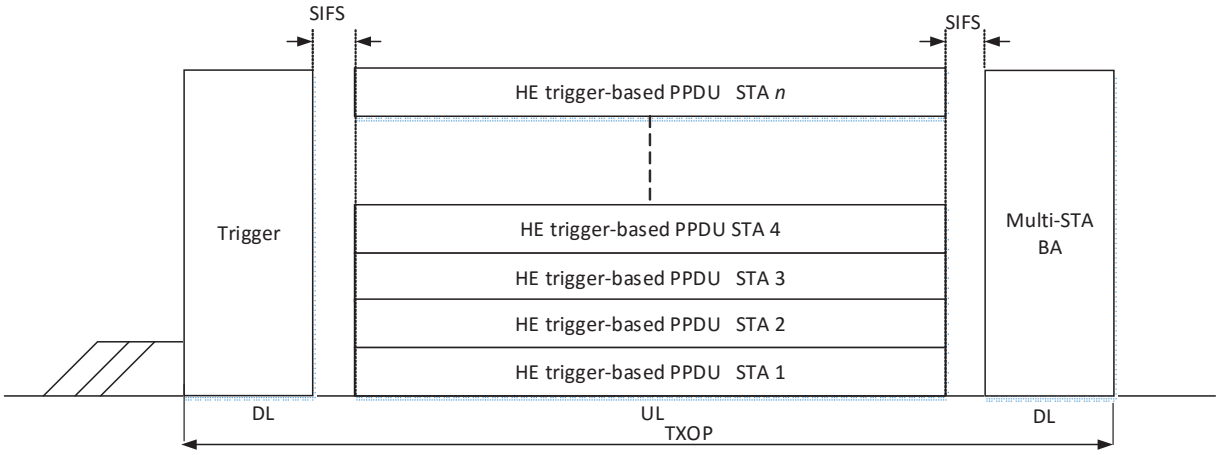

Figure 10-12c—An example of UL MU transmissions with an immediate Multi-STA BlockAck frame acknowledging the MPDUs

An example of a Multi-STA BlockAck frame acknowledgement in a non-HT Duplicate PPDU is given in Figure 10-12d (An example of UL MU transmissions with an immediate DL non-HT duplicate PPDU containing the Multi-STA BlockAck frame).

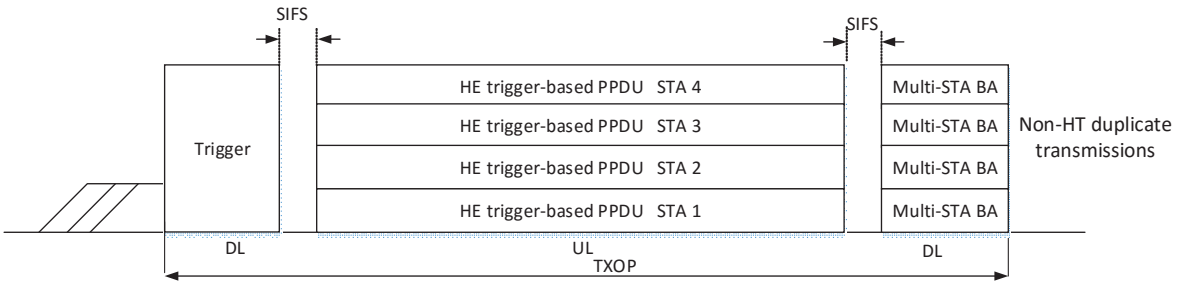

Figure 10-12d—An example of UL MU transmissions with an immediate DL non-HT duplicate PPDU containing the Multi-STA BlockAck frame

The Ack Policy subfield of a QoS data frame sent in an HE trigger-based PPDU shall not be set to Block Ack.

A STA may use a BlockAckReq frame to solicit the acknowledgment frame(s), to whom the STA sent the QoS Data frame(s) with Ack Policy subfield equal to Block Ack or from whom the STA did not receive the immediate acknowledgement frames after sending QoS Data frame(s) in a HE trigger-based PPDU with Ack Policy subfield equal to Normal Ack or Impilcit BAR.

10.3.5 Individually addressed MPDU transfer procedure

~~A~~ When HE duration-based RTS is disabled, a STA using the DCF shall use an RTS/CTS exchange for individually addressed frames when the length of the PSDU is greater than the length threshold indicated by

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dot11RTSThreshold. When HE duration-based RTS is enabled, a non-AP STA using the DCF or EDCA shall use an RTS/CTS exchange for individually addressed frames when the duration of the TXOP is greater than the duration threshold indicated by dot11DurationRTSThreshold. A STA may also use an RTS/CTS exchange for individually addressed frames when it is necessary to distribute the NAV or when it is necessary to establish protection (see 10.26 (Protection mechanisms)). Otherwise a STA using the DCF shall not use the RTS/CTS exchange.

If dot11RTSThreshold is 0 or dot11DurationRTSThreshold is 0, all MPDUs shall be delivered with the use of RTS/CTS. If dot11RTSThreshold is larger than the maximum PSDU length, all PSDUs shall be delivered without RTS/CTS exchanges.

NOTE—A non-AP STA that transmits the MPDUs in an HE trigger-based PPDU is exempt from these requirements.

When an RTS/CTS exchange is used, the PPDU containing the PSDU shall be transmitted starting one SIFS after the end of the CTS frame.

NOTE—No regard is given to the busy or idle status of the medium when transmitting this PSDU.

When an RTS/CTS exchange is not used, the PSDU shall be transmitted following the success of the basic access procedure. With or without the use of the RTS/CTS exchange procedure, the STA that is the destination of a Data frame shall follow the acknowledgment procedure.

10.5 Fragmentation

Change the 2nd paragraph as follows:

With static fragmentation, t~~T~~he length of each fragment shall be an equal number of octets for all fragments except the last, which may be smaller. The length of each fragment shall be an even number of octets, except for the last fragment of an MSDU or MMPDU, which may be either an even or an odd number of octets. The length of a static fragment shall never be larger than dot11FragmentationThreshold unless security encapsulation is invoked for the MPDU. If security encapsulation is active for the MPDU, then the MPDU shall be expanded by the encapsulation overhead and this may result in a fragment larger than dot11FragmentationThreshold. Unless the conditions described in 27.3.2 (Support and requirements for dynamic fragmentation) are met, static fragmentation is used.

Change the 4th paragraph as follows:

A STA shall be capable of receiving fragments, containing all or part of an MSDU, of arbitrary length that is less than or equal to the maximum MSDU size as specified in Table 9-19 (Maximum data unit sizes (in octets) and durations (in microseconds)) ~~defined in 9.2.3 (General frame format), plus any security encapsulation overhead, plus MAC header and FCS~~.

10.7 Multirate support

10.7.1 Overview

Change the last two paragraphs as follows:

For specific PHYs, the value of the Duration/ID field is determined using the PLME-TXTIME.request primitive and the PLME-TXTIME.confirm primitive. These specific PHYs are defined in:

- Clause 16 (High rate direct sequence spread spectrum (HR/DSSS) PHY specification) for HR/DSSS
- Clause 17 (Orthogonal frequency division multiplexing (OFDM) PHY specification) for OFDM
- Clause 18 (Extended Rate PHY (ERP) specification) for ERP

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- Clause 19 (High Throughput (HT) PHY specification) for HT
- Clause 20 (Directional multi-gigabit (DMG) PHY specification) for DMG
- Clause 21 (Very High Throughput (VHT) PHY specification) for VHT
- Clause 22 (Television Very High Throughput (TVHT) PHY specification) for TVHT
- Clause 28 (High Efficiency (HE) PHY specification) for HE

The two PLME-TXTIME primitives are defined in the respective PHY specifications:

- 16.3.4 (HR/DSSS TXTIME calculation) for HR TXTIME calculation
- 17.4.3 (OFDM TXTIME calculation) for OFDM TXTIME calculation
- 18.5.3.2 (ERP-OFDM TXTIME calculations)
- 19.4.3 (TXTIME calculation) for HT TXTIME calculation
- 20.12.3 (TXTIME calculation) for DMG PLME TXTIME calculation
- 21.4.3 (TXTIME and PSDU_LENGTH calculation) for VHT PLME TXTIME calculation
- 22.4.3 (TXTIME and PSDU_LENGTH calculation) for TVHT PLME TXTIME calculation
- 28.4.2 (TXTIME and PSDU_LENGTH calculation) for HE PLME TXTIME calculation

10.7.6 Rate selection for Control frames

10.7.6.5 Rate selection for control response frames

10.7.6.5.2 Selection of a rate or MCS

Insert the following at the end of the subclause:

The rate, HT-MCS, <VHT-MCS, NSS> tuple or <HE-MCS, NSS> tuple selected by an HE AP for a Block-Ack frame or Ack frame that is an immediate response to frames received in an HE trigger-based PPDU shall be selected from those supported by the STA addressed in the frame.

An AP that transmits a Multi-STA BlockAck frame in a non-HT PPDU, HT PPDU, VHT PPDU or HE PPDU shall use a rate, HT-MCS, <VHT-MCS, NSS> tuple or <HE-MCS, NSS> tuple, respectively, that is supported by all the recipients.

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10.7.9 Modulation classes

Change Table as follows:

Table 10-6—Modulation classes

Description of modulation	Condition that selects this modulation class			
	Clause 15 (DSSS PHY specification for the 2.4 GHz band designated for ISM applications) to Clause 18 (Extended Rate PHY (ERP) specification) PHYs or Clause 20 (Directional multi-gigabit (DMG) PHY specification) PHY	**Clause 19 (High Throughput (HT) PHY specification) PHY**	**Clause 21 (Very High Throughput (VHT) PHY specification) PHY**	**Clause 28 (High Efficiency (HE) PHY specification)**
DSSS and HR/DSSS	Clause 15 (DSSS PHY specification for the 2.4 GHz band designated for ISM applications) or Clause 16 (High rate direct sequence spread spectrum (HR/DSSS) PHY specification) transmission	FORMAT is NON_HT. NON_HT_MODULATION is ERP-DSSS or ERP-CCK.	N/A	N/A
ERP-OFDM	18.4 (ERP operating specifications (general)) transmission	FORMAT is NON_HT. NON_HT_MODULATION is ERP-OFDM.	N/A	N/A
OFDM	Clause 17 (Orthogonal frequency division multiplexing (OFDM) PHY specification) transmission	FORMAT is NON_HT. NON_HT_MODULATION is OFDM or NON_HT_DUP_OFDM.	FORMAT is NON_HT. NON_HT_MODULATION is OFDM or NON_HT_DUP_OFDM.	FORMAT is NON_HT. NON_HT_MODULATION is OFDM or NON_HT_DUP_OFDM.
HT	N/A	FORMAT is HT_MF or HT_GF.	FORMAT is HT_MF or HT_GF.	FORMAT is HT_MF or HT_GF.
DMG Control	Clause 20 (Directional multi-gigabit (DMG) PHY specification) transmission and MCS is 0	NA	NA	N/A
DMG SC	Clause 20 (Directional multi-gigabit (DMG) PHY specification) transmission and $1 \leq MCS \leq 12$	NA	NA	N/A

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Table 10-6—Modulation classes *(continued)*

Description of modulation	Condition that selects this modulation class			
	Clause 15 (DSSS PHY specification for the 2.4 GHz band designated for ISM applications) to Clause 18 (Extended Rate PHY (ERP) specification) PHYs or Clause 20 (Directional multi-gigabit (DMG) PHY specification) PHY	**Clause 19 (High Throughput (HT) PHY specification) PHY**	**Clause 21 (Very High Throughput (VHT) PHY specification) PHY**	**Clause 28 (High Efficiency (HE) PHY specification)**
DMG OFDM	Clause 20 (Directional multi-gigabit (DMG) PHY specification) transmission and $13 \leq MCS \leq 24$	NA	NA	N/A
DMG Low-power SC	Clause 20 (Directional multi-gigabit (DMG) PHY specification) transmission and $25 \leq MCS \leq 31$	NA	NA	N/A
VHT	N/A	N/A	FORMAT is VHT.	FORMAT is VHT
HE	N/A	N/A	N/A	FORMAT is HE_SU, HE_EXT_SU, HE_MU and HE_TRIG

10.7.10 Non-HT basic rate calculation

Change as follows:

This subclause defines how to convert an HT MCS ~~or,~~ a VHT-MCS or an HE-MCS to a non-HT basic rate for the purpose of determining the rate of the response frame. It consists of two steps as follows:

a) Use the modulation and coding rate determined from the HT MCS (defined in 19.5 (Parameters for HT MCSs)) or VHT-MCS (defined in 21.5 (Parameters for VHT-MCSs)) or HE-MCS (defined in 28.5 (Parameters for HE-MCSs)) to locate a non-HT reference rate by lookup into Table 10-7 (Non-HT reference rate).[1] In the case of an MCS with UEQM, the modulation of stream 1 is used.

b) The non-HT basic rate is the highest rate in the BSSBasicRateSet that is less than or equal to this non-HT reference rate.

[1] For example, if an HT PPDU transmission uses 64-QAM and coding rate of 3/4, the related non-HT reference rate is 54 Mb/s.

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Change Table 10-7 (Non-HT reference rate) as follows:

Table 10-7—Non-HT reference rate

Modulation	Coding rate (R)	Non-HT reference rate (Mb/s)
BPSK	1/2	6
BPSK	3/4	9
QPSK	1/2	12
QPSK	3/4	18
16-QAM	1/2	24
16-QAM	3/4	36
64-QAM	1/2	48
64-QAM	2/3	48
64-QAM	3/4	54
64-QAM	5/6	54
256-QAM	3/4	54
256-QAM	5/6	54
1024-QAM	3/4	54
1024-QAM	5/6	54

NOTE—In a TVWS band, the non-HT reference rate is scaled as described in 22.2.4 (Support for NON_HT and HT formats).

10.9 HT Control field operation

Change 10.9 as follows:

If the value of dot11HTControlFieldSupported is true, a STA shall set the +HTC Support subfield of the HT Extended Capabilities field of the HT Capabilities element to 1 in HT Capabilities elements that it transmits. If the value of dot11VHTControlFieldOptionImplemented is true, a STA shall set the +HTC-VHT Support subfield of the VHT Capabilities Information field of the VHT Capabilities element to 1 in VHT Capabilities elements that it transmits. If dot11HEControlFieldOptionImplemented is true, a STA shall set the +HTC-HE Support subfield of the HE Capabilities Information field of the HE Capabilities element to 1 in HE Capabilities elements that it transmits.

A STA that has a value of true for at least one of dot11RDResponderOptionImplemented, dot11MCSFeedbackOptionImplemented, and dot11AlternateEDCAActivated shall set dot11HTControlFieldSupported or dot11VHTControlFieldOptionImplemented or both to true. A STA for which at least one of dot11HEULMUResponseSchedulingOptionImplemented, dot11HEMCSFeedbackOptionImplemented or dot11OMIOptionImplemented is true shall set dot11HEControlFieldOptionImplemented to true.

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An HT variant HT Control field shall not be present in a frame addressed to a STA unless that STA declares support for +HTC-HT in the HT Extended Capabilities field of its HT Capabilities element (see 9.2.4.6 (HT Control field)).

A VHT variant HT Control field shall not be present in a frame addressed to a STA unless that STA declares support for +HTC-VHT in the VHT Capabilities Information field of its VHT Capabilities element.

NOTE−An HT STA that does not support +HTC (HT or VHT variant) that receives a +HTC frame addressed to another STA still performs the CRC on the actual length of the MPDU and uses the Duration/ID field to update the NAV, as described in <reference>.

An HE variant HT Control field shall not be present in a frame addressed to a STA unless that STA declares support for +HTC-HE in the HE Capabilities Information field of its HE Capabilities element. The HE variant HT Control field carried in the frame may contain a Control subfield supported by the intended receiver that has:

- A value of 0 in the Control ID subfield when the transmitting STA expects an HE trigger-based PPDU that carries an immediate acknowledgement, as described in 27.5.2 (UL MU operation).
- A value of 1 in the Control ID subfield when the transmitting STA changes the receive operating mode, as described in 27.8 (Operating mode indication).
- A value of 2 in the Control ID subfield when the transmitting STA follows the HE link adaptation procedure, as described in 10.31.4 (Link adaptation using the HE variant HT Control field).
- A value of 3 in the Control ID subfield when the transmitting STA follows the corresponding buffer status report procedure, as described in 27.5.2.5 (HE buffer status feedback operation for UL MU)
- A value of 4 in the Control ID subfield when the transmitting STA follows the UL MU operation procedure, as described in 28.3.14.2 (Power pre-correction).
- A value of 5 in the Control ID subfield when the transmitting STA follows the bandwidth query report procedure, as described in 27.5.1.3 (HE bandwidth query report operation for DL MU).

If the HT Control field is present in an MPDU aggregated in an A-MPDU, then all MPDUs of the same frame type (i.e., having the same value for the Type subfield of the Frame Control field) aggregated in the same A-MPDU shall contain an HT Control field. The HT Control field of all MPDUs containing the HT Control field aggregated in the same A-MPDU shall be set to the same value.

If an A-Control field is present in a frame then it shall contain at least one Control subfield, and the Control subfield shall be present in the A-Control field only if it is supported by the receiving STA; otherwise it shall not be present. At most one Control subfield with a given Control ID value shall be present in the A-Control field of QoS Data or Management frames carried in an (A-)MPDU.

NOTE—An A-Control field that is present in a frame cannot contain only the Padding subfield.

An HE STA that receives an A-Control field shall ignore the remainder of the A-Control field that follows a Control ID subfield whose value is not recognized or is not supported by the STA.

10.10 Control Wrapper operation

Change as follows:

A STA supporting the HT Control field that receives a Control Wrapper frame shall process it as though it received a frame of the subtype of the wrapped frame. An HE STA shall not send a Control Wrapper frame to another HE STA.

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10.12 A-MSDU operation

Change the 3rd paragraph as follows:

An A-MSDU shall be carried, without fragmentation, within a single QoS Data frame, when the recipient has not indicated support for reception of fragmented A-MSDUs. An A-MSDU may be fragmented and each fragment transmitted within a single QoS Data frame, when the recipient has indicated support for reception of fragmented A-MSDUs. Support for reception of fragmented A-MSDUs is indicated with the Fragmented A-MSDU Support bit of the HE Capabilities element.

10.13 A-MPDU operation

10.13.1 A-MPDU contents

Change the 2nd paragraph as follows:

When an A-MPDU contains multiple QoS Control fields, bits 4 shall be identical across all MPDUs that contain the QoS Control fields and bits 8–15 of these QoS Control fields shall be identical across all MPDUs with equal value of the TID subfield.

10.13.2 A-MPDU length limit rules

Change as follows:

A STA indicates in the Maximum A-MPDU Length Exponent field in its HT Capabilities element the maximum A-MPDU length that it can receive in an HT PPDU. A STA indicates in the Maximum A-MPDU Length Exponent field in its VHT Capabilities element the maximum length of the A-MPDU pre-EOF padding that it can receive in a VHT PPDU. A DMG STA indicates in the Maximum A-MPDU Length Exponent field in its DMG Capabilities element the maximum A-MPDU length that it can receive. A STA indicates in the Maximum A-MPDU Length Exponent field in its HE Capabilities element the maximum length of the A-MPDU pre-EOF padding that it can receive in an HE PPDU. The encoding of these fields is defined in Table 9-163 (Subfields of the A-MPDU Parameters field) for an HT PPDU, in Table 9-249 (Subfields of the VHT Capabilities Information field) for a VHT PPDU, and in Table 9-229 (Subfields of the A-MPDU Parameters subfield) for a DMG STA, and in 9.4.2.213 (HE Capabilities element).

A VHT STA that sets the Maximum A-MPDU Length Exponent field in its VHT Capabilities element to a value in the range 0 to 3 shall set the Maximum A-MPDU Length Exponent in its HT Capabilities to the same value. A VHT STA that sets the Maximum A-MPDU Length Exponent field in the VHT Capabilities element to a value larger than 3 shall set the Maximum A-MPDU Length Exponent in its HT Capabilities element to 3.

Using the Maximum A-MPDU Length Exponent fields in the HT Capabilities, and VHT Capabilities, and HE Capabilities elements, the STA establishes at association the maximum length of an A-MPDU pre-EOF padding that can be sent to it. An HT STA shall be capable of receiving A-MPDUs of length up to the value indicated by the Maximum A-MPDU Length Exponent field in its HT Capabilities element. A VHT STA shall be capable of receiving A-MPDUs where the A-MPDU pre-EOF padding length is up to the value indicated by the Maximum A-MPDU Length Exponent field in its VHT Capabilities element. An HE STA shall be capable of receiving A-MPDUs where the A-MPDU pre-EOF padding length is up to the value indicated by the Maximum A-MPDU Length Exponent field in its HE Capabilities element.

A STA shall not transmit an A-MPDU in an HT PPDU that is longer than the value indicated by the Maximum A-MPDU Length Exponent field in the HT Capabilities element received from the intended receiver. MPDUs in an A-MPDU carried in an HT PPDU shall be limited to a maximum length of 4095 octets. A STA shall not transmit an A-MPDU in a VHT PPDU where the A-MPDU pre-EOF padding length is longer than the value

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indicated by the Maximum A-MPDU Length Exponent field in the VHT Capabilities element received from the intended receiver. A DMG STA shall not transmit an A-MPDU that is longer than the value indicated by the Maximum A-MPDU Length Exponent field in the DMG Capabilities element received from the intended receiver. A STA shall not transmit an A-MPDU in an HE PPDU where the A-MPDU pre-EOF padding length is longer than the value indicated by the Maximum A-MPDU Length Exponent field in the HE Capabilities element received from the intended receiver.

10.22 HCF

10.22.2 HCF contention based channel access (EDCA)

10.22.2.2 EDCA backoff procedure

Change the 2nd paragraph as follows:

For the purposes of this subclause, transmission failure of an MPDU is defined as follows:

- After transmitting an MPDU (even if it is carried in an A-MPDU or as part of a VHT MU PPDU that is sent using TXVECTOR parameter NUM_USERS > 1) that requires ~~an~~ one or more immediate response:
  - The STA shall wait for a timeout interval of duration aSIFSTime + aSlotTime + aRxPHYStartDelay, starting when the MAC receives a PHY-TXEND.confirm primitive. If a PHY-RXSTART.indication primitive does not occur during the timeout interval, the transmission of the MPDU has failed.
  - If a PHY-RXSTART.indication primitive does occur during the timeout interval, the STA shall wait for the corresponding PHY-RXEND.indication primitive to recognize ~~a~~ one or more valid response MPDUs (see Annex G) that either does not have a TA field or is sent by ~~the~~ one or more recipients of the MPDU requiring a response. If anything else, including any other valid frame, is recognized, the transmission of the MPDU has failed.
- The nonfinal (re)transmission of an MPDU that is delivered using the GCR unsolicited retry retransmission policy (10.22.2.11.2 (Unsolicited retry procedure))) is defined to be a failure.
- In all other cases, the transmission of the MPDU has not failed.

Change the last paragraph as follows:

If the backoff procedure is invoked for reason c), d), e) or f) above, or the transmission failure of a non-initial frame by the TXOP holder], the value of CW[AC] shall be updated as follows before invoking the backoff procedure:

- If the QSRC[AC] or the QLRC[AC] has reached dot11ShortRetryLimit or dot11LongRetryLimit respectively, CW[AC] shall be reset to CWmin[AC].
- If dot11RobustAVStreamingImplemented is true and either the QSDRC[AC] or the QLDRC[AC] has reached dot11ShortDEIRetryLimit or dot11LongDEIRetryLimit, respectively, CW[AC] shall be reset to CWmin[AC].
- Otherwise,
  - If CW[AC] is less than CWmax[AC], CW[AC] shall be set to the value (CW[AC] + 1) × 2 – 1.
  - If CW[AC] is equal to CWmax[AC], CW[AC] shall be left unchanged.
  - For an HE STA, if CW[AC] is greater than CWmax[AC], CW[AC] shall be set to CWmax[AC].

Insert the following at the end of subclause 10.22.2.2:

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When an HE STA successfully receives the corresponding acknowledgement frame in response to the MPDU sent in HE trigger based PPDU, the backoff for the associated EDCAF resumes the backoff counter countdown.

When an HE STA does not receive the corresponding acknowledgement frame in response to the MPDU sent in HE trigger based PPDU, the backoff for the associated EDCAF resumes the backoff counter countdown.

If an HE STA does not successfully receive the corresponding acknowledgement frame in response to the MPDU sent in an HE trigger based PPDU, the short retry counters and long retry counters for the associated EDCAF are not changed.

10.22.2.4 Obtaining an EDCA TXOP

Change the last paragraph and insert a new paragraph as follows:

A STA shall save the TXOP holder address for the BSS in which it is associated, which is the MAC address from the Address 2 field of the frame that initiated a frame exchange sequence except when this is a CTS frame, in which case the TXOP holder address is the Address 1 field. If the TXOP holder address is obtained from a Control frame, a VHT STA or HE STA shall save the nonbandwidth signaling TA value obtained from the Address 2 field. If a non-VHT non-HE STA receives an RTS frame with the RA address matching the MAC address of the STA and the MAC address in the TA field in the RTS frame matches the saved TXOP holder address, then the STA shall send the CTS frame after SIFS, without regard for, and without resetting, its NAV. If a VHT STA or HE STA receives an RTS frame with the RA address matching the MAC address of the STA and the nonbandwidth signaling TA value obtained from the Address 2 field in the RTS frame matches the saved TXOP holder address, then the STA shall send the CTS frame after SIFS, without regard for, and without resetting, its NAV. When a STA receives a frame addressed to it that requires an immediate response, except for RTS and Trigger frames (see 27.5.2.4 (UL MU CS mechanism)), it shall transmit the response independent of its NAV. The saved TXOP holder address shall be cleared when the NAV is reset or when the NAV counts down to 0.

During an EDCA TXOP, Address 2 field excluding the Individual/Group bit of all control frames sent by a TXOP holder shall be set to the same address value.

Change the title of subclause 10.22.2.5 as follows:

10.22.2.5 EDCA channel access in a VHT, HE or TVHT BSS

Change 4th paragraph as follows:

If a STA is permitted to begin a TXOP (as defined in 10.22.2.4 (Obtaining an EDCA TXOP)) and the STA has at least one MSDU pending for transmission for the AC of the permitted TXOP, the STA shall perform exactly one of the following actions:

a) Transmit a 160 MHz or 80+80 MHz mask PPDU if the secondary channel, the secondary 40 MHz channel, and the secondary 80 MHz channel were idle during an interval of PIFS immediately preceding the start of the TXOP.

b) Transmit an 80 MHz mask PPDU on the primary 80 MHz channel if both the secondary channel and the secondary 40 MHz channel were idle during an interval of PIFS immediately preceding the start of the TXOP.

c) Transmit a 40 MHz mask PPDU on the primary 40 MHz channel if the secondary channel was idle during an interval of PIFS for the 5 GHz band and DIFS for an HE STA operating in the 2.4 GHz band immediately preceding the start of the TXOP.

d) Transmit a 20 MHz mask PPDU on the primary 20 MHz channel.

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e) Restart the channel access attempt by invoking the backoff procedure as specified in 10.22.2 (HCF contention based channel access (EDCA)) as though the medium is busy on the primary channel as indicated by either physical or virtual CS and the backoff timer has a value of 0.

f) Transmit a TVHT_4W or TVHT_2W+2W mask PPDU if the secondary TVHT_W channel and the secondary TVHT_2W channel were idle during an interval of PIFS immediately preceding the start of the TXOP.

g) Transmit a TVHT_2W or TVHT_W+W mask PPDU if the secondary TVHT_W channel was idle during an interval of PIFS immediately preceding the start of the TXOP.

h) Transmit a TVHT_W mask PPDU on the primary TVHT_W channel.

NOTE 1—In the case of rule e), the STA selects a new random number using the current value of CW[AC], and the retry counters are not updated (as described in 10.22.2.7 (Multiple frame transmission in an EDCA TXOP); backoff procedure invoked for event a)).

NOTE 2—For ~~both~~ an HT, ~~and~~ a VHT and an HE STA, an EDCA TXOP is obtained based on activity on the primary channel (see 10.22.2.4 (Obtaining an EDCA TXOP)). The width of transmission is determined by the CCA status of the nonprimary channels during the PIFS interval for the 5 GHz band or DIFS interval for an HE STA operating in the 2.4 GHz band before transmission (see ~~VHT description in~~ 10.3.2 (Procedures common to the DCF and EDCAF)).

10.22.2.6 Sharing an EDCA TXOP

Change the 1st three paragraphs as follows:

This mode applies only to an AP that supports DL-MU-MIMO or DL-OFDMA. The AC associated with the EDCAF that gains an EDCA TXOP becomes the primary AC. TXOP sharing is allowed when primary AC traffic is transmitted in a VHT MU PPDU or an HE MU PPDU and resources permit traffic from secondary ACs to be included, targeting up to four STAs if it is transmitted in the VHT MU PPDU. The inclusion of secondary AC traffic in a VHT MU PPDU shall not increase the duration of the VHT MU PPDU beyond that required to transport the primary AC traffic. The inclusion of secondary AC traffic in an HE MU PPDU is described in 27.10.4 (A-MPDU with multiple TIDs). If a destination in a VHT MU PPDU is targeted by frames in the queues of both the primary AC and at least one secondary AC, the frames in the primary AC queue shall be transmitted to the destination first, among a series of downlink transmissions within a TXOP. The decision of which secondary ACs and destinations are selected for TXOP sharing, as well as the order of transmissions, are implementation specific and out of scope of this standard. For an HE MU PPDU, the inclusion of secondary AC traffic in the HE MU PPDU shall not cause the TXOP limit of the primary AC to be exceeded.

When sharing, the TXOP limit that applies is the TXOP limit of the primary AC.

NOTE—An AP can protect an immediate response by preceding the VHT MU PPDU or the HE MU PPDU (which might have TXVECTOR parameter NUM_USERS > 1) with an RTS/CTS exchange or an MU-RTS/CTS exchange or a CTS-to-self transmission.

10.22.2.7 Multiple frame transmission in an EDCA TXOP

Change the 1st paragraph as follows:

A frame exchange, in the context of multiple frame transmission in an EDCA TXOP, may be one of the following:

— A frame not requiring immediate acknowledgment (such as a group addressed frame or a frame transmitted with an acknowledgment policy that does not require immediate acknowledgment) or an A-MPDU containing only such frames

— A frame requiring acknowledgment (such as an individually addressed frame transmitted with an acknowledgment policy that requires immediate acknowledgment) or an A-MPDU containing at least one such frame, followed after SIFS by a corresponding acknowledgment frame

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— A Trigger frame or a frame carrying an UL MU Response Scheduling A-Control subfield followed after SIFS by the requested immediate response

— Either

  — a VHT NDP Announcement frame followed after SIFS by a VHT NDP followed after SIFS by a PPDU containing one or more VHT Compressed Beamforming frames, or

  — a Beamforming Report Poll frame followed after SIFS by a PPDU containing one or more VHT Compressed Beamforming frames

A DL MU PPDU may carry MPDUs addressed to multiple recipients, hence multiple frame exchanges are performed simultaneously. If at least one of those frame exchanges requires an immediate response (i.e. the AP includes at least one Trigger frame or UL MU Response Scheduling A-Control field) and if the AP receives an immediate response with at least one correct MPDU from at least one of the solicited STAs, the rules in this subclause apply.

Change the 7th and 8th paragraphs as follows:

If a TXOP is protected by an RTS or CTS frame carried in a non-HT or a non-HT duplicate PPDU, the TXOP holder shall set the TXVECTOR parameter CH_BANDWIDTH of a PPDU as follows:

— To be the same or narrower than RXVECTOR parameter CH_BANDWIDTH_IN_NON_HT of the last received CTS frame in the same TXOP, if the RTS frame with a bandwidth signaling TA and TXVECTOR parameter DYN_BANDWIDTH_IN_NON_HT set to Dynamic has been sent by the TXOP holder in the last RTS/CTS exchange.

— Otherwise, to be the same or narrower than the TXVECTOR parameter CH_BANDWIDTH of the RTS frame that has been sent by the TXOP holder in the last RTS/CTS exchange in the same TXOP.

If a TXOP is protected by an MU-RTS or CTS frame carried in a non-HT or a non-HT duplicate PPDU, the TXOP holder shall set the TXVECTOR parameter CH_BANDWIDTH of a PPDU as follows:

— To be the same or narrower than the TXVECTOR parameter CH_BANDWIDTH of the MU-RTS frame that has been sent by the TXOP holder in the last MU-RTS/CTS exchange in the same TXOP, if the RU Allocation subfields of the MU-RTS frame for all intended receiver are equal to the BW subfield in the Common Info field of the MU-RTS frame.

— Otherwise, to be the same or narrower than the TXVECTOR parameter CH_BANDWIDTH of the preceding PPDU that it has transmitted in the same TXOP.

If there is no RTS/CTS or MU-RTS/CTS exchange in non-HT duplicate format in a TXOP, and the TXOP includes at least one non-HT duplicate frame exchange that does not include a PS-Poll, then the TXOP holder shall set the CH_BANDWIDTH parameter in TXVECTOR of a PPDU sent after the first non-HT duplicate frame that is not a PS-Poll to be the same or narrower than the CH_BANDWIDTH parameter in TXVECTOR of the initial frame in the first non-HT duplicate frame exchange in the same TXOP.

10.22.2.8 TXOP limits

Change the 3rd paragraph as follows:

A TXOP limit of 0 indicates that the TXOP holder may transmit or cause to be transmitted (as responses) the following within the current TXOP:

a) One of the following at any rate, subject to the rules in 10.7 (Multirate support)

  1) One or more SU PPDUs carrying fragments of a single MSDU or MMPDU

  2) An SU PPDU or a VHT MU PPDU or an HE MU PPDU or an HE trigger-based PPDU carrying a single MSDU, a single MMPDU, a single A-MSDU, or a single A-MPDU

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3) A VHT MU PPDU or an HE MU PPDU carrying A-MPDUs to different users (a single A-MPDU to each user)
4) A QoS Null frame or PS-Poll frame
5) Trigger frame

b) Any required acknowledgments
c) Any frames required for protection, including one of the following:
1) An RTS/CTS or MU-RTS/CTS exchange
2) CTS to itself
3) Dual CTS as specified in 10.3.2.8 (Dual CTS protection)
d) Any frames required for beamforming as specified in 10.30 (Sounding PPDUs), 10.34.5 (VHT sounding protocol) and 10.38 (DMG beamforming).
e) Any frames required for link adaptation as specified in 10.31 (Link adaptation)
f) Any number of BlockAckReq or MU-BAR frames

NOTE 1—This is a rule for the TXOP holder. A TXOP responder need not be aware of the TXOP limit nor of when the TXOP was started.

NOTE 2—This rule prevents the use of RD when the TXOP limit is 0.

Insert the following at the end of the subclause:

When the Duration field value in the MAC header of an HE trigger-based PPDU is set to 0, the HE trigger-based PPDU shall not include any frames that solicit a control response frame from the AP.

10.22.2.9 Truncation of TXOP

Insert the following at the end of the subclause:

An HE STA that receives a CF-End frame should not reset its NAV if any of following conditions is met, otherwise it resets its NAV:

— The received CF-End frame is an inter-BSS frame and the most recent NAV update was due to an intra-BSS frame (see 27.2.1 (Intra-BSS and inter-BSS frame detection)).
— The received CF-End frame is an intra-BSS frame and the most recent NAV update was due to an inter-BSS frame (see 27.2.1 (Intra-BSS and inter-BSS frame detection)).

NOTE 1—For HE STAs with two NAVs, the TXOP truncation rule applies to each NAV separately.

10.22.4 Admission Control at the HC

10.22.4.2 Contention based admission control procedures

10.22.4.2.3 Procedure at non-AP STAs

Change the 8th paragraph as follows:

The MPDUExchangeTime equals the time required to transmit the MPDU sequence. For the case of an MPDU transmitted with Normal Ack policy and without RTS/CTS protection, this equals the time required to transmit the MPDU plus the time required to transmit the expected response frame plus one SIFS. Frame exchange sequences for Management frames and the HE trigger-based PPDU are excluded from the used_time update. If the used_time value reaches or exceeds the admitted_time value, the corresponding EDCAF shall no longer transmit QoS Data frames or QoS Null MPDUs using the EDCA parameters for that AC as specified in the QoS Parameter Set element. However, a STA may choose to temporarily replace the EDCA

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parameters for that EDCAF with those specified for an AC of lower priority, if no admission control is required for those ACs.

10.24 Block acknowledgement (block ack)

10.24.10 GCR block ack

10.24.10.3 GCR block ack BlockAckReq and BlockAck frame exchanges

Change the following 2nd and 3rd paragraphs as follows:

When the retransmission policy for a group address is GCR Block Ack, an originator shall not transmit more than the GCR buffer size number of A-MSDUs with RA set to the GCR concealment address and the DA field of the A-MSDU subframe set to the GCR group address before sending a BlockAckReq frame to one of the STAs that has a GCR block ack agreement for this group address. The RA field of the BlockAckReq frame shall be set to the MAC address of the destination STA. Upon reception of the BlockAck frame, an originator may send a BlockAckReq frame to another STA that has a block ack agreement for this group address, and this process may be repeated multiple times. If the originator has a GCR block ack agreement with one or more of the HE STAs for this group address, the originator may send an MU-BAR frame (MU-BAR variant Trigger frame) or GCR MU-BAR frame (GCR MU-BAR variant Trigger frame) to one or more of the HE STAs. Upon reception of the BlockAck frame from one or more HE STAs, the originator may send an MU-BAR frame to one or more other HE STAs that have a GCR block ack agreement, and this process may be repeated multiple times.

NOTE 1—If the originator sends a BlockAckReq frame to a STA with a MAC address that matches the SA in any of the A-MSDUs transmitted during the GCR TXOP, the Block Ack Bitmap subfield does not indicate the MSDUs sourced from this STA. This is because the STA will have discarded all group addressed MPDUs transmitted by the AP that have the source address equal to their MAC address (see 10.3.6 (Group addressed MPDU transfer procedure)).

When a recipient receives a BlockAckReq frame with the GCR Group Address subfield equal to a GCR group address, the recipient shall transmit a BlockAck frame at a delay of SIFS after the BlockAckReq frame. The BlockAck frame acknowledges the STA's reception status of the block of group addressed frames requested by the BlockAckReq frame. When an HE STA receives an MU-BAR frame with User Identifier subfield set to the AID of the HE STA, the HE STA shall transmit BlockAck frame in the indicated resource unit SIFS after the Trigger frame. The BlockAck frames report the HE STA's reception status of the block of group addressed frames requested by the MU-BAR frame.

Figure 10-36 (Example of a frame exchange with GCR block ack retransmission policy) shows an example of a frame exchange when the GCR block ackretransmission policy is used. The AP sends several A-MSDUs using the GCR block ack retransmission policy. The AP then sends a BlockAckReq frame to group member 1 of the GCR group, waits for the BlockAck frame, and then sends a BlockAckReq frame to group member 2. After receiving the BlockAck frame from GCR group member 2, the AP determines whether any A-MSDUs need to be retransmitted and sends additional A-MSDUs (some of which might be retransmissions of previous A-MSDUs) using the GCR block ack retransmission policy.

Insert the following paragraph and associated figure:

Figure 10-36a (Example of a frame exchange with GCR block ack retransmission policy) shows another example of a frame exchange when the GCR block ack retransmission policy is used. The HE AP sends several A-MSDUs using the GCR block ack retransmission policy. The HE AP then sends an MU-BAR to group members 1 and 2 of the GCR group, waits for the BlockAck frames, and then sends an MU-BAR to group members 3 and 4 and then waits for the BlockAck frame. The HE AP then sends a BAR frame to group member 5, which is a non-HE STA, and waits for the BlockAck frame. After receiving the BlockAck frames, the HE AP determines whether any A-MSDUs need to be retransmitted and sends additional A-

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MSDUs (some of which might be retransmissions of previous A-MSDUs) using the GCR block ack retransmission policy.

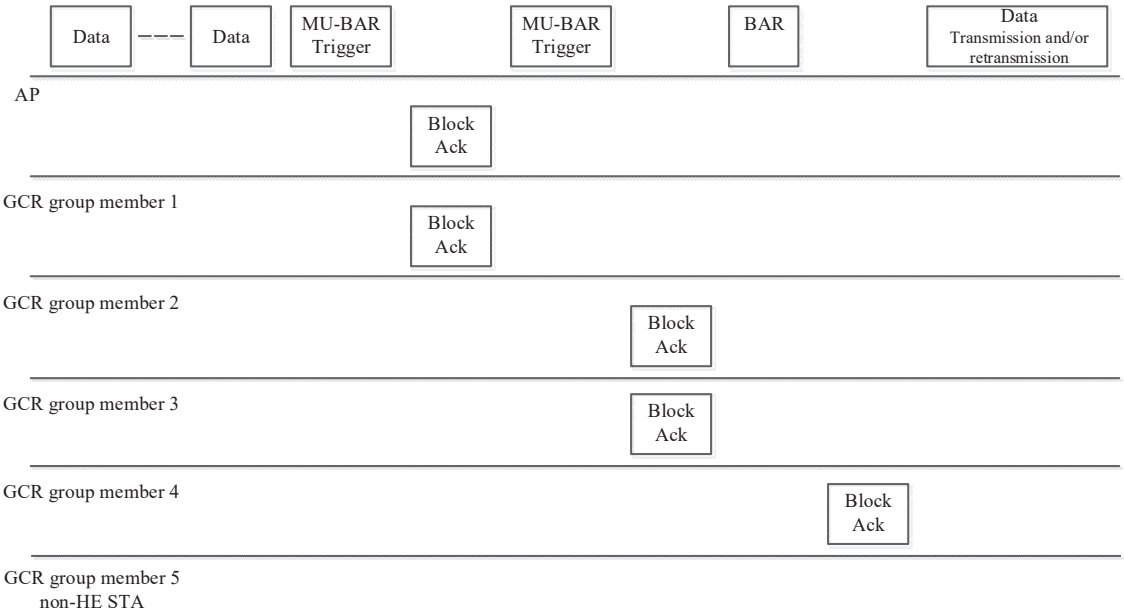

Figure 10-36a—Example of a frame exchange with GCR block ack retransmission policy

Change the 6th,7th and 8th paragraph as follows:

After completing the BlockAckReq or MU-BAR and BlockAck frame exchanges, the originator determines from the information provided in the BlockAck bitmap and from the missing BlockAck frames which, if any, A-MSDUs need to be retransmitted.

An originator adopting the GCR block ack retransmission policy for a GCR group address chooses a lifetime limit for the group address. The originator may vary the lifetime limit for the group address at any time and may use different lifetime limits for different GCR group addresses. The originator transmits and retries each A-MSDU until the appropriate lifetime limit is reached or until each one has been received by all group members to which a BlockAckReq frame or an MU-BAR frame has been sent, whichever occurs first.

For GCR streams with retransmission policy equal to GCR Block Ack, an originator may regularly send a BlockAckReq frame with the GCR Group Address subfield in the BAR Information field set to the GCR group address and the Block Ack Starting Sequence Control subfield set to the Sequence Number field of the earliest A-MSDU of the GCR stream that has not been acknowledged by all group members and has not expired due to lifetime limits, in order to minimize buffering latency at receivers in the GCR group. An originator may also send an MU-BAR frame with AID12 fields set to AIDs of HE STAs that transmit the BlockAck frames and the Block Ack Starting Sequence Control subfield set to the Sequence Number field of the earliest A-MSDU of the GCR stream that has not been acknowledged by all group members and has not expired due to lifetime limits, in order to minimize buffering latency at receivers in the GCR group.

NOTE 2—This is because an originator might transmit Management frames, QoS Data frames with a group address in the Address 1 field (including different GCR streams), and non-QoS Data frames intermingled. Since these are transmitted using a single sequence counter, missing frames or frames sent to group addresses absent from a receiving STA's dot11GroupAddresses table complicate receiver processing for GCR streams with a GCR block ack retransmission policy since the cause of a hole in a receiver's block ack bitmap is ambiguous: it is due either to an MPDU being lost from the GCR stream or to transmissions of MPDUs not related to the GCR service using the same sequence number counter.

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Change the last paragraph as follows:

If the beginning of such reception does not occur during the first slot time following a SIFS, then the originator may perform error recovery by retransmitting a BlockAckReq frame or an MU-BAR frame PIFS after the previous BlockAckReq frame or an MU-BAR frame when both of the following conditions are met:

— The carrier sense mechanism (see 10.3.2.1 (CS mechanism)) indicates that the medium is idle at the TxPIFS slot boundary (defined in 10.3.7 (DCF timing relations)) after the expected start of a BlockAck frame, and

— The remaining duration of the GCR TXOP is longer than the total time required to retransmit the GCR BlockAckReq frame or an MU-BAR frame plus one slot time.

NOTE 3—If an originator fails to receive a BlockAck frame in response to a BlockAckReq frame and there is insufficient time to transmit a recovery frame, the AP retransmits the BlockAckReq frame in a new TXOP.

10.28 Reverse direction protocol

10.28.3 Rules for RD initiator

Change the 3rd and subsequent 2 paragraphs as follows:

Transmission of a +HTC or DMG frame by an RD initiator with the RDG/More PPDU subfield equal to 1 (either transmitted as a non-A-MPDU frame, as a VHT single MPDU, or within an A-MPDU) indicates that the duration indicated by the Duration/ID field is available for the RD response burst and RD initiator final PPDU (if present).

NOTE—An HE RD initiator includes the RDG/More PPDU subfield in the RDP A-Control field of QoS Data or Management frames it transmits.

An RD initiator that sets the RDG/More PPDU field to 1 in a +HTC or DMG frame transmitted during a TXOP shall set the AC Constraint subfield to 1 in that frame if the TXOP was gained through the EDCA channel access mechanism and shall otherwise set it to 0. An RD initiator that sets the RDG/More PPDU field to 1 in a DMG frame transmitted during an SP can set the AC Constraint subfield to 1 to limit the Data frames transmitted by the RD responder. An HE non-AP STA RD initiator that sets the RDG/More PPDU field to 1 in a frame transmitted during a TXOP shall set the AC Constraint to 1, while an HE AP RD initiator may set the AC Constraint subfield to 1.

~~An~~ A non-HE RD initiator shall not transmit a +HTC or DMG frame with the RDG/More PPDU subfield set to 1 that requires a response MPDU that is not one of the following frames:

— Ack

— Compressed BlockAck

— Multi-STA BlockAck

10.28.4 Rules for RD responder

Change the 5th and subsequent 2 paragraphs as follows:

An RD responder shall not transmit an MPDU (either individually or aggregated within an A-MPDU) that is not one of the following frames:

— Ack

— Compressed BlockAck

— Compressed BlockAckReq

— Extended Compressed BlockAck

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— Extended Compressed BlockAckReq
— Multi-STA BlockAck
— QoS data
— Management

If the AC Constraint subfield is equal to 1, the non-HE RD responder shall transmit Data frames of only the same AC as the last frame received from the RD initiator, while the HE RD responder may transmit A-MPDU with MPDUs from multiple TIDs that are from the same AC or higher ACs, as described in 25.10.4 (A-MPDU with multiple TID).

For a BlockAckReq or BlockAck frame, the AC is determined by examining the TID field. For a Management frame, the AC is AC_VO. The RD initiator shall not transmit a MPDU with the RDG/More PPDU subfield set to 1 from which the AC cannot be determined. If the AC Constraint subfield is equal to 0, the non-HE RD responder may transmit Data frames of any TID, while the HE RD responder may transmit Data frames of any TIDs, as described in 27.10.4 (A-MPDU with multiple TIDs).

10.43 Target wake time (TWT)

10.43.1 TWT overview

Change the 2nd paragraph as follows:

A TWT requesting STA communicates wake scheduling information to its TWT responding STA and the TWT responding STA devises a schedule and delivers TWT values to the TWT requesting STA when a TWT agreement has been established between them. When explicit TWT is employed, a TWT requesting STA wakes and performs a frame exchange and receives the next TWT information in a response from the TWT responding STA as described in 10.43.2.2 (Explicit TWT operation). When implicit TWT is used, the TWT requesting STA calculates the Next TWT by adding a fixed value to the current TWT value as described in 10.43.3 (Implicit TWT operation).

Insert a new paragraph and table after the 9th paragraph:

The result of an exchange of TWT Setup frames is defined in Table 10-19a (TWT setup exchange command interpretation). In general, the meaning of Request TWT is that the transmitting STA will negotiate the TWT parameters for a TWT agreement, Suggest TWT indicates that the transmitting STA offers a set of preferred TWT parameters for a TWT agreement but will accept whatever the responding STA indicates and Demand TWT indicates tha the transmitting STA will accept only the indicated TWT parameters for a TWT agreeement. For a responding STA, accept TWT indicates that the responding STA has initiated a TWT agreement with the given parameters, alternate TWT indicates a counter-offer of TWT parameters without the creation of a TWT agreement and dictate TWT indicates that no TWT agreement is created, but one can be created using the indicated TWT parameters.

Table 10-19a—TWT setup exchange command interpretation

Initiating frame	Response frame	
TWT Setup Command field value within a TWT Setup frame transmitted from first STA to second STA	TWT Setup Command field value within a TWT Setup frame transmitted from second STA to first STA	TWT condition after the completion of the exchange

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Table 10-19a—TWT setup exchange command interpretation

Request TWT or Suggest TWT or Demand TWT with Wake TBTT Negotiation subfield = don't care	No frame transmitted	No new active individual TWT agreement exists with the TWT Flow ID corresponding to the Flow ID in the initiating frame. No new active Broadcast individual TWT agreement exists.
Request TWT or Demand TWT with Wake TBTT Negotiation subfield = 0	Accept TWT with Broadcast subfield = 0	An individual TWT agreement is now active and is using the TWT parameters identified in the initiating frame. The TWT parameters in the response frame match the TWT parameters of the initiating frame.
Suggest TWT with Wake TBTT Negotiation subfield = 0	Accept TWT with Broadcast subfield = 0	An individual TWT agreement is now active and is using the TWT parameters identified in the ~~responding~~ response frame.
Request TWT or Suggest TWT or Demand TWT with Wake TBTT Negotiation subfield = 0	Accept TWT with Broadcast subfield = 1	This response is not allowed.
Suggest TWT or Demand TWT with Wake TBTT Negotiation subfield = 0	Alternate TWT or Dictate TWT with Broadcast subfield = 0	This response is not allowed.
Request TWT with Wake TBTT Negotiation subfield = 0	Alternate TWT with Broadcast subfield = 0	No active individual TWT agreement exists with the associated TWT Flow ID. The responder is offering an alternative set of parameters vs. those indicated in the initiating frame, as a means of negotiating TWT parameters with the requester. The requesting STA can send a new request with any set of TWT parameters and the responder might entertain the creation of an individual TWT agreement using those parameters.
Request TWT with Wake TBTT Negotiation subfield = 0	Dictate TWT with Broadcast subfield = 0	No active individual TWT agreement exists with the associated TWT Flow ID. The responder offers an alternative set of parameters vs. those indicated in the TWT request. By selecting "Dictate TWT", the responder indicates that it is not willing to accept any other TWT parameters for the requesting STA at this time. The requesting STA can send a new request, but will only receive an Accept TWT if it uses the dictated TWT parameters.
Request TWT with Wake TBTT Negotiation subfield = 0	Dictate TWT with Broadcast subfield = 1	No active individual TWT agreement exists with the associated TWT Flow ID. A broadcast TWT agreement is now active and is using the TWT parameters identified in the ~~responding frame~~ response frame including a Broadcast TWT ID subfield. The broadcast TWT agreement is not necessarily a newly created broadcast TWT agreement. The responding STA will not create any new individual TWT agreement with the requester at this time. The STA transmitting the initiating frame is not a member of the broadcast TWT.
Request TWT or Suggest TWT or Demand TWT with Wake TBTT Negotiation subfield = 0	Reject TWT with Broadcast subfield = 0	No active individual TWT agreement exists with the associated TWT Flow ID. The responding STA will not create any new individual TWT agreement with the requester at this time.

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Table 10-19a—TWT setup exchange command interpretation

Suggest TWT or Demand TWT with Wake TBTT Negotiation subfield = 1	Accept TWT or Alternate TWT or Dictate TWT or Reject TWT with Broadcast subfield = 0	This response is not allowed.
Demand TWT with Wake TBTT Negotiation subfield = 1	Accept TWT with Wake TBTT Negotiation subfield = 1 and Broadcast subfield = 1	An active broadcast TWT agreement exists or has been created with the TWT parameters indicated in the initiating frame and the STA transmitting the initiating frame is a member of the Broadcast TWT identified by the Broadcast TWT ID and the TA of the response frame.
Suggest TWT with Wake TBTT Negotiation subfield = 1	Accept TWT with Wake TBTT Negotiation subfield = 1 and Broadcast subfield = 1	An active broadcast TWT agreement exists or has been created with the TWT parameters indicated in the ~~responding frame~~ response frame and the STA transmitting the initiating frame is a member of the broadcast TWT identified by the broadcast TWT ID and the TA of the response frame.
Request TWT with Wake TBTT Negotiation subfield = 1	Alternate TWT with Wake TBTT Negotiation subfield = 1 and Broadcast subfield = 1	No active broadcast TWT agreement has been created with the TWT parameters indicated in the initiating frame. The responder is offering an alternative set of parameters vs. those indicated in the initiating frame, as a means of negotiating TWT parameters with the requester. The requesting STA can send a new request with any set of TWT parameters and the responder might entertain the creation of a new broadcast TWT agreement using those parameters.
Suggest TWT or Demand TWT with Wake TBTT Negotiation subfield = 1	Alternate TWT with Broadcast subfield = 1	This response is not allowed.
Suggest TWT or Demand TWT with Wake TBTT Negotiation subfield = 1	Dictate TWT with Broadcast subfield = 1	An active broadcast TWT agreement is either created or already exists and is using the TWT parameters identified in the ~~responding frame~~ response frame, including a broadcast TWT ID. The responding STA will not create any new broadcast TWT agreement with the requester at this time
Suggest TWT or Demand TWT with Wake TBTT Negotiation subfield = 1	Reject TWT with Broadcast subfield = 1	~~No new active broadcast TWT agreement is created and the responding STA will not create any new broadcast TWT agreement at this time.~~ The STA transmitting the initiating frame is a not a member of a broadcast TWT identified by the broadcast TWT ID and the TA of the response frame, if such a broadcast TWT exists.
Accept TWT or Alternate TWT or Dictate TWT or Reject TWT with Wake TBTT Negotiation subfield = 0	No frame transmitted	This exchange is not allowed.
Accept TWT with Wake TBTT Negotiation subfield = ~~1~~ 0 and Broadcast subfield = 1	No frame transmitted	~~A~~ When transmitted by a scheduling STA, a broadcast TWT agreement exists and is using the TWT parameters identified in the initiating frame including a broadcast TWT ID. Not permitted to be transmitted by a scheduled STA.

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Table 10-19a—TWT setup exchange command interpretation

Alternate TWT or Dictate TWT with Wake TBTT Negotiation subfield = ~~1~~ 0 and Broadcast subfield = 1	No frame transmitted	~~The~~ When transmitted by a scheduling STA, the TWT parameters of the existing broadcast TWT agreement identified by the TWT Flow ID and the TA of the initiating frame have been updated to the values of the TWT parameters of the initiating frame including a broadcast TWT ID. Not permitted to be transmitted by a scheduled STA.
Reject TWT with Wake TBTT Negotiation subfield = ~~1~~ 0 and Broadcast subfield = 1	No frame transmitted	~~The~~ When transmitted by a scheduled STA, the scheduled STA membership in the broadcast TWT agreement identified by the ~~TWT Flow ID~~ broadcast TWT ID and the ~~TA~~ RA of the initiating frame ~~frame~~ is terminated. Not permitted to be transmitted by a scheduling STA.
Reject TWT with Wake TBTT Negotiation subfield = 1 and Broadcast subfield = 1	No frame transmitted	When transmitted by a scheduling STA, the broadcast TWT agreement identified by the broadcast TWT ID and the TA of the initiating frame frame is terminated. Not permitted to be transmitted by a scheduled STA.
Reject TWT with Wake TBTT Negotiation subfield = 0 and Broadcast subfield = 0	No frame transmitted	The individual TWT agreement identified by the TA, RA pair of the transmitted frame and with the corresponding TWT Flow ID is terminated.
NOTE 1—Initiating frames ~~are all required to~~ not explicitly indicating broadcast have Broadcast subfield value of 0. NOTE 2—Request frame settings not listed in the table are not allowed.		

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11. MLME

11.1 Synchronization

11.1.3 Maintaining synchronization

11.1.3.8 Multiple BSSID procedure

Insert the following at the end of the subclause:

The AP corresponding to the transmitted BSSID includes the Multiple BSSID element in the Beacon and Probe Response frames it transmits. In an HE AP that operates with multiple BSSIDs, there shall not be more than one AP corresponding to the transmitted BSSID. An HE AP shall set MaxBSSID Indicator and Tx BSSID Indicator as defined in 9.4.2.219.

An HE AP corresponding to a nontransmitted BSSID shall set the MaxBSSID Indicator field in the HE Operation element to a nonzero value. An HE STA that associates with the HE AP whose MaxBSSID Indicator field is set to *n* and whose Tx BSSID Indicator is set to 0 shall decodes the Beacon frame with Multiple BSSID element whose 48 – *n* MSBs of the BSSID are same as the 48 – *n* MSBs of BSSID of the AP with which the STA is associated.

Insert a new subclause at the end of 11.1.3 as follows:

11.1.3.10 Beacon generation in an HE BSS

An HE AP may transmit beacon frames and group addressed traffic in two PHY formats to ensure the BSS discoverability and BSS operating parameter distribution for the whole BSS coverage.

The HE AP that transmits Beacon frames in two PHY formats shall set the Dual Beacon subfield to 1 in the HE Operation elements it transmits. Otherwise, the AP shall set the field to 0. When Beacon frames are transmitted in two PHY formats, the HE AP shall transmit Beacon frames in non-HE format and in HE_EXT_SU format. The Beacon frame transmitted in non-HE PPDU format has TBTT at the TSF value 0. The TBTT repeats every Beacon interval as indicated in the Beacon frame transmitted in non-HE PPDU format.

The Beacon frame transmitted in HE extended range SU PPDU has TBTT at the TSF value 0 plus the TBTT offset which value is a half of the value of the Beacon Interval field of the Beacon frame sent in non-HE format. The TBTT of the beacon frame transmitted in an HE extended range SU PPDU repeats every beacon interval as indicated in the Beacon frame transmitted in the HE extended range SU PPDU.

The non-HE format and HE EXT_SU PPDU format Beacon frames may contain different set of elements.

11.2 Power management

11.2.2 Power management in a non-DMG infrastructure network

11.2.2.6 AP operation during the CP

Change item g) in the 2nd paragraph as follows:

g) When the AP receives a PS-Poll frame from a STA that is in PS mode, it shall forward to the STA a single buffered BU. The AP shall respond after a SIFS either with a Data or Management frame, or with an Ack frame; in which case the corresponding Data or Management frame is delayed. Until

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the transmission of this BU either has succeeded or is presumed failed (when maximum retries are exceeded), the AP shall acknowledge but ignore all PS-Poll frames from the same STA. This prevents a retried PS-Poll frame from being treated as a new request to deliver a buffered BU.

For a STA using U-APSD, the AP transmits one BU destined for the STA from any AC that is not delivery-enabled in response to PS-Poll frame from the STA. The AP should transmit the BU from the highest priority AC that is not delivery-enabled and that has a buffered BU. When all ACs associated with the STA are delivery-enabled, the AP transmits one BU from the highest priority AC that has a BU.

For a STA in PS mode and not using U-APSD, the AP shall set the More Data subfield of the response Data or Management frame to 1 to indicate the presence of further buffered BUs (not including the BU currently being transmitted) for the polling STA. For a STA using U-APSD, the AP shall set the More Data subfield to 1 to indicate the presence of further buffered BUs (not including the BU currently being transmitted) that do not use deliveryenabled ACs. When all ACs associated with the STA are delivery-enabled, the AP shall set the More Data subfield to 1 to indicate the presence of further buffered BUs (not including the BU currently being transmitted) using delivery-enabled ACs.

If there are buffered BUs to transmit to the STA, the AP may set the More Data bit in a QoS +CFAck frame to 1 in response to a QoS Data frame to indicate that it has one or more pending BUs buffered for the PS STA identified by the RA in the QoS +CF-Ack frame. An AP may also set the More Data bit in an Ack frame to 1 in response to a QoS Data frame to indicate that it has one or more pending BUs buffered for the PS STA identified by the RA in the Ack frame, if that PS STA has set the More Data Ack subfield in the QoS Capability element to 1. An HE AP may also set the More Data bit in a BlockAck or Multi-STA BlockAck frame to 1 to indicate that it has one or more pending BUs buffered for the HE PS STA identified by the RA in the BlockAck or Multi-STA Blockack frame, if that HE PS STA has set the More Data Ack subfield in the QoS Capability element to 1. An HE AP indicates support of sending Ack, BlockAck, or Multi-STA BlockAck frames with a nonzero More Data subfield by setting the More Data Ack subfield to 1 in the QoS Info field of frames it transmits.

Unless indicated above, the AP shall set the More Data bit to 0.

11.2.2.8 Receive operation for STAs in PS mode during the CP

Change item e) in the 2nd paragraph as follows:

The following rules describe operation of a STA in PS mode during the CP:

e) When dot11FMSActivated is false and ReceiveDTIMs is true, the STA shall wake up early enough to be able to receive either every non-STBC DTIM or every STBC DTIM sent by the AP of the BSS. When dot11FMSActivated is true and ReceiveDTIMs is true and the STA has been granted by the AP an alternate delivery interval for a multicast stream, the STA shall wake up before the non-STBC DTIM or STBC DTIM having Current Count of FMS Counter field set to 0 for that particular FMS stream.

A STA that stays awake to receive group addressed BUs shall elect to receive all group addressed non-STBC transmissions or all group addressed STBC transmissions and remain awake until the More Data subfield of the appropriate type (non-STBC or STBC) of group addressed BUs indicates there are no further buffered group addressed BUs of that type, or until a TIM is received indicating there are no more buffered group addressed BUs of that type, or until an FMS Descriptor element is received indicating that there are no further buffered group addressed BUs for which the STA has previously received an FMS Response element in a frame that has a value in Address 1 that matches

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its MAC address or that has an Address 1 value that is a group address corresponding to a group of which it is a member and that was transmitted by the AP with which it is associated and which had an Element Status value in the FMS Status subelement of "Accept". If a STA receives a QoS +CFAck frame from its AP with the More Data bit equal to 1, then the STA shall operate exactly as if it received a TIM with its AID bit equal to 1. If a STA has set the More Data Ack subfield in QoS Capability element to 1, then if it receives an Ack frame from its AP with the More Data bit equal to 1, the STA shall operate exactly as if it received a TIM with its AID bit equal to 1. If an HE STA has set the More Data Ack subfield in the QoS Capability element to 1, then if it receives a BlockAck or Multi-STA BlockAck frame from its AP with the More Data bit equal to 1, the STA shall operate exactly as if it received a TIM with its AID bit equal to 1. For example, a STA that is using the PS-Poll delivery method shall issue a PS-Poll frame to retrieve a buffered BU. See also 10.3.6 (Group addressed MPDU transfer procedure).

11.2.2.17 TIM Broadcast

Change the 11th paragraph as follows:

The AP shall increase the value (modulo 256) of the Check Beacon field in the next transmitted TIM frame(s) when a critical update occurs to any of the elements inside the Beacon frame. The following events shall classify as a critical update:

a) Inclusion of a Channel Switch Announcement element
b) Inclusion of an Extended Channel Switch Announcement element
c) Modification of the EDCA parameters element
d) Inclusion of a Quiet element
e) Modification of the DSSS Parameter Set
f) Modification of the CF Parameter Set element
g) Modification of the HT Operation element
h) Inclusion of a Wide Bandwidth Channel Switch element
i) Inclusion of a Channel Switch Wrapper element
j) Inclusion of an Operating Mode Notification element
k) Inclusion of a Quiet Channel element
l) Modification of the VHT Operation element
m) Modification of an HE Operation element
n) Inclusion of a Broadcast TWT element

11.23 Tunneled direct-link setup

11.23.1 General

Change as follows:

The VHT Operation element shall be present in a TDLS Setup Confirm frame when both STAs are VHT capable and the TDLS direct link is not established in the 2.4 GHz band. When the TDLS Setup Confirm frame includes a VHT Operation element, the Basic VHT-MCS And NSS Set field is reserved.

The HE Operation element shall be present in a TDLS Setup Confirm frame when both STAs are HE capable.

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11.24 Wireless network management procedures

11.24.6 Fine timing measurement procedure

11.24.6.4 Measurement exchange

Change the 10th paragraph as follows:

For the Fine Timing Measurement frames transmitted during the FTM session:

- The responding STA shall not use a bandwidth wider than that indicated by the STA in the initial Fine Timing Measurement frame.
- The responding STA shall not use an HE format if the STA indicated VHT or HT-mixed or non-HT format in the initial Fine Timing Measurement frame.
- The responding STA shall not use a VHT format if the STA indicated HT-mixed or non-HT format in the initial Fine Timing Measurement frame.
- The responding STA shall not use an HT format if the STA indicated non-HT format in the initial Fine Timing Measurement frame.

Insert a new subclause 11.49 at the end of Clause 11:

11.49 HE BSS operation

11.49.1 AID assign rule

If the value of Partial BSS Color field is set to 1, then the HE AP shall allocate AIDs according to the formula for AID (5: 8)

$$AID(5:8) = bin[(BCB(0:3) - (BSSID(44:47) \oplus BSSID(40:43))) \bmod 2^4, 4]$$

where *BCB*(0:3) stands for the least significant 4 BSS color bits and *bin*[x, 4] is the operator that casts decimal value *x* into 4 bits binary vector.

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17. Orthogonal frequency division multiplexing (OFDM) PHY specification

17.2 OFDM PHY specific service parameter list

17.2.2 TXVECTOR parameters

17.2.2.1 General

Insert a new last row into Table 17-1 (TXVECTOR parameters) as follows:

Table 17-1—TXVECTOR parameters

Parameter	Associated primitive	Value
TRIGGER_RESPONDING	PHY-TXSTART.request (TXVECTOR)	If present, false or true. When true, the MAC entity requests that the PHY entity does synchronization as defined in 17.3.9.10 (Pre-correction accuracy requirements). When false, the MAC entity requests that the PHY entity does not have to do synchronization as defined in 17.3.9.10 (Pre-correction accuracy requirements).

Insert a new subclause at the end of 17.2.2 as follows:

17.2.2.6 TRIGGER_RESPONDING

If present, the allowed values are false or true. A parameter value of true indicates that the MAC sublayer is requesting that the PHY entity does synchronization as defined in 17.3.9.10 (Pre-correction accuracy requirements). A parameter value of false indicates that the MAC sublayer is requesting that the PHY entity does not do synchronization as defined in 17.3.9.10 (Pre-correction accuracy requirements).

17.3 OFDM PHY

17.3.9 PHY transmit specifications

Insert a new subclause at the end of 17.3.9 as follows:

17.3.9.10 Pre-correction accuracy requirements

A STA that transmits a PPDU where the TXVECTOR parameter TRIGGER_RESPONDING is true shall pre-compensate for carrier frequency offset (CFO) error and symbol clock error. After compensation, the absolute value of residual CFO error with respect to the PPDU carrying the soliciting MU-RTS frame shall not exceed 2 kHz when measured as the 10% point of CCDF of CFO errors in AWGN at a received power of –60 dBm in the primary 20 MHz. The residual CFO error measurement shall be made on the non-HT PPDU or non-HT duplicate PPDU following the L-STF field. The symbol clock error shall be pre-compensated by the same ppm amount as CFO error.

A STA that transmits an non-HT or non-HT duplicate PPDU where the TXVECTOR parameter TRIGGER_RESPONDING is true shall have timing accuracy of ±0.4 μs relative to the actual ending time of the PPDU carrying the MU-RTS frame. This requirement does not include round trip delay. This requirement is the same as the timing requirement for HE trigger based PPDU.

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18. Extended Rate PHY (ERP) specification

18.2 PHY-specific service parameter list

Insert two new last rows into Table 18-1 (TXVECTOR parameters) as follows:

Table 18-1—TXVECTOR parameters

Parameter	Value
CH_BANDWIDTH_IN_NON_HT	If present, CBW20 or CBW40
DYN_BANDWIDTH_IN_NON_HT	If present, Static or Dynamic

Insert two new last rows into Table 18-3 (RXVECTOR parameters) as follows:

Table 18-3—RXVECTOR parameters

Parameter	Value
CH_BANDWIDTH_IN_NON_HT	If present, CBW20 or CBW40
DYN_BANDWIDTH_IN_NON_HT	If present, Static or Dynamic

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Insert new Clauses 27 and 28 following Clause 26 as follows:

27. High Efficiency (HE) MAC specification

27.1 Introduction

The use of HCCA and TSPEC are banned at HE STAs.

27.2 Channel Access

27.2.1 Intra-BSS and inter-BSS frame detection

An HE STA determines whether a received frame is an inter-BSS or an intra-BSS frame by using the RXVECTOR parameters (e.g., BSS_COLOR in HE PPDUs or GROUP_ID and PARTIAL_AID in VHT PPDUs) or MAC address.

A frame received by the STA is an intra-BSS frame if one of the following conditions is true:

— The RXVECTOR parameter BSS_COLOR in the received PPDU carrying the frame is the same as the BSS color announced by the AP to which the STA is associated

— The RA field, TA field or BSSID field of the received frame with the Individual/Group bit forced to the value 0 is the same as the BSSID of AP to which the STA is associated

— The AP to which the STA is associated is a member of a Multiple BSSID Set with two or more members and the RA field, TA field or BSSID field of the received frame with the Individual/Group bit forced to the value 0 is same as the BSSID of any member of the Multiple BSSID Set

— The RXVECTOR parameter PARTIAL_AID in the received VHT PPDU with the RXVECTOR parameter GROUP_ID equal to 0 is the same as the BSSID[39:47] of the AP to which the STA is associated

— The value of RXVECTOR parameter PARTIAL_AID [5:8] in the received VHT PPDU with the RXVECTOR parameter GROUP_ID equal to 63 is the same as the partial BSS color announced by the AP to which the STA is associated when the Partial BSS Color field in the most recently received HE Operation element is 1.

— The frame is a control frame that does not have a TA field and the RA matches the saved TXOP holder address for the BSS to which it is associated.

A frame received by the STA is an inter-BSS frame if one of the following conditions is true:

— The RXVECTOR parameter BSS_COLOR of the PPDU carrying the frame is not 0 and does not match the BSS color announced by the AP to which the STA is associated

— When the RXVECTOR parameter BSS_COLOR of the PPDU carrying the frame is not present:

  • The BSSID field of the received frame with Individual/Group bit forced to the value 0, if available, does not match the BSSID of AP to which the STA is associated
  • If the BSSID field is not available, both the RA and TA fields exist, and none of the address fields of the received frame with Individual/Group bit forced to the value 0 match the BSSID of AP to which the STA is associated

— The AP to which the STA is associated is a member of a Multiple BSSID Set with two or more members and the BSSID field of the received frame with Individual/Group bit forced to the value 0, if available, does not match the BSSID of any member of the Multiple BSSID Set

— If the AP to which the STA is associated is a member of a Multiple BSSID Set with two or more members, the BSSID field is not available, both the RA and TA fields exist, and none of the address

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fields of the received frame with the Individual/Group bit forced to the value 0 match the BSSID of any member of the Multiple BSSID Set

— The RXVECTOR parameter PARTIAL_AID of the received VHT PPDU frame with the RXVECTOR parameter GROUP_ID equal to 0 is different from the BSSID[39:47] of the AP to which the STA is associated

— The value of RXVECTOR parameter PARTIAL_AID [5:8] in the received VHT PPDU with the RXVECTOR parameter GROUP_ID equal to 63 is different from the partial BSS color announced by the AP to which the STA is associated when the Partial BSS Color field in the most recently received HE Operation element is 1.

— An HE AP receives either a VHT MU PPDU or an HE MU PPDU.

If the received frame satisfies both intra-BSS and inter-BSS conditions, the decision made by using the MAC address takes precedence over the decision made by using the RXVECTOR parameter BSS_COLOR .

If the received frame does not satisfy any of the intra-BSS and inter-BSS conditions, then the frame cannot be determined as intra-BSS or inter-BSS frame.

27.2.2 Updating two NAVs

An HE non-AP STA shall maintain two NAV timers. An HE AP STA may maintain two NAV timers.

The requirements in 10.3.2.1 (CS mechanism) applies to an HE STA maintaining two NAVs with the exception of virtual CS indication of medium. For an HE STA maintaining two NAVs, if both the NAV timers are 0, the virtual CS indication is that the medium is idle; if one of the two NAV timers is nonzero, the virtual CS indication is that the medium is busy.

For the two NAVs maintained by an HE STA, one is identified as intra-BSS NAV, and the second one is identified as basic NAV. Intra-BSS NAV is used to store NAV value, if needed, from a PPDU identified as intra-BSS. Basic NAV is used to store NAV value, if needed, from a PPDU identified as inter-BSS or cannot be identified as intra-BSS or inter-BSS. Note that the method of identifying a PPDU as intra-BSS or inter-BSS is described in 27.2.1 (Intra-BSS and inter-BSS frame detection).

The duration information is indicated by a frame in a PSDU as follows:

— If there is a Duration field in the frame, then the duration information is indicated by the Duration field

— If the frame is PS-Poll, then the duration information is equal to the time, in microseconds, required to transmit one Ack frame plus one SIFS under the data rate selection rules. If the calculated duration information includes a fractional microsecond, that duration information is rounded up to the next higher integer.

A STA shall update the intra-BSS NAV with the duration information indicated by the received frame in a PSDU if and only if all the following conditions are met:

— The frame is identified as intra-BSS according to the rule described in 27.2.1 (Intra-BSS and inter-BSS frame detection)

— The indicated duration information is greater than the STA's current intra-BSS NAV value

— The STA is not solicited an immediate response by the PPDU carrying the frame.

— The frame is not solicited by the STA if the STA is a TXOP holder

A STA shall update the basic NAV with the duration information indicated by the received frame in a PSDU if and only if all the following conditions are met:

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- The frame is identified as inter-BSS or cannot be identified as intra-BSS or inter-BSS according to the rule described in 27.2.1 (Intra-BSS and inter-BSS frame detection)
- The indicated duration information is greater than the STA's current basic NAV value
- The STA is not solicited an immediate response by the PPDU carrying the frame.

A STA shall update the intra-BSS NAV with the duration information indicated by the RXVECTOR parameter TXOP_DURATION if and only if all the following conditions are met:

- The RXVECTOR parameter TXOP_DURATION is not set to all 1s
- The PPDU that carried information of the RXVECTOR parameter is identified as intra-BSS according to the rule described in 27.2.1 (Intra-BSS and inter-BSS frame detection)
- The STA does not receive a frame with the duration information indicated by a Duration field in the PSDU of the PPDU carrying the RXVECTOR parameter TXOP_DURATION
- The duration information indicated by the RXVECTOR parameter TXOP_DURATION is greater than the STA's current intra-BSS NAV
- The PPDU that carried information of the RXVECTOR parameter is not an HE trigger-based PPDU triggered by the STA

A STA shall update the basic NAV with the duration information indicated by the RXVECTOR parameter TXOP_DURATION if and only if all the following conditions are met:

- The RXVECTOR parameter TXOP_DURATION is not set to all 1s
- The PPDU that carried information for the RXVECTOR parameter is identified as inter-BSS or cannot be identified as intra-BSS or inter-BSS according to the rule described in 27.2.1 (Intra-BSS and inter-BSS frame detection)
- The STA does not receive a frame with the duration information indicated by a Duration field in the PSDU of the PPDU carrying the RXVECTOR parameter TXOP_DURATION
- The duration information indicated by the RXVECTOR parameter TXOP_DURATION is greater than the STA's current basic NAV

NOTE 1—If a PS-Poll is received carried in a received HE SU PPDU, HE extended range SU PPDU, or HE MU PPDU, then the RXVECTOR parameter TXOP_DURATION does not indicate duration information (see 27.11.5 (TXOP_DURATION).

NOTE 2—Based on the setting rule, if a STA receives a frame with the duration information indicated by both a Duration field in the PSDU and the RXVECTOR parameter TXOP_DURATION, then the duration information indicated by the RXVECTOR parameter TXOP_DURATION is ignored.

NOTE 3—The additional rules of NAV consideration for a STA that is solicited for an immediate response are described in 10.3.2.7 (CTS and DMG CTS procedure), 10.3.2.9 (Acknowledgment procedure), and 27.5.2.4 (UL MU CS mechanism).

Various additional conditions may set or reset the intra-BSS NAV or basic NAV, as described in 10.4.3.3 (NAV operation during the CFP). When one NAV is reset, if the other NAV timer is 0, a PHY-CCARESET.request primitive shall be issued. The exact time of updating the NAVs uses the same rule as defined in 10.3.2.4 (Setting and resetting the NAV).

A STA that maintains two NAVs has the capability to maintain NAV set by intra-BSS PPDU and inter-BSS PPDU separately. Maintaining two NAV is beneficial in dense deployment scenarios where a STA requires protection from frames transmitted by STAs within its BSS, i.e., intra-BSS, and avoid interference from frames transmitted by STAs in neighboring BSS, i.e., inter-BSS. For example, in a TXOP initiated by the associated AP for UL MU transmission, the intra-BSS NAV of the STA can be set by the AP to prevent the STA from contending the channel, and the basic NAV will not be updated by the associated AP so that NAV set by inter-BSS PPDU can be considered in UL MU CS as described in 27.5.2.4 (UL MU CS mechanism).

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An HE STA that used information from an RTS or MU-RTS frame as the most recent basis to update its NAV setting is permitted to reset the NAV which is updated by the RTS or MU-RTS if no PHY-RXSTART.indication primitive is received from the PHY during a period with a duration of 2 × aSIFSTime + CTS_Time + aRxPHYStartDelay + 2 × aSlotTime starting when the MAC receives a PHY-RXEND.indication primitive corresponding to the detection of the RTS or MU-RTS frame.

27.2.3 Obtaining an EDCA TXOP for UL MU capable STAs

An UL MU capable non-AP HE STA that receives a Basic Trigger frame that contains a Per User Info field with the AID of the STA, and that receives an immediate response from the AP for the transmitted Trigger-based PPDU, shall update its CWmin[AC], CWmax[AC], AIFSN[AC] and HEMUEDCATimer[AC] state variables to the values contained in the most recently received MU EDCA Parameter Set element sent by the AP to which the STA is associated, for all the ACs from which QoS Data frames were transmitted in the HE trigger-based PPDU.

Each HEMUEDCATimer[AC] shall uniformly count down to 0 when its value is nonzero.

NOTE 1—A non-AP STA that sends a frame to the AP with an OMI A-Control field containing a value of 1 in the UL MU Disable field does not participate in UL MU operation, as such it is exempt from updating its EDCA access parameters to the values contained in the MU EDCA Parameter Set element.

NOTE 2—A non-AP STA that sends a QoS Data frames with Ack policy set to No Ack updates its EDCA access parameters to the values contained in the MU EDCA Parameter Set element irrespective of receiving immediate response from the AP.

When the HEMUEDCATimer[AC] reaches zero, then the HE non-AP UL MU capable STA may update the CWmin[AC], CWmax[AC] and AIFSN[AC] either to the values that are contained in the most recently received EDCA Parameter Set element sent by the AP to which the STA is associated, or to the values contained in the default dot11EDCATable if an EDCA Parameter Set element has not been received.

27.3 Fragmentation

27.3.1 General

An HE STA supports the static fragmentation procedure defined in 10.2.7 (Fragmentation/defragmentation overview), 10.5 (Fragmentation), and 10.6 (Defragmentation). In addition, an HE STA can support the dynamic fragmentation procedure defined in this subclause.

An HE STA can dynamically fragment individually addressed MSDUs, A-MSDUs or MMPDUs and defragment received MPDUs as defined in this subclause, and using the fragmentation/defragmentation processes defined in 10.2.7 (Fragmentation/defragmentation overview) without being subject to the rules defined in that subclause. Dynamic fragmentation provides further flexibility in aggregating the data so that padding can be minimized (see 27.5 (MU operation)).

27.3.2 Support and requirements for dynamic fragmentation

A dynamic fragment is an MPDU, the payload of which carries a portion of an MSDU, A-MSDU or MMPDU. The generation of dynamic fragments follows the rules defined in 10.2.7 (Fragmentation/defragmentation overview) and 10.5 (Fragmentation), except for:

— Generation of dynamic fragments and their transmission within an MPDU or A-MPDU under HT-immediate block ack agreements is allowed for an HE STA under the conditions defined in 27.3.4 (Procedure at the recipient).

— Reception of dynamic fragments is not mandatory. An HE STA declares its dynamic fragments reception capability in the HE Fragmentation Support field of the HE Capabilities element.

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- Fragmentation of A-MSDUs is permitted when supported by the recipient
- The length of each fragment is not required to be equal for all fragments of the MSDU, A-MSDU or MMPDU. The length of each fragment may be of any nonzero value, except that the length of the first fragment of an MSDU or A-MSDU shall be greater than or equal to the minimum fragment size specified by the receiver STA in the Minimum Fragment Size subfield of the HE Capabilities element it transmits. An MSDU or A-MSDU with a size that is less than the minimum fragment size shall not be fragmented.

27.3.3 Procedure at the originator

27.3.3.1 General

An originator STA transmitting an MPDU or A-MPDU that contains one or more dynamic fragments shall solicit an immediate response from the recipient STA for each of the fragments contained in the MPDU or A-MPDU, except when the fragments are sent under level 3 dynamic fragmentation (see 27.3.3.4 (Level 3 dynamic fragmentation))..

A STA shall not transmit a fragment containing all or part of an A-MSDU that is greater than the maximum A-MSDU size as specified in Table 9-19 (Maximum data unit sizes (in octets) and durations (in microseconds)).

NOTE—The originator STA sends the fragments in order as defined in 10.5 (Fragmentation), except for level 3 dynamic fragmentation.

If the originator STA received explicit indications in response frames that none of the transmissions of previously transmitted fragment(s) of an MSDU, A-MSDU or MMPDU have been successfully received then the STA may retransmit the full MSDU, A-MSDU or MMPDU instead of retransmitting all the failed fragments. Otherwise, the originator STA may retransmit the failed fragment, in which case the frame body length and contents of the retransmitted fragment shall be the same as the first transmitted fragment and shall remain fixed for the lifetime of the MSDU, A-MSDU or MMPDU at that STA.

NOTE—An explicit indication is the absence of a valid Ack frame, BlockAck frame or Multi-STA BlockAck frame that is expected to be present in the first MPDU of the immediately received A-MPDU, or the absence of a BA Information field in the immediately received Multi-STA BlockAck frame for the TID of the transmitted fragment(s).

An originator STA shall not transmit to a recipient STA an MPDU or A-MPDU containing dynamic fragments that do not satisfy the conditions in the subclauses below.

27.3.3.2 Level 1 dynamic fragmentation

An originator STA may transmit to a recipient STA an MPDU or S-MPDU that contains one dynamic fragment of an MMPDU or of an MSDU that is not sent under a block ack agreement if the recipient STA has indicated a value 1 in the HE Fragmentation Support field of its HE Capabilities element. An originator STA may transmit to a recipient STA an MPDU or S-MPDU that contains one dynamic fragment of an A-MSDU if the recipient STA has indicated a value of 1 in the A-MSDU Fragmentation Support field of its HE Capabilities element.

An originator STA may transmit to a recipient STA an MPDU or S-MPDU that contains one dynamic fragment of an MSDU provided the following conditions are met:

- The HE Fragmentation Support field in the HE Capabilities element received from the STA is 1
- For the block ack agreement associated with the TID of the MSDU, the ADDBA Extension element is present and the HE Fragmentation Operation subfield is 1 in the ADDBA Response frame received from the STA.

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The originator STA shall follow the rules defined in 10.13.8 (Transport of S-MPDUs) for generating the S-MPDU.

27.3.3.3 Level 2 dynamic fragmentation

An originator STA may transmit fragmented MMPDUs or MSDUs that are not sent under a block ack agreement to a recipient STA using level 2 dynamic fragmentation if the HE Fragmentation Support field of the HE Capabilities element received from the STA is 2.

An originator STA may transmit fragmented MSDUs under a block ack agreement to a recipient STA using level 2 dynamic fragmentation provided the following conditions are met:

— The HE Fragmentation Support field in the HE Capabilities element received from the STA is 2

— For the block ack agreement associated with the TID of the MSDU, the ADDBA Extension element is present and the HE Fragmentation Operation subfield is 2 in the ADDBA Response frame received from the STA.

Using level 2 dynamic fragmentation, an originator STA may transmit to a recipient STA an MPDU, S-MPDU, or A-MPDU that contains:

— One dynamic fragment of an MSDU, A-MSDU if supported by the recipient, or MMPDU in an MPDU or S-MPDU

  • The originator STA shall follow the rules defined in 10.13.8 (Transport of S-MPDUs) for generating the S-MPDU

— Up to one dynamic fragment of an MSDU, A-MSDU if supported by the recipient, or MMPDU for each MSDU and for the MMPDU in an A-MPDU format

  • The originator STA shall follow the rules defined in 10.24.7.7 (Originator's behavior) for generating the A-MPDU and the rules defined in 27.10.4 (A-MPDU with multiple TIDs) for generating the multi-TID A-MPDU (that can contain the fragment of the MMPDU)

27.3.3.4 Level 3 dynamic fragmentation

An HE STA may transmit an L3 Frag BA Request frame to a receiver STA that has indicated a value of 3 in the HE Fragmentation Support field of the HE Capabilities element it transmits. The receiver STA that accepts the HT-Immediate block ack session shall respond with an L3 Frag BA Response if it has allocated resources for operating in a block ack session with level 3 fragmentation enabled. Otherwise, it shall respond with a BA Response frame to indicate that it has not allocated resources for operating in a block ack session where level 3 fragmentation is enabled.

NOTE—A block ack session with level 3 fragmentation enabled requires a block acknowledgment record that maintains up to 4 bits per MSDU (one bit for each fragment of the MSDU).

An originator STA may transmit to a recipient STA, which has indicated a value 3 in the HE Fragmentation Support field of its HE Capabilities element, an MPDU, S-MPDU, or A-MPDU that contains:

— One dynamic fragment of an MSDU, A-MSDU if supported by the recipient, or MMPDU in an MPDU or S-MPDU

  • The originator STA shall follow the rules defined in 10.13.8 (Transport of S-MPDUs) for generating the S-MPDU

— Up to four dynamic fragments of an MSDU for each MSDU and up to one dynamic fragment of an MMPDU in an A-MPDU, and up to four dynamic fragments of an A-MSDU for each A-MSDU if supported by the recipient

  • The originator STA shall set the Fragment Number subfield of each MPDU to a value less than 4
  • The originator STA shall follow the rules defined in 10.24.7.7 (Originator's behavior) for generating the A-MPDU with the exception that the A-MPDU shall contain MPDUs whose range of

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the Sequence Number subfields does not exceed $B_L/4$, where B_L is the length of the Block Ack Bitmap field of the BlockAck or Multi-STA BlockAck frame that corresponds to a TID of a transmitted fragment (see 10.24.7 (HT-immediate block ack extensions) and 27.4 (Block acknowledgement).

27.3.4 Procedure at the recipient

27.3.4.1 General

An HE STA shall set the HE Fragmentation Support subfield of the HE Capabilities element it transmits to 0 if its dot11HEDynamicFragmentationImplemented is false. Otherwise the HE STA shall set the HE Fragmentation Support subfield as follows:

— Set to 1 if the STA supports reception of dynamic fragments following the procedure defined in 27.3.3.2 (Level 1 dynamic fragmentation)

— Set to 2 if the STA supports reception of dynamic fragments following the procedure defined in 27.3.3.3 (Level 2 dynamic fragmentation)

— Set to 3 if the STA supports reception of dynamic fragments following the procedure defined in 227.3.3.4 (Level 3 dynamic fragmentation)

Defragmentation of dynamic fragments shall follow the rules defined in 10.6 (Defragmentation) with the following exceptions:

— The recipient STA shall support the concurrent reception of dynamic fragments of a number of *outstanding* MSDUs, A-MSDUs when supported and MMPDUs from a transmitting STA that is equal to N_{max}, where N_{max} for MSDUs is indicated in the Maximum Number of Fragmented MSDUs subfield of the HE Capabilities element transmitted by the STA, and N_{max} is equal to 1 for MMPDUs. The term *outstanding* refers to an MPDU containing all or part of an MSDU, A-MSDU or MMPDU for which transmission has been started, and for which delivery of the MSDU, A-MSDU or MMPDU has not yet been completed (i.e., an acknowledgment of the final fragment has not been received and the MSDU, A-MSDU or MMPDU has not been discarded due to retries, lifetime, or for some other reason).

— The recipient STA is not subject to the receive timer rules for each of the MSDUs, A-MSDUs and MMPDUs defined in 10.6 (Defragmentation).

A STA that has dot11AMSDUFragmentationOptionImplemented true shall set the A-MSDU Fragmentation Support subfield in the HE Capability element to 1. Otherwise, the STA shall set the A-MSDU Fragmentation Support subfield in the HE Capability element to 0.

A STA that has dot11AMSDUFragmentationOptionImplemented true shall be capable of receiving fragments containing all or part of an A-MSDU of arbitrary length that is less than or equal to the maximum A-MSDU size as specified in Table 9-19 (Maximum data unit sizes (in octets) and durations (in microseconds)).

27.3.4.2 Level 1 dynamic defragmentation

Upon reception of an MPDU or S-MPDU that carries one or more dynamic fragments, the recipient STA responds with an Ack frame when the received fragment is contained in an MPDU or S-MPDU that solicits the immediate response. The receiver STA shall follow the rules defined in 10.3.2.9 (Ack procedure) for generating the Ack frame and the rules defined in 27.4 (Block acknowledgement) for generating the Multi-STA BlockAck frame that contains the acknowledgement for the soliciting S-MPDU carried in a Trigger-based PPDU.

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27.3.4.3 Level 2 dynamic fragmentation

Upon reception of an MPDU or A-MPDU that carries one or more dynamic fragments, the recipient STA responds with one of the following frames:

— An Ack frame when the received fragment is contained in an MPDU or S-MPDU that solicits the immediate response. The recipient STA shall follow the rules defined in 10.3.2.9 (Ack procedure) for generating the Ack frame and the rules defined in 27.4 (Block acknowledgement) for generating the Multi-STA BlockAck frame that contains the acknowledgement for the soliciting S-MPDU carried in an HE trigger-based PPDU.

— A BlockAck frame when the received fragments, up to one fragment for each MSDU or A-MSDU, are contained in an A-MPDU that solicits an immediate response. The recipient STA shall follow the rules defined in 10.24.7.5 (Generation and transmission of BlockAck frames by an HT STA or DMG STA) for generating the BlockAck frame and the rules in 27.4 (Block acknowledgement) for generating the Multi-STA BlockAck frame, except that the STA shall:

- Set to 0 the LSB of the Fragment Number subfield in the Block Ack Starting Sequence Control subfield of the BlockAck frame or Multi-STA BlockAck frame that corresponds to a TID of a received fragment
- Set to 1 each bit of the Block Ack Bitmap field that corresponds to a Sequence Number subfield and TID subfield of a successfully received fragment contained in the soliciting A-MPDU or multi-TID A-MPDU
- Update the corresponding block ack record only when an MSDU or A-MSDU that is received in fragments is successfully reconstructed (see 10.6 (Defragmentation)) otherwise it shall not update the block ack record for that MSDU or A-MSDU.

A recipient STA shall discard any fragments that have been received during an HT-immediate BA session for a TID if it receives a BlockAckReq frame from the originator STA for that TID when the fragments have a Sequence Number field value that is less than the value of the Starting Sequence Number field of the BlockAckReq frame (where the comparison of the two values is performed modulo 4096).

27.3.4.4 Level 3 dynamic fragmentation

Upon reception of an MPDU or A-MPDU that carries one or more dynamic fragments, the recipient STA responds with one of the following frames:

— An Ack frame when the received fragment is contained in an MPDU or S-MPDU that solicits the immediate response. The recipient STA shall follow the rules defined in 10.3.2.9 (Ack procedure) for generating the Ack frame and the rules defined in 27.4 (Block acknowledgement) for generating the Multi-STA BlockAck frame that contains the acknowledgement for the soliciting S-MPDU carried in a Trigger-based PPDU.

— A BlockAck frame when the received fragments, one or more fragments for each MSDU or A-MSDU, are contained in an A-MPDU where at least one MPDU's Fragment Number field is of non-zero value that solicits the immediate response and is sent during a BA session that was setup with an L3 FRAG ADDBA Response frame. The recipient STA shall follow the rules in 10.24.7.5 (Generation and transmission of BlockAck frames by an HT STA or DMG STA) for generating the BlockAck frame, except that the STA shall:

- Set to 1 the LSB of the Fragment Number subfield in the Block Ack Starting Sequence Control subfield of the BlockAck frame or Multi-STA BlockAck frame that corresponds to a TID of a received fragment
- Set to 1 each bit in position B of the Block Ack Bitmap field that corresponds to a successfully received fragment and shall set it to 0 otherwise, with B calculated as:
  $B = 4 \times (SN - SSN) + FN$, where the operations on the sequence numbers are performed module 4096
  SN is the value of the Sequence Number subfield of an MPDU containing the fragment for which

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the receive status is indicated
SSN is the value of the Starting Sequence Number subfield of the Block Ack Starting Sequence Control subfield of the BlockAck frame

- Update the corresponding block ack record only when an MSDU or A-MSDU that is received in fragments is successfully reconstructed (see 10.6 (Defragmentation)). Otherwise it shall not update the block ack record for that MSDU.

The recipient STA shall discard any fragments that have been received during an HT-immediate BA session for a TID if it receives a BlockAckReq frame from the originator STA for that TID when the fragments have a Sequence Number field value that is less than the value of the Starting Sequence Number field of the BlockAckReq frame (where the comparison of the two values is performed modulo 4096).

27.4 Block acknowledgement

27.4.1 Overview

An HE STA can use Compressed BlockAck frame or Multi-STA BlockAck frame after setting up a block ack agreement. An HE STA shall support generation of Compressed BlockAck frames if HT-immediate BA is supported in the role of recipient (see 10.24.7.1 (Introduction). An HE STA shall support generation of Multi-STA BlockAck frame if either UL MU operation (see 27.5.2 (UL MU operation)) or multi-TID A-MPDU operation (27.10.4 (A-MPDU with multiple TIDs)) is supported in the role of recipient.

An HE non-AP STA that sends a Multi-STA BlockAck frame shall set the AID subfield in the Per STA Info field of the Multi-STA BlockAck frame to 0 and the RA field to the BSSID when the intended receiver of the frame is the AP.

When sending Multi-STA BlockAck frame, the HE STA shall transmit the Multi-STA BlockAck using one of rate, MCS, NSS that all of the acknowledgement receivers support.

An HE STA may send a Multi-STA BlockAck frame in response to an HE trigger-based PPDU. A Multi-STA BlockAck frame contains one or more BA Information fields with one or more AIDs and one or more different TIDs. An HE AP that transmits a Multi-STA BlockAck frame with different AID subfield values shall set the RA field to the broadcast address. An HE AP that transmits a Multi-STA BlockAck frame with a single AID subfield or with the same values of the AID subfield in Per STA Info subfields shall set the RA field to the address of the recipient STA that requested the Block Ack or to the broadcast address. An HE non-AP STA shall transmit a Multi-STA BlockAck frame with a single AID subfield or with the same values of the AID subfield in Per STA Info subfields and shall set the RA field to the address of the recipient STA that requested the Block Ack frame.

An HE STA that supports Multi-STA BlockAck shall examine each received Multi-STA sent by an STA with which it has a BA agreement. On receiving such a Multi-STA BlockAck frame a STA performs the following for each BA Information field with its AID:

— If the Ack Type field is 0 then the Block Ack Starting Sequence Control, TID and Block Ack Bitmap fields of the STA Info field are processed according to 10.24.7 (HT-immediate block ack extensions) and 27.3 (Fragmentation).

— If the Ack Type field is 1, then the STA Info field indicates either the acknowledgement of a single MPDU identified by the value of the TID or of all MPDUs carried in the eliciting PPDU, when the TID field is set to 14.

An HE STA that receives a BlockAckReq frame or a MU-BAR variant Trigger frame that contains a Compressed BlockAckReq variant in the User Info field addressed to the STA shall respond with a BlockAck frame as defined in 10.24.7 (HT-immediate block ack extensions) or a Multi-STA BlockAck frame as defined in 27.4 (Block acknowledgement).

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An HE STA that receives a Multi-TID BlockAckReq frame or a MU-BAR variant Trigger frame that contains a Multi-TID BlockAckReq variant in the User Info field addressed to the STA shall respond with a Multi-STA BlockAck frame that contains a STA Info subfield with a Block Ack Bitmap subfield for each of the TIDs (with values less than 8) contained in the BlockAckReq frame and the length of each Block Ack Bitmap subfields shall be equal to the solicited Bitmap length (i.e., FN subfields in solicited Block Ack Request Starting Sequence Control and responding Block Ack Starting Sequence Control for the same TID are equal).

If an HE AP does not receive an HE Capabilities element with the Rx Control Frame To MultiBSS set to 1 from a STA, then the HE AP shall not send a Multi-STA Block Ack frame whose destination STAs associate with more than one APs to the STA.

An HE non-AP STA that is associated with a nontransmitted BSSID and has indicated support for receiving Control frames with TA set to the Transmitted BSSID (Rx Control Frame To MultiBSS set to 1 in HE Capabilities element), shall respond with a BlockAck frame whose RA is set either to the (nontransmitted) BSSID it is associated with or the transmitted BSSID (i.e., the TA of the soliciting MU BAR frame).

27.4.2 Acknowledgement, block acknowledgment or all acknowledgement selection in a Multi-STA BlockAck frame

A recipient sets the Ack Type and TID subfields in a Per AID TID Info field of the Multi-STA BlockAck frame sent as a response depending on the acknowledgement context.

a) All Ack context: if the originator had set the All Ack Supported subfield to 1 in the HE Capabilities element, then the recipient may set the Ack Type field to 1 and the TID subfield to 14 to indicate the successful reception of all the MPDUs intended to it carried in the eliciting A-MPDU or multi-TID A-MPDU only. Otherwise the recipient shall not set the Ack Type field to 1 and the TID subfield to 14. The Multi-STA BlockAck frame shall contain only one Per STA Info field addressed to an originator in the Multi-STA BlockAck frame.

b) Ack context: A recipient receiving a single MPDU, that requires an acknowledgment, shall set the Ack Type field to 1 and the TID field to the TID value of that MPDUs to indicate the successful reception of that MPDU.

   If multiple single MPDUs in a Multi-TID A-MPDUs are received by a recipient that supports its reception, the Multi-STA BlockAck frame may contain multiple occurrences of these Per STA Info fields that are intended to an originator, one for each successfully received single MPDU requesting an acknowledgment.

   The allowed values for the TID field in this context are 0 to 7 (for indicating acknowledgement of QoS Data or QoS Null frames) or 15 (for indicating acknowledgement of an Action frame).

c) BlockAck context: The recipient shall set the Ack Type field to 0 and the TID field of a Per STA Info field to the TID value of MPDUs requesting block acknowledgement that are carried in the eliciting A-MPDU or multi-TID A-MPDU.

   The Multi-STA BlockAck frame may contain multiple occurrences of these Per STA Info fields addressed to an originator, one for each MPDU that is requesting block acknowledgement, in which case the Block Ack Starting Sequence Control and Block Ack Bitmap fields shall be set according to 10.24.7 (HT-immediate block ack extensions) for each block ack session, and according to 27.3 (Fragmentation) for each block ack session with dynamic fragmentation.

   The allowed values for the TID field in this context are 0 to 7 (for indicating block acknowledgement of QoS Data frames).

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Variable bitmap lengths can be included in the Per STA Info field when the originator and recipient negotiate their use as defined in 27.4.3 (Negotiation of block ack bitmap lengths).

An originator shall examine each received Multi-STA BlockAck frame sent by an STA as a response to a soliciting PPDU.

Upon reception of the Multi-STA BlockAck frame the originator performs the following operations for each Per STA Info field that has an AID field addressed to the originator (i.e., the AID subfield is an AID if the originator is a non-AP STA and is 0 when the originator is an AP):

— If the Ack Type field is 0 then the BlockAck Starting Sequence Control, TID and BA Bitmap fields of the Per STA Info field are processed according to 10.24.7 (HT-immediate block ack mechanism), 27.3 (Fragmentation), and as defined below.

— If the Ack Type field is 1 then the Per STA Info field indicates either the acknowledgement of a single MPDU identified by the value of the TID.

— If the Ack Type field is 1 and the TID subfield of Per AID TID Info field is 14, then the Per STA Info field indicates the acknowledgement of all MPDUs carried in the eliciting PPDU as defined by the acknowledgement context.

27.4.3 Negotiation of block ack bitmap lengths

Both the Compressed BlockAck frame and Multi-STA BlockAck frame allow different Block Ack Bitmap subfield lengths. The length of the Block Ack Bitmap subfield is indicated in the Fragment Number subfield of the Block Ack Starting Sequence Control field as defined in 9.3.1.9 (BlockAck frame format). The Block Ack Bitmap subfield length of a BlockAck frame used during a BA session depends on the negotiated buffer size between the originator and the recipient as indicated below:

— When a Compressed BlockAck frame is used:
  - If the negotiated buffer size is within [1, 64] then a BlockAck Bitmap length of 64 shall be used during the BA session
  - If the negotiated buffer size is within [1, 256] then a BlockAck Bitmap length of either 64 or 256 shall be used during the BA session

— When a Multi-STA BlockAck frame is used:
  - If the negotiated buffer size is within [1, 64] then a BlockAck Bitmap length of either 32 or 64 shall be used during the BA session
  - If the negotiated buffer size is within [1, 128] then a BlockAck Bitmap length of 32, 64 or 128 shall be used during the BA session
  - If the negotiated buffer size is within [1, 256] then a BlockAck Bitmap length of 32, 64, 128 or 256 shall be used during the BA session

The recipient shall not include in the Buffer Size field of an ADDBA Response frame a value that would cause the BlockAck Bitmap length of its block ack responses to exceed the BlockAck Bitmap length that is derived by the Buffer Size field of the ADDBA Request frame sent by the originator.

A recipient shall not include in a transmitted Multi-STA BlockAck frame a BlockAck Bitmap field of size 32 bits that is intended to a STA that has not declared support of its reception in the HE Capabilities element it transmits.

NOTE—The recipient can include in the Multi-STA BlockAck frame BlockAck Bitmap fields of 32 bits for other intended recipients that declare reception support and the nonsupporting recipient needs to parse these fields to be able to locate the block ack information that is intended to it.

A recipient that is the intended receiver of an (multi-TID) A-MPDU, (multi-TID) BlockAckReq frame or MU-BAR variant Trigger frame that solicits an immediate BlockAck frame response for each TID shall follow the rules defined in 10.24.7 (HT-immediate block ack extensions) except that:

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- — *WinSizeR* is set to the smaller of *BitmapLength* and the value of the Buffer Size field of the associated ADDBA Response frame that established the block ack agreement, where the *BitmapLength* is the largest value for the BlockAckBitmap that can be used by the recipient
- — The Starting Sequence Number subfield of the Block Ack Starting Sequence Control subfield shall be set to any value in the range from (*WinEndR* – *BitmapLength* + 1) to *WinStartR*
- — The values in the recipient's record of status of MPDUs beginning with the MPDU for which the Sequence Number subfield value is equal to *WinStartR* and ending with the MPDU for which the Sequence Number subfield value is equal to *WinEndR*, wherein the length of the BlockAck Bitmap field shall be greater than or equal to the smallest *BitmapLength* that is greater than *WinEndR* – *WinStartR*

NOTE 1—An HE STA follows the rules in 10.24.7 (HT-immediate block ack extensions) where the value 64 is replaced with *BitmapLength*, and the value 63 is replaced with *BitmapLength* minus 1.

NOTE 2—An HE STA can generate a Block Ack frame with variable length Block Ack Bitmap field in which case the STA ensures that the Block Ack frame response fits within the remaining duration of the TXOP.

If the HE Fragmentation Support subfield in the HE Capabilities element it transmits is 3, then the LSB of the Fragment Number subfield of the BA frame may be set to 1. If the LSB of the Fragment Number subfield of the BA frame is set to 1, then the BA Bitmap fields are re-mapped as defined in 27.3 (Fragmentation).

27.4.4 Per-PPDU acknowledgment selection rules

27.4.4.1 General

A STA that sends a PPDU to an intended recipient can solicit different immediate responses by using the Ack Policy field of QoS Data or QoS Null frames, the type of the frame (e.g., Action, (multi-TID) BAR, MU-BAR variant Trigger frame, etc.) and the EOF field setting when these frames are carried in an A-MPDU or multi-TID A-MPDU.

An HE AP may solicit BlockAck frame responses from multiple HE STAs using a MU-BAR variant Trigger frame. If an MU-BAR variant Trigger frame is aggregated in an A-MPDU then no other BlockAckReq frames shall be present in the same A-MPDU. The MU-BAR variant Trigger frame shall contain either Compressed BlockAckReq variant or Multi-TID BlockAckReq variant in each of the Per User Info fields. An HE AP shall not send a Multi-TID BlockAckReq (neither as part of a Per User Info field intended to the STA in an MU-BAR variant Trigger frame nor as a BAR frame) to a STA that has not indicated support for multi-TID A-MPDU. (Multi-TID) BlockAckReq, BlockAckReq, and MU-BAR variant Trigger frames indicate the length of the soliciting block ack responses according to the FN settings defined in 9.3.1.9 (BlockAck frame format).

27.4.4.2 DL MU PPDU soliciting an SU PPDU response

An AP that sends a DL MU PPDU that intends to solicit an immediate response carried in an SU PPDU shall set the Ack Policy to Normal Ack (or Implicit BAR) for at most one of the (A-)MPDUs contained in the soliciting DL MU PPDU (see 10.3.2.11.2 (MU acknowledgement procedure for DL MU PPDU in SU format) for an example of this sequence). The AP shall not solicit an immediate response for any of the other (A-) MPDUs carried in the DL MU PPDU. The A-MPDUs carried in the soliciting DL MU PPDU shall not contain an Action frame or a MMPDU that solicits a response. A non-AP STA that receives a DL MU PPDU that solicits an immediate response shall follow the following acknowledgment procedure:

1) If the DL MU PPDU carries a S-MPDU intended to it with the Ack Policy equal to Normal Ack, then the STA shall respond with an Ack frame carried in an SU PPDU
2) If the DL MU PPDU carries an A-MPDU intended to it with the Ack Policy equal to Implicit BAR, then the STA shall respond with an Compressed BlockAck frame carried in an SU PPDU

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3) If the DL MU PPDU carries a multi-TID A-MPDU intended to it with the Ack Policy equal to Implicit BAR, then the STA shall respond with a Multi-STA BlockAck frame carried in an SU PPDU

NOTE—The control response frame carried in SU PPDU format follows the rules defined in 10.7.6.5 (Rate selection for control response frames).

27.4.4.3 DL MU PPDU soliciting an HE trigger-based PPDU response

An AP that sends a DL MU PPDU that intends to solicit an immediate response carried in an HE trigger-based PPDU shall set the Ack Policy to MU Ack ('01') for each of the (A-)MPDUs for which it intends to solicit an immediate response (see 10.3.2.11.3 (MU acknowledgement procedure for HE MU PPDU in MU format) for an example of this sequence). An Action frame in the DL MU PPDU is always responded with an HE trigger-based PPDU. A non-AP STA that receives a DL MU PPDU that solicits an immediate response shall follow the following acknowledgment procedure:

1) If the DL MU PPDU carries a S-MPDU intended to it that solicits an immediate response, and either an UL MU Response Scheduling A-Control field or a Trigger frame is present, then the STA shall respond with an Ack frame carried in the HE trigger-based PPDU sent as a response.
2) If the DL MU PPDU carries an A-MPDU intended to it that solicits an immediate response, and either a Trigger frame or UL MU Response Scheduling A-Control field is present, then the STA shall respond with a Compressed BlockAck frame carried in the HE trigger-based PPDU sent as a response.
3) If the DL MU PPDU carries a multi-TID A-MPDU intended to it that solicits an immediate response, and either a Trigger frame or an UL MU Response Scheduling A-Control field is present, then the STA shall respond with a Multi-STA BlockAck frame carried in the Trigger-based PPDU sent as a response.

27.4.4.4 HE trigger-based PPDU soliciting a DL SU PPDU response

A non-AP STA that sends an HE trigger-based PPDU as a response to a Basic variant Trigger frame that intends to solicit an immediate response shall set the Ack Policy to Normal Ack/Implicit BAR (see 10.3.2.11.4 (MU acknowledgement procedure for an UL MU transmission) for an example of this sequence). If the HE AP intends to send the response in a DL SU PPDU format, then the HE AP shall follow the following acknowledgment procedure:

1) If the HE trigger-based PPDU carries a Single MPDU from a single STA that solicits an immediate response, then the HE AP shall respond with either an Ack frame or a Multi-STA BlockAck frame with the Ack Type field set to 1 carried in a DL SU PPDU format.
2) If the HE trigger-based PPDU carries an A-MPDU from a single STA that solicits an immediate response, then the HE AP shall respond with a Compressed BlockAck frame, a Multi-STA Block-Ack with the Ack Type field set to 1 and the TID field set to 14 or a Multi-STA BlockAck frame with the Ack Type field set to 0 carried in a DL SU PPDU format.
3) If the HE trigger-based PPDU carries a Multi-TID A-MPDU that solicits an immediate response from a single STA then the HE AP shall send a Multi-STA BlockAck frame carried in a DL SU PPDU format.

If the HE trigger-based PPDU carries Single MPDUs, A-MPDUs, or multi-TID A-MPDUs from more than one STA, or a combination of Single MPDUs from a subset of STAs, A-MPDUs from another subset of STAs, or multi-TID A-MPDUs from another subset of STAs then the AP shall respond with a Multi-STA BlockAck frame carried in a DL SU PPDU format that contains the appropriate settings in each Per STA Info field intended to each STA as defined in the previous subclauses.

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27.4.4.5 HE trigger-based PPDU soliciting a DL MU PPDU response

A non-AP STA that sends an HE trigger-based PPDU as a response to a Basic variant Trigger frame that intends to solicit an immediate response shall set the Ack Policy to Normal Ack/Implicit BAR (see 10.3.2.11.4 (MU acknowledgement procedure for an UL MU transmission) for an example of this sequence). If the HE AP intends to send the response in an HE MU PPDU format, then the HE AP shall follow the following acknowledgment procedure:

a) If the HE trigger-based PPDU carries an S-MPDU from more than one STA, or (multi-TID) A-MPDU from more than one STA, or a combination of an S-MPDU from some STAs and (multi-TID) A-MPDU from other STAs, then the HE-AP shall do one of the following:
   - The AP shall respond with Ack frame or an individually addressed Multi-STA BlockAck frame to each of the STAs from which a Single MPDU that solicited an immediate response was received, and with a Compressed BlockAck frame or a Multi-STA BlockAck frame to each of the STAs from which an A-MPDU that solicited an immediate response was received, or a Multi-STA BlockAck frame to each of the STA from which a multi-TID A-MPDU that solicited an immediate response was received. The control response frames for each STA shall be sent in the allocated RU that is identified by the AID of each STA.
   - The AP may respond with group addressed Multi-STA BlockAck frame(s) in an HE MU PPDU if the receivers of group-addressed Multi-STA BlockAck frame announce the support the reception of MU Multi-STA BlockAck frame. The Ack Type field shall be set according to the acknowledgement context.. A HE AP should only transmit a group addressed Multi-STA BlockAck frame in a DL MU PPDU to a non-AP HE STA *n* on the (broadcast RU) RU (26/52/106/242/484/996) that includes the RU used for receiving the immediate preceding HE trigger-based PPDU from STA *n*. There shall be no more than one Multi-STA BlockAck frame that is addressed to multiple recipients carried in a broadcast RU of the DL MU PPDU.

27.5 MU operation

27.5.1 HE DL MU operation

27.5.1.1 General

HE DL MU operation allows an AP to transmit simultaneously to one or more non-AP STAs in DL OFDMA, DL MU-MIMO or both.

An AP shall not transmit to a STA an HE MU PPDU with the HE-SIG-B allocating spatial streams to more than one recipient STA, unless the STA sets the Downlink MU-MIMO On Partial Bandwidth Rx subfield of the HE Capabilities element to 1.

The transmission of each RU in an HE MU PPDU shall be padded to end at the same time, indicated by the L-SIG field as described in 28.3.10.5 (L-SIG).

The padding procedure for each A-MPDU in an HE MU PPDU is defined in 27.10.3 (A-MPDU padding for an HE trigger-based PPDU).

A STA shall not transmit a DL OFDMA With MIMO PPDU that contains a unicast RA that corresponds to a STA from which it has not received an HE Capabilities element with the DL OFDMA With MIMO Support field set to 1.

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27.5.1.2 HE MU PPDU payload

The Type and Subtype subfields in the Frame Control field and address type (individually addressed or group addressed) of MPDUs may be different across A-MPDUs in different RUs within a same HE MU PPDU.

Two STA-ID fields in HE-SIG-B shall not have the same value, unless the value is 2046, which is used to indicate an unallocated RU. If an AP sets one of the STA-ID field in the HE-SIG-B field to match the AID of a non-AP STA, then the non-AP STA may disregard any broadcast RU in the same HE MU PPDU.

An MPDU sent in a broadcast RU of an HE MU PPDU shall not include information intended for a STA that is identified as the recipient of another RU in the same HE MU PPDU.

27.5.1.3 HE bandwidth query report operation for DL MU

A non-AP STA with A-BQR Support subfield of its HE Capabilities element equal to 1 delivers bandwidth query reports (BQRs) to assist the AP in allocating DL MU and UL MU resources in an efficient way. The non-AP STA can either implicitly deliver BQRs in the BQR A-Control field of a frame transmitted to the AP (unsolicited BQR) or explicitly deliver BQRs in any frame sent to the AP in response to a BQRP variant Trigger frame (solicited BQR).

A non-AP STA reports its channel availability information (unsolicited BQR) to the AP to which it is associated using the BQR A-Control field of frames it transmits as defined below:

— The HE STA may report the channel availability information in the BQR A-Control subfield of frames it transmits if the AP has indicated its support in the A-BQR Support subfield of its HE Capabilities element; otherwise the STA shall not report the channel availability information in the BQR A-Control subfield.

A HE AP can solicit one or more HE non-AP STAs with A-BQR Support subfield of its HE Capabilities element equal to 1 for their BQR(s) by sending a BQRP variant Trigger frame (see 9.3.1.23 (Trigger frame format)). The non-AP STA with A-BQR Support subfield of its HE Capabilities element equal to 1 responds (solicited BQR) as defined below:

— The STA that receives a BQRP variant Trigger frame shall follow the rules defined in 27.5.2.3 (STA behavior) to generate the HE trigger-based PPDU when the Trigger frame contains the STA's AID in any of the Per User Info fields; otherwise the STA shall follow the rules defined in 27.5.2.6 (UL OFDMA-based random access) to gain access to a random RU and generate the HE trigger-based PPDU when the Trigger frame contains one or more random RU(s).

— The STA shall include in the HE trigger-based PPDU one or more QoS Null or QoS Data frames containing the BQR A-Control field with the channel availability information of the STA when the AP has indicated its support in the A-BQR Support subfield of its HE Capabilities element. The HE STA shall not solicit an immediate response for the frames carried in the HE trigger-based PPDU (e.g., by setting the Ack Policy subfield of the frame to Normal Ack or Implicit BAR).

27.5.2 UL MU operation

27.5.2.1 General

The UL MU operation allows an AP to solicit simultaneous immediate response frames from one or more non-AP STAs. Non-AP STAs transmit their response frames using HE trigger-based PPDU format, in either UL OFDMA, UL MU-MIMO, or both, except when the Trigger frame is of type MU-RTS, in which case the response (CTS) is sent in a non-HT PPDU format (see 10.3.2.8a (MU-RTS/CTS procedure)).

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An HE STA with dot11ULMUMIMOOptionImplemented set to true shall set B22 of the UL MU subfield of the HE PHY Capabilities Information field of the HE Capabilities element it transmits to 1. Otherwise, the HE STA shall set B22 of the UL MU subfield to 0.

A non-AP STA with dot11ULMUMIMOOptionImplemented equal to true is referred to as an UL MU capable STA.

An HE STA shall set the UL MU Response Scheduling Support subfield of the HE Capabilities element it transmits to 1 if its dot11HEULMUResponseSchedulingOptionImplemented is true; otherwise the STA shall set it to 0.

A STA shall not transmit a Trigger frame assigning an MU-MIMO RU in an UL OFDMA PPDU when the RU does not span that entire PPDU bandwidth to a STA from which it has not received an HE Capabilities element with B23 of the UL MU subfield of the HE PHY Capabilities Information field set to 1.

A STA shall not transmit a Trigger frame soliciting a full bandwidth UL MU-MIMO HE trigger-based PPDU from a STA from which it has not received an HE Capabilities element with B22 of the UL MU subfield of the HE PHY Capabilities Information field set to 1.

A STA transmitting an UL OFDMA PPDU shall operate as either a class A or class B device as defined in 28.3.14 (Transmit requirements for an HE trigger-based PPDU). A STA that is a class A device shall set the Class A subfield in HE Capabilities elements that it transmits to 1. A STA that is a class B device shall set the Class A subfield in HE Capabilities elements that it transmits to 0.

27.5.2.2 Rules for soliciting UL MU frames

27.5.2.2.1 General

An AP shall not send to a STA an MPDU that contains an UL MU Response Scheduling A-Control subfield, unless the STA has set the UL MU Response Scheduling Support subfield to 1 in the HE Capabilities element it transmits.

An AP may transmit a PPDU that elicits an HE trigger-based PPDU from one or more STAs by including in the PPDU:

— One or more Trigger frames that includes one or more User Info fields addressed to one or more of the recipient STAs. For recipient STAs that are associated with the AP, the User Info field is addressed to a recipient STA if the value of the AID12 subfield of the User Info field is equal to the AID of the STA or to 0 (indicating a random access allocation).. A value of 0 also indicates that non-associated STAs can transmit on the allocated resource using the random access procedure as described in 27.5.2.6 (UL OFDMA-based random access).

— An UL MU Response Scheduling A-Control subfield of individually addressed MPDUs contained in the HE MU PPDU that:

  • Are carried in a S-MPDU format that solicits an immediate Ack frame (see 10.13.8 (Transport of S-MPDUs))
  • Are carried in an A-MPDU format that solicits an immediate BlockAck frame (see 10.24.7.7 (Originator's behavior))
  • Are carried in a multi-TID A-MPDU format that solicits an immediate Multi-STA BA frame (see 27.10.4 (A-MPDU with multiple TIDs))

NOTE—The AP additionally follows the rules defined in 27.3.3 (Procedure at the originator) when fragments are present in the generated MPDU(s).

More than one Trigger frame may be aggregated in an A-MPDU. If more than one Trigger frame is aggregated in an A-MPDU, all of them shall have the same content.

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The following two frames shall not be present in the same A-MPDU:

— A Trigger frame with a User Info field addressed to a STA

— An MPDU that contains an UL MU Response Scheduling A-Control subfield and that is addressed to the same STA

When one or more Trigger Frames are aggregated with other frames in an A-MPDU, the following ordering rules apply:

— When an Ack, BlockAck or Multi-STA BlockAck frame is not present in the A-MPDU, a Trigger frame shall be the first MPDU in the A-MPDU

— When an Ack, BlockAck or Multi-STA BlockAck frame is present in the A-MPDU, the Ack, BlockAck or Multi-STA BlockAck frame shall be the first MPDU in the A-MPDU and a Trigger frame shall follow the Ack, BlockAck or Multi-STA BlockAck frame

A non-AP STA shall not send a Trigger frame or an MPDU carrying an UL MU Response Scheduling A-Control field.

A transmitted Trigger frame that contains a User Info field with the AID of a non-AP STA may contain a Padding field, whose length shall ensure that at least *MinTrigProcTime*, in microseconds, passes from the end of the User Info field that contains that AID and the end of the PPDU that contains the Trigger frame, where the *MinTrigProcTime* is equal to the value specified by the non-AP STA in the Trigger Frame MAC Padding subfield of the HE Capabilities element it transmits. The AP shall apply the Trigger Frame MAC Padding field with duration corresponding to the longest value among all STAs that have requested extra *MinTrigProcTime* through Trigger Frame MAC Padding Duration capability.

The AP shall ensure that the duration of the symbols that follow the symbol in the Trigger Frame that contains the last bit of the STA's User Info field is larger than or equal to the *MinTrigProcTime* value specified by the STA.

NOTE 1—The start of the Padding subfield is identified by a User Info field that has a value of the AID equal to 2047, and the remaining subfields of the Padding field are set to 1.

NOTE 2—This rule applies to all variants of the Trigger frame (Basic, MU-BAR, MU-RTS, etc).

27.5.2.2.2 Allowed settings of the Trigger frame fields and UL MU Response Scheduling A-Control subfields

An AP that transmits a Trigger frame shall set the TA field of the frame to one of the following:

— The MAC address of the AP transmitting the frame when dot11MultiBSSIDActivated is false or when dot11MultiBSSIDActivated is true and the Trigger frame is directed to STAs that intend to communicate with the AP

— The MAC address of the transmitted BSSID when dot11MultiBSSIDActivated is true and the Trigger frame is directed to STAs that intend to communicate with at least two different BSSs of the multiple BSSID set and that have indicated reception support for this Trigger frame in the Multiple BSSID Control Support field of the HE Capabilities element it transmits (see 11.1.3.8 (Multiple BSSID procedure)).

NOTE—All MPDUs within an A-MPDU carried in an HE trigger-based PPDU have the same RA (see 9.7.3 (A-MPDU contents). The settings of the address fields of MPDUs within the A-MPDU depend on the type and subtype of the MPDU as defined in 9.3 (Format of individual frame types).

If an HE AP does not receive an HE Capabilities element with the Rx Control Frame To MultiBSS field equal to 1 from a STA, the HE AP shall not send a Trigger frame whose destination STAs associate with more than one APs to the STA. The RA field of the frames sent in response to a MU-RTS frame is set as defined in 9.3.1.3 (CTS frame format). The RA field of the MPDUs sent in response of a MU-BAR is set as

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defined in 9.3.1.9 (BlockAck frame format). BlockAck frame and Data frames whose RAs are different shall not be aggregated in one A-MPDU in responding to an MU-BAR frame. The RA field of the Data frames and Management frames sent in response to a Trigger frame shall be set to the MAC address of the destination AP.

An AP shall not set any subfields of the Common Info field of a Trigger frame to a value that is not supported by all the recipient STAs of the Trigger frame.

An AP shall set all the subfields, except the Trigger Type subfield, of the Common Info field of a Trigger frame to the same value of the corresponding subfield of the Common Info field of any other Trigger frame that is carried in the same PPDU. An AP shall set the UL PPDU Length and DL Tx Power subfields of an UL MU Response Scheduling A-Control subfield to the same value of the corresponding subfield of any UL MU Response Scheduling A-Control that is carried in the same PPDU. An AP shall set the following subfields of the Common Info field of a Trigger frame accordingly if an UL MU Response Scheduling A-Control subfield is carried in an MPDU within the same PPDU:

— MU-MIMO LTF Mode and STBC are set to 0
— Number of HE-LTF Symbols is set to 1
— Spatial Reuse is set to SR_Disallowed
— GI and LTF Type is set to 3 if the carrying PPDU TXVECTOR parameter CP_LTF_TYPE is 4x LTF + 3.2 μs CP or 2x LTF + 1.6 μs CP; otherwise is set to 2
— CS Required subfield is set to 0

NOTE—STAs obtain the common information either explicitly, or implicitly or both. Explicit information is obtained in the Common Info field of a Trigger frame, or in the UL PPDU Length and DL TX Power subfields of the UL MU Response Scheduling A-Control field contained in the soliciting PPDU. Implicit information is obtained in previously exchanged frames with the AP, e.g., in the BSS Color and the Default PE Duration subfields of the HE Operation element, or from default values specified in 27.5.2.3 (STA behavior).

An AP shall not set any subfields of the User Info field of a Trigger frame to a value that is not supported by the recipient STAs of the User Info field. An AP shall not set any subfields of an UL MU Response Scheduling A-Control subfield in an HE variant HT Control field to a value that is not supported by the recipient STAs of the User Info field.

If a Trigger frame is transmitted in an RU of an HE MU PPDU and the RU is addressed to multiple STAs, then the Trigger frame shall not include any User Info fields addressed to a STA that is identified as recipient of another RU or spatial stream of the same HE MU PPDU.

An HE variant HT Control field with an UL MU Response Scheduling A-Control subfield shall not be included in an MPDU that is group addressed.

If an AP includes one or more Trigger Frames or HE variant HT Control fields with an UL MU Response Scheduling A-Control subfield, then they shall collectively elicit HE trigger-based PPDU responses such that at least one RU is allocated for each 20 MHz channel occupied by the eliciting PPDU. An AP shall not allocate UL subchannel in any 20 MHz channel that is not occupied by the immediately preceding DL PPDU.

The responding STA shall not aggregate QoS Data frames in the multi-TID A-MPDU with a number of TIDs that exceeds the value indicated by the TID Aggregation Limit subfield in the Trigger Dependent User Info field of a Basic Trigger frame (see 9.3.1.23.1 (Basic Trigger variant)) intended to it.

The AP shall set the value in the TID Aggregation Limit subfield in the Type Dependent User Info field to 0 or 1 for an HE STA that has 0 in the Multi-TID Support field of the HE MAC Capabilities Information field of the HE Capabilities element it transmits and is identified by the AID12 subfield of the User Info field of a Basic Trigger frame (see 9.3.1.23 (Trigger frame format)).A value 0 indicates to the STA that it shall not

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solicit any immediate response for the MPDUs that the STA aggregates in the HE trigger-based PPDU.A value greater than 0 indicates the number of TIDs that the STA can aggregate in the A-MPDU carried in the HE trigger-based PPDU (see 27.10.4 (A-MPDU with multiple TIDs)).

The AP may assign any value between 0 and 7 in the TID Aggregation Limit subfield in the Trigger Dependent User Info field for an HE STA that has a nonzero value in the Multi-TID Support subfield of the HE MAC Capabilities Information field of the HE Capabilities element it transmits and is identified by the AID12 subfield of the User Info field of a Basic Trigger frame.

The AP may assign any value in the AC Preference Level subfield in the Trigger Dependent User Info field for an HE STA identified by the AID12 subfield of the User Info field of a Basic Trigger frame.

The AP may assign any value defined in Table 9-25i (Preferred AC subfield encoding) in the AC Preference Level subfield in the Trigger Dependent User Info field to 1 for an HE STA and identified by the AID12 subfield of the User Info field of a Basic Trigger frame.

NOTE—A STA follows the rules in 27.10.4 (A-MPDU with multiple TIDs) for aggregating the QoS Data frames with multiple TIDs in HE trigger-based PPDUs.

27.5.2.2.3 AP access procedures for UL MU operation

When an AP receives an immediate response with at least one MPDU from at least one STA solicited by a Trigger frame, the procedures described in 9.22.2.7 (Multiple frame transmission in an EDCA TXOP) apply.

When an AP does not receive an immediate response with at least one MPDU from at least one STA solicited by a Trigger frame, i.e., transmission failure, the backoff procedure described in 9.22.2.2 (EDCA backoff procedure) applies.

An AP may use any AC for sending a PPDU that contains only Trigger frames. If the PPDU contains frames that are not Trigger frames in addition to a Trigger frame, then the AP shall follow the rules defined in 10.22.2.6 (Sharing an EDCA TXOP).

An AP may send the Trigger frame using any access category and follows the rules defined in 10.22.2 (HCF contention based channel access (EDCA)) for obtaining and sharing the TXOP.

27.5.2.3 STA behavior

A STA shall not send an HE trigger-based PPDU unless it is explicitly triggered by an AP in one of the operation modes described in this subclause.

The inter-frame space between a PPDU that contains a Trigger frame or contains an UL MU Response Scheduling A-Control field that solicits an immediate response and the HE trigger-based PPDU is SIFS.

A STA shall commence the transmission of an HE trigger-based PPDU at the SIFS time boundary after the end of a received PPDU, when all the following conditions are met

- The received PPDU contains either a Trigger frame (that is not an MU-RTS variant) with a User Info field addressed to the STA, or an MPDU addressed to the STA that contains an UL MU Response Scheduling A-Control subfield. The User Info field is addressed to a STA if the AID12 subfield is equal to the AID of the STA and the STA is associated with the AP. If the STA is not associated with the AP, TBD.
- The CS Required subfield in the Trigger frame is 1 and the UL MU CS condition described in 27.5.2.4 (UL MU CS mechanism) indicates the medium is idle, or the CS Required subfield in a Trigger frame is 0.
- Otherwise, a STA shall not send an HE trigger-based PPDU

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A STA transmitting an HE trigger-based PPDU in response to a Trigger frame sets the TXVECTOR parameter as follows:

— The FORMAT parameter shall be set to HE_TRIG

— The PE_DURATION parameter shall be set according to the value of the Packet Extension field in the soliciting Trigger frame

— The TXOP_DURATION parameter shall be set according the rules defined in 27.2.2 (Updating two NAVs)

— The BSS_COLOR parameter shall be set as follows:

  • If the preceding Trigger frame was received in an HE PPDU, then set to the value of the RXVECTOR parameter BSS_COLOR of the HE PPDU
  • If the Trigger frame was received in a non-HE PPDU, then set to the value of the BSS Color subfield of the most recently received HE Operation element for that BSS

— The L_LENGTH parameter shall be set to the value indicated by the Length subfield of the eliciting Trigger frame

— The GI_TYPE and HE_LTF_TYPE parameters shall be set to the value indicated by the GI and LTF Type subfield of the Common Info field of the eliciting Trigger frame

— The NUM_STS parameter shall be set to the number of space time streams indicated by the Number Of Spatial Streams subfield of the SS Allocation field of the User Info field and STBC field in the Common Info field of the Trigger frame

— The CH_BANDWIDTHW parameter shall be set to the value of the BW field in the Common Info field of the eliciting Trigger frame

— The HE_LTF_MODE parameter shall be set to the value indicated by the MU-MIMO LTF Mode subfield of the Common Info field of the eliciting Trigger frame

— The NUMBER_HE_LTF_SYM parameter shall be set to the value indicated by the Number Of HE-LTF Symbols subfield of the Common Info field of the eliciting Trigger frame

— The STBC parameter shall be set to the value indicated by the STBC subfield of the Common Info field of the eliciting Trigger frame

— The LDPC_EXTRA_SYM parameter shall be set to the value indicated by the LDPC Extra Symbol Segment subfield of the Common Info field of the eliciting Trigger frame

— The SPATIAL_REUSE parameter shall be set to the value of the Spatial Reuse field in the Common Info field of the eliciting Trigger frame

— The HE_SIGA_RESERVED parameter shall be set to the value of the HE-SIG-A Reserved field in the Common Info field of the eliciting Trigger frame

— The MCS parameter shall be set to shall be set to the value of the MCS field in the Common Info field of the eliciting Trigger frame

— The DCM parameter shall be set to the value indicated by the DCM subfield of the User Info field of the eliciting Trigger frame

— The STARTING_STS_NUM parameter shall be set to shall be set to the value of the Starting Spatial Stream subfield of the SS Allocation field in the Common Info field of the eliciting Trigger frame

— The FEC_CODING parameter shall be set to the value indicated by the Coding Type subfield of the User Info field of the eliciting Trigger frame

— The RU_ALLOCATION parameter shall be set to the value indicated by the RU Allocation field of the User Info subfield of the eliciting Trigger frame

— The TXPWR_LEVEL_INDEX parameter shall be set to the value based on the Transmit Power Control for HE trigger-based PPDU and based on the value of the AP Tx Power subfield in the Common Info field and the Target RSSI subfield in the User Info field of the eliciting Trigger frame (28.3.14.2 (Power pre-correction)).

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A STA transmitting an HE trigger-based PPDU in response to soliciting MPDU(s), containing an UL MU Response Scheduling A-Control subfield, shall set the TXVECTOR parameters as follows:

- N_{SYM} shall be set to the F_{VAL} + 1, where F_{VAL} is the value of the UL PPDU Length subfield of the UL MU Response Scheduling subfield
- UL_TARGET_RSSI, DL_TX_POWER, RU_ALLOCATION, and MCS parameters shall be set to the values of UL Target RSSI, DL TX Power, RU Allocation, and UL MCS subfields of the UL MU Response Scheduling subfield, respectively.
- BW shall be equal to the bandwidth of the soliciting DL MU PPDU
- BSS_COLOR, and DCM shall be set to the values of the RXVECTOR parameters BSS_COLOR, and DCM of the soliciting DL MU PPDU, respectively
- MU_MIMO_LTF_MODE, LDPC_EXTRA, NSTS, STBC, CODING TYPE, SS_ALLOCATION shall all be set to 0
- SPATIAL_REUSE shall be set to the value indicating SR_Disallowed
- PE_DURATION shall be set to the default PE duration value for UL MU response scheduling, which is indicated by the AP in the Default_PE Duration subfield of the HE Operation element it transmits, and the pre-FEC padding factor shall be set to 4 (see 28.3.12 (Packet extension))
- TXOP_DURATION parameter shall be set according the rules defined in 27.2.2 (Updating two NAVs)
- CP_LTF_TYPE parameter shall be set to indicate 4x LTF + 3.2 μs CP if the RXVECTOR parameter CP_LTF_TYPE is 4x LTF + 3.2 μs CP or 2x LTF + 1.6 μs CP ; otherwise shall be set to indicate 2x LTF + 1.6 μs CP

NOTE 1—The HE trigger-based PPDU in this case is only sent in UL OFDMA format and CS is not required prior to its transmission (see 27.5.2.4 (UL MU CS mechanism)).

NOTE 2—The use of BCC limits the available RU sizes as defined in 28.3.11.8 (BCC interleavers).

The STA that responds to a DL MU PPDU containing MPDU(s) addressed to it that include UL MU Response Scheduling A-Control subfield(s) follows the rules defined in 10.3.2.9 (Ack procedure) for generating the Ack frame, the rules defined in 10.24.7.5 (Generation and transmission of BlockAck frames by an HT STA or DMG STA) for generating the BlockAck frame, and the rules defined in 27.4 (Block acknowledgement) for generating the Multi-STA BlockAck frame. The STA shall construct the A-MPDU carried in the trigger-based PPDU as defined in Table 9-428 (A-MPDU contents MPDUs in the control response context) when the A-MPDU containing the UL MU Response Scheduling A-Control subfield solicits an immediate response and as defined in Table 9-426 (A-MPDU contents in the data enabled no immediate response context) when the A-MPDU does not solicit an immediate response.

NOTE—The STA additionally follows the rules defined in 27.3.3 (Procedure at the originator) when fragments are present in the soliciting (A-)MPDU(s).

The MAC padding procedure is described in 10.42.2.1.2.

The content of each A-MPDU in an HE trigger-based PPDU is defined in 9.7.3 (A-MPDU contents) in 27.10.3 (A-MPDU padding for an HE trigger-based PPDU) and subject to the following additional constraints:

- If the Trigger Type field of a Trigger frame is not Basic Trigger, then the STA shall include in the response A-MPDU at least one MPDU of the required type. A Beamforming Report Poll Trigger frame solicits HE Compressed Beamforming Feedback frames (see 27.6 (HE sounding protocol), an MU BAR Trigger frame solicits BlockAck frames (see 27.4 (Block acknowledgement)), and a BSRP Trigger frame solicits QoS Null frames (see 27.5.2.5 (HE buffer status feedback operation for UL MU). The MPDUs included in the response shall not solicit a response.

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— If the Trigger Type field of the soliciting Trigger frame is Basic Trigger and the STA does not have a frame of the required type, the STA shall either not transmit a response or transmit one or more QoS Null frames.

A STA that is an intended receiver of a Trigger frame that is not a Basic Trigger frame shall construct the A-MPDU carried in the HE trigger-based PPDU as defined in 9-428 (A-MPDU contents MPDUs in the control response context). A STA that is an intended receiver of a Basic Trigger frame may include MPDUs with any TID in the HE trigger-based PPDU sent in response to a Trigger frame subject the rules of 27.10.4 (A-MPDU with multiple TIDs).

NOTE 1—An AP can include other MPDUs in a soliciting DL MU PPDU that contains Trigger frames as specified in 9.7.3 (A-MPDU contents).

NOTE 2—The frame type of MPDUs may be different across A-MPDUs within a same HE trigger-based PPDU..

27.5.2.4 UL MU CS mechanism

The ED-based CCA and virtual CS functions are used to determine the state of the medium if CS is required before responding to a received Trigger frame. ED-based CCA for UL MU CS follows the same procedure as defined in VHT receiver specification. ED-based CCA is described in 21.3.18.5.2 (CCA sensitivity for operating classes requiring CCA-ED) and virtual CS is defined in 10.3.2.1 (CS mechanism).

A NAV is considered in virtual CS for a STA that is solicited by a Trigger frame for transmission unless one of the following conditions is met:

— The response generated by the STA contains an Ack frame or a BlockAck frame and the Length subfield in the Common Info field of the Trigger frame is less than or equal to 418

— The NAV was set by an intra-BSS frame

NOTE 1—The details of how a STA is solicited by the Trigger frame for transmission are described in 27.5.2.2.2 (Allowed settings of the Trigger frame fields and UL MU Response Scheduling A-Control subfields).

If one or both of the NAVs are considered and the considered NAV's counter is nonzero, then the virtual CS indicates busy. Otherwise, the virtual CS is idle.

If the CS Required subfield in a Trigger frame is set to 1, the STA shall consider the status of the CCA (using Energy Detect defined in 21.3.18.5.2 CCA sensitivity for operating classes requiring CCA-ED) and the virtual carrier sense (NAV) before UL MU transmission in response to the Trigger frame. In this case, the STA shall sense the medium using energy-detect (ED) after receiving the PPDU that contains the Trigger frame (i.e. during the SIFS time), and it shall perform the energy-detect (ED) at least in the subchannel that contains the STA's UL allocation, where the sensed subchannel consists of either a single 20 MHz channel or multiple of 20 MHz channels. The STA may transmit an HE trigger-based PPDU when the 20 MHz channels containing the allocated RUs in the Trigger frame are considered idle; if the STA detects that the 20 MHz channels containing the allocated RUs are not all idle, then the STA shall not transmit anything in the allocated RUs.

If the CS Required subfield in a Trigger frame is set to 0 or an UL MU response scheduling A-Control field is included in the received (A-)MPDU that solicits a response, the STA may respond with an HE trigger-based PPDU without regard to the busy/idle state of the medium.

The CS Required subfield in the MU-RTS variant of the Trigger frame shall be set to 1.

The AP shall set the CS Required subfield to 1 except when all solicited HE trigger-based PPDUs contain an Ack or BlockAck frame and the Length subfield in the Common Info field of the Trigger frame is less than or equal to 418.

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NOTE—The threshold value 418 of the Length subfield in the Common Info field of the Trigger frame is obtained from the maximum HE trigger-based PPDU duration, 584 μs, that can be solicited by the UL MU Response Scheduling A-Control subfield based on Equation (28-16). This duration is the sum of 20 μs for the L-STF, L-LTF and L-SIG fields, 20 μs for the RL-SIG, HE-SIG-A and HE-STF fields, 16 μs for the 4x HE-LTF field with 3.2 μs GI, 512 μs for 32 OFDM symbols in the Data field with 3.2 μs GI, and 16 μs PE field (see 9.2.4.6.4.2 (UL MU response scheduling), 27.5.2.3 (STA behavior), and 28.3.4 (HE PPDU formats)).

27.5.2.5 HE buffer status feedback operation for UL MU

A non-AP STA delivers buffer status reports (BSRs) to assist its AP in allocating UL MU resources in an efficient way. The non-AP STA can either implicitly deliver BSRs in the QoS Control field or BSR A-Control field of any frame transmitted to the AP (unsolicited BSR) or explicitly deliver BSRs in any frame sent to the AP in response to a BSRP variant Trigger frame (solicited BSR).

A non-AP STA reports its buffer status (unsolicited BSR) to the AP to which it is associated using either the QoS Control field or the BSR A-Control field of frames it transmits as defined below:

— The HE STA shall report the buffer status for a given TID in the Queue Size subfield of the QoS Control field in QoS Data or QoS Null frames it transmits; except that the STA may set the Queue Size subfield to 255 to indicate an unknown/unspecified BSR for that TID.
  - The HE STA may aggregate multiple QoS Data frames or QoS Null frames in an A-MPDU to report the buffer status for different TIDs. The HE STA shall follow the A-MPDU aggregation rules defined in 27.10.4 (A-MPDU with multiple TIDs) for aggregating QoS Data frames with multiple TIDs. The HE STA does not follow the rules defined in 27.10.4 (A-MPDU with multiple TIDs) for QoS Null frames whose Ack Policy subfield is No Ack.

— The HE STA may report the buffer status in the BSR A-Control subfield of frames it transmits if the AP has indicated its support in the A-BSR Support subfield of its HE Capabilities element; otherwise the STA shall not report the buffer status in the BSR A-Control subfield.
  - The HE STA shall report the buffer status for its preferred AC, indicated by the ACI High subfield, in the Queue Size High subfield of the BSR A-Control field; except that the STA may set the Queue Size High subfield to 255 to indicate an unknown/unspecified BSR for that AC
  - The HE STA shall report the buffer status for all ACs, indicated by the ACI Bitmap subfield, in the Queue Size All subfield of the BSR A-Control field; except that the STA may set the Queue Size All subfield to 255 to indicate an unknown/unspecified BSR for those ACs(#2190, 2191)
  - The HE STA shall set the Delta TID subfield according to Table 9-XX (Delta TID subfield encoding), and the Scaling Factor subfield as defined in 9.2.4.6.4.5 (Buffer Status Report (BSR)).

NOTE 1—The STA can send an unsolicited BSR in response to Basic variant Trigger frames (with or without random RUs, as defined in 27.5.2.3 (STA behavior) and in 27.5.2.6 (UL OFDMA-based random access)) or it can send the unsolicited BSR after accessing the WM using EDCA.

NOTE 2—The STA can include both the QoS Control and the BSR A-Control field in the same frame and it can set the Queue Size subfield of either of them to a value of 255.

An AP can also solicit one or more non-AP STAs for their BSR(s) by sending a BSRP variant Trigger frame (see 9.3.1.23 (Trigger frame format)). The non-AP STA responds (solicited BSR) as defined below:

— The STA that receives a BSRP variant Trigger frame shall follow the rules defined in 27.5.2.3 (STA behavior) to generate the trigger-based PPDU when the Trigger frame contains the STA's AID in any of the Per User Info fields; otherwise the STA shall follow the rules defined in 27.5.2.6 (UL OFDMA-based random access) to gain access to a random RU and generate the Trigger-based PPDU when the Trigger frame contains one or more random RU(s).

— The STA shall include in the HE trigger-based PPDU one or more QoS Null frames containing one or more of the following:

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- The QoS Control field(s) with Queue Size subfields for each of the TIDs for which the STA has buffer status to report to the AP.
- The BSR A-Control field with the Queue Size All subfield indicating the queue size for all the ACs, indicated by the ACI Bitmap subfield, for which the STA has buffer status to report to the AP when the AP has indicated its support in the A-BSR Support subfield of its HE Capabilities element. The STA shall set Delta TID, SF, ACI High and Queue Size High subfields of the BSR A-Control field as defined in 9.2.4.6.4.5 (Buffer Status Report (BSR))).

— The HE STA shall not solicit an immediate response for the frames carried in the trigger-based PPDU (e.g., by setting the Ack Policy subfield of the frame to Normal Ack or Implicit BAR).

NOTE—Similar to unsolicited BSR, the STA can set Queue Sizes in either QoS Control or BSR A-Control field to 255 to indicate unknown/unspecified BSR for a TID, AC or all AC.

An AP may include a BSRP Trigger frame together with other control, data and management frames in one A-MPDU to a STA if the HE Capabilities element received from the STA has the BSRP A-MPDU Aggregation field equal to 1. If a STA receives a BSRP Trigger frame aggregated with control, data and management frames that asks for acknowledgement, the acknowledgement has high priority to be transmitted.

27.5.2.6 UL OFDMA-based random access

27.5.2.6.1 General

A STA shall set the UL OFDMA RA Support subfield in the HE Capabilities element to 1 if it supports UL OFDMA-based random access and set it 0, otherwise.

UL OFDMA-based random access is a mechanism for HE STAs to randomly select resource units (RUs) assigned by an AP in a soliciting Trigger frame that contains RUs for random access. An RU for random access shall be identified by an AID12 subfield equal to 0 contained in a User Info field of a Trigger frame. An HE AP may transmit a Basic Trigger frame or a BSRP Trigger frame that contains one or more RUs for random access.

The HE AP may include the RAPS element (see 9.4.2.220 (OFDMA-based Random Access Parameter Set (RAPS) element) in Beacon and Probe Response frames it transmits. The AP shall indicate the range of OFDMA contention window (OCW) in the RAPS element for HE STAs to initiate random access following the Trigger frame transmission.

An HE STA shall use the OCWmin and OCWmax values indicated in the RAPS element within the most recently received Beacon or Probe Response regardless of the access category of traffic the HE STA intends to transmit.

NOTE—If the STA does not receive the RAPS element, the STA does not transmit any HE trigger-based PPDU using random access RUs.

The non-AP STA with dot11OFDMARandomAccessOptionImlemented set to true shall maintain an internal OFDMA backoff (OBO) counter. The HE STA shall follow the random access procedure defined in 27.5.2.6.2 (Random access procedure) to contend for an RU assigned for random access.

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27.5.2.6.2 Random access procedure

In this subclause, the random access procedure is described with respect to UL OFDMA contention parameters. The procedure is also illustrated in Figure 27-1 (Illustration of the UL OFDMA-based random access procedure). The OFDMA contention window (OCW) is an integer with an initial value of OCWmin.

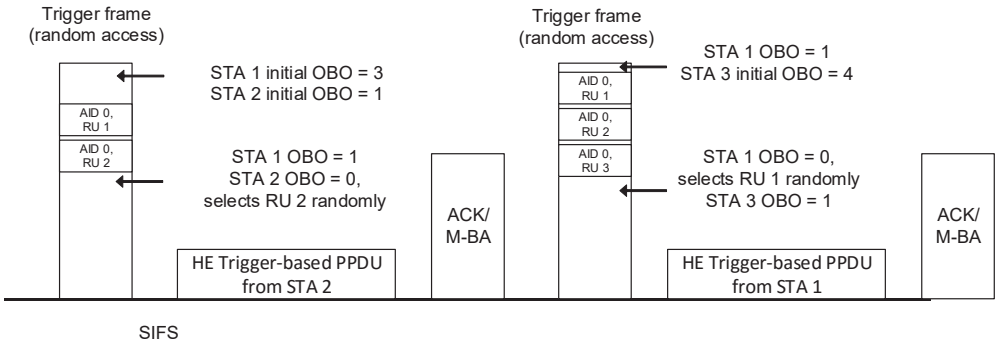

Figure 27-1—Illustration of the UL OFDMA-based random access procedure

An HE AP indicates the values of OCWmin and OCWmax in the RAPS element in a Beacon or Probe Response frame for the random access operation. OCWmax is the upper limit of OCW.

For an initial HE trigger-based PPDU transmission or following a successful HE trigger-based PPDU transmission, when an HE STA obtains the value of OCWmin from the HE AP indicated in the RAPS element, it shall set the value of OCW to the OCWmin and shall initialize its OBO counter to a random value in the range of 0 and OCWmin.

For an HE STA, if the OBO counter is smaller than the number of RUs assigned to AID value 0 in a Trigger frame, then the HE STA shall decrement its OBO counter to zero. Otherwise, the HE STA decrements its OBO counter by a value equal to the number of RUs assigned to AID value 0 in a Trigger frame. For instance, as shown in Figure 27-1 (Illustration of the UL OFDMA-based random access procedure), HE STA 1 and HE STA 2 decrement their nonzero OBO counters by 1 in every RU assigned to AID value 0 for random access within the Trigger frame.

For an HE STA, if the OBO counter is 0 or if the OBO counter decrements to 0, then the STA randomly selects one of the RUs assigned to AID value 0If the selected RU is idle as a result of both physical and virtual carrier sensing as defined in subclause 27.5.2.4 (UL MU CS mechanism), the HE STA transmits its HE trigger-based PPDU in the randomly selected RU. If the selected RU is considered busy as a result of either physical or virtual carrier sensing, then the HE STA shall not transmit its HE trigger-based PPDU in the randomly selected RU and it randomly selects any one of the RUs that are assigned to AID value 0 in the subsequent Trigger frame. If the OBO counter is not zero and does not decrements to 0, the STA resumes with its OBO counter in the next Trigger frame with RUs assigned for random access.

If the HE trigger-based PPDU is successfully transmitted in the randomly selected RU, then the STA shall set its OCW to OCWmin.

NOTE—If the transmitted HE trigger-based PPDU does not solicit an immediate response, then the STA follows the OCW reset rule that applies to successful transmission.

The MU acknowledgment procedure for random access follows the procedure as defined in 10.3.2.10.3 (Acknowledgement procedure for an UL MU transmission).

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If a STA transmits an HE trigger-based PPDU that solicits an immediate response in a random access RU and the expected response is not received, the transmission is considered unsuccessful and the STA invokes the UL OFDMA-based random access retransmission procedure as defined in 27.5.2.6.3 (Retransmission procedure for random access).

27.5.2.6.3 Retransmission procedure for random access

If an HE trigger-based PPDU soliciting an immediate response that is sent by a STA in its randomly selected RU (see 27.5.2.6.2 (Random access procedure)) fails, then the STA may attempt to retransmit the HE trigger-based PPDU using random access. This subclause defines the retransmission procedure that a STA may follow using random access.

If the HE trigger-based PPDU is not successfully transmitted in the randomly selected RU, the STA shall update its OCW to $2 \times \text{OCW} + 1$ for every retransmission, until the OCW reaches the value of OCWmax. Once the OCW reaches OCWmax for successive retransmission attempts, the OCW shall remain at the value of OCWmax until the OCW is reset.

27.5.2.7 NDP feedback report procedure

The NDP feedback report is a mechanism for an HE AP to collect short feedbacks from a very high number of HE STAs, in an efficient manner. The feedbacks (e.g. resource requests) are sent without data payloads in response to a Trigger frame. The feedbacks are not for channel sounding. This mechanism is optional for non-AP STA.

27.5.3 HE MU cascading operation

A TXOP can include both DL MU and UL MU transmissions.

If MU Cascading Support field in the HE MAC Capabilities Information field of the HE Capabilities element is set to 1 by both HE AP and HE non-AP STA(s), an HE AP can initiate a cascading sequence of MU PPDUs in a TXOP, allowing alternating HE MU PPDUs and HE trigger-based PPDUs starting with an

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HE MU PPDU in the same TXOP, as illustrated in Figure 27-2 (An example of cascading sequence of MU PPDUs).

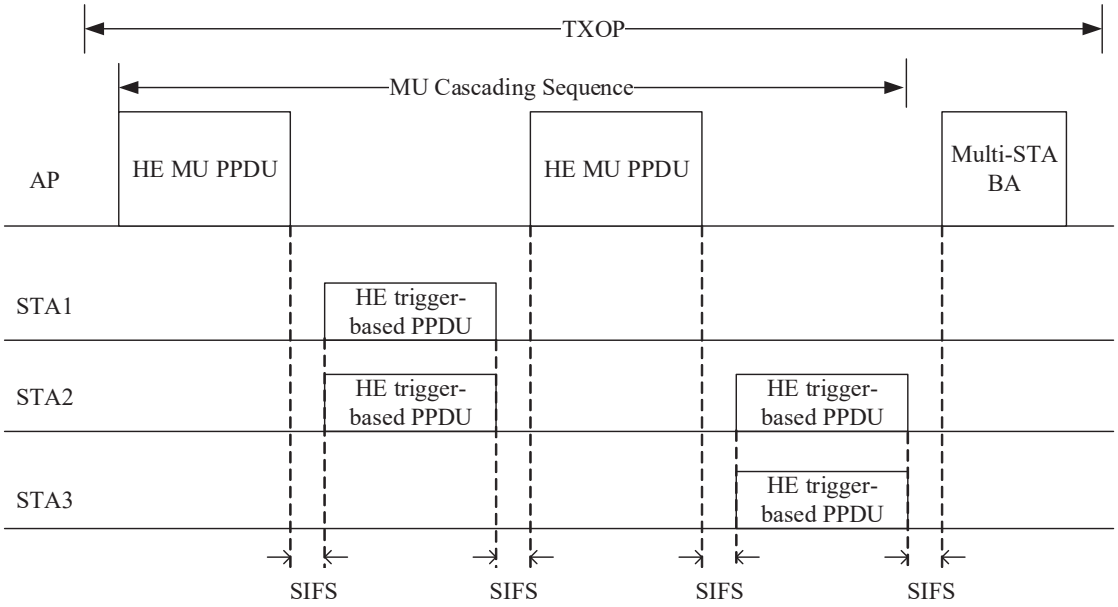

Figure 27-2—An example of cascading sequence of MU PPDUs

An HE MU PPDU transmitted by the AP a SIFS after an HE trigger-based PPDU has the following A-MPDU contents:

— At most one Ack, BlockAck or Multi-STA BlockAck frame for the preceding HE trigger-based PPDU and,

— Zero or more MPDUs and,

— One or more Trigger frames or UL MU Response Scheduling A-Control fields if this is not the last PPDU of the MU cascading sequence.

The presence of an HE MU PPDU with that A-MPDU contents starts an MU cascading sequence within that TXOP.

If MU Cascading Support field in the HE MAC Capabilities Information field of the HE Capabilities element is set to 0 by an HE AP, the HE AP shall not initiate a cascading sequence of MU PPDUs in its TXOP(s).

If MU Cascading Support field in the HE MAC Capabilities Information field of the HE Capabilities element is set to 0 by an HE non-AP STA, the HE AP associated by the HE non-AP STA shall not initiate a cascading sequence of MU PPDUs to the HE non-AP STA in its TXOP(s).

The cascading sequence may have different UL transmitters within each HE trigger-based PPDU. The cascading sequence may have a different set of transmitters in HE trigger-based PPDUs as compared to the HE MU PPDU that immediately follows the HE trigger-based PPDUs within the same TXOP. The cascading sequence may have a different set of receivers in the DL HE MU PPDU as compared to the HE trigger-based PPDUs that immediately follows the DL HE MU PPDU within the same TXOP.

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27.6 HE sounding protocol

27.6.1 General

Transmit beamforming and DL MU-MIMO require knowledge of the channel state to compute a steering matrix that is applied to the transmit signal to optimize reception at one or more receivers. HE STAs use the HE sounding protocol to determine the channel state information. As with the VHT sounding protocol, the HE sounding protocol uses explicit feedback mechanism where the HE beamformee measures the channel using a training signal transmitted by the HE beamformer and sends back a transformed estimate of the channel state. The HE beamformer uses this estimate to derive the steering matrix.

27.6.2 Rules for HE sounding protocol sequences

The HE beamformer shall initiate a sounding sequence by transmitting an HE NDP Announcement frame followed by an HE NDP after a SIFS.

If an HE AP does not receive an HE Capabilities element with the Rx Control Frame To MultiBSS subfield in the HE MAC Capabilities Information field equal to 1 from a STA, the HE AP shall not send a NDP Announcement frame whose destination STAs associate with more than one APs to the STA.

If the HE NDP Announcement frame includes more than one STA Info field, the RA field of the HE NDP Announcement frame shall be set to the broadcast address, otherwise it shall be set to the MAC address of the STA whose AID is included in the STA Info field. The HE NDP Announcement frame shall indicate the *Ng*, codebook and *Nc* to be used by the intended receiver STAs for the generation of HE compressed beamforming feedback report except when the HE NDP Announcement frame contains only one STA Info field. When the HE NDP Announcement frame contains only one STA Info field, then the *Ng*, codebook and *Nc* to be used for the generation of the HE compressed beamforming feedback report shall be determined by the recipient of the NDP Announcement frame.

An HE beamformer that transmits an HE NDP Announcement frame with more than one STA Info field shall transmit a Beamforming Report Poll Trigger frame a SIFS after the HE NDP to retrieve HE compressed beamforming feedback from the intended HE beamformees in the same TXOP. The HE beamformer may subsequently send additional Beamforming Report Poll Trigger frames a SIFS after receiving the HE compressed beamforming feedback to retrieve a subset of the feedbacks in the same TXOP.

An HE beamformer that sets the Feedback Type subfield of a STA Info field to MU shall set the Nc Index field to a value less than or equal to the minimum of:

— The maximum number of supported spatial streams according to the corresponding HE beamformee's Rx HE-MCS Map subfield in the supported HE-MCS and NSS set field

— The maximum number of supported spatial streams according to the Rx NSS subfield value in the operating mode field of the most recently received Operating Mode Notification frame or the Operating Mode Notification element with the Rx NSS Type subfield equal to 0 for the corresponding HE beamformee

— The maximum number of supported spatial streams according to the Rx NSS subfield value in the most recently received frame that carried a Received Operating Mode Indication subfield (see 27.8 (Operating mode indication)).

The HE beamformee shall indicate the maximum number of space-time streams it can receive in an HE NDP as well as the total number of space-time streams (summed across all users) it can receive in a DL MU-MIMO packet through the Beamformee STS Capability field. For an HE beamformee, the value of this capability field shall be greater than or equal to 4.

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An HE beamformer that sets the Feedback Type subfield of the STA Info field to MU shall set the Ng field value in the STA Info field of the HE NDP Announcement frame to either 0 (for *Ng* = 4) or 1 (for *Ng* = 16).

An HE beamformer with multiple STA Info elements shall set the RU Start Index and RU End Index in the STA Info field to indicate the starting 26-tone RU and the ending 26-tone RU of the requested HE compressed beamforming feedback report only if the HE beamformee indicates it is capable of Partial Bandwidth feedback. The RU Start Index is 7 bits and indicates the lowest 26-tone RU for which the HE beamformer is requesting feedback. The RU End Index is 7 bits and indicates the highest 26-tone RU for which the HE beamformer is requesting feedback. The 26-tone RU location is based on the RXVECTOR parameter CH_BANDWIDTH of the HE NDP Announcement when received in an HE PPDU or the RXVECTOR parameter CH_BANDWIDTH_IN_NON_HT when the HE NDP Announcement is received in a non-HT PPDU. If the HE beamformee is not capable of partial bandwidth feedback or if there is only one STA info element in the NDP Announcement frame then the HE beamformer shall set the RU Start Index and the RU End Index to values indicating a full bandwidth feedback such as in the case of *Ng* = 4, for 80 MHz full bandwidth feedback the RU Start Index and RU End Index is set to 0 and 36, respectively as shown in Table YY-1.

The HE beamformer shall set the starting RU index to a value equal to the maximum of:

— The minimum 26-tone RU located within the channel width in the VHT Operation Information field

— The minimum 26-tone RU located within the channel width in the Receive Operating Mode Notification Indication (see 27.8 (Operating mode indication))

The HE beamformer shall set the ending RU index to a value equal to the minimum of:

— The maximum 26-tone RU located within the channel width in the VHT Operation Information field

— The maximum 26-tone RU located within the channel width in the Receive Operating Mode Notification Indication

An HE beamformer that transmits an HE NDP Announcement frame that has only one STA Info field shall set the Nc Index field to 0 and the Ng field to 0.

An example of HE sounding protocol with a single HE beamformee is shown in Figure 27-3 (An example of the sounding protocol with a single HE beamformee).

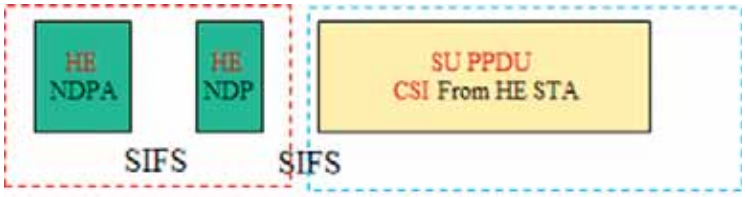

Figure 27-3—An example of the sounding protocol with a single HE beamformee

An HE beamformee that receives an HE NDP Announcement frame from an HE beamformer with which it is associated and that contains the HE beamformee's AID in the AID subfield of STA Info field, and there is only one STA Info field, shall transmit its HE compressed beamforming feedback a SIFS after receiving the HE NDP. The TXVECTOR parameter CH_BANDWIDTH for the PPDU containing the HE compressed beamforming feedback shall be set to indicate a bandwidth not wider than that indicated by the RXVECTOR parameter CH_BANDWIDTH of the HE NDP Frame.

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An example of HE sounding protocol with more than one HE beamformee is shown in Figure 27-4 (An example of the sounding protocol with more than one HE beamformee).

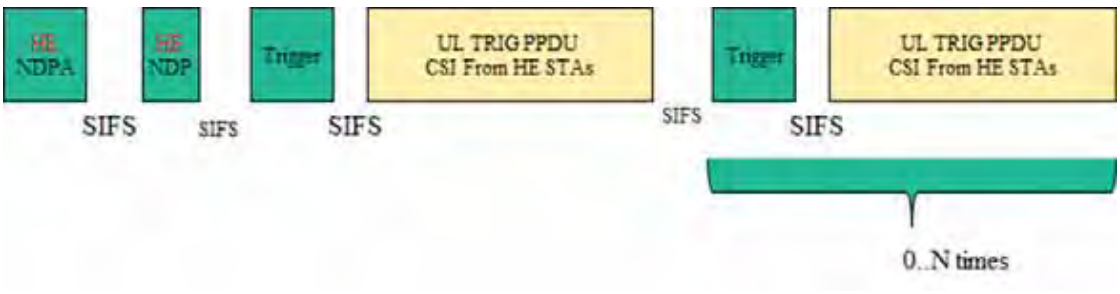

Figure 27-4—An example of the sounding protocol with more than one HE beamformee

A non-AP HE beamformee that receives an HE NDP Announcement frame from an HE beamformer with which it is associated and that contains the HE beamformee's AID in any of the STA Info field, and there are multiple STA Info fields in the HE NDP Announcement, shall compute the HE compressed beamforming feedback after receiving the HE NDP. The STA shall transmit the HE compressed beamforming feedback as a response to a Beamforming Report Poll variant Trigger frame that contains the AID of the STA in any of the User Info fields following the rules defined in 27.5.2.3 (STA behavior).

The value of the Sounding Dialog Token Number in the HE MIMO Control field shall be set to the same value as the Sounding Dialog Token Number field in the corresponding HE NDP Announcement frame.

The HE Compressed Beamforming feedback is comprised of the HE Compressed Beamforming Report information and the MU Exclusive Beamforming Report information.

Supporting SU-type feedback over full BW is mandatory for an HE beamformee participating in the HE sounding protocol with a single beamformee.

The beamformer initiating HE sounding protocol with one beamformee, shall not request MU-type feedback, CQI feedback, and SU-type partial bandwidth feedback, i.e., RU start index and RU end index do not cover full bandwidth, in NDP announcement.

Supporting MU-type feedback over full BW is mandatory for HE beamformees participating in HE sounding protocol with more than one beamformee.

Supporting SU-type feedback over partial BW is optional for HE beamformees participating in HE sounding protocol with more than one beamformee. The beamformer shall not request partial BW SU-type feedback in NDP announcement if the beamformee does not claim support for parital BW SU-type feedback in the HE capabilities field as in 9.4.2.218 (HE Capabilities element).

Supporting MU-type feedback over partial BW is optional for HE beamformees participating in HE sounding protocol with more than one beamformee. The beamformer shall not request partial BW MU-type feedback in NDP announcement if the beamformee does not claim support for parital BW MU-type feedback in the HE capabilities field as in 9.4.2.218 (HE Capabilities element).

Supporting CQI-only feedback with any RU start index and RU end index is optional for HE beamformees participating in HE sounding protocol with more than one beamformee.The beamformer shall not request CQI-only feedback with any RU start index and RU end index in NDP announcement if the beamformee does not claim support CQI-only feedback in the HE capabilities field as in 9.4.2.213 (HE Capabilities Element).

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27.6.3 Rules for segmented feedback in HE sounding protocol sequences

HE Compressed beamforming feedback shall be transmitted in a single PPDU unless the size of the feedback is greater than 11 454 octets. The HE beamformer shall support maximum MPDU length for HE Compressed beamforming feedback of size which is the minimum of:

— 11 454 octets
— The size of the HE compressed beamforming feedback requested

27.6.4 HE NDP transmission

An HE NDP shall use the HE SU PPDU format as described in 26.1.4 (PPDU formats). An HE STA shall transmit an HE NDP using the following TXVECTOR parameters:

— APEP_LENGTH set to 0
— HE_LTF_TYPE set to either 2x HE-LTF or 4x HE-LTF
— NUM_STS indicates two or more space-time streams
— CH_BANDWIDTH set to the same value as the TXVECTOR parameter CH_BANDWIDTH in the preceding HE NDP Announcement frame
— GI_TYPE set to either 0.8 us or 1.6 us when HE_LTF_TYPE is set to 2x HE-LTF; otherwise GI_TYPE set to 3.2 us
— PE_DURATION set to 4 us
— SPATIAL_REUSE set to SR disallowed

The number of space-time streams sounded and as indicated by the NUM_STS parameter shall not exceed the value indicated in the Beamformee STS Capability field in the HE Capabilities element of any intended recipient of the HE NDP. The NUM_STS parameter may be set to any value, subject to the constraint of the previous sentence, regardless of the value of the Supported HE-MCS and NSS Set field of the HE Capabilities element at either the transmitter or recipient of the HE NDP.

The destination of an HE NDP is equal to the RA of the immediately preceding HE NDP Announcement frame.

The source of an HE NDP is equal to the TA of the immediately preceding HE NDP Announcement frame.

27.7 TWT operation

27.7.1 General

Target wake times (TWTs) allow STAs to manage activity in the BSS by scheduling STAs to operate at different times in order to minimize contention between STAs and to reduce the required amount of time that a STA in PS mode needs to be awake.

An HE STA can negotiate individual TWT values, as defined in 10.43 (Target wake time (TWT)), subject to the additional rules and restrictions that are defined in 27.7.2 (Individual TWT agreements). An HE AP can deliver broadcast TWT values to HE non-AP STAs, without requiring that an individual TWT agreement has been established between them, as described in 27.7.3 (Broadcast TWT operation).

STAs need not be made aware of the TWT values of other STAs or that a TWT service period (SP) can be used to exchange frames with multiple STAs. Frames transmitted during a TWT SP can be carried in any PPDU format supported by the STAs, including HE MU PPDU, HE trigger-based PPDU, etc.

An HE STA with dot11TWTOptionActivated equal to true shall set:

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— The TWT Requester Support subfield to 1 in the HE Capabilities element that it transmits if it supports operating in the role of a TWT requester STA; otherwise set to 0.

— The TWT Responder Support subfield to 1 in the HE Capabilities elements that it transmits if it supports operating in the role of a TWT responding STA; otherwise set to 0.

— The Broadcast TWT Support subfield to 1 in the HE Capabilities element that it transmits if it supports operating in the role of a TWT scheduled STA or in the role of a TWT scheduling STA; otherwise set to 0.

An HE AP shall set the TWT Responder Support subfields of the Extended Capabilities element and HE Capabilities element to 1.

An AP may set the TWT Required subfield to 1 in the HE Operation element it transmits to request TWT participation by all STAs that are associated to it and that have declared support for TWT. A STA that supports TWT and is associated with an AP from which it receives an HE Operation element whose TWT Required subfield is 1 shall either negotiate individual TWT agreements, as defined in 27.7.2 (Individual TWT agreements), or participate in broadcast TWT operation, as defined in 27.7.3 (Broadcast TWT operation).

27.7.2 Individual TWT agreements

An HE STA may negotiate individual TWT agreements with another HE STA as defined in 10.43.1 (TWT overview), except that the STA:

— May set the Responder PM Mode subfield to 1 if it is a TWT responding STA that intends to go to doze state outside of TWT SPs.
  - If the TWT responding STA is an AP then it may set the Responder PM Mode subfield to 1 only if all non-AP STAs, which are associated to it, indicate support of TWT in the role of a TWT requester; otherwise it shall set it to 0.
  - An AP that sets the Responder PM Mode subfield to 1 follows the rules defined in 10.43.7 (TWT Sleep Setup).

— Shall set the Implicit subfield to 1 and the NDP Paging Indicator subfield to 0 in the TWT element it transmits during the TWT setup

— May set the Trigger subfield to 1 in the TWT element it transmits during the TWT setup to negotiate a trigger-enabled TWT
  - A successful TWT agreement whose Trigger subfield in the TWT response sent by the AP is 1 is a trigger-enabled TWT; otherwise it is an implicit TWT
  - A successful TWT agreement whose Flow Type subfield is 1 is an unannounced TWT; otherwise it is an announced TWT

— May set the TWT Channel subfield in the TWT element it transmits to a value that corresponds to the primary channel of the BSS to indicate a 20 MHz operation; otherwise it shall set it to 0.

— May set the TWT Protection field to 1 to indicate that TXOPs within the TWT SPs shall be initiated with a NAV protection mechanism, such as (MU) RTS/CTS, or CTS-to-self frame; otherwise it shall set it to 0.

An HE STA that successfully sets up a TWT agreement with another HE STA shall follow the rules defined in 10.43.1 (TWT overview) and 10.43.4 (Implicit TWT operation), except that the additional rules defined in this subclause supercede the respective rules defined in 10.43.1 (TWT overview) and 10.43.4 (Implicit TWT operation). A TWT or TWT SP that is setup under an implicit TWT agreement is an implicit TWT or implicit TWT SP, respectively (see 10.43.1 (TWT overview). A TWT or TWT SP that is setup under a trigger-enabled TWT agreement is a trigger-enabled TWT or trigger-enabled TWT SP, respectively.

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An HE STA that successfully sets up an individual TWT agreement and operates in PS mode shall not be required to listen to Beacon frames, as defined in 11.2.2.1 (General).

An HE AP may send an unsolicited TWT response frame with the Trigger subfield equal to 1 to an HE non-AP STA that has set the TWT Requester Support subfield to 1 in the HE Capabilities elements that it transmits to the AP.

An HE STA shall not transmit BAT, TACK, or STACK frames.

A TWT requesting STA should not initiate transmission of frames to the TWT responding STA outside of negotiated TWT SPs (for both implicit TWT and trigger-enabled TWT) for that TWT agreement and should not initiate transmission of frames to the TWT responding STA within trigger-enabled TWT SPs for that TWT agreement.

NOTE—The STA decides what frames to transmit within or outside TWT SPs.

The TWT responding STA of a trigger-enabled TWT agreement shall schedule for transmission a Trigger frame for the TWT requesting STA, as described in 27.5.2 (UL MU operation), within each TWT SP for that TWT agreement. The TWT responding STA that intends to transmit additional Trigger frames during a trigger-enabled TWT SP shall set the Cascade Indication field of the Trigger frame to 1 to indicate that it will transmit another Trigger frame within the same TWT SP. The TWT responding STA shall set the Cascade Indication field to 0 when the Trigger frame is the last Trigger frame of the TWT SP or when the Trigger frame is sent outside of a TWT SP.

NOTE 1—The TWT responding STA is not required to schedule for transmission a Trigger frame for the TWT requesting STA when the TWT agreement is not a trigger-enabled TWT agreement or when the TWT requesting STA has sent an OMI A-Control field that has the UL MU disable bit equal to 1 (see 27.8 (Operating mode indication).

NOTE 2— The Trigger frame can also be an UL MU Response Scheduling A-Control field contained in an MPDU carried in a DL MU PPDU.

A TWT requesting STA transmits a trigger-based PPDU as a response to a Trigger frame that is intended for it and is sent during a trigger-enabled TWT SP (see 27.5.2 (UL MU operation)). A TWT requesting STA that is in PS mode and is awake shall include a PS-Poll frame or an APSD trigger frame in the trigger-based PPDU if the TWT is an announced TWT unless the STA has already transmitted the PS-Poll or APSD trigger frame within that TWT SP. The STA may include other frames in the trigger-based PPDU.

NOTE–A Trigger frame is intended for a TWT requesting STA if it is sent by the AP to which the STA is associated and the frame contains the STA's AID in any of its Per User Info fields. The Trigger frame can have multiple recipients, each of which is identified by the presence of the recipient's AID in any of its Per User Info fields (see 27.5.2 (UL MU operation)).

A TWT responding STA that receives a PS-Poll frame or an APSD trigger frame from a TWT requesting STA during an announced TWT SP shall follow the rules defined in 11.2.2.2.6 (AP operation during the CP) to deliver buffered BUs to the STA. A TWT responding STA may deliver multiple buffered BUs to the TWT requesting STAs during:

— An announced TWT SP, without following the rules in 11.2.2.2.6 (AP operation during the CP) as long as the BU delivery does not exceed the duration of the TWT SP and the PS STA sending the QoS Null frame does not follow APSD.

— An unannounced TWT SP, without following the rules in 11.2.2.2.6 (AP operation during the CP) as long as the BU delivery does not exceed the duration of the TWT SP.

NOTE—The TWT responding STA can deliver the buffered BUs in an A-MPDU under a block ack agreement if the TWT is an announced TWT and the PS mode of the STA allows it, or if the TWT is an unannounced TWT.

A TWT requesting STA in PS mode that is awake for a TWT SP may transition to the doze state after AdjustedMinimumTWTWakeDuration time has elapsed from the TWT SP start time as identified by the

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TWT requesting STA if there is no frame exchange with the STA during the AdjustedMinimumTWTWakeDuration or after an early TWT SP termination event if there is at least one frame exchange with the STA during AdjustedMinimumTWTWakeDuration. The TWT requesting STA may classify any of the following events as an early TWT SP termination event:

1) The reception of a Trigger frame with the Cascade Indication field equal to 0 that is not intended to the STA and does not allocate any random RU during an unannounced TWT
2) The transmission of an acknowledgement in response to a soliciting frame sent by the TWT responding STA that had either the EOSP subfield equal to 1 or the More Data field equal to 0 when the frame does not contain an EOSP subfield
3) The reception of a frame sent by the TWT responding STA that had either the EOSP subfield equal to 1 or the More Data field equal to 0 when the frame does not contain an EOSP subfield

The classification of a More Data field equal to 0 in an Ack, BlockAck and Multi-STA BlockAck frame as an early termination event can occur only when both STAs have indicated support of transmitting or receiving the frame with a nonzero More Data subfield, which is indicated in the More Data Ack subfield of the QoS Info field of frames they transmit (see 11.2.2 (Power management in a non-DMG infrastructure network)).

27.7.3 Broadcast TWT operation

27.7.3.1 General

A TWT scheduling STA is an HE AP with dot11TWTOptionActivated equal to true that includes a broadcast TWT element in the Beacon frame, and follows the rules described in 27.7.3.2 (Rules for TWT scheduling STA). The TWT scheduling STA may also include the broadcast TWT element in broadcast Probe Response frames.

A TWT scheduled STA is an non-AP HE STA that:

— Sets the Broadcast TWT Support field of the HE Capabilities element it transmits to 1
— Receives a broadcast TWT element transmitted by an HE AP that is a TWT scheduling STA and,
— Has not negotiated any implicit TWT agreement with the HE AP as described in 27.7.2 (Individual TWT agreements).

A TWT scheduled STA follows the schedule provided by the TWT scheduling STA as described in 27.7.3.3 (Rules for TWT scheduled STA). A TWT scheduled STA can negotiate the wake TBTT and listen interval for Beacon frames it intends to receive as described in 27.7.3.3 (Rules for TWT scheduled STA).

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An example of broadcast TWT operation is shown in Figure 27-5 (Example of broadcast TWT operation), where the AP is the TWT scheduling STA and STA 1 and STA 2 are the TWT scheduled STAs.

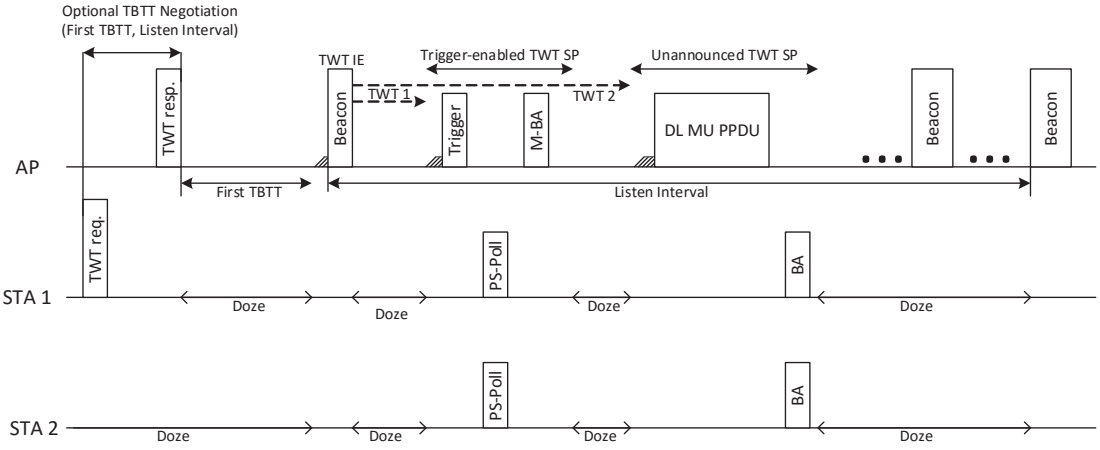

Figure 27-5—Example of broadcast TWT operation

Each broadcast TWT is uniquely identified by the <broadcast TWT ID, MAC address> tuple, where the broadcast TWT ID is the value of the Broadcast TWT ID subfield of a TWT parameter set from the TWT element that describes the broadcast TWT and the MAC address is one of the following:

— The TA of the MMPDU that contains the TWT element if the TWT command value is Accept, Alternate or Dictate

— The RA of the MMPDU that contains the TWT element if the TWT command value is Request, Suggest or Demand

When the TWT command value is Reject, the broadcast TWT is identified by the Broadcast TWT ID subfield and the TA of the MMPDU that contains the TWT element if the Wake TBTT Negotiation subfield is 0 and by the RA of the MPDU that contains the TWT element if the Wake TBTT Negotiation subfield is 1.

27.7.3.2 Rules for TWT scheduling STA

A TWT scheduling STA may include a broadcast TWT element in a Beacon frame that is scheduled at a TBTT (see 11.1.3.2 (Beacon generation in non-DMG infrastructure networks)). The TWT scheduling STA shall include one or more TWT parameter sets in the TWT element, and each TWT parameter set may indicate a periodic occurrence of TWTs. The TWT scheduling STA shall set the NDP Paging Indicator subfield to 0, the Broadcast subfield to 1, the Implicit subfield to 1, and the Responder PM Mode subfield to 0 in the TWT element (see 10.43.7 (TWT Sleep Setup)). Each TWT parameter set specifies the TWT parameters of a specific broadcast TWT that are valid within a broadcast TWT SP. Each specific broadcast TWT is identified as indicated in 27.7.3.1 (General). Individual STAs have membership in broadcast TWTs as the result of negotiation with a scheduling STA as indicated in Table 10-19a (TWT setup exchange command interpretation).

A TWT scheduled STA may include a TWT element with the Wake TBTT Negotiation subfield set to 1 in (Re)Association Request frames.

A TWT scheduling STA may include a TWT element with the Broadcast subfield set to 1 in (Re)Association Response frames.

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A TWT scheduling STA should not include a STA's AID in a User Info field of a Trigger frame transmitted within a broadcast TWT SP unless the STA has established membership in the broadcast TWT.

The TWT scheduling STA sets the TWT parameters of each TWT parameter set as described below.

The TWT scheduling STA shall set the TWT Request subfield to 0 and the TWT Setup Command subfield to Accept TWT, except that it may set the TWT Setup Command subfield to:

— Reject TWT when the periodic TWT is being terminated or,

— Alternate TWT when the periodic TWT is being modified

The TWT scheduling STA shall set the Trigger field to 1 to indicate a trigger-enabled TWT. Otherwise, it shall set the Trigger field to 0 to indicate an implicit TWT.

The TWT scheduling STA shall schedule for transmission a Trigger frame addressed to one or more TWT scheduled STAs during a trigger-enabled TWT SP. The TWT scheduling STA that intends to transmit additional Trigger frames during a trigger-enabled TWT SP shall set the Cascade Indication field of the Trigger frame to 1 to indicate that it will transmit another Trigger frame within the same TWT SP. The TWT scheduling STA shall set the Cascade Indication field to 0 when the Trigger frame is the last Trigger frame of the TWT SP or when the Trigger frame is sent outside of a TWT SP.

NOTE 1—The TWT scheduling STA is not required to schedule for transmission a Trigger frame for the TWT scheduled STA when the broadcast TWT is not a trigger-enabled TWT or when the TWT scheduled STA has sent an OMI A-Control field that has the UL MU disable bit equal to 1 (see 27.8 (Operating mode indication)).

NOTE 2—The Trigger frame can also be an UL MU Response Scheduling A-Control field contained in an MPDU carried in a DL MU PPDU.

The TWT scheduling STA shall set the Flow Type field to 1 to indicate an unannounced TWT. Otherwise, it shall set the Flow Type field to 0 to indicate an announced TWT.

The TWT scheduling STA should schedule delivery of DL BUs during unannounced TWT SPs.

The TWT scheduling STA shall set the TWT Flow Identifier field according to Table 9.248l1 (TWT Flow Identifier field for a broadcast TWT element).

The TWT scheduling STA should only send frames that satisfy the TWT flow identifier recommendations listed in Table 9.248l1 (TWT Flow Identifier field for a broadcast TWT element) during the TWT SP(s). A Trigger frame transmitted during a broadcast TWT SP whose TWT parameter set has the TWT Flow Identifier subfield equal to 0 may contain zero or more random RU (see 27.5.2.6 (UL OFDMA-based random access)). A Trigger frame transmitted during a broadcast TWT SP whose TWT parameter set has the TWT Flow Identifier subfield equal to 1 shall contain no random RU (see 27.5.2.6 (UL OFDMA-based random access)). A Trigger frame transmitted during a broadcast TWT SP whose TWT parameter set has the TWT Flow Identifier subfield equal to 2 shall contain at least one random RU (see 27.5.2.6 (UL OFDMA-based random access)).

The TWT scheduling STA shall set the TWT field to the TSF timer [4: 19] at which the first TWT is scheduled for this TWT parameter set.

The TWT scheduling STA shall include a nonzero value for the TWT wake interval in the TWT Wake Interval Exponent and TWT Wake Interval Mantissa fields for a periodic TWT and a zero value for an aperiodic TWT.

The TWT parameters are valid for each successive TWT of the periodic TWT or for the only TWT of the aperiodic TWT.

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The TWT scheduling STA may set the TWT Protection field to 1 to indicate that TXOPs within the TWT SP shall be initiated with a NAV protection mechanism defined in 10.3.2.4 (Setting and resetting the NAV), 10.3.2.8a (MU-RTS/CTS procedure), or CTS-to-self as described in 10.3.2.13 (NAV distribution); otherwise it shall set it to 0.

A TWT scheduling STA that receives a PS-Poll or an APSD trigger frame from a TWT scheduled STA during an announced TWT SP shall follow the rules defined in 11.2.2.2.6 (AP operation during the CP) to deliver buffered BUs to the STA. A TWT scheduling STA may deliver multiple buffered BUs to the TWT scheduled STA during:

— An announced TWT SP, without following the rules in 11.2.2.2.6 (AP operation during the CP) as long as the BU delivery does not exceed the duration of the TWT SP and the PS STA sending the QoS Null frame does not follow APSD.

— An unannounced TWT SP, without following the rules in 11.2.2.2..6 (AP operation during the CP) as long as the BU delivery does not exceed the duration of the TWT SP and the STA has switched to AM.

NOTE—The TWT scheduling STA can deliver the buffered BUs in an A-MPDU under a BlockAck agreement.

A TWT scheduling STA should indicate Alternate TWT or Reject TWT in the TWT Command Setup field of the broadcast TWT element for as many DTIM periods as needed to exceed the longest interval any STA is expected to not receive Beacon frames either when:

— The TWT parameters of a periodic TWT have changed, or

— The periodic TWT specified by that TWT parameter set is terminated.

A change in the TWT parameter set occurs in a subsequent DTIM Beacon frame.

27.7.3.3 Rules for TWT scheduled STA

A TWT scheduled STA that receives a broadcast TWT element in a Beacon frame shall follow the rules defined in this subclause to interact with the TWT scheduling STA.

A TWT scheduled STA should not initiate transmission of frames to the TWT scheduling STA outside of broadcast TWT SPs and within trigger-enabled TWT SPs.

A TWT scheduled STA that is in PS mode may go to doze state after receiving the Beacon frame and shall be in the awake state at a broadcast TWT start time during which the STA intends to exchange frames with the TWT scheduling STA. The TWT scheduled STA shall be in the awake state for AdjustedMinimumTWTWakeDuration time that corresponds to that TWT parameter set, except that the STA may go to doze state when a TWT SP termination event occurs. The TWT SP termination event occurs when the AdjustedMinimumWakeDuration time has elapsed from the TWT SP start time as identified by the TWT scheduled STA if there is no frame exchange with the STA during the AdjustedMinimumTWTWakeDuration or after an early TWT SP termination event if there is at least one frame exchange with the STA during AdjustedMinimumTWTWakeDuration. The early TWT SP termination events are as defined below:

1) The reception from the TWT scheduling STA of a Trigger frame with a Cascade Indication field equal to 0 that is not intended to the STA and does not allocate any random RU.

2) The transmission of an acknowledgement in response to a soliciting frame sent by the TWT responding STA that has either the EOSP subfield equal to 1 or the More Data field equal to 0 when the frame does not contain an EOSP subfield.

The reception of a frame sent by the TWT responding STA that has either the EOSP subfield equal to 1 or the More Data field equal to 0 when the frame does not contain an EOSP subfield.

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The classification of a More Data field equal to 0 in an Ack, BlockAck and Multi-STA BlockAck frame as an early termination event can occur only when both STAs have indicated support of transmitting or receiving the frame with a nonzero More Data subfield, which is indicated in the More Data Ack subfield of the QoS Info field of frames they transmit (see 11.2.2 (Power management in a non-DMG infrastructure network)).

NOTE—A Trigger frame, sent by the TWT scheduling STA, is defined as intended for the TWT scheduled STA when the Trigger frame contains the AID of the STA in one of its Per User Info fields (see 27.5.2 (UL MU operation)). Otherwise, the Trigger frame is not intended for the STA. If the Trigger frame contains one or more random RU(s) for which the STA can gain access according to 27.5.2.6 (UL OFDMA-based random access) then the STA can follow the rules defined in 27.14.2 (Power save with UL OFDMA-based random access) to determine an early TWT SP termination event.

A TWT scheduled STA transmits a trigger-based PPDU as a response to a Trigger frame that is intended for it and is sent during a trigger-enabled TWT SP (see 27.5.2 (UL MU operation)). The TWT scheduled STA that is in PS mode and is awake shall include a PS-Poll frame or an APSD trigger frame in the trigger-based PPDU if it intends to solicit buffered BUs from the TWT scheduling STA (see 11.2.2.8 (Receive operation for STAs in PS mode during the CP)) unless the STA has already transmitted the PS-Poll or APSD trigger frame within that TWT SP. The STA may include other frames in the HE trigger-based PPDU.

NOTE—A TWT scheduling STA sets the bit in the TIM element of the Beacon frame that corresponds to the AID of the TWT scheduled STA to 1 to indicate that it expects the TWT scheduled STA to solicit available buffered BUs (see 11.2.2.8 (Receive operation for STAs in PS mode during the CP)).

A TWT scheduled STA should only send frames that satisfy the TWT flow identifier recommendations defined in Table 9.248l1 (TWT Flow Identifier field for a broadcast TWT element) during the corresponding TWT SP(s). Frames sent as a response to a Trigger frame are subject to further restrictions as defined in 27.5.2 (UL MU operation).

27.7.3.4 Negotiation of wake TBTT and listen interval

A TWT scheduled STA that intends to operate in power save mode (see 11.2.2.2 (STA Power Management modes)) may transmit a TWT request frame to the TWT scheduling STA that identifies the wake TBTT of the first Beacon frame and the wake interval between subsequent Beacon frames it intends to receive. The TWT request frame shall contain:

— The value of the Wake TBTT Negotiation subfield equal to 1 and the TWT Command field to Suggest TWT or Demand TWT, and

— The value of the requested listen interval between consecutive TBTTs in the TWT Wake Interval Mantissa and TWT Wake Interval Exponent fields.

— All other fields in the TWT element are reserved.

A TWT scheduling STA that receives a TWT request frame from a STA whose value of the Wake TBTT Negotiation subfield is 1 shall respond with a TWT response frame that contains either Accept TWT or Reject TWT in the TWT Command field and, in the case of an Accept TWT, it shall also contain:

— The value of the Wake TBTT Negotiation subfield equal to 1, and

— The value of the allocated first wake TBTT in the Target Wake Time field, and

— The value of the listen interval between consecutive TBTTs in the TWT Wake Interval Mantissa and TWT Wake Interval Exponent fields.

— All other fields in the TWT element are reserved.

After successfully completing the negotiation, the TWT scheduled STA may go to doze state until its TSF matches the next negotiated wake TBTT provided that the STA is in power save mode, and no other condition requires the STA to remain awake. The TWT scheduled STA shall be in the awake state to listen to

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Beacon frames transmitted at negotiated wake TBTTs and shall operate as described in 27.7.3.3 (Rules for TWT scheduled STA).

After receiving the Beacon frame at or after TBTT, the TWT scheduled STA may go to doze state until the next wake TBTT if no other condition requires the STA to remain awake.

Either STA can tear down an established negotiation following the tear down procedure described in 10.44.8 (TWT Teardown).

27.7.4 Use of TWT Information frames

An HE STA may transmit a TWT Information frame to its peer STA during an individual TWT session, broadcast TWT session, or at any time if the peer STA has set the Flexible TWT Schedule Support of the HE Capabilities it transmits to 1.

The TWT Information frame shall have the Response Requested subfield equal to 0, the Next TWT Request subfield equal to 0, and one of the following:

— A nonzero value in the Next TWT subfield when the frame is transmitted by a TWT responding STA, a TWT scheduling STA, or by any HE STA to a peer STA that supports TWT
  - The value of the Next TWT shall be selected from existing TWT values for a TWT session if the Flexible TWT Schedule Support field of the peer STA is 0
  - The Next TWT may contain any nonzero value if Flexible TWT Schedule Support field of the peer STA is 1

— A Next TWT subfield that is present when the frame is transmitted by a TWT requesting STA, a TWT scheduled STA, or any HE STA to a peer STA that supports TWT
  - The Next TWT indicates the TWT at which the TWT session is resumed and shall be selected from existing TWT values for that TWT session if the Flexible TWT Schedule Support field of the peer STA is 0
  - The Next TWT may contain any nonzero value if Flexible TWT Schedule Support field of the peer STA is 1
    NOTE—In such case, the TWT requesting STA or TWT scheduled STA or peer STA that transmitted the TWT Information frame preserves the PM mode from the time it sent the TWT Information frame to the time it is expected to wake-up.

— A Next TWT subfield that is not present when the frame is transmitted by a TWT requesting STA or a TWT scheduled STA to indicate suspension of the TWT session

A TWT requesting STA that receives a TWT Information frame follows the rules defined in 10.43.4 (Implicit TWT operation). A TWT requesting STA that receives an acknowledgment in response to a TWT Information frame that:

— Does not contain a Next TWT field shall consider that TWT session suspended, and can follow the procedure in 27.7.3 (Broadcast TWT operation) until the TWT session is resumed.

— Contains a Next TWT field shall consider the corresponding TWT session resumed, starting from the value indicated in the Next TWT field of the transmitted TWT Information frame.

A TWT scheduling STA that receives a TWT Information frame follows the rules defined in 27.7.3.3 (Rules for TWT scheduled STA), except that it shall use the Next TWT value contained in the received TWT Information frame. A TWT scheduling STA that receives an acknowledgment in response to a TWT Information frame that:

— Does not contain a Next TWT field shall consider the TWT session suspended, and can follow the default PS procedure defined in 11.2 (Power management) until the TWT session is resumed.

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— Contains a Next TWT field shall consider the corresponding TWT session resumed, starting from the value indicated in the Next TWT field of the transmitted TWT Information frame.

An HE non-AP STA that transmits a TWT Information frame to a peer STA may go to doze state after receiving the acknowledgment and shall be in the awake state at the specified TWT indicated in the TWT Information frame. An HE non-AP STA that receives a TWT Information frame from a peer STA may go to doze state after transmitting the acknowledgment and shall be in the awake state at the specified TWT indicated in the TWT Information frame.

NOTE—The TWT Flow Identifier, together with the MAC addresses of the TWT requesting STA and TWT Responding STA identifies the TWT agreement for which the TWT Information frame is sent (see 10.43.1 (TWT overview)). The receiving STA that has not set up a TWT agreement with that TWT Flow Identifier with the transmitting STA interprets the TWT Information frame as part of a broadcast TWT session or as part of no TWT session.

27.8 Operating mode indication

27.8.1 General

An HE STA can change its operating mode setting either using the procedure described in 11.42 (Notification of operating mode changes), or the procedure described in this subclause. Operating mode indication (OMI) is a procedure used between an OMI initiator and an OMI responder. An HE STA that transmits a frame including an OMI A-Control field is defined as an OMI initiator. An HE STA that receives a frame including an OMI A-Control field is defined as an OMI responder.

If dot11OMIOptionImplemented is true, an HE STA may send a QoS Data or QoS Null frame that contains the OMI A-Control field to indicate a change in its receive and/or transmit operating parameters. An HE AP shall set dot11OMIOptionImplemented to true and the HE AP shall implement the reception of the OMI A-Control field.

The OMI initiator shall indicate a change in its receive operating mode by including the OMI A-Control field in a QoS Data or QoS Null frame that solicits an immediate acknowledgement and is addressed to the OMI responder. The OMI A-Control field indicates that the OMI initiator supports receiving PPDUs with a bandwidth up to the value indicated by the Rx Channel Width subfield and with a number of spatial streams up to the value indicated by the Rx NSS subfield as defined in 27.8.2 (Receive operating mode (ROM) indication).

The OMI initiator shall indicate a change in its transmit operating mode by including the OMI A-Control field in a QoS Data or QoS Null frame that solicits an acknowledgement frame and is addressed to the OMI responder as defined in 27.8.3 (Rules for transmit operation mode (TOM) indication).

27.8.2 Receive operating mode (ROM) indication

The ROM indication allows the OMI initiator to adapt the maximum operating channel width and/or the maximum number of spatial streams it can receive from the OMI responder.

An OMI initiator that sent the frame including the OMI A-Control field should change its OMI parameters, Rx NSS and Rx Channel Width, as follows:

— When the OMI initiator changes an OMI parameter from higher to lower, it should make the change for that parameter only after receiving the immediate acknowledgement from the OMI responder.

— When the OMI initiator changes an OMI parameter from lower to higher, it should make the change for that parameter either after ACK Timeout has expired or after receiving the immediate acknowledgement from the OMI responder.

NOTE—In the event of transmission failure of the frame containing the OMI A-Control field, the OMI initiator attempts the recovery procedure defined in 10.22.2.7 (Multiple frame transmission in an EDCA TXOP).

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If an OMI mode change is reported during a TXOP then the change should occur at least after that TXOP.

The OMI responder shall use the values indicated by the Rx Channel Width and Rx NSS subfields of the most recently received OMI A-Control field sent by the OMI initiator to send PPDUs to the OMI initiator in subsequent TXOP.

After transmitting the acknowledgement frame immediate response immediate acknowledgement for the frame containing the OMI A-Control field, the OMI responder may transmit subsequent SU PPDUs or MU PPDUs that are addressed to the OMI initiator.

NOTE—A subsequent PPDU is a PPDU that is intended for the ROM Initiator and needs not be the immediately following PPDU.

27.8.3 Rules for transmit operation mode (TOM) indication

An OMI initiator that is a non-AP STA may indicate changes in its transmit parameters by sending a frame that contains the OMI A-Control field to the OMI responder. The OMI initiator shall set:

— The UL MU Disable subfield to 1 to indicate suspension of the UL MU operation (see 27.5.2 (UL MU operation); otherwise it shall set the UL MU Disable subfield to 0 to indicate resumption or continuation of participation in UL MU operation.
  - An AP that is an OMI initiator shall set the UL MU Disable subfield to 0.

— The Tx NSS subfield to the maximum number of Nss that the STA will use in response to Trigger frames.

NOTE—The Channel Width subfield indicates the maximum channel width that the STA will use in response to Trigger frames

An OMI responder that successfully receives a frame containing an OMI A-Control field from an OMI initiator:

— Shall consider the OMI initiator as not participating in UL MU operation for subsequent TXOPs (see 27.5.2 (UL MU operation)) when the UL MU Disable subfield is 1 in the received OMI A-Control field

NOTE—The STA sets the UL MU Disable subfield to 1 to indicate that it will not respond to all variants of the Trigger frame.

— Shall consider the OMI initiator as participating in UL MU operation for subsequent TXOPs when the UL MU Disable subfield is 0 in the received OMI A-Control field in which case:
  - The maximum number of spatial streams that the OMI initiator can transmit in response to Trigger frames is indicated in the Tx NSS subfield of the OMI A-Control field
  - The maximum channel width over which the OMI initiator can transmit in response to Trigger frames is indicated in the Channel Width subfield of the OMI A-Control field

— Shall indicate a number of spatial streams in the Per User Info field of a Trigger frame, which contains the AID of the OMI initiator, that is less than or equal to the number of spatial streams that is calculated from the Tx NSS subfield of the OMI A-Control field received by the OMI initiator

— Shall indicate a channel width in the RU Allocation subfield of the Per User Info field of a Trigger frame, containing the AID of the OMI initiator, that is less than or equal to the value specified in the Channel Width subfield of the OMI A-Control field received by the OMI initiator

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27.9 Spatial reuse operation

27.9.1 General

The objective of the HE spatial reuse operation is to improve the system level performance, the utilization of medium resources and power saving in dense deployment scenarios by early identification of signals from overlapping basic service sets (OBSSs) and interference management.

When the conditions specified in 27.9 (Spatial reuse operation) are met that allow the transmission of an SR PPDU, an HE STA may transmit an SR PPDU to either an HE STA or a non-HE STA.

27.9.2 OBSS_PD-based spatial reuse operation

27.9.2.1 General

If the PHY of a STA issues a PHY-CCA.indication with a value equal to BUSY followed by an RXSTART.indication due to a PPDU reception then the STA's MAC sublayer may a) issue a PHY-CCARESET.request primitive and b) not update its NAV timers based on frames carried in the PPDU if all the following conditions are met:

— The received PPDU is an Inter-BSS PPDU (see 27.2.1 (Intra-BSS and inter-BSS frame detection))

— The RXVECTOR parameter RSSI_LEGACY in the PHY-RXSTART.indication primitive, which defines the received power level measured from the legacy portion of the PPDU is below the OBSS_PD level (defined in 27.9.2.2 (Adjustment of OBSS_PD and transmit power))

— The PPDU is not one of the following:

  • A non-HT PPDU that carries an individually addressed Public Action frame where the RA field is equal to the STA MAC address
  • A non-HT PPDU that carries a group addressed Public Action frame

The PHYCCARESET.request primitive shall be issued at the end of the PPDU if the PPDU is HE SU PPDU or HE extended range SU PPDU and the RXVECTOR parameter SPATIAL_REUSE indicates SR_Delay.

If the PHYCCARESET.request primitive is issued before the end of the PPDU, and a TXOP is initiated within the duration of the PPDU, then the TXOP shall be limited to the duration of the PPDU if the PPDU is HE MU PPDU and the RXVECTOR parameter SPATIAL_REUSE indicates SR_Restricted.

If the inter-BSS frame is carried in an HE extended range SU PPDU (where power of the L-STF/L-LTF symbols is boosted 3 dB), the received power measured based on the legacy preamble and captured in the RXVECTOR parameter RSSI_LEGACY in the PHY-RXSTART.indication primitive shall be decreased by 3 dB to compensate for the power boost factor when compared to the OBSS PD level.

SR Backoff procedure for SR delayed case.

The STA may resume its backoff procedure after the end of the PPDU carrying the SR delay entry by following the procedure defined in 10.22.2 (HCF contention based channel access (EDCA)).

NOTE—The countdown of an existing backoff procedure is suspended until the end of the PPDU carrying the SR delay entry since the medium is busy during the duration of the PPDU carrying the SR delay entry.

If an HE STA's MAC sublayer issues a PHY-CCARESET.request primitive and not update its NAV timer as allowed above, the HE STA may resume its backoff procedure when the medium condition is IDLE as defined in 10.22.2.2 (EDCA backoff procedure).

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27.9.2.2 Adjustment of OBSS_PD and transmit power

Adjusting the OBSS_PD level and transmit power can improve the system level performance and the utilization of the spectrum. When using OBSS_PD-based spatial reuse, an HE STA is allowed to adjust the OBSS_PD level in conjunction with its transmit power based on the following adjustment rule:

Allowable $OBSS_PD_{level} \leq max(OBSSPD_{min}, min(OBSSPD_{max}, OBSSPD_{min} + (TXPWR_{ref} - TXPWR)))$

The adjustment rule is illustrated in Figure 27-6 (Illustration of the adjustment rules for OBSS_PD and TX_PWR).

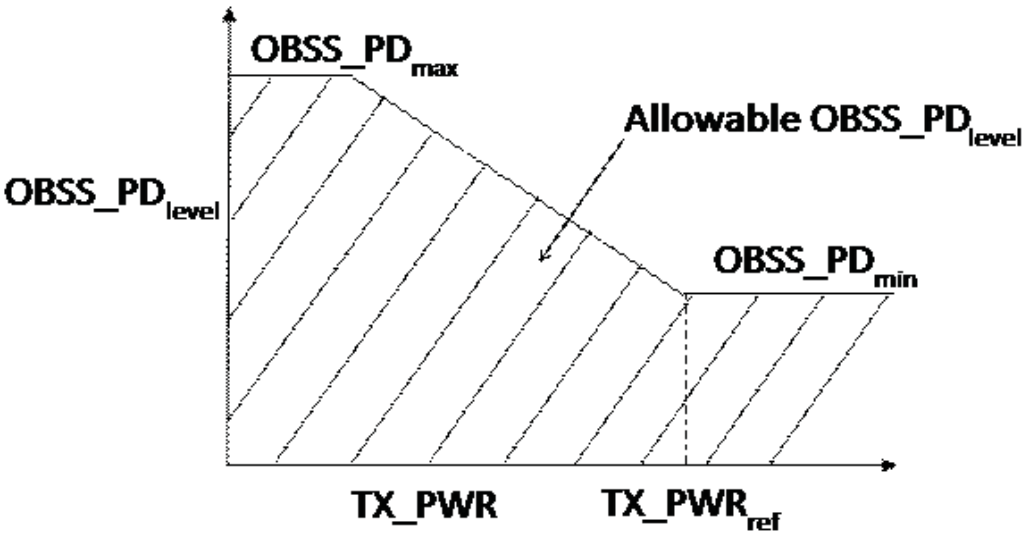

Figure 27-6—Illustration of the adjustment rules for OBSS_PD and TX_PWR

The $OBSS_PD_{level}$ is applicable to the start of a 20 MHz PPDU received on the primary 20 MHz channel. The $OBSS_PD_{level}$(40 MHz) which is applicable to the start of a 40 MHz PPDU received on the primary 40 MHz channel, the $OBSS_PD_{level}$(80 MHz) which is applicable to the start of a 80 MHz PPDU received on the primary 80 MHz channel and the $OBSS_PD_{level}$(160 MHz or 80+80 MHz) which is applicable to the start of a 160 MHz or 80+80 MHz PPDU, can be derived by the following equations:

— $OBSS_PD_{level}$(40 MHz)= $OBSS_PD_{level}$ + 3 dB

— $OBSS_PD_{level}$(80 MHz)= $OBSS_PD_{level}$ + 6 dB

— $OBSS_PD_{level}$(160 MHz or 80+80 MHz) = $OBSS_PD_{level}$ + 9 dB

$TXPWR_{ref}$ = 21 dBm for non-AP STAs.

$TXPWR_{ref}$ = 21 dBm for an AP with the Highest NSS Supported M1 subfield in the Tx Rx HE MCS Support field of its HE Capabilities element field equal to or less than 1.

$TXPWR_{ref}$ = 25 dBm for an AP with the Highest NSS Supported M1 subfield in the Tx Rx HE MCS Support field of its HE Capabilities element field equal to or greater than 2.

$OBSS_PD_{min_default}$ = –82 dBm and $OBSS_PD_{max_default}$ = –62 dBm.

TXPWR is the STA transmission power in dBm at the antenna connector.

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NOTE—considering the antenna connector definition section 3.1.

A STA can select an $OBSS_PD_{level}$ during its operation under SR mode. This level can be dynamically adjusted or can be static.

If a STA chooses a specific $OBSS_PD_{level}$ during its operation under SR mode, the maximum transmit power is defined in Equation (27-1).

$$TXPWR_{max} = \begin{cases} \text{unconstrained, if } OBSS_PD_{level} = OBSS_PD_{min} \\ TXPWR_{ref} - (OBSS_PD_{level} - OBSS_PD_{min}), \text{ if } OBSS_PD_{max} \geq OBSS_PD_{level} > OBSS_PD_{min} \end{cases} \quad (27\text{-}1)$$

If a STA regards an inter-BSS PPDU as not having been received at all using a specific $OBSS_PD_{level}$, the STA's power as measured at the output of the antenna connector, shall be equal or lower than the $TXPWR_{max}$, calculated with this specific $OBSS_PD_{level}$ with Equation (27-1), for the transmissions of any PPDU (including UL TB PPDU) until the end of the TXOP that the STA gains once its backoff reaches zero. The STA may increase the $OBSS_PD_{level}$ during the backoff procedure, its maximum transmit power being adjusted as defined above. The minimum $OBSS_PD_{level}$ used by the STA shall be above the received signal strength of the inter-BSS PPDU, which means that the maximum $TXPWR_{max}$ shall be calculated with $OBSS_PD_{level}$ equal to the received signal strength of the inter-BSS PPDU, with Equation (27-1).

27.10 A-MPDU operation

27.10.1 General

A-MPDU operation for an HE PPDU follows the procedures defined in 10.13 (A-MPDU operation) and, additionally, the procedures defined in this subclause.

27.10.2 A-MPDU padding for an HE SU PPDU, HE extended range SU PPDU and HE MU PPDU

An HE STA that transmits an DL HE MU PPDU that contains one or more PSDUs, each of which carries an A-MPDU, shall construct the A-MPDU(s) as described in 10.13.6 (A-MPDU padding for VHT PPDU).An HE STA that transmits an HE SU PPDU, HE extended range SU PPDU or UL HE MU PPDU that contains one A-MPDU, shall construct the A-MPDU(s) as described in 10.13.6 (A-MPDU padding for VHT PPDU).

27.10.3 A-MPDU padding for an HE trigger-based PPDU

A non-AP STA that transmits an HE trigger-based PPDU shall construct the PSDU carried in the HE trigger-based PPDU as described in this subclause.

The STA computes the PSDU_LENGTH based on the TXVECTOR parameters.

The STA may add A-MPDU subframes to the A-MPDU contained in the PSDU provided that the following constraints are fulfilled:

- The A-MPDU content constraints (see 10.13.1 (A-MPDU contents) and 27.10.4 (A-MPDU with multiple TIDs)) for the intended recipient
- The Length limit constraints (see 9.7.1 (A-MPDU format) and 10.13.2 (A-MPDU length limit rules)) for the intended recipient
- The MPDU start spacing constraints (see 10.13.3 (Minimum MPDU Start Spacing field)) for the intended recipient

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provided that the following conditions are met:

— The A-MPDU subframes have a value greater than 0 in the MPDU Length field, or have a value 0 in the MPDU Length field and a value 0 in the EOF field.

— After incrementing the A-MPDU_Length with the length of each such added A-MPDU subframe, the relationship A-MPDU_Length ≤ PSDU_LENGTH is true.

Padding is then added such that the resulting A-MPDU contains exactly PSDU_LENGTH octets as follows:

— First, while A-MPDU_Length < PSDU_LENGTH and A-MPDU_Length mod 4 ≠ 0, add an octet to the final A-MPDU subframe's Padding subfield and increment A-MPDU_Length by 1.

— Then, while A-MPDU_Length + 4 < PSDU_LENGTH, add an EOF padding subframe to the EOF Padding Subframes field and increment A-MPDU_Length by 4.

— Finally, while A-MPDU_Length < PSDU_LENGTH, add an octet to the EOF Padding Octets subfield and increment A-MPDU_Length by 1.

The STA shall not add an A-MPDU subframe with EOF equal to 0 after any A-MPDU subframe with EOF set to 1. The STA shall not add an A-MPDU subframe with EOF equal to 1 and with MPDU Length field equal to 0 before an A-MPDU subframe that contains a Single MPDU (see 10.13.7 (Setting the EOF field of the MPDU delimiter)).

An A-MPDU pre-EOF padding is constructed from each user from any of the following:

— A-MPDU subframes constructed from the MPDUs available for transmission from any AC that is selected by the STA

— A-MPDU subframes with 0 in the MPDU Length field and 0 in the EOF field

27.10.4 A-MPDU with multiple TIDs

A multi-TID A-MPDU is an A-MPDU that contains QoS Data frames with two or more different TID values.

An HE STA with dot11MPDUAskedforAckInMultiTIDAMPDU set to true shall set dot11AMPDUwithMultipleTIDOptionImplemented to true. An HE STA with dot11MPDUAskedforAckInMultipleTIDAMPDU set to true shall set the Ack Enabled Multi-TID A-MPDU Support subfield of the HE Capabilities element it transmits to 1; otherwise, the HE STA shall set it to 0. An HE transmitter shall not aggregate MPDU that asks for Ack in a multiple-TID A-MPDU to the HE recipient unless the recipient sets Ack Enabled Multi-TID A-MPDU Support subfield to 1 in its announced HE Capabilities element.

An HE STA shall construct a multi-TID A-MPDU as defined in 9.7 (Aggregate MPDU (A-MPDU)) and 10.13 (A-MPDU operation) except that the EOF subfield shall be set to 1 in a nonzero length MPDU delimiter that precedes a QoS Data frame, or Action frame if the QoS Data frame or Action frame solicits an immediate Ack frame.

A multi-TID A-MPDU may contain multiple noncontiguous nonzero length MPDU delimiters with EOF subfield equal to 1, one for each TID that solicits Ack and/or multiple noncontiguous nonzero length MPDU delimiters with EOF subfield equal to 0, one for each TID that solicits BlockAck.

An HE STA that receives a multi-TID A-MPDU shall respond with a Multi-STA BlockAck frame that contains (see 27.4 (Block acknowledgement)):

— One Per STA Info field indicating an Ack for each successfully received MPDU that solicits a response that is preceded by a nonzero length MPDU delimiter whose EOF is 1 (TID value equals that of the QoS Data/QoS Null frame or 15 for the Action frame),

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— One Per STA Info field indicating a BlockAck for each TID of a successfully received MPDU that solicits a response that is preceded by a nonzero length MPDU delimiter whose EOF is 0 (TID value equals that of the QoS Data frame).

An HE STA with dot11AMPDUwithMultipleTIDOptionImplemented set to true shall set the Multi-TID Aggregation Support subfield of the HE Capabilities element it transmits to a nonzero value. Otherwise, the HE STA shall set it to 0.

An HE STA shall not send a multi-TID A-MPDU to an HE STA that has the Multi-TID Aggregation Support subfield in the HE Capabilities element equal to 0.

An HE STA may aggregate in a multi-TID A-MPDU QoS Data frames with multiple TIDs as defined in Table 9-425 (A-MPDU contents in the data enabled immediate response context) or Table 9-426 (A-MPDU contents in the data enabled no immediate response context).

If the multi-TID A-MPDU is transmitted in a PPDU that is not an HE trigger-based PPDU, then the number of different TID values in the multi-TID A-MPDU shall not exceed the number specified by the intended recipient in the Multi-TID Aggregation Support field of the HE Capabilities element.

If the multi-TID A-MPDU is transmitted in an HE trigger-based PPDU, then the number of different TID values in the multi-TID A-MPDU shall not exceed the value specified in the Multi-TID Aggregation Limit subfield in the Trigger Dependent User Info subfield of the User Info field in the Basic Trigger variant Trigger frame that allocated resources for the HE trigger-based PPDU.

A multi-TID A-MPDU shall not be transmitted in an HE SU PPDU or HE extended range SU PPDU except when TXOP limit is not zero for the AC that is used to gain access to the medium. This AC is defined as the primary AC. When TXOP limit is not zero then the STA may aggregate QoS Data frames from one or more TIDs in the A-MPDU under the following conditions:

— The A-MPDU shall be carried in an HE SU PPDU or an HE ER SU PPDU transmitted within the obtained TXOP

— The A-MPDU shall contain one or more MPDUs with any of the TIDs that correspond to the primary AC

— When any of the buffers is empty or when no more MPDUs can be aggregated in the A-MPDU from any of the TIDs that correspond to the primary AC then the A-MPDU may additionally contain one or more MPDUs with TIDs that do not correspond to the primary AC if the TIDs correspond to any AC that has a higher priority with respect to the primary AC and the addition of these MPDUs does not cause the STA to exceed the current TXOP duration

The Multi-STA BlockAck frame shall be used to acknowledge the MPDUs in a multi-TID A-MPDU. The rules for Multi-STA BlockAck are defined in subclause 27.4 (Block acknowledgement).

The responding HE STA with dot11AMPDUwithMultipleTIDOptionImplemented set to true shall not aggregate QoS Data frames in the multi-TID A-MPDU with a number of TIDs that exceeds the value indicated in the TID Aggregation Limit subfield in the Trigger Dependent User Info field of a Basic Trigger variant Trigger frame (9.3.1.23.1 Basic Trigger) intended for it.

For an HE STA with dot11AMPDUwithMultipleTIDOptionImplemented set to true and having a single A-MPDU containing MPDUs with different value of TIDs, the MPDUs with the same TID value may be aggregated in non-contiguous A-MPDU subframes.

When the AP specifies a value defined in Table 9-25i (Preferred AC subfield encoding) in the Preferred AC subfield and a value of 1 in the AC Preference Level subfield in the Trigger Dependent User Info field of a Basic Trigger variant Trigger frame, then an HE STA with

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dot11AMPDUwithMultipleTIDOptionImplemented set to true and with buffered traffic in the indicated preferred AC should aggregate MPDUs from any one of the TIDs from the same AC or higher AC as indicated in the Preferred AC subfield of the Trigger Dependent User Info field in the Trigger frame.

When the AP specifies a value defined in Table 9-25i (Preferred AC subfield encoding) in the Preferred AC subfield and a value of 1 in the AC Preference Level subfield in the Trigger Dependent User Info field of a Basic Trigger variant Trigger frame, then an HE STA with dot11AMPDUwithMultipleTIDOptionImplemented set to true may aggregate MPDUs from any other TID.

The STA may aggregate MPDUs from TIDs in other ACs within the remaining time to the UL PPDU duration value indicated in the Length subfield in the Common Info field of the Trigger frame.

The total number of TIDs from which QoS Data MPDUs are aggregated by the STA shall not exceed the limit indicated in the TID Aggregation Limit subfield of its User Info field in the Trigger frame.

When the AP specifies a value of 0 in the AC Preference Level subfield in the Trigger Dependent User Info field of a Basic Trigger variant Trigger frame, then an HE STA with dot11AMPDUwithMultipleTIDOptionImplemented set to true may aggregate MPDUs from any AC/TID or combination of TIDs, up to the limit indicated in the TID Aggregation Limit subfield in Trigger Dependent User Info field of the Trigger frame.

An HE STA with dot11AMPDUwithMultipleTIDOptionImplemented set to false should select any one of the TID value within the AC value indicated in the Preferred AC subfield and AC Preference Level subfield is 1 in the Trigger Dependent User Info field of a Basic Trigger variant Trigger frame.

An HE STA with dot11AMPDUwithMultipleTIDOptionImplemented set to false may select a TID from any AC when the AC Preference Level subfield is 0 in the Trigger Dependent User Info field of a Basic Trigger variant Trigger frame.

NOTE—A multi-TID A-MPDU allows the aggregation of an Action Ack frame as well.

An HE AP may aggregate MPDUs from any TIDs in multi-TID A-MPDU for DL HE MU PPDU transmission and the number of TIDs in multi-TID A-MPDU shall not be more than the Multi-TID Aggregation Support announced by the recipient.

27.11 Setting TXVECTOR parameters for an HE PPDU

27.11.1 STA_ID_LIST

Each element of the TXVECTOR parameter STA_ID_LIST identifies the STA or group of STAs that is the recipient of an RU in the HE MU PPDU. If an RU is intended for a single STA, then the STA_ID_LIST element for that RU is set to the AID of the STA receiving the PSDU contained in that RU. If an RU is intended for an AP, then the STA_ID_LIST contains only one element that is set to the AID of the non-AP STA transmitting the PPDU. If an RU is intended for a group of STAs then the STA_ID_LIST element is set as follows:

— For an AP with dot11MultiBSSIDActivated equal to false, if the RU is intended for more than one STA in the BSS, the STA_ID_LIST element is set to 0. The AP may include only one element with this value in a DL MU PPDU.

— For an AP with dot11MultiBSSIDActivated equal to true, if the RU is intended for more than one STA in any of its BSSs, the STA_ID_LIST element is set to partial virtual bitmap value assigned for the group addressed frame (see 9.4.2.6 (TIM element)). The AP may include only one element for each BSSID of the multiple BSSID set in the HE MU PPDU, and the number of such elements shall not exceed the maximum number of BSSs of the multiple BSSID set.

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— For an AP with dot11MultiBSSIDActivated equal to true, if the RU is intended for more than one STA on all its BSSs, the STA_ID_LIST element is set to 2047. The AP may include only one element with this value in a DL MU PPDU.

27.11.2 UPLINK_FLAG

The Uplink Flag is carried in the TXVECTOR parameter UPLINK_FLAG of an HE SU PPDU, HE extended range SU PPDU, and HE MU PPDU and is set as follows:

— A STA transmitting an HE PPDU that is addressed to an AP shall set the TXVECTOR parameter UPLINK_FLAG to 1, except when the HE PPDU is an HE extended range SU PPDU with the TXOP Duration field set to all 1s and contains an RTS or CTS frame in which case the STA may set the TXVECTOR parameter UPLINK_FLAG to 0

— An AP transmitting an HE PPDU that is addressed to a non-AP STA shall set the TXVECTOR parameter UPLINK_FLAG to 0

— A STA transmitting an HE PPDU in a direct path to a (T)DLS peer STA, or to a member of an IBSS, or to a mesh STA, shall set the TXVECTOR parameter UPLINK_FLAG to 0

NOTE—A (T)DLS peer STA or the member of an IBSS can identify that the HE PPDU is sent in a direct path from the To DS and From DS fields of the MAC header of its MPDU(s)

The TXVECTOR parameter UPLINK_FLAG is not present for HE trigger-based PPDUs.

27.11.3 BEAM_CHANGE

The TXVECTOR parameter BEAM_CHANGE of an HE SU PPDU, HE extended range SU PPDU shall be set to 1 if the number of spatial streams is greater than 2 or the PPDU is the first PPDU in a TXOP.

27.11.4 BSS_COLOR

The BSS Color is an identifier of the BSS and is used to assist a receiving STA in identifying the BSS from which a PPDU originates so that the STA can use the channel access rules as described in 27.9 (Spatial reuse operation) or reduce power consumption as described in 27.14.1 (Intra-PPDU power save for HE non-AP STAs).

An HE STA transmitting an HE Operation element shall select a value in the range 1 to 63 to include in the BSS Color subfield of the HE Operation element that it transmits and shall maintain that single value of the BSS Color subfield for the lifetime of the BSS. An HE STA that transmitted an HE Operation element shall set the TXVECTOR parameter BSS_COLOR of an HE PPDU to the value indicated in the BSS Color subfield of its HE Operation element.

An HE STA receiving an HE Operation element shall set the TXVECTOR parameter BSS_COLOR of an HE PPDU to the value indicated in the BSS Color subfield of the HE Operation element received from the HE STA with which it is associated or intends to transmit.

An HE STA that received an HE PPDU with RXVECTOR parameter BSS_COLOR with a value between 1 and 63 may ignore the HE PPDU subject to the rules as described in 27.9 (Spatial reuse operation).

An HE STA transmitting an HE SU PPDU or an HE extended range SU PPDU for which one or more intended recipient STAs is not a member of a transmitting STA's BSS shall set the TXVECTOR parameter BSS_COLOR of the HE PPDU to 0.

An HE STA that received an HE SU PPDU or an HE extended range SU PPDU with RXVECTOR parameter BSS_COLOR equal to 0 shall not discard the HE PPDU.

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An HE STA associated with an HE AP that is transmitting an HE PPDU in a direct path to a DLS or TDLS peer STA shall set the TXVECTOR parameter BSS_COLOR to the value of the value indicated in the BSS Color subfield of the HE Operation element received from the HE AP.

All APs that are members of a Multiple BSSID Set element shall use the same BSS Color.

An HE AP that decides to discontinue the use of the BSS color for the BSS that it serves, for example, after detecting a BSS Color overlap with an OBSS shall set the value of BSS Color Disabled subfield in the HE Operation element to 1 to inform associated STAs that the BSS Color is disabled; otherwise the AP shall set the BSS Color Disabled subfield to 0.

If the most recently received HE Operation element from the AP to which it is associated contained a value of 1 in the BSS Color Disabled subfield then:

— A HE non-AP STA should use the A1, A2 and Duration/ID fields of the MPDUs contained in the received PPDUs instead of the BSS_COLOR and TXOP_Duration field in the HE-SIG-A field to determine whether the STA should update the Intra-BSS NAV.

— A HE non-AP STA should use the A1, A2 of the MPDUs contained in the received PPDUs instead of the BSS_COLOR and STA_ID_LIST field in the HE SIG A field to determine whether the STA may go to doze state for the duration of that PPDU (see 27.14.1 (Intra-PPDU power save for HE non-AP STAs)).

The HE non-AP STA may use the BSS color if the most recently received HE Operation element from the AP to which it is associated contained a value of 0 in the BSS Color Disabled subfield.

27.11.5 TXOP_DURATION

TXOP Duration field is carried in the TXVECTOR parameter TXOP_DURATION of an HE PPDU and indicates duration information for NAV setting and protection of TXOP.

A STA that transmits an HE SU PPDU, HE extended range SU PPDU, or HE MU PPDU may indicate no duration information for NAV setting by setting the TXVECTOR parameter TXOP_DURATION to all 1s.

If a STA transmits an HE SU PPDU, HE extended range PPDU, or HE MU PPDU that carries a PS-Poll frame, the STA shall set the TXVECTOR parameter TXOP_DURATION to all 1s.

A TXOP responder that transmits an HE trigger-based PPDU shall set the TXVECTOR parameter TXOP_DURATION to all 1s if the RXVECTOR parameter TXOP_DURATION of the soliciting PPDU is set to all 1s.

A TXOP responder that transmits an HE trigger-based PPDU shall not set the TXVECTOR parameter TXOP_DURATION to all 1s if any one of the following condition is met:

— The RXVECTOR parameter TXOP_DURATION of the soliciting PPDU is not set to all 1s

— The RXVECTOR parameter FORMAT of the soliciting PPDU is not equal to HE_SU, HE_MU, or HE_EXT_SU

If the TXVECTOR parameter TXOP_DURATION of an HE PPDU is not set to all 1s, and there exists Duration field in the MAC header of the HE PPDU, the duration information indicated by the TXVECTOR parameter TXOP_DURATION is determined based on the duration information indicated by the Duration field in the MAC header and shall indicate the largest feasible duration information that is smaller than or equal to the duration information indicated by the Duration field.

NOTE 1—Except for a PS-Poll frame, the Duration/ID field in a data frame, management frame and control frame indicates duration information.

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NOTE 2—For a TXOP responder, the Duration field in the MAC header of the response PPDU is set based on the Duration field in the MAC header of the soliciting PPDU as described in 9.2.5.7 (Setting for control response frames) or 9.2.5.8 (Setting for other response frames).

For a TXOP responder that transmits an HE trigger-based PPDU carrying a PS-Poll frame, if the TXOP responder does not set the TXVECTOR parameter TXOP_DURATION of the HE trigger-based PPDU to all 1s, the TXOP responder first calculates potential duration information equal to the duration information indicated by the Duration field of the frame that solicits the response minus the time, in microseconds, between the end of the PPDU carrying the frame that soliciting the HE trigger-based PPDU and the end of the HE trigger-based PPDU. If the calculated potential duration information includes a fractional microsecond, the potential duration information is rounded up to the next higher integer. Then the duration information indicated by the TXVECTOR parameter TXOP_DURATION is determined based on the calculated potential duration information and shall indicate the largest feasible duration information that is smaller than or equal to the calculated potential duration information.

The encoding of TXVECTOR/RXVECTOR parameter TXOP_DURATION for indicating duration information is defined in Table 28-1 (TXVECTOR and RXVECTOR parameters).

27.11.6 SPATIAL_REUSE

Spatial Reuse field is carried in the TXVECTOR parameter SPATIAL_REUSE of an HE PPDU and indicates spatial reuse information (See 27.9.2 (OBSS_PD-based spatial reuse operation)).

A STA that transmits an HE SU PPDU or HE extended range SU PPDU may set the TXVECTOR parameter SPATIAL_REUSE to SR_Delay entry only if a Trigger frame is carried in the HE SU PPDU or HE extended range SU PPDU.

A STA that transmits an HE MU PPDU may set the TXVECTOR parameter SPATIAL_REUSE to SR_Restricted entry only if a Trigger frame is carried in the HE MU PPDU.

27.12 HE PPDU post FEC padding and packet extension

An HE STA with dot11PPEThresholdsRequired set to false may set the PPE Thresholds Present subfield in HE Capabilities elements that it transmits to 0.

An HE STA with dot11PPEThresholdsRequired set to true shall set the PPE Thresholds Present subfield in HE Capabilities elements that it transmits to 1.

A STA that sets the PPE Thresholds Present subfield in HE Capabilities elements that it transmits to 1 shall indicate its minimum post-FEC padding and packet extension duration value per constellation, NSS and RU allocation by setting the subfields of the PPE Thresholds field according to 9.4.2.218 (HE Capabilities element) and using the corresponding values from dot11PPEThresholdsMappingTable.

A STA transmitting an HE PPDU to a receiving STA shall include a minimum post-FEC padding as determined by the post-FEC padding pre-FEC padding factor (see 28.3.11 (Data field) and after including the post-FEC padding, the transmitting STA shall include a packet extension that yields a total post-FEC padding plus packet extension that corresponds to at least the value indicated in the HE Capabilities element received from the receiving STA.

27.13 Link adaptation using the HE variant HT Control field

This subclause applies to frame exchange sequences that include PPDUs containing an HE variant HT Control field.

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The HE-MCS subfield of the MFB subfield of HE link adaptation field should be set to the highest data-rate, for given transmission properties, that results in frame error rate of 10% or lower for a MPDU length of 3895 octets. The transmission properties, RU_ALLOCATION, DCM, NUM_STS, FEC_CODING, BEAMFORMED, BEAM_CHANGE, and STBC, are determined by the RXVECTOR of the PPDU used to estimate recommended MFB.

27.14 Power management

27.14.1 Intra-PPDU power save for HE non-AP STAs

An HE non-AP STA has dot11IntraPPDUPowerSaveOptionActivated equal to true operates in intra-PPDU power save mode.

An HE non-AP STA that is in intra-PPDU power save mode may enter the doze state until the end of a PPDU currently being received when one of the following conditions is met:

— The PPDU is an HE MU PPDU where the RXVECTOR parameter BSS_COLOR is the BSS color of the BSS with which the STA is associated, the RXVECTOR parameter UL_FLAG is 0 and the RXVECTOR parameter STA_ID_LIST does not include the identifier of the STA or the broadcast identifier(s) intended for the STA.

— The PPDU is an HE MU PPDU, HE SU PPDU or HE extended range SU PPDU and one of the following conditions are true:

  • The RXVECTOR parameter BSS_COLOR is the BSS color of the BSS with which the STA is associated and the RXVECTOR parameter UL_FLAG is 1

  • The RXVECTOR parameter BSS_COLOR is the BSS color of the BSS with which the STA is associated, the RXVECTOR parameter UL_FLAG is 0 and a PHY-RXEND.indication(UnsupportedRate) primitive was received

— The PPDU is an HE trigger-based PPDU where the RXVECTOR parameter BSS_COLOR is the BSS color of the BSS with which the STA is associated

— The PPDU is a VHT PPDU where the RXVECTOR parameter PARTIAL_AID is the BSSID[39:47] of the BSS with which the STA is associated and the RXVECTOR parameter GROUP_ID is 0.

— The PPDU is a PPDU with:

  • An A-MPDU including TA or RA equal to either the BSSID of the BSS with which the STA is associated or the BSSID of any BSS of a multiple BSSID set that the STA's associated BSS belongs to and,

  • The RA is not the MAC address of the STA

An HE STA that is in intra-PPDU power save mode and has entered doze state shall continue to operate its NAV timers and consider the medium busy during doze state and shall transition into awake state at the end of the PPDU.

NOTE—The STA can contend for access to the medium immediately on the expiry of the NAV timers.

27.14.2 Power save with UL OFDMA-based random access

This subclause illustrates the power save mechanisms for HE STAs using the random access procedure (see 27.5.2.6.2 (Random access procedure)).

An HE AP may indicate one or more start times for Trigger frames with random access allocations in the broadcast TWT element that is included in the Beacon frame or a management frame as described in 27.7.3.2 (Rules for TWT scheduling STA). The power save operation is shown in Figure 27-7 (Trigger

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frame (TF) start time in the Beacon frame for power save operation with random access operation) with the indication of the start time for a Trigger frame with random access allocations in a Beacon frame.

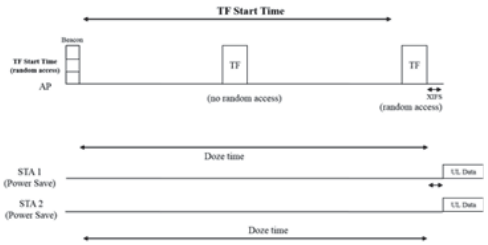

Figure 27-7—Trigger frame (TF) start time in the Beacon frame for power save operation with random access operation

An HE STA that receives a Beacon frame or a management frame containing a TWT element that has a value of 1 in the Broadcast subfield a value of 2 in the TWT Flow Identifier subfield may enter the doze state until the start of that TWT SP as described in 27.7.3.3 (Rules for TWT scheduled STA).

If random access allocations are made in a sequence of Trigger frames within a trigger-enabled TWT SP, then all the Trigger frames in the sequence shall have the Cascade Indication field set to 1, except for the last Trigger frame in the sequence, which shall have the Cascade Indication field set to 0.

An HE STA may use the value indicated in the Cascade Indication field in a Trigger frame to enter the doze state. If the OBO counter decrements to a non-zero value with the random access procedure in a Trigger frame with Cascade Indication field set to 0, it may enter the doze state immediately. If the OBO counter decrements to a non-zero value with the random access procedure in a Trigger frame with Cascade Indication field set to 1, it may remain awake for random access in the cascaded Trigger frame.

27.14.3 Opportunistic power save in congested environment

27.14.3.1 AP operation for opportunistic power save

Opportunistic power save mechanism has the objective for an AP to split a beacon interval into several periodic broadcast TWT SPs and to provide, at the beginning of each SP, the scheduling information to all non-AP STAs. Based on this information, the non-AP STAs may opportunistically go to doze state until the next TWT SP.

To enable opportunistic power save, an AP shall include a TWT element in beacons to set a periodic Broadcast TWT SP with the TWT flow identifier field set to 3.

At the beginning of these periodic TWT SPs, the AP shall transmit a TIM frame or a FILS Discovery frame that includes a TIM element (see 9.4.2.6 (TIM element)). The AP should transmit a FILS Discovery frame instead of a TIM frame if the TWT start time aligns with the transmission time of a FILS Discovery frame.

For any HE non-AP STA for which their associated AP set their corresponding bit in the traffic indication virtual bitmap field of the TIM element to 0, the AP shall neither send unicast or multicast frames to those STAs, nor trigger those STAs for UL MU transmissions during the TWT SP and, unless otherwise specified, until the next TWT SP.

For an HE non-AP STA for which their associated AP set their corresponding bit in the traffic indication virtual bitmap field of the TIM element to 1, if the STA was not served before the next TWT SP then the AP

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shall set its corresponding bit in the traffic indication virtual bitmap field of the TIM element to 1 in the subsequent TWT SP.

27.14.3.2 STA operation for opportunistic power save

When receiving a TIM element in TIM frame or FILS Discovery frame at the beginning of a broadcast TWT SP, an HE non-AP STA with AID *N* may enter the doze state during the TWT SP and until the next TWT SP, if the bit *N* in the traffic indication virtual bitmap field of the current TIM element is set to 0.

27.15 PPDU format, BW, MCS, NSS, and DCM selection rules

27.15.1 General

An HE STA can transmit different PPDUs formats, with different transmit parameters, such as channel width, MCS, NSS, DCM. This subclause defines the rules followed by an HE STA for selecting these parameters depending on the capabilities of the intended receiver(s) and other considerations.

27.15.2 PPDU format selection

An HE STA may transmit non-HT, HT, VHT PPDUs following the rules defined in 10.7 (Multirate support). An HE STA may transmit an HE SU PPDU or a 242-tone HE extended range SU PPDU to a peer HE STA.

An HE AP transmits HE MU PPDUs as defined in 27.5.1 (HE DL MU operation). An HE non-AP STA transmits HE trigger-based PPDUs as defined in 27.5.2 (UL MU operation).

An HE STA may transmit a 106-tone HE extended range SU PPDU to a peer STA if it has received from the peer STA an HE Capabilities element with the HE extended range SU PPDU Payload field equal to 1; otherwise the STA shall not transmit a 106-tone HE extended range SU PPDU to the peer STA.

An HE non-AP STA may transmit an HE trigger-based PPDU to a peer STA if it has received from the peer STA an HE Capabilities element with the UL MU PPDU Support field equal to 1; otherwise the STA shall not transmit an HE trigger-based PPDU to the peer STA.

An HE STA shall send Control frames in non-HT PPDU format following the rules defined in 10.7.6 (Rate selection for Control frames)) with the following exceptions:

- A Control frame sent in response to an HE extended range SU PPDU, HE SU PPDU, or HE trigger-based PPDU that uses STBC shall be carried in the same format as the soliciting PPDU
- A Control frame sent by the AP as a response to an HE trigger-based PPDU may be carried in any PPDU format that is supported by the intended receiver(s)
- A Control frame sent as a response to an HE PPDU, containing a Trigger frame that is not an MU RTS or containing an UL MU Response Scheduling A-Control field, is carried in an HE trigger-based PPDU (see 27.5.2 (UL MU operation))
- An Ack frame sent as a response to an HE extended range SU PPDU, HE SU PPDU, or HE trigger-based PPDU containing an FTM frame shall be sent in the same PPDU format as the soliciting PPDU
- If a Control frame is sent as a response to a soliciting HE extended range SU PPDU the frame shall be carried in an HE extended range SU PPDU except when the most recent successfully received PPDU sent by the responding STA to the soliciting STA after association was not an HE extended range SU PPDU in which case the control frame shall be carried in non-HT PPDU
- If the Control frame is sent as a response to a soliciting HE SU PPDU then the frame shall be carried in non-HT PPDU except when the most recent successfully received PPDU sent by the responding

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STA to the soliciting STA after association was an HE extended range SU PPDU in which case the control frame shall be carried in HE extended range SU PPDU

NOTE—PPDU format switching between non-HT and ER SU PPDU occurs in subsequent TXOPs. A STA that solicits a control frame from a peer STA accounts for the PPDU format of the control frame to calculate the expected duration of the TXOP.

27.15.3 MCS, NSS, BW and DCM selection

An HE STA shall follow the rules defined in 10.7 (Multirate support) and 27.15.4 (Rate selection constraints for HE STAs) for selecting the rate, MCS, NSS, and the rules defined in 10.3.2.6 (VHT RTS procedure), 10.3.2.7 (CTS and DMG CTS procedure), 10.7.6.6 (Channel Width selection for Control frames) and 10.7.11 (Channel Width in non-HT and non-HT duplicate PPDUs) for selecting the channel width (BW) of transmitted PPDUs with the following exceptions:

— MCS, NSS, and BW selection for a Trigger-based PPDU are defined in 27.5.2.3 (STA behavior).

— Rate and BW selection for a CTS sent in response to MU RTS are defined in 10.3.2.8a.3 (CTS response to MU-RTS)

— MCS, and NSS for a Control frame sent in response to an ER SU PPDU shall be <MCS0, 1> and BW shall be 20 MHz.

— NSS and BW selection is further constrained as defined in 27.8 (Operating mode indication) and 11.42 (Notification of operating mode changes).

An HE STA that transmits an HE PPDU shall use an <HE-MCS, NSS> tuple supported by the receiver STA. A <HE-MCS, NSS> tuple is supported if reported as such in the Supported HE-MCS and NSS Set field in the HE Capabilities element received from that STA. When the Supported HE-MCS and NSS set of the receiving STA or STAs is not known, the transmitting STA shall transmit using a <HE-MCS, NSS> tuple in the basic HE-MCS and NSS set. The STA shall select a <HE-MCS, NSS> tuple from the basic HE-MCS and NSS set when protection is required (as defined in 10.26 (Protection mechanisms)) and shall select a <HE-MCS, NSS> tuple from the operational HE-MCS and NSS set parameter of the intended receiver when protection is not required.

If a control response frame is to be transmitted within an HE SU PPDU, HE MU PPDU, the channel width (CH_BANDWIDTH parameter of the TXVECTOR) shall be selected first according to 10.7.6.6 (Channel Width selection for Control frames), and then the <HE-MCS, NSS> tuple shall be selected from a set of <HE-MCS, NSS> tuples called the CandidateMCSSet as described in 10.7.6.5.3 (Control response frame MCS computation).

An HE STA may transmit an HE PPDU with DCM to a peer STA if it has received from the peer STA an HE Capabilities element with the DCM Encoding Rx field equal to 1; otherwise the STA shall not transmit a HE PPDU with DCM to the peer STA. An HE STA transmits an HE trigger-based PPDU with DCM as defined in 27.5.2.3 (STA behavior).

An HE STA that sends a control frame in an ER SU PPDU format shall use:

— DCM encoding if the most recent successfully received PPDU sent by the HE STA to the soliciting STA after association used DCM; otherwise the STA shall not use DCM for the control frame.

— 106-tone HE extended range SU PPDU if the most recent successfully received PPDU sent by the HE STA to the soliciting STA after association was a 106-tone ER SU PPDU.

NOTE—TX parameter switching occurs in subsequent TXOPs. A STA that solicits a control frame from a peer STA accounts for the TX parameter of the control frame to calculate the expected duration of the TXOP.

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27.15.4 Rate selection constraints for HE STAs

27.15.4.1 Rx Supported HE-MCS and NSS Set

The Rx Supported HE-MCS and NSS Set of a first HE STA is determined by a second HE STA for each <HE-MCS, NSS> tuple NSS = 1, …, 8 and bandwidth (20 MHz, 40 MHz, 80 MHz, and 160 MHz or 80+80 MHz) from the Supported HE-MCS and NSS Set field received from the first STA as follows:

— If support for the HE-MCS for NSS spatial streams at that bandwidth is mandatory (see 26.5 (Parameters for HE-MCSs)), then the <HE-MCS, NSS> tuple at that bandwidth is supported by the first STA on receive.

— Otherwise, if the Max HE-MCS For n SS subfield (n = NSS) in the Rx HE-MCS Map subfield indicates support, then

— The <HE-MCS, NSS> tuple at that bandwidth is supported by the first STA on receive as defined in 9.4.2.213.3 Tx Rx HE MCS Support field.

— Otherwise, the <HE-MCS, NSS> tuple at that bandwidth is not supported by the first STA on receive.

The <HE-MCS, NSS> tuples excluded by 27.15.4.3 (Additional rate selection constraints for HE PPDUs) can also be eliminated from the Rx Supported HE-MCS and NSS Set.

An HE STA shall not, unless explicitly stated otherwise, transmit a HE PPDU unless the <HE-MCS, NSS> tuple and bandwidth used are in the Rx Supported HE-MCS and NSS Set of the receiving STA(s).

27.15.4.2 Tx Supported HE-MCS and NSS Set

The Tx Supported HE-MCS and NSS Set of a first HE STA is determined by a second STA for each <HE-MCS, NSS> tuple NSS = 1, …, 8 and bandwidth (20 MHz, 40 MHz, 80 MHz, and 160 MHz or 80+80 MHz) from the Supported HE-MCS and NSS Set field received from the first STA as follows:

— If support for the <HE-MCS, NSS> tuple at that bandwidth is mandatory (see 28.5 (Parameters for HE-MCSs)), then the <HE-MCS, NSS> tuple at that bandwidth is supported by the first STA on transmit.

— Otherwise, if the Max HE-MCS For *n* SS subfield (*n* = NSS) in the Tx HE-MCS Map subfield indicates support, then

— The <HE-MCS, NSS> tuple at that bandwidth is supported by the first STA on receive as defined in 9.4.2.218.4 (Tx Rx HE MCS Support field).

— Otherwise, the <HE-MCS, NSS> tuple at that bandwidth is not supported by the first STA on transmit.

27.15.4.3 Additional rate selection constraints for HE PPDUs

The following apply for a STA that transmits a HE PPDU with a number of spatial streams (NSS) less than or equal to 8:

— If the channel width of the PPDU is equal to CBW20 or CBW40, then the STA should not use a <HE-MCS, NSS> tuple if the HE-MCS is equal to 0, 1, 2, or 3 and the HT MCS with value VHT MCS + 8×(NSS – 1) is marked as unsupported in the Rx MCS bitmask of the HT capabilities element of the receiver STA.

— If the channel width of the PPDU is equal to CBW80, CBW160, or CBW80+80, then the STA should not use a <HE-MCS, NSS> tuple if the HE-MCS is equal to 0 or 1 and both the HT MCS values $2 \times \text{HE-MCS} + 8 \times (\text{NSS} - 1)$ and $2 \times (\text{HE-MCS} + 1) + 8 \times (\text{NSS} - 1)$ are marked as unsupported in the Rx MCS bitmask of the HT Capabilities element of the receiver STA.

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An example tabulation of this behavior is given in Table 18-4 (Example of rate selection for HE PPDUs).

Table 18-4—Example of rate selection for HE PPDUs

HT MCSs that are marked as unsupported	<HE-MCS, NSS> tuples that are not used for CBW20 and CBW40	<HE-MCS, NSS> tuples that are not used for CBW80, CBW160, and CBW80+80
0, 8, 16	<0, 1>, <0, 2>, <0, 3>	-
1, 9	<1, 1>, <1, 2>	-
10	<2, 2>	-
3	<3, 1>	-
0, 1	<0, 1>, <1, 1>	<0, 1>
2, 3	<2, 1>, <3, 1>	<1, 1>
0, 1, 8, 9	<0, 1>, <1, 1>, <0, 2>, <1, 2>	<0, 1>, <0, 2>

27.16 HE BSS operation

27.16.1 Basic HE BSS functionality

An HE STA has dot11HEOptionImplemented equal to true.

A STA that is starting an HE BSS shall be able to receive and transmit at each of the <HE-MCS, NSS> tuple values indicated by the Basic HE-MCS And NSS Set field of the HE Operation parameter of the MLME-START.request primitive and shall be able to receive at each of the <HE-MCS, NSS> tuple values indicated by the Supported HE-MCS and NSS Set field of the HE Capabilities parameter of the MLME-START.request primitive. The basic HE-MCS and NSS set is the set of <HE-MCS, NSS> tuples that are supported by all HE STAs that are members of an HE BSS. It is established by the STA that starts the HE BSS, indicated by the Basic HE-MCS And NSS Set field of the HE Operation parameter in the MLME-START.request primitive. Other HE STAs determine the basic HE-MCS and NSS set from the Basic HE-MCS And NSS Set field of the HE Operation element in the BSSDescription derived through the scan mechanism (see 11.1.4.1 (General)).

An HE STA shall not attempt to join (MLME-JOIN.request primitive) a BSS unless it supports (i.e., is able to both transmit and receive using) all of the <HE-MCS, NSS> tuples in the basic HE-MCS and NSS set.

NOTE—An HE STA does not attempt to (re)associate with an HE AP unless the STA supports (i.e., is able to both transmit and receive using) all of the <HE-MCS, NSS> tuples in the Basic HE-MCS And NSS Set field in the HE Operation element transmitted by the AP because the MLME-JOIN.request primitive is a necessary precursor to (re)association.

A STA for which dot11HEOptionImplemented is true shall set dot11VeryHighThroughputOptionImplemented or dot11HighThroughputOptionImplemented to true.

A STA that is an HE AP or an HE mesh STA declares its channel width capability in the HE Capabilities element as described in Table 9-262aa (Subfields of the HE PHY Capabilities Information field). If the STA is an HE AP then it shall indicate support for at least 80 MHz channel width if it operates in 5 GHz; otherwise it may indicate any channel width support.

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A STA shall set the Supported Channel Width Set subfield of VHT Capabilities and HT Capabilities element it transmits to a value that indicates the same channel width capability as the channel width capability provided in the HE Capabilities element it transmits. A STA shall set all the subfields of the VHT Capabilities and HT Capabilities element it transmits to respective values that indicate the same capabilities provided in the HE Capabilities element it transmits.

At a minimum, an HE STA sets the Rx MCS Bitmask of the Supported MCS Set field of its HT Capabilities element according to the setting of the Rx HE-MCS Map subfield of the Supported HE-MCS and NSS Set field of its HE Capabilities element as follows: for each subfield Max HE-MCS For n SS, $1 < n < 4$, of the Rx HE-MCS Map field with a value other than 3 (no support for that number of spatial streams), the STA shall indicate support for MCSs $8(n – 1)$ to $8(n – 1) + 7$ in the Rx MCS Bitmask, where n is the number of spatial streams, except for those MCSs marked as unsupported as described in 27.15.4.3 (Additional rate selection constraints for HE PPDUs).

A STA that is an HE AP or an HE mesh STA shall set the STA Channel Width subfield in the HT Operation element HT Operation Information field, the Channel Width, Channel Center Frequency Segment 0 and Channel Center Frequency Segment 1 subfields in the HE Operation element VHT Operation Information field to indicate the BSS bandwidth as defined in Table 11-24 (VHT BSS bandwidth).

The setting of the Channel Center Frequency Segment 0 and Channel Center Frequency Segment 1 subfields is shown in Table 11-25 (Setting of Channel Center Frequency Segment 0, Channel Center Frequency Segment 1 and Channel Center Frequency Segment 2 subfields), except that the Max NSS support is provided by the HE STA in frames that contain an HE Capabilities element (see 9.4.2.218 (HE Capabilities element)) and an Operating Mode field (see 9.2.4.6.4.3 (Operating Mode) and 9.4.1.53 (Operating Mode field)), wherein in the table the Max NSS support refers to the HE Max NSS support instead of the VHT Max NSS support for an HE STA.

An HE STA shall determine the channelization using the information in the HT Operation element Primary Channel field when operating in 2.4 GHz and the combination of the information in the HT Operation element Primary Channel field and the HE Operation element VHT Operation Information field Channel Center Frequency Segment 0 and Channel Center Frequency Segment 1 subfields when operating in 5 GHz (see 21.3.14 (Channelization)).

An HE AP or an HE mesh STA shall set the HT Operation element HT Operation Information field Secondary Channel Offset subfield to indicate the secondary 20 MHz channel as defined in Table 9-168 (HT Operation element fields and subfields), if the BSS bandwidth is more than 20 MHz.

An HE STA that is a member of an HE BSS shall follow the same rules that are defined in 11.40.1 (Basic VHT BSS functionality) when transmitting a 20 MHz, 40 MHz, 80 MHz, 160 MHz or 80+80 MHz HE PPDUs with the following exceptions:

— An HE trigger-based PPDU sent in response to a Trigger frame or an UL MU Response Scheduling A-Control field follows the rules defined in 27.5.2.3 (STA behavior).

— An 80 MHz, 160 MHz or 80+80 MHz HE DL MU PPDU with preamble puncture may be transmitted if either the primary 20 MHz or the primary 40 MHz, or both are occupied by the transmission (see Table 28-17 (HE-SIG-A field of an HE MU PPDU)).

An HE STA shall not transmit to a second HE STA using a bandwidth that is not indicated as supported in the Supported Channel Width Set subfield in the HE Capabilities element received from that HE STA.

A STA shall not transmit an MPDU in an HE PPDU to a STA that exceeds the maximum MPDU length capability indicated in the VHT Capabilities element received from the recipient STA or that exceeds the Maximum A-MSDU Length in the HT Capabilities element received from the recipient STA.

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A STA shall not transmit an A-MPDU in an HE PPDU to a STA that exceeds the maximum A-MPDU length capability indicated in the HE Capabilities, VHT Capabilities, and HT Capabilities element received from the recipient STA. The maximum A-MPDU length capability is obtained as a combination of the Maximum A-MPDU Length Exponent subfields in the HE Capabilities and VHT Capabilities element if the recipient STA has transmitted the VHT Capabilities; otherwise it is obtained from a combination of the Maximum A-MPDU Length Exponent subfields in the HE Capabilities and the HT Capabilities element.

An HE AP shall set the RIFS Mode field in the HT Operation element to 0.

An HE STA shall follow the rules defined in 11.40 (VHT BSS operation) for channel selection, determining scanning requirements, channel switching, NAV assertion and antenna indication when operating in 5 GHz unless explicitly stated otherwise in Clause 27.

An HE STA shall follow the rules defined in 11.16 (20/40 MHz BSS operation) for channel selection, determining scanning requirements, channel switching, NAV assertion when operating in 2.4 GHz unless explicitly stated otherwise in Clause 27.

27.16.2 Selecting and advertising new BSS Color

An HE AP that sets up a BSS selects a BSS Color as defined in 27.11.4 (BSS_COLOR). An HE AP may choose to change the BSS Color under certain conditions such as when it detects that there is at least one other OBSS AP in the neighborhood that uses the same color as the BSS Color of its BSS.

The algorithm to choose a new BSS Color is beyond the scope of this standard.

An HE AP shall announce its decision to change the BSS Color via the BSS Color Change Announcement element which is carried in the Beacon, Probe Response and (Re)Association Response frames. The AP may also advertise the BSS Color change event via the HE BSS Color Change Announcement frame. The BSS Color change announcement should be advertised for a period of time that is sufficient for all STAs in the BSS, including STAs in power save mode, to have the opportunity to receive at least one BSS Color Change Announcement element before the BSS Color change occurs.

BSS Color change TBTT is the one at which the Color Switch Countdown time has reached 0 and the BSS switches to the new color.

During the time leading up to the BSS Color change TBTT, an HE AP shall continue to advertise the existing BSS Color via the BSS Color subfield in HE Operation element.

At the BSS Color change TBTT, an HE AP shall:

- Set the BSS Color Disabled subfield in the HE Operation element to 0
- Start advertising the new BSS Color via BSS Color subfield in the HE Operation element
- Start using the new BSS color

A HE non-AP STA that receives a BSS Color Change Announcement element shall start using the BSS Color specified in the received BSS Color Change Announcement element subsequent to the BSS Color change TBTT.

A HE non-AP STA in an infrastructure BSS shall not transmit the BSS Color Change Announcement element.

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27.16.3 Quieting HE STAs in a HE BSS

27.16.3.1 General

The QTP (Quiet time period) defines a period for STA-to-STA operation during which only the HE STA which supports the STA-to-STA operation can transmit frames. During the period an HE STA should not transmit frames unless it participates in the STA-to-STA operation. All HE STAs in the HE BSS not participating the STA-to-STA operation should stay quiet in the period.

An AP that supports QTP shall set the QTP Support field in the AP's HE Capabilities element to 1 and shall set the QTP Capability field to 0 otherwise.

27.16.3.2 Procedure at the requester HE STA

Upon the reception of an MLME-QTP.request primitive, an HE STA shall perform the following procedure to start the Quiet Time Period Operation (Figure 27-8 (Quieting Time Period operation)):

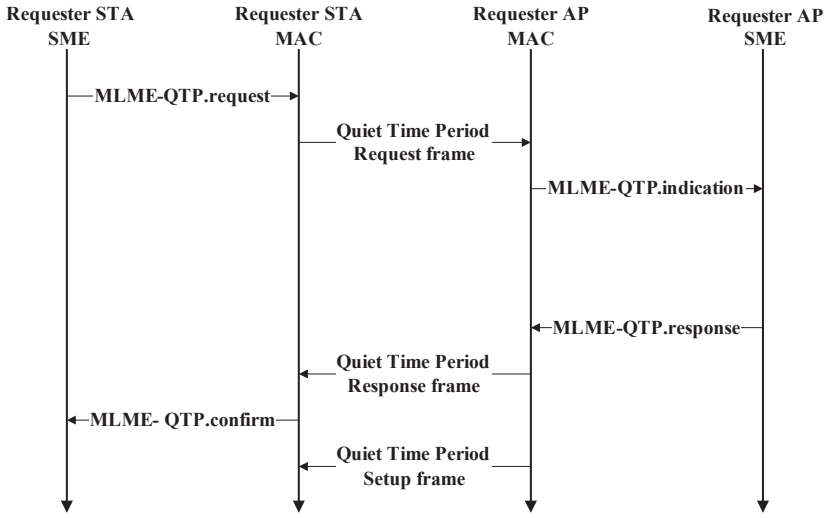

Figure 27-8—Quieting Time Period operation

a) If responder AP and requester HE STA are QTP capable as indicated by the QTP Support field in the HE Capabilities element, the requester HE STA sends a Quiet Time Period Request frame indicating the duration, interval, and type of operation (indicated by vendor specific service type). The requester HE STA may include multiple Quiet Time Period Request elements in one frame for multiple types of STA-to-STA operations.

b) If a Quiet Time Period Response frame is received with the matching dialog token and request token with a status code set to a value of SUCCESS, the AP has confirmed the reception of the Quiet Time Period Request element, and the MLME shall issue an MLME-QTP.confirm primitive indicating the success of the procedure.

c) When a Quite Time Period Setup frame is received, the requested HE STA can transmit frame belongs to the requested type of STA-to-STA operation indicated by the vendor specific service identifier of the Quiet Time Period Response. The transmission of a frame by the HE STA in this period shall follow the CCA rules.

NOTE—The GAS protocol can be used by an HE STA to inform an AP the type of STA-to-STA operations.

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27.16.3.3 Procedure at the responder AP

A responder AP may operate as follows (Figure 27-8 (Quieting Time Period operation)):

a) When a QTP Request frame is received from an HE STA, the MLME shall issue an MLME-QTP.indication primitive.

b) Upon receipt of the MLME-QTP.response primitive, the AP may respond by sending Quiet Time Period Response frame.

   1) If the result code is SUCCESS, the request is accepted. The responder AP shall schedule the quiet period(s) according to the accepted request. Contained in the transmitted Quiet Time Period Response frame is the copy of the request token from the requester HE STA. The QTP procedure shall be terminated if the number of quiet periods exceeds the value of the Repetition Count field specified.

   2) If the result code is REJECTED, the request has not been fulfilled.

c) When the scheduled quiet time periods arrive, the responder AP may transmit a Quiet Time Period Setup frame including Quiet Time Period Setup element. Only the HE STA which supports the operation indicated by the Vendor Specific Service Identifier field of the Quiet Time Period Setup element can transmit frames in the quiet time period. The responder AP shall set the Quiet Period Duration field of Quiet Time Period Setup frame to the value no larger than indicated in Quiet Period Duration field of the Quiet Time Period Request element sent by the requester HE STA.

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28. High Efficiency (HE) PHY specification

28.1 Introduction

28.1.1 Introduction to the HE PHY

Clause 28 specifies the PHY entity for a high efficiency (HE) orthogonal frequency division multiplexing (OFDM) system. In addition to the requirements in Clause 28, an HE STA shall be capable of transmitting and receiving PPDUs that are compliant with the mandatory requirements of the following PHY specifications:

— Clause 19 (High Throughput (HT) PHY specification) and Clause 21 (Very High Throughput (VHT) PHY specification) when the HE STA with greater than or equal to 80 MHz capability is operating in the 5 GHz band

— Clause 19 (High Throughput (HT) PHY specification) when the 20 MHz only non-AP HE STA is operating in the 5 GHz band

— Clause 19 (High Throughput (HT) PHY specification) when the HE STA is operating in the 2.4 GHz band

The HE PHY with greater than or equal to 80 MHz capability is based on the VHT PHY defined in Clause 21 (Very High Throughput (VHT) PHY specification), which in turn is based on the HT PHY defined in Clause 19 (High Throughput (HT) PHY specification), which in turn is further based on the OFDM PHY defined in Clause 17 (Orthogonal frequency division multiplexing (OFDM) PHY specification). The HE PHY with 20 MHz only capability (see 28.3.9 (Mathematical description of signals)) is based on the HT PHY defined in Clause 19, which in turn is based on the OFDM PHY defined in Clause 17. The HE PHY extends the maximum number of users supported for downlink multi-user MIMO (MU-MIMO) transmissions to eight and provides support for downlink and uplink orthogonal frequency division multiple access (OFDMA) as well as for uplink MU-MIMO. Both downlink and uplink MU-MIMO transmissions are supported on portions of the PPDU bandwidth (on resource units greater than or equal to 106 tones) and in an MU-MIMO resource unit, there is support for up to eight users with up to four space-time streams per user with the total number of space-time streams not exceeding eight.

The HE PHY provides support for 20 MHz, 40 MHz, 80 MHz and 160 MHz contiguous channel widths and support for 80+80 MHz non-contiguous channel width, depending on the frequency band and capability. For channel widths greater than or equal to 80 MHz, the HE PHY supports channel puncturing transmissions where one or more of the non-primary 20 MHz channels in an HE MU PPDU with more than one RU is zeroed out.

The HE PHY provides support for 0.8 μs, 1.6 μs and 3.2 μs guard interval durations.

The HE PHY provides support for 3.2 μs (1x LTF), 6.4 μs (2x LTF), and 12.8 μs (4x LTF) LTF symbol durations (symbol duration not including the guard interval). The HE PHY supports a single Data field OFDM symbol duration of 12.8 μs (excluding guard interval).

The HE PHY data subcarrier frequency spacing is a quarter of VHT PHY and HT PHY subcarrier frequency spacing defined in Clause 21 (Very High Throughput (VHT) PHY specification) and Clause 19 (High Throughput (HT) PHY specification), respectively. The HE PHY data subcarriers are modulated using binary phase shift keying (BPSK), BPSK dual-carrier modulation (DCM), quadrature phase shift keying (QPSK), 16-quadrature amplitude modulation (16-QAM), 16-QAM DCM, 64-QAM, 256-QAM and 1024-QAM. Forward error correction (FEC) coding (convolutional or LDPC coding) is used with coding rates of 1/2, 2/3, 3/4 and 5/6.

An HE STA refers to an AP STA and a non-AP STA.

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A non-AP STA is inclusive of a 20 MHz-only non-AP STA.

An HE STA shall support the following Clause 28 features:

- Transmission and reception of an HE SU PPDU that consists of a single RU spanning the entire PPDU bandwidth
- Transmission and reception of an HE extended range SU PPDU that consists of a single RU spanning the entire primary 20 MHz PPDU bandwidth
- Binary convolutional coding (transmit and receive). Note that binary convolutional coding is not defined for the following:
  - An HE SU PPDU with a bandwidth greater than 20 MHz
  - An RU of size greater than 242 subcarriers
  - An HE SU PPDU or an RU allocated to a single user with number of spatial streams greater than 4
  - An HE PPDU using HE MCS 10 or 11
- LDPC coding (transmit and receive) in all supported HE PPDU types, RU sizes, and number of spatial streams if the STA supports transmitting and receiving HE SU PPDUs of bandwidths greater than 20 MHz
- LDPC coding (transmit) in all supported HE PPDU types, RU sizes, and number of spatial streams if the STA declares support for transmitting more than 4 spatial streams except when the STA is an 20 MHz only non-AP STA
- LDPC coding (receive) in all supported HE PPDU types, RU sizes, and number of spatial streams if the STA declares support for receiving more than 4 spatial streams except when the STA is an 20 MHz only non-AP STA
- LDPC when declaring support for MCS10 and MCS11
- Transmit and receive of HE-SIG-B field in HE MU PPDUs at HE-MCSs 0 to 5
- HE-MCSs 0 to 7 (transmit and receive) in all supported channel widths and RU sizes for HE SU PPDUs, HE MU PPDUs, and HE_TRIG PPDUs
- 0.8 μs GI duration on both HE-LTF and data symbols when the HE-LTF is a 2x LTF (transmit and receive)
- 1.6 μs GI duration on both HE-LTF and data symbols when the HE-LTF is 1x (transmit and receive) for full bandwidth UL MU-MIMO if the STA supports UL MU-MIMO
- 1.6 μs GI duration on both HE-LTF and data symbols when the HE-LTF is a 2x LTF (transmit and receive)
- 3.2 μs GI duration on both HE-LTF and data symbols when the HE-LTF is a 4x LTF (transmit and receive)
- Single spatial stream HE-MCSs 0 - 2 in primary 20 MHz channel for HE_EXT_SU PPDUs
- 20 MHz channel width and all RU sizes and locations applicable to the 20 MHz channel width in 2.4 GHz and 5 GHz bands (transmit and receive)

An HE STA may support the following Clause 28 features:

- HE-MCSs 8 to 11 (transmit and receive)
- Dual carrier modulation (transmit and receive)
- 0.8 μs GI duration on both HE-LTF and data symbols when the HE-LTF is a 1x LTF (transmit and receive) for HE SU PPDUs
- LDPC coding (transmit) if
  - the maximum number of spatial streams the STA is capable of transmitting in an HE SU PPDU is less than or equal to 4, and
  - the STA is not capable of transmitting an HE SU PPDU with a bandwidth greater than 20 MHz

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— LDPC coding (receive) if
  - the maximum number of spatial streams the STA is capable of receiving in an HE SU PPDU is less than or equal to 4, and
  - the STA is not capable of transmitting an HE SU PPDU with a bandwidth greater than 20 MHz
— Single spatial stream HE-MCS 0 in the right 106-tone RU of the primary 20 MHz channel for an HE extended range SU PPDU
— STBC (transmit and receive)

An HE AP shall support the following Clause 28 features:

— Transmission of an HE MU PPDU where none of the RUs utilize MU-MIMO (DL OFDMA)
— Reception of an HE trigger-based PPDU where none of the RUs utilize MU-MIMO (UL OFDMA)
— Transmission of an HE MU PPDU consisting of a single RU spanning the entire PPDU bandwidth and utilizing MU-MIMO (DL MU-MIMO), provided the AP is capable of transmitting 4 or more spatial streams
— 40 MHz and 80 MHz channel widths and all RU sizes and locations applicable to the 40 MHz and 80 MHz channel width in 5 GHz band (transmit and receive)

An HE AP may support the following Clause 28 features:

— MU-MIMO transmission on an RU in an HE MU PPDU where the RU does not span the entire PPDU bandwidth (downlink MU-MIMO with OFDMA)
— MU-MIMO reception on an RU in an HE trigger-based PPDU where the RU spans the entire PPDU bandwidth (uplink MU-MIMO)
— MU-MIMO reception on an RU in an HE trigger-based PPDU where the RU does not span the entire PPDU bandwidth (uplink MU-MIMO with OFDMA)
— Reception of the payload of an HE MU PPDU over a 106-tone RU within a 20 MHz PPDU bandwidth and full bandwidth PPDU
— 40 MHz channel width in the 2.4 GHz band (transmit and receive). If it is supported then all RU sizes and locations applicable to 40 MHz channel width are supported in 2.4 GHz band (transmit and receive)
— 160 MHz and 80+80 MHz channel widths and 2×996-tone RU size applicable to the 160/80+80 MHz channel width in 5 GHz band (transmit and receive)
— Transmission of an HE MU PPDU with preamble puncturing

An HE non-AP STA shall support the following Clause 28 features:

— Reception of an HE MU PPDU where the RU allocated to the non-AP STA is not utilizing MU-MIMO (DL OFDMA)
— Transmission of an HE trigger-based PPDU where the RU allocated to the non-AP STA is not utilizing MU-MIMO (UL OFDMA)
— Reception of an HE MU PPDU consisting of a single RU spanning the entire PPDU bandwidth and utilizing MU-MIMO (DL MU-MIMO). The maximum number of spatial streams per user the non-AP STA can receive in the DL MU-MIMO transmission shall be equal to the minimum of 4 and the maximum number of spatial streams supported for reception of HE SU PPDUs. The total number of spatial streams in the DL MU-MIMO transmission that the non-AP STA can receive shall be at least 4.
— Responding with the requested beamforming feedback in an HE sounding procedure with the maximum number of space-time streams in the HE NDP that the non-AP STA can respond to being at least 4
— 40 MHz and 80 MHz channel widths and all RU sizes and locations applicable to the 40 MHz and 80 MHz channel widths in 5 GHz band (transmit and receive) except if the non-AP STA is

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20 MHz-only capable in which case the 40 MHz and 80 MHz channel widths, 996-tone RU, and 484-tone RU sizes in 5 GHz band are not applicable

— A non-AP STA that is 20 MHz-only capable shall support 106/52/26-tone RU sizes and locations in 40 MHz and 80 MHz channel width in 5 GHz band (transmit and receive)

An HE non-AP STA may support the following:

— Transmission of an HE MU PPDU over partial PPDU bandwidth and full PPDU bandwidth

— 40 MHz channel width in the 2.4 GHz band (transmit and receive). If 40 MHz channel width in the 2.4 GHz band is supported then all RU sizes and locations applicable to 40 MHz channel width are supported. If the non-AP STA is 20 MHz-only capable then 40 MHz channel width and 484-tone RU size in 2.4 GHz band are not supported

— 242-, 106-, 52- and 26-tone RU sizes and locations in a 40 MHz channel width in the 2.4 GHz band if the non-AP STA is 20 MHz-only capable

— 242-tone RU sizes and locations in a 40 MHz and 80 MHz channel widths in 5 GHz band if the non-AP STA is 20 MHz-only capable

— 242-tone RU sizes and locations in a 160 MHz and 80+80 MHz channel widths in 5 GHz band if the non-AP STA is 20 MHz-only capable

— 160 MHz and 80+80 MHz channel width and 2×996-tone RU size applicable to the 160 MHz and 80+80 MHz channel width in 5 GHz band (transmit and receive). If the non-AP STA is 20 MHz-only capable then 160 MHz and 80+80 MHz channel width, 2×996-, 996- and 484-tone RU sizes in 5 GHz band are not applicable

— MU-MIMO reception on an RU in an HE MU PPDU where the RU does not span the entire PPDU bandwidth (DL MU-MIMO with OFDMA). The maximum number of spatial streams per user in the DL MU-MIMO with OFDMA transmission that the non-AP STA can receive shall be a minimum of 4 and the maximum number of spatial streams supported for reception of HE SU PPDUs. The total number of spatial streams in the DL MU-MIMO with OFDMA transmission that the non-AP STA can receive shall be at least 4

— MU-MIMO transmit on an RU in an HE trigger-based PPDU where the RU spans the entire PPDU bandwidth (UL MU-MIMO). If it is supported then a total of up to 8 space-time streams are supported

— MU-MIMO transmit on an RU in an HE_TRIG PPDU where the RU does not span the entire PPDU bandwidth (UL MU-MIMO with OFDMA). If it is supported then a total of up to 8 space-time streams are supported

28.1.2 Scope

The services provided to the MAC by the HE PHY consist of the following protocol functions:

a) A function that maps the PSDU received from the MAC into a PPDU for transmission to one or more receiving STAs.

b) A function that defines the characteristics and method of transmitting and receiving data through a wireless medium between two or more STAs. Depending on the PPDU format, these STAs support a mixture of HE, Clause 21 (Very High Throughput (VHT) PHY specification), Clause 19 (High Throughput (HT) PHY specification) and Clause 17 (Orthogonal frequency division multiplexing (OFDM) PHY specification) PHYs.A non-AP STA with 20 MHz only capability supports a mixture of HE, Clause 19 and Clause 17 PHYs.

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28.1.3 HE PHY functions

28.1.3.1 General

The HE PHY contains two functional entities: the PHY function, and the physical layer management function (i.e., the PLME). Both of these functions are described in detail in 28.3 (HE PHY) and 28.4 (HE PLME). The HE PHY service is provided to the MAC through the PHY service primitives defined in Clause 8 (PHY service specification). The HE PHY service interface is described in 28.2 (HE PHY service interface).

28.1.3.2 PHY management entity (PLME)

The PLME performs management of the local PHY functions in conjunction with the MLME.

28.1.3.3 Service specification method

The models represented by figures and state diagrams are intended to be illustrations of the functions provided. It is important to distinguish between a model and a real implementation. The models are optimized for simplicity and clarity of presentation; the actual method of implementation is left to the discretion of the HE-PHY-compliant developer.

The service of a layer is the set of capabilities that it offers to a user in the next higher layer. Abstract services are specified here by describing the service primitives and parameters that characterize each service. This definition is independent of any particular implementation.

28.1.4 PPDU formats

The structure of the PPDU transmitted by an HE STA is determined by the TXVECTOR parameters as defined in Table 28-1 (TXVECTOR and RXVECTOR parameters).

The FORMAT parameter determines the overall structure of the PPDU and can take on one of the following values:

— Non-HT format (NON_HT), based on Clause 17 (Orthogonal frequency division multiplexing (OFDM) PHY specification) and including non-HT duplicate format.

— HT-mixed format (HT_MF) as specified in Clause 19 (High Throughput (HT) PHY specification).

— HT-greenfield format (HT_GF) as specified in Clause 19 (High Throughput (HT) PHY specification).

— VHT format (VHT) as defined in Clause 21 (Very High Throughput (VHT) PHY specification).

— HE SU PPDU format (HE_SU) carries a single PSDU. With this format the HE-SIG-A field is not repeated. Support for the HE SU PPDU format is mandatory.

— HE extended range SU PPDU format (HE_EXT_SU) carries a single PSDU. It is similar to the HE SU PPDU format, except that the HE-SIG-A field is repeated. Support for the HE extended range SU PPDU format is mandatory.

— HE MU PPDU format (HE_MU) carries one or more PSDUs to one or more users. Support for the HE MU PPDU format is mandatory.

— HE trigger-based PPDU format (HE_TRIG) carries a single PSDU and is sent in response to a PPDU that carries a Trigger frame. The preamble format prior to the HE-STF field is identical to the HE SU PPDU. Support for the HE trigger-based PPDU format is mandatory.

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28.2 HE PHY service interface

28.2.1 Introduction

The PHY provides an interface to the MAC through an extension of the generic PHY service interface defined in 8.3.4 (Basic service and options). The interface includes TXVECTOR, RXVECTOR, and PHYCONFIG_VECTOR.

Using the TXVECTOR, the MAC supplies the PHY with per-PPDU transmit parameters. Using the RXVECTOR, the PHY informs the MAC of the received PPDU parameters. Using the PHYCONFIG_VECTOR, the MAC configures the PHY for operation, independent of frame transmission or reception.

28.2.2 TXVECTOR and RXVECTOR parameters

The parameters in Table 28-1 (TXVECTOR and RXVECTOR parameters) are defined as part of the TXVECTOR parameter list in the PHY-TXSTART.request primitive and/or as part of the RXVECTOR parameter list in the PHY-RXSTART.indication primitive.

Table 28-1—TXVECTOR and RXVECTOR parameters

Parameter	Condition	Value	TXVECTOR	RXVECTOR
FORMAT		Determines the format of the PPDU. Enumerated type: NON_HT indicates Clause 17 (Orthogonal frequency division multiplexing (OFDM) PHY specification) or non-HT duplicate PPDU format. In this case, the modulation is determined by the NON_HT_MODULATION parameter. HT_MF indicates HT-mixed format. HT_GF indicates HT-greenfield format. VHT indicates VHT format. HE_SU indicates HE SU PPDU format. HE_MU indicates HE MU PPDU format. HE_EXT_SU indicates HE extended range SU PPDU format. HE_TRIG indicates HE trigger-based PPDU format.	Y	Y
NON_HT_MODULATION	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).			

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Table 28-1—TXVECTOR and RXVECTOR parameters *(continued)*

L_LENGTH	FORMAT is HE_SU, HE_MU or HE_EXT_SU	Not present. NOTE—The Length field of the L-SIG for HE PPDU is defined in Equation (28-11) using the TXTIME value defined in 28.4.2 (TXTIME and PSDU_LENGTH calculation), which in turn depend on other parameters including the TXVECTOR parameter APEP_LENGTH.	N	N
	FORMAT is HE_TRIG	Indicates the value in the Length field of the L-SIG in the range of 1 to 4095. The value comes from the trigger frame which triggers the HE trigger-based PPDU.	Y	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
L_DATARATE	FORMAT is HE_SU, HE_MU, HE_EXT_SU or HE_TRIG	Not present NOTE—The RATE field in the L-SIG field in HE PPDU is set to the value representing 6 Mb/s in the 20 MHz channel spacing column of Table 17-6 (Contents of the SIGNAL field).	N	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
LSIGVALID	FORMAT is HE_SU, HE_MU, HE_EXT_SU or HE_TRIG	Not present	N	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
SERVICE	FORMAT is HE_SU, HE_MU, HE_EXT_SU or HE_TRIG	Not present	N	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
SMOOTHING	FORMAT is HE_SU, HE_MU, HE_EXT_SU or HE_TRIG	Not present	N	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
AGGREGATION	FORMAT is HE_SU, HE_MU, HE_EXT_SU or HE_TRIG	Not present	N	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
NUM_EXTEN_SS	FORMAT is HE_SU, HE_MU, HE_EXT_SU or HE_TRIG	Not present	N	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		

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Table 28-1—TXVECTOR and RXVECTOR parameters *(continued)*

ANTENNA_SET	FORMAT is HE_SU, HE_MU, HE_EXT_SU or HE_TRIG	Not present	N	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
N_TX	FORMAT is HE_SU, HE_MU, HE_EXT_SU or HE_TRIG	Indicates the number of transmit chains.	N	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
EXPANSION_MAT_TYPE	FORMAT is HE_SU, HE_MU, HE_EXT_SU or HE_TRIG	Set to COMPRESSED_SV.	Y	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
EXPANSION_MAT	FORMAT is HE_SU, HE_EXT_SU or HE_TRIG	Contains a vector in the number of selected subcarriers containing feedback matrices as defined in 28.3.15.2 (Beamforming feedback matrix V) based on the channel measured during the training symbols of previous HE NDP PPDUs or VHT NDP PPDUs.	Y	N
	FORMAT is HE_MU	For each user, contains a vector in the number of all the subcarriers within the RU which is assigned to this user. The vector for each subcarrier contains feedback matrices as defined in in 28.3.15.2 (Beamforming feedback matrix V) based on the channel measured during the training symbols of previous HE NDP PPDUs or VHT NDP PPDUs.	M U	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
CHAN_MAT_TYPE	FORMAT is HE_SU, HE_MU, HE_EXT_SU or HE_TRIG	Set to COMPRESSED_SV.	N	Y
	FORMAT is HE_MU or HE_EXT_SU or HE_TRIG or (FORMAT is HE_SU and PSDU_LENGTH is greater than 0)	Not present.	N	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		

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Table 28-1—TXVECTOR and RXVECTOR parameters *(continued)*

CHAN_MAT	FORMAT is HE_SU and PSDU_LENGTH is 0	Contains a vector in the number of selected subcarriers containing feedback matrices as defined in 26.3.12.3.2 (Beamforming Feedback) based on the channel measured during the training symbols of previous HE NDP PPDU.	N	Y
	FORMAT is HE_MU or HE_EXT_SU or HE_TRIG or (FORMAT is HE_SU and PSDU_LENGTH is greater than 0)	Not present.	N	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
DELTA_SNR	FORMAT is HE_SU, HE_MU, HE_EXT_SU or HE_TRIG	Contains an array of delta SNR values as defined in 9.4.1.64 (HE MU Exclusive Beamforming Report field) based on the channel measured during the training symbols of the received VHT NDP PPDU or HE NDP PPDU. NOTE—In the RXVECTOR this parameter is present only for HE NDP PPDUs for MU sounding.	M U	Y
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
RCPI	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).			
SNR	FORMAT is HE_SU, HE_MU, HE_EXT_SU or HE_TRIG	For an HE SU PPDU and HE extended range SU PPDU, contains an array of average values of received SNR measurements for each spatial stream. For and HE MU PPDU, contains an array of average values of received SNR measurements for each spatial stream of the receiver. For HE trigger-based PPDU, contains an array of average values of received SNR measurements for each spatial stream per user. SNR indications of 8 bits are supported. Average value of SNR shall be the sum of the decibel values of SNR per tone divided by the number of tones represented in each stream as described in 9.4.1.63 (HE Compressed Beamforming Report field).	N	Y
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
CQI	FORMAT is HE_SU and PSDU_LENGTH is 0	Contains an array of received per-RU average SNRs for each space-time stream, where each per-RU average SNR is the arithmetic mean of the SNR in decibels over a 26-tone RU as described in 9.4.1.65 (HE CQI-only Report field).	N	Y
	Otherwise	Not present.	N	N

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Table 28-1—TXVECTOR and RXVECTOR parameters *(continued)*

NO_SIG_EXTN	FORMAT is HE_SU, HE_MU, HE_EXT_SU or HE_TRIG	Not present.	N	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
FEC_CODING	FORMAT is HE_SU, HE_MU, HE_EXT_SU or HE_TRIG	Indicates which FEC encoding is used. Enumerated type: BCC_CODING indicates binary convolutional code. LDPC_CODING indicates low-density parity check code.	M U	M U
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
LDPC_EXTRA_SYMBOL	FORMAT is HE_TRIG and FEC_CODING is LDP-C_CODING	Indicates the presence of the extra OFDM symbol for LDPC in an HE trigger-based PPDU. Set to 1 if an extra OFDM symbol for LDPC is present. Set to 0 if an extra OFDM symbol for LDPC is not present. See 27.5.2.3 (STA behavior) for details	Y	N
	Otherwise	Not present.	N	N
STBC	FORMAT is HE_SU, HE_MU, HE_EXT_SU or HE_TRIG	Indicates if STBC is used. In an HE MU PPDU where each RU includes no more than 1 user: Set to 1 to indicate all RUs are STBC encoded in the payload Set to 0 to indicate all RUs are not STBC encoded in the payload In HE SU PPDU, HE extended range SU PPDU or HE trigger-based PPDU: Set to 1 to indicate that STBC is used in the payload Set to 0 to indicate that STBC is not used in the payload STBC is not applied in MU-MIMO RUs, in case of HE MU PPDU if any RU is assigned to more than 1 user; STBC is set to 0 to indicate all RUs are not STBC encoded in the payload. STBC is applied only for a single spatial stream ($N_{SS} = 1$). DCM is not used in conjunction with STBC.	Y	Y
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
GI_TYPE	FORMAT is HE_SU, HE_MU, HE_EXT_SU or HE_TRIG	Indicates the length of the GI for the HE-LTF and HE-Data fields. Enumerated type: 0.8 μs 1.6 μs 3.2 μs NOTE—the length of GI for pre-HE modulated fields is 0.8 μs.	Y	Y
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		

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Table 28-1—TXVECTOR and RXVECTOR parameters *(continued)*

TXPWR_LEVEL_INDEX	FORMAT is HE_SU, HE_MU, HE_EXT_SU or HE_TRIG	The allowed values for the TXPWR_LEVEL_INDEX parameter are in the range from 1 to numberOfOctets (dot11TxPowerLevelExtended)/2. This parameter is used to indicate which of the available transmit output power levels defined in dot11TxPowerLevelExtended shall be used for the current transmission.	Y	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
RSSI	FORMAT is HE_SU, HE_EXT_SU, HE_MU or HE_TRIG	The allowed values for the RSSI parameter are in the range 0 to 255 inclusive. This parameter is a measure by the PHY of the power observed at the antennas used to receive the current PPDU measured during the reception of the HE-LTF field. RSSI is intended to be used in a relative manner, and it is a monotonically increasing function of the received power.	N	Y
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
RSSI_LEGACY		The allowed values for the RSSI_LEGACY parameter are in the range 0 to 255 inclusive. This parameter is a measure by the PHY of the power observed at the antennas used to receive the current PPDU measured during the reception of PHY legacy preamble. RSSI_LEGACY is intended to be used in a relative manner, and it is a monotonically increasing function of the received power.	N	Y
MCS	FORMAT is HE_SU, HE_MU, HE_EXT_SU or HE_TRIG	Indicates the modulation and coding scheme used in the transmission of the PPDU. Integer: range 0 to 11	M U	M U
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
DCM	FORMAT is HE_SU, HE_MU, HE_EXT_SU or HE_TRIG	Set to 1 to indicate that dual carrier modulation is used for the HE-Data field. Set to 0 to indicate that dual carrier modulation is not used for the HE-Data field. NOTE—DCM is only applied to MCS0, MCS1, MCS3 and MCS4. DCM is only applied to 1 and 2 spatial streams. DCM is only applied to HE SU PPDU, HE extend range SU PPDU, and SU RUs in HE MU PPDU. DCM is not applied to MU-MIMO. DCM is not applied to STBC.	M U	M U
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
MCS_SIG_B	FORMAT is HE_MU	Indicates the modulation and coding scheme used for HE-SIG-B field. Integer in the range 0 to 5	Y	Y
	Otherwise	Not present.	N	N

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Table 28-1—TXVECTOR and RXVECTOR parameters *(continued)*

DCM_SIG_B	FORMAT is HE_ MU	Set to 1 to indicate that dual carrier modulation is used for the HE-SIG-B field. Set to 0 to indicate that dual carrier modulation is not used for the HE-SIG-B field.	Y	Y
	Otherwise	Not present.	N	N
SIG_B_COMPRESSION_MODE	FORMAT is HE_MU	Used to differentiate full bandwidth MU-MIMO from OFDMA MU PPDU. In case of full bandwidth MU-MIMO set to 1, otherwise set to 0.	Y	N
	Otherwise	Not present.	N	N
REC_MCS	FORMAT is HE_SU, HE_MU or HE_EXT_SU	Indicates the MCS that the receiver recommends	N	O
	FORMAT is HE_TRIG	Not present.	N	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		

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Table 28-1—TXVECTOR and RXVECTOR parameters *(continued)*

CH_BANDWIDTH	FORMAT is HE_SU	Indicates the channel width of the transmitted PPDU. Enumerated type: CBW20 for 20 MHz CBW40 for 40 MHz CBW80 for 80 MHz CBW160 for 160 MHz CBW80+80 for 80+80 MHz	Y	Y
	FORMAT is HE_EXT_SU	Indicates the channel width of the transmitted PPDU. Enumerated type: 242-tone RU Right 106-tone RU within the primary 20 MHz	Y	Y
	FORMAT is HE_MU	Indicates the channel width occupied by the preamble supporting channel bonding. See the Bandwidth field in Table 28-17 (HE-SIG-A field of an HE MU PPDU)	Y	Y
	FORMAT is HE_TRIG	In TXVECTOR, indicates the Bandwidth field of the HE-SIG-A in the transmitted PPDU. In RXVECTOR, indicates the estimated channel width of the received PPDU. Enumerated type: CBW20 for 20 MHz CBW40 for 40 MHz CBW80 for 80 MHz CBW160 for 160 MHz CBW80+80 for 80+80 MHz NOTE—The TXVECTOR parameter CH_BANDWIDTH does not represent the channel width of the transmitted PPDU.	Y	Y
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
DYN_BANDWIDTH_IN_NON_HT	FORMAT is HE_SU, HE_MU, HE_EXT_SU or HE_TRIG	Not present.	N	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
CH_BANDWIDTH_IN_NON_HT	FORMAT is HE_SU, HE_MU, HE_EXT_SU or HE_TRIG	Not present.	N	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		

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Table 28-1—TXVECTOR and RXVECTOR parameters *(continued)*

LENGTH	FORMAT is HE_SU, HE_MU, HE_EXT_SU or HE_TRIG	Not present.	N	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
APEP_LENGTH	FORMAT is HE_SU, HE_MU, HE_EXT_SU or HE_TRIG	If equal to 0, indicates an HE NDP PPDU. If greater than 0, indicates the number of octets in the range 1 to 1048575 in the A-MPDU pre-EOF padding (see 10.13.2 (A-MPDU length limit rules)) carried in the PSDU.	M U	O
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
PSDU_LENGTH	FORMAT is HE_SU, HE_MU, HE_EXT_SU or HE_TRIG	Indicates the number of octets in the HE PSDU in the range of 0 to aPSDUMaxLength octets (see Table 28-46 (HE PHY characteristics)). A value of 0 indicates an HE NDP PPDU.	N	Y
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
USER_POSITION	FORMAT is HE_SU, HE_MU, HE_EXT_SU or HE_TRIG	Not present.	N	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
NUM_STS	FORMAT is HE_SU	Indicates the number of space-time streams. Integer in the range 1-8.	Y	Y
	FORMAT is HE_EXT_SU	Indicates the number of space-time streams. Integer in the range 1-2.	Y	Y
	FORMAT is HE_MU	Indicates the number of space-time streams. Integer in the range: 1-4 per user per MU-MIMO RU in the TXVECTOR 1-4 per MU-MIMO RU in the RXVECTOR 1-8 per non MU-MIMO RU in the TXVECTOR and RXVECTOR NUM_STS summed over all users per RU is not greater than 8.	M U	M U
	FORMAT is HE_TRIG	Indicates the number of space-time streams. Integer in the range: 1-4 for a MU-MIMO RU in the TXVECTOR 1-4 per user per MU-MIMO RU in the RXVECTOR 1-8 for a non MU-MIMO RU in the TXVECTOR and RXVECTOR NUM_STS summed over all users per RU is not greater than 8.	M U	M U
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		

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Table 28-1—TXVECTOR and RXVECTOR parameters *(continued)*

GROUP_ID	FORMAT is HE_SU, HE_MU, HE_EXT_SU or HE_TRIG	Not present	N	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
PARTIAL_AID	FORMAT is HE_SU, HE_MU, HE_EXT_SU or HE_TRIG	Not present	N	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
TXOP_DURATION	FORMAT is HE_SU, HE_MU, HE_EXT_SU or HE_TRIG	Indicates a duration of time that is used to update the NAV for this TXOP (see 27.2.2 (Updating two NAVs)), except for a value of 127 (i.e., all 1s) which indicates an invalid value of TXOP duration in the HE-SIG-A field (see 27.11.5 (TXOP_DURATION)). B0 indicates whether the granularity is 8 μs or 128 μs. When B0 is 0, then B1 to B6 indicate a duration, in units of 8 μs, starting from 0 to 504 us (i.e, duration = (8 μs × value of (B1-B6)) μs). When B0 is 1, then B1 to B6 indicate a duration, in units of 128 μs, starting from 512 μs until 8448 μs (i.e, duration = (512 + 128 × value of (B1-B6)) μs). See 27.11.5 (TXOP_DURATION) for more details. NOTE—B1-B6 indicates an integer, where B1 is MSB.	Y	Y
	Otherwise	Not present.	N	N
SPATIAL_REUSE	FORMAT is HE_SU, HE_MU, HE_EXT_SU or HE_TRIG	Indicates the spatial reuse parameter. There is only one value for an HE SU PPDU, HE extended range SU PPDU and HE MU PPDU. There might be one to four values for an HE trigger-based PPDU depending on the bandwidth of the PPDU. See the Spatial Reuse field definition in 28.3.10.7.2 (Content). See 27.11a (TXVECTOR parameters SPATIAL_REUSE for an HE PPDU) for the setting rule.	Y	Y
	Otherwise	Not present	N	N
DOPPLER	FORMAT is HE_SU, HE_MU, HE_EXT_SU or HE_TRIG	Indicates whether the doppler effect should be considered for the PPDU. The value is 0 or 1	Y	N
	Otherwise	Not present	N	N

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Table 28-1—TXVECTOR and RXVECTOR parameters *(continued)*

NUM_USERS	FORMAT is HE_SU, HE_MU, HE_EXT_SU or HE_TRIG	Not present. NOTE—number of users for an HE SU PPDU, HE extended range SU PPDU and HE trigger-based PPDU is always 1. The number of users for an HE MU PPDU is determined by RU_ALLOCATION.	N	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
RU_ALLOCATION	FORMAT is HE_MU	Each 8 bit per 20 MHz PPDU BW for signaling: The RU assignment in frequency domain Number of MU-MIMO allocations See 28.3.10.8.4 (HE-SIG-B common content) for details.	Y	Y
	FORMAT is HE_TRIG	8 bit for RU allocation in the whole bandwidth. See 9.3.1.23 (Trigger frame format) for details	Y	Y
	Otherwise	Not present	N	N
BEAMFORMED	FORMAT is HE_SU or HE_EXT_SU	Set to 1 if a beamforming steering matrix is applied to the waveform in an SU transmission. Set to 0 otherwise.	Y	Y
	FORMAT is HE_MU or HE_TRIG	For a single user allocation in an RU, set to 1 if a beamforming steering matrix is applied, and set to 0 otherwise. For each user in a multi-user allocation in an RU, always set to 0.	M U	O
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
HE_LTF_TYPE	FORMAT is HE_SU, HE_MU, HE_EXT_SU or HE_TRIG	Indicates the type of HE-LTF. Enumerated type: 1x HE-LTF for 3.2 μs 2x HE-LTF for 6.4 μs 4x HE-LTF for 12.8 μs See 28.3.10.10 (HE-LTF) for details.	Y	Y
	Otherwise	Not present.	N	N
HE_LTF_MODE	FORMAT is HE_TRIG	Indicates whether the UL MU MIMO transmission uses single stream pilots or a mask on each spatial stream of the LTF sequence by a distinct orthogonal code. It is only present for full bandwidth MU-MIMO.	Y	N
	Otherwise	Not present.	N	N
NUM_HE_LTF	FORMAT is HE_TRIG	Indicate the number of HE-LTF symbols. See 27.5.2.3 (STA behavior) for details.	Y	N
	Otherwise	Not present.	N	N

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Table 28-1—TXVECTOR and RXVECTOR parameters *(continued)*

HE_SIGA_RESERVED	FORMAT is HE_TRIG	Indicates the Reserved field setting for HE-SIG-A2 of HE trigger based PPDU. See 27.5.2.3 (STA behavior) and Table 28-18 (HE-SIG-A field of an HE trigger-based PPDU) for details.	Y	N
	Otherwise	Not present.	N	N
STARTING_STS_NUM	FORMAT is HE_TRIG	Indicates the starting STS number in the global space-time streams for the UL MU MIMO.	Y	N
	Otherwise	Not present.	N	N
TXOP_PS_NOT_ALLOWED	FORMAT is HE_SU, HE_MU, HE_EXT_SU or HE_TRIG	Not present	N	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
TIME_OF_DEPARTURE_REQUE	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).			
RX_START_OF_FRAME_OFFSET	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).			
PREAMBLE_TYPE	FORMAT is NON_HT and NON_HT_MODULATION is one of ERP-DSSS ERP-CCK	Enumerated type: SHORTPREAMBLE LONGPREAMBLE	Y	Y
	Otherwise	Not present	N	N

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Table 28-1—TXVECTOR and RXVECTOR parameters *(continued)*

PE_DURATION	FORMAT is HE_SU, HE_MU, HE_EXT_SU or HE_TRIG.	Determines the duration of PE field in an HE PPDU. Possible values are 0 μs, 4 μs, 8 μs, 12 μs and 16 μs. Enumerated type: PE0 for 0 μs PE1 for 4 μs PE2 for 8 μs PE3 for 12 μs PE4 for 16 μs	Y	Y
BEAM_CHANGE	FORMAT is HE_SU or HE_EXT_SU	Boolean value: true indicates that the pre-HE-STF portion of the PPDU is spatially mapped differently from HE-LTF1. false indicates that the pre-HE-STF portion of the PPDU is spatially mapped the same way as HE-LTF1 on each tone.	Y	Y
	Otherwise	Not present		
BSS_COLOR	FORMAT is HE_SU, HE_MU, HE_EXT_SU or HE_TRIG	Set to a value of the AP's choosing within the range 0 to 63 (see 27.11 (Setting TXVECTOR parameters for an HE PPDU)).	Y	Y
	Otherwise	Not present	N	N
UPLINK_FLAG	FORMAT is HE_SU or HE_MU or HE_EXT_SU	Set to 1 if the HE PPDU is addressed to an AP. Set to 0 otherwise (see 27.11 (Setting TXVECTOR parameters for an HE PPDU)).	Y	Y
	Otherwise	Not present	N	N
STA_ID_LIST	FORMAT is HE_MU	Indicates the list of STA IDs for an HE MU PPDU (see 27.11 (Setting TXVECTOR parameters for an HE PPDU)).	M U	Y
	Otherwise	Not present	N	N

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Table 28-1—TXVECTOR and RXVECTOR parameters *(continued)*

SCRAMBLER_INTIAL_STATE	FORMAT is NON_HT	In TXVECTOR, if present, indicates the initial state of the scrambler of the transmitted PPDU. In RXVECTOR, indicates the Scrambler Initialization value in the Service field, prior to descrambling.	O	Y
	FORMAT is HE_MU or HE_TRIG	Not present.	N	N
	Otherwise	Indicates the Scrambler Initialization value in the Service field, prior to descrambling.	N	Y

NOTE—In the "TXVECTOR" and "RXVECTOR" columns, the following apply:
Y = Present;
N = Not present;
O = Optional;
MU indicates that the parameter is present once for an HE SU PPDU and HE extended range SU PPDU and present per user for an HE MU PPDU. For an HE trigger-based PPDU, MU in the TXVECTOR column indicates that the parameter is present once and MU in the RXVECTOR column indicates the parameter is present per user. Parameters specified to be present per user are conceptually supplied as an array of values indexed by *u*, where *u* takes values 0 to NUM_USERS–1.

28.3 HE PHY

28.3.1 Introduction

This subclause provides the procedure by which PSDUs are converted to and from transmissions on the wireless medium.

During transmission, a PSDU (in the SU case) or one or more PSDUs (in the MU case) are processed (i.e., scrambled and coded) and appended to the PHY preamble to create the PPDU. At the receiver, the PHY preamble is processed to aid in the detection, demodulation, and delivery of the PSDU.

28.3.2 MU transmission

28.3.2.1 Introduction

The MU transmissions include DL MU transmissions and UL MU transmissions.

The DL MU transmission allows an AP to simultaneously transmit frames to more than one non-AP STAs. For the DL MU transmission, the AP uses the HE MU PPDU format, and employs either DL OFDMA, DL MU-MIMO, or a mixture of both. The UL MU transmission allows an AP to receive simultaneous frames from more than one non-AP STAs. Non-AP STAs transmit their frames using HE trigger-based PPDU format and employ either UL OFDMA, UL MU-MIMO, or a mixture of both.

The HE PHY supports OFDMA transmissions, both in the DL and the UL where different users can occupy different RUs in a PPDU (see 28.3.9 (Mathematical description of signals)). On an RU in a PPDU, it is allowed to have single stream transmissions to one user or spatial multiplexing to one user (SU-MIMO) or spatial multiplexing to multiple users (MU-MIMO). Note that the VHT PHY supports only full bandwidth DL MU-MIMO as described in 21.3.11 (SU-MIMO and DL-MU-MIMO Beamforming). The HE PHY defines DL MU-MIMO and UL MU-MIMO, for the full bandwidth case as well as for the case where they

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are being used on only certain RUs in the PPDU. The combination of SU transmissions and MU-MIMO transmissions on different RUs in one PPDU is also supported.

28.3.3 OFDMA and SU tone allocation

28.3.3.1 General

Orthogonal Frequency Division Multiple Access (OFDMA) is an OFDM-based multiple access scheme where different subsets of subcarriers are allocated to different users, allowing simultaneous data transmission to or from several users. In OFDMA, in general, users are allocated different subsets of subcarriers which can change from one PPDU to the next. In HE, the time region covers the entire data portion of an HE PPDU, and the frequency region includes a number of contiguous subcarriers with the exception of the RUs which straddle DC where nulls are placed in the middle of the band. The difference between OFDM and OFDMA is illustrated in Table 28-15 (CH_BANDWIDTH and for pre-HE modulated fields). Similar to OFDM, OFDMA employs multiple subcarriers, but the subcarriers are divided into several groups of subcarriers where each group is denoted as a resource unit (RU). The grouping of subcarriers into groups of resource units is referred to as subchannelization.

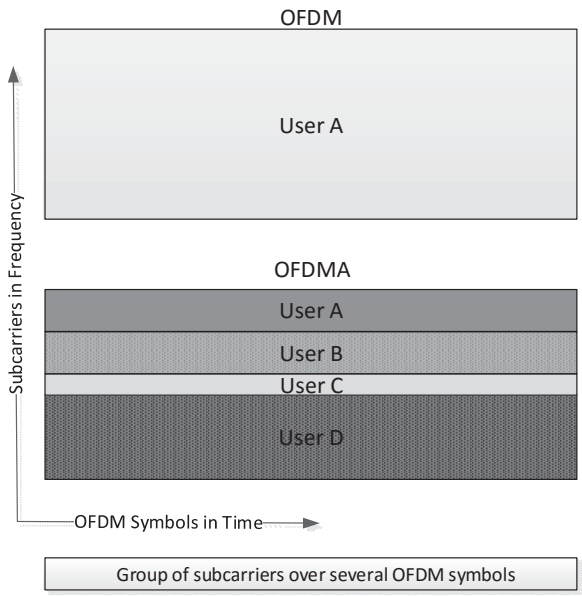

Figure 28-1—Illustration of OFDM and OFDMA concepts

Subchannelization defines subchannels that can be allocated to stations depending on their channel conditions and service requirements. An OFDMA system may allocate different transmit powers to different subchannels.

In OFDMA, an OFDM symbol is constructed of subcarriers, the number of which is a function of the PPDU bandwidth. There are several subcarrier types: 1) Data subcarriers which are used for data transmission; defined in 28.3.3.2 (Resource unit, guard and DC subcarriers), 2) Pilot subcarriers which are utilized for phase information and parameter tracking; defined in 28.3.3.4 (Pilot subcarriers), and 3) unused subcarriers which are not used for data/pilot transmission. The unused subcarriers are the DC subcarrier (defined in 28.3.3.2 (Resource unit, guard and DC subcarriers)), the Guard band subcarriers at the band edges (defined in 28.3.3.2 (Resource unit, guard and DC subcarriers)), and the Null subcarriers (defined in 28.3.3.3 (Null subcarriers)).

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28.3.3.2 Resource unit, guard and DC subcarriers

The following resource units (RUs) are defined for DL and UL transmission: a 26-tone RU, 52-tone RU, 106-tone RU, 242-tone RU, 484-tone RU and 996-tone RU and 2×996-tone RU.

The 26-tone RU, 52-tone RU, 106-tone RU and 242-tone RU are used in the 20 MHz, 40 MHz, 80 MHz, 160 MHz and 80+80 MHz HE MU PPDU formats or HE trigger-based PPDU formats using OFDMA transmission, with the exception that if an HE AP operates in a DFS channel where there is a non-HE OBSS, the HE AP shall not trigger any 26-tone RU and the HE non-AP STA shall not respond with 26-tone RU in a HE trigger-based PPDU in which HE data field is conveyed.

NOTE—If a HE non-AP STA does not respond with a 26-tone RU in HE trigger-based PPDU in a DFS channel, then AP is advised to trigger 52-tone RU for the same HE non-AP STA in the next HE trigger-based PPDU transmission.

The 484-tone RU is used in the 40 MHz, 80 MHz, 160 MHz and 80+80 MHz HE MU PPDU formats or HE trigger-based PPDU formats using OFDMA transmission. The 996-tone RU is used in the 80 MHz, 160 MHz and 80+80 MHz HE MU PPDU formats or HE trigger-based PPDU formats using OFDMA transmission. The 2×996-tone RU is used in the 160 MHz and 80+80 MHz HE MU PPDU formats or HE trigger-based PPDU formats using OFDMA transmission.

The 242-tone and larger RUs are used in the HE SU PPDU formats. The 242-tone RU is used in the 20 MHz HE SU PPDU format. The 484-tone RU is used in the 40 MHz HE SU PPDU format. The 996-tone RU is used in the 80 MHz HE SU PPDU format. The 2×996-tone RU is used in the 160 MHz and 80+80 MHz HE SU PPDU formats.

The maximum number of RUs in the 20 MHz, 40 MHz, 80 MHz, 160 MHZ and 80+80 MHz HE PPDU formats are defined in Table 28-2 (Maximum number of RUs for each channel width)..

Table 28-2—Maximum number of RUs for each channel width

RU type	CBW20	CBW40	CBW80	CBW80+80 and CBW160
26-tone RU	9	18	37	74
52-tone RU	4	8	16	32
106-tone RU	2	4	8	16
242-tone RU	1	2	4	8
484-tone RU	N/A	1	2	4
996-tone RU	N/A	N/A	1	2
2×996 tone RU	N/A	N/A	N/A	1

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An HE MU PPDU using OFDMA transmission can carry a mixture of 26-, 52-, 106-, 242-, 484 and 996-tone RUs.

Table 28-3—Subcarrier indices for RUs in a 20 MHz HE PPDU

RU type					
26-tone RU	RU 1 [−121: −96]	RU 2 [−95: −70]	RU 3 [−68: −43]	RU 4 [−42: −17]	RU 5 [−16: −4, 4: 16]
	RU 6 [17: 42]	RU 7 [43: 68]	RU 8 [70: 95]	RU 9 [96: 121]	
52-tone RU	RU 1 [−121: −70]	RU 2 [−68: −17]	RU 3 [17: 68]	RU 4 [70: 121]	
106-tone RU	RU 1 [−122: −17]		RU 2 [17: 122]		
242-tone RU	RU 1 [−122: −2, 2:122]				

Table 28-4—Subcarrier indices for RUs in a 40 MHz HE PPDU

RU type					
26-tone RU	RU 1 [−243: −218]	RU 2 [−217: −192]	RU 3 [−189: −164]	RU 4 [−163: −138]	RU 5 [−136: −111]
	RU 6 [−109: −84]	RU 7 [−83: −58]	RU 8 [−55: −30]	RU 9 [−29: −4]	
	RU 10 [4: 29]	RU 11 [30: 55]	RU 12 [58: 83]	RU 13 [84: 109]	RU 14 [111: 136]
	RU 15 [138: 163]	RU 16 [164: 189]	RU 17 [192: 217]	RU 18 [218: 243]	
52-tone RU	RU 1 [−243: −192]	RU 2 [−189: −138]	RU 3 [−109: −58]	RU 4 [−55: −4]	
	RU 5 [4: 55]	RU 6 [58: 109]	RU 7 [138: 189]	RU 8 [192: 243]	
106-tone RU	RU 1 [−243: −138]	RU 2 [−109: −4]	RU 3 [4: 109]	RU 4 [138: 243]	
242-tone RU	RU 1 [−244: −3]		RU2 [3: 244]		
484-tone RU	RU 1 [−244: −3, 3: 244]				

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Table 28-5—Subcarrier indices for RUs in an 80 MHz HE PPDU

RU type					
26-tone RU	RU 1 [−499: −474]	RU 2 [−473: −448]	RU 3 [−445: −420]	RU 4 [−419: −394]	RU 5 [−392: −367]
	RU 6 [−365: −340]	RU 7 [−339: −314]	RU 8 [−311: −286]	RU 9 [−285: −260]	
	RU 10 [−257: −232]	RU 11 [−231: −206]	RU 12 [−203: −178]	RU 13 [−177: −152]	RU 14 [−150: −125]
	RU 15 [−123: −98]	RU 16 [−97: −72]	RU 17 [−69: −44]	RU 18 [−43: −18]	RU 19 [−16: −4, 4: 16]
	RU 20 [18: 43]	RU 21 [44: 69]	RU 22 [72: 97]	RU 23 [98: 123]	RU 24 [125: 150]
	RU 25 [152: 177]	RU 26 [178: 203]	RU 27 [206: 231]	RU28 [232: 257]	
	RU 29 [260: 285]	RU 30 [286: 311]	RU 31 [314: 339]	RU 32 [340: 365]	RU 33 [367: 392]
	RU 34 [394: 419]	RU 35 [420: 445]	RU 36 [448: 473]	RU37 [474: 499]	
52-tone RU	RU 1 [−499: −448]	RU 2 [−445: −394]	RU 3 [−365: −314]	RU 4 [−311: −260]	
	RU 5 [−257: −206]	RU 6 [−203: −152]	RU 7 [−123: −72]	RU 8 [−69: −18]	
	RU 9 [18: 69]	RU 10 [72: 123]	RU 11 [152: 203]	RU 12 [206: 257]	
	RU 13 [260: 311]	RU 14 [314: 365]	RU 15 [394: 445]	RU 16 [448: 499]	
106-tone RU	RU 1 [−499: −394]	RU 2 [−365: −260]	RU 3 [−257: −152]	RU 4 [−123: −18]	
	RU 5 [18: 123]	RU 6 [152: 257]	RU 7 [260: 365]	RU 8 [394: 499]	
242-tone RU	RU 1 [−500: −259]	RU 2 [−258: −17]	RU 3 [17: 258]	RU 4 [259: 500]	
484-tone RU	RU 1 [−500: −17]		RU 2 [17: 500]		
996-tone RU	RU 1 [−500: −3, 3: 500]				

A 26-tone RU consists of 24 data subcarriers and 2 pilot subcarriers. The positions of the pilots for the 26-tone RU are defined in 28.3.3.4 (Pilot subcarriers). The location of the 26-tone RUs are fixed as defined in Table 28-3 (Subcarrier indices for RUs in a 20 MHz HE PPDU), Table 28-4 (Subcarrier indices for RUs in a 40 MHz HE PPDU) and Table 28-5 (Subcarrier indices for RUs in an 80 MHz HE PPDU) and shown in Figure 28-2 (RU locations in a 20 MHz HE PPDU), Figure 28-3 (RU locations in a 40 MHz HE PPDU) and Figure 28-4 (RU locations in an 80 MHz HE PPDU) for the 20 MHz, 40 MHz and 80 MHz HE MU PPDU formats or HE trigger-based PPDU formats using OFDMA transmission, respectively. The same structure as used for the 80 MHz HE MU PPDU formats or HE trigger-based PPDU formats using OFDMA

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transmission is used for each 80 MHz frequency segment of the 160 MHz and 80+80 MHz HE MU PPDU or HE trigger-based PPDU formats using OFDMA transmission. The center 26-tone RU in the 20 MHz and 80 MHz HE MU PPDU or HE trigger-based PPDU formats using OFDMA transmission (Figure 28-2 (RU locations in a 20 MHz HE PPDU) and Figure 28-4 (RU locations in an 80 MHz HE PPDU)) is located on subcarriers [–16: –4, 4: 16].

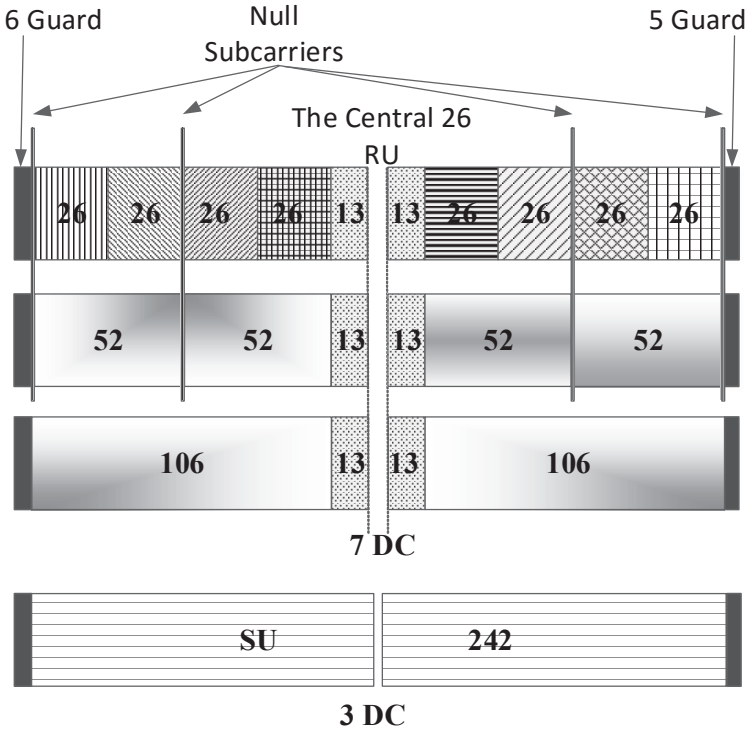

Figure 28-2—RU locations in a 20 MHz HE PPDU

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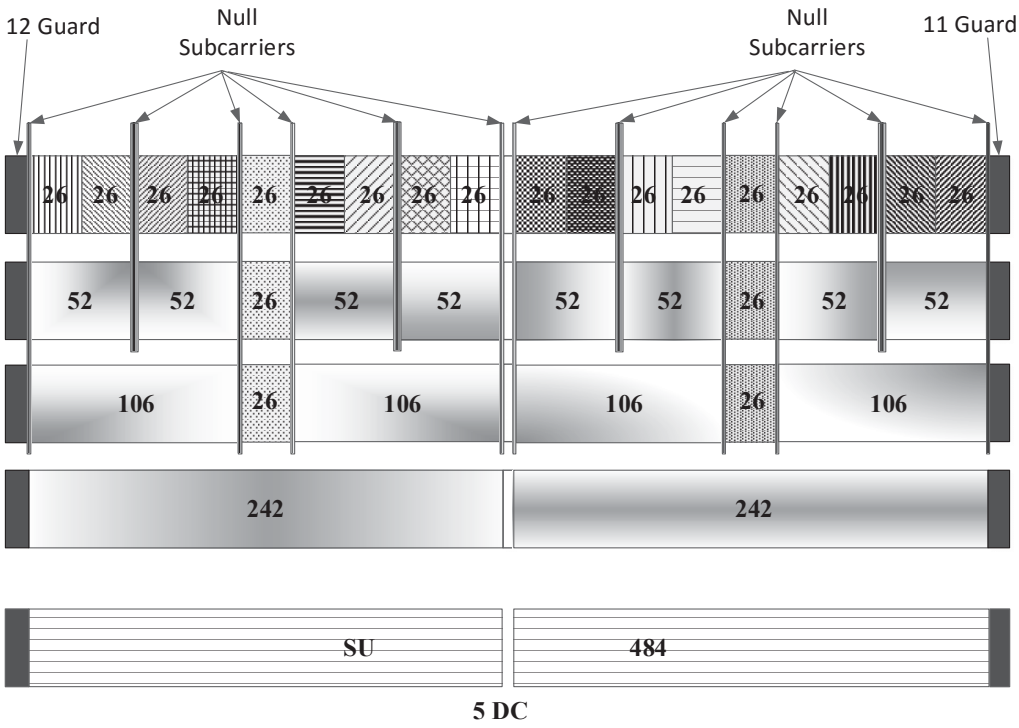

Figure 28-3—RU locations in a 40 MHz HE PPDU

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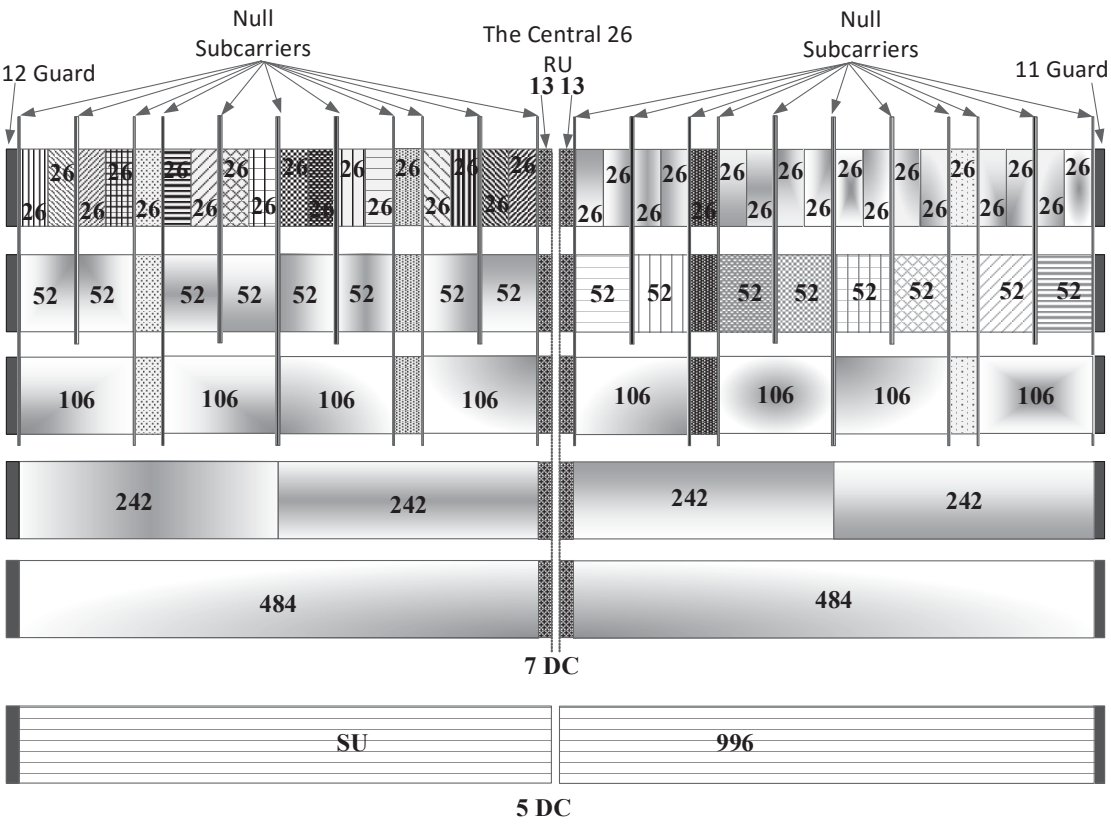

Figure 28-4—RU locations in an 80 MHz HE PPDU

A 52-tone RU consists of 48 data subcarriers and 4 pilot subcarriers. The positions of the pilots for the 52-tone RU are defined in 28.3.3.4 (Pilot subcarriers). The locations of the 52-tone RUs are fixed as defined in Table 28-3 (Subcarrier indices for RUs in a 20 MHz HE PPDU), Table 28-4 (Subcarrier indices for RUs in a 40 MHz HE PPDU) and Table 28-5 (Subcarrier indices for RUs in an 80 MHz HE PPDU) and illustrated in Figure 28-2 (RU locations in a 20 MHz HE PPDU), Figure 28-3 (RU locations in a 40 MHz HE PPDU) and Figure 28-4 (RU locations in an 80 MHz HE PPDU) for the 20 MHz, 40 MHz and 80 MHz HE MU PPDU formats or HE trigger-based PPDU formats using OFDMA transmission, respectively. The same structure as used in the 80 MHz HE MU PPDU format or HE trigger-based PPDU formats using OFDMA transmission is used for each 80 MHz frequency segment of the 160 MHz and 80+80 MHz HE MU PPDU formats or HE trigger-based PPDU formats using OFDMA transmission.

A 106-tone RU consists of 102 data subcarriers and 4 pilot subcarriers. The positions of the pilots for the 106-tone RU are defined in 28.3.3.4 (Pilot subcarriers). The locations of the 106-tone RUs are fixed as defined in Table 28-3 (Subcarrier indices for RUs in a 20 MHz HE PPDU), Table 28-4 (Subcarrier indices for RUs in a 40 MHz HE PPDU) and Table 28-5 (Subcarrier indices for RUs in an 80 MHz HE PPDU) and illustrated in Figure 28-2 (RU locations in a 20 MHz HE PPDU), Figure 28-3 (RU locations in a 40 MHz HE PPDU) and Figure 28-4 (RU locations in an 80 MHz HE PPDU) for the 20 MHz, 40 MHz and 80 MHz HE MU PPDU formats or HE trigger-based PPDU formats using OFDMA transmission, respectively. The same structure as used in the 80 MHz HE MU PPDU formats or HE trigger-based PPDU formats using OFDMA transmission is used for each 80 MHz frequency segment of the 160 MHz and 80+80 MHz HE MU PPDU formats or HE trigger-based PPDU formats using OFDMA transmission.

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A 242-tone RU consists of 234 data subcarriers and 8 pilot subcarriers. The positions of pilots for the 242-tone RU are defined in 28.3.3.4 (Pilot subcarriers). The locations of the 242-tone RUs are fixed as defined in Table 28-3 (Subcarrier indices for RUs in a 20 MHz HE PPDU), Table 28-4 (Subcarrier indices for RUs in a 40 MHz HE PPDU) and Table 28-5 (Subcarrier indices for RUs in an 80 MHz HE PPDU) and illustrated in Figure 28-2 (RU locations in a 20 MHz HE PPDU), Figure 28-3 (RU locations in a 40 MHz HE PPDU) and Figure 28-4 (RU locations in an 80 MHz HE PPDU) for the 20 MHz, 40 MHz and 80 MHz HE PPDU formats, respectively. The same structure as used in the 80 MHz HE PPDU formats is used for each 80 MHz frequency segment of the 160 MHz and 80+80 MHz HE PPDU formats.

A 484-tone RU consists of 468 data subcarriers and 16 pilot subcarriers. The position of the pilots for the 484-tone RU is defined in 28.3.3.4 (Pilot subcarriers). The locations of the 484-tone RUs are fixed as defined in Table 28-4 (Subcarrier indices for RUs in a 40 MHz HE PPDU) and Table 28-5 (Subcarrier indices for RUs in an 80 MHz HE PPDU) and illustrated in Figure 28-3 (RU locations in a 40 MHz HE PPDU) and Figure 28-4 (RU locations in an 80 MHz HE PPDU) for the 40 MHz and 80 MHz HE PPDU formats. The same structure as used for the 80 MHz HE PPDU formats is used for each 80 MHz frequency segment of the 160 MHz and 80+80 MHz HE PPDU formats.

A 996-tone RU consists of 980 data subcarriers and 16 pilot subcarriers. The position of the pilots for the 996-tone RU is defined in 28.3.3.4 (Pilot subcarriers). The locations of the 996-tone RUs are fixed and located on subcarrier [−1012: −515, −509: −12] and [12: 509, 515: 1012] for each half of the BW, respectively, for 160 MHz and 80+80 MHz HE PPDU formats.

The 20 MHz HE MU PPDU and HE trigger-based PPDU with more than one RU has 7 DC subcarriers located at [−3: 3]. The 20 MHz HE SU PPDU with a 242-tone RU has 3 DC subcarriers located at [−1: 1]. The 40 MHz HE PPDU with a 484-tone RU has 5 DC subcarriers located at [−2: 2]. An 80 MHz HE MU PPDU and HE trigger-based PPDU with more than one RU has 7 DC subcarriers located at [−3: 3]. The 80 MHz HE SU PPDU with a 996-tone RU has 5 DC subcarriers located at [−2: 2]. The same structure as used in the 80 MHz HE PPDU is used for each 80 MHz frequency segment of the 160 MHz and 80+80 MHz HE PPDU. The DC tones are located on subcarriers [−11: 11].

The 20 MHz HE PPDU format has 11 guard subcarriers (6, 5) located at [−128: −123] and [123: 127] as shown in Figure 28-2 (RU locations in a 20 MHz HE PPDU). The 40 MHz HE PPDU has 23 guard subcarriers (12, 11) located at [−256: −245] and [245: 255] as shown in Figure 28-3 (RU locations in a 40 MHz HE PPDU). The 80 MHz HE PPDU has 23 guard subcarriers (12, 11) located at [−512: −501] and [501: 511] as shown in Figure 28-4 (RU locations in an 80 MHz HE PPDU). For 160 MHz and 80+80 MHz HE PPDUs, the same number of leftmost and rightmost guard subcarriers as 80 MHz are defined at each edge of the 160 MHz.

In an HE MU PPDU, at least *N*x4x26 subcarriers (contiguous or non-contiguous), where *N* is the number of 20 MHz channels' legacy preambles present, shall be occupied throughout the signaled BW.

28.3.3.3 Null subcarriers

There are null subcarriers between the 26-, 52- and 106-tone RU locations as illustrated in Figure 28-2 (RU locations in a 20 MHz HE PPDU), Figure 28-3 (RU locations in a 40 MHz HE PPDU) and Figure 28-4 (RU

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locations in an 80 MHz HE PPDU). The null subcarriers have zero energy. The indices of the null subcarrier are enumerated in Table 28-6 (Null subcarrier indices).

Table 28-6— Null subcarrier indices

Channel Width	RU Size	Null Subcarrier Indices
20 MHz	26, 52	±69, ±122
	106	none
	242	none
40 MHz	26, 52	±3, ±56, ±57, ±110, ±137, ±190, ±191, ±244
	106	±3, ±110, ±137, ±244
	242, 484	none
80 MHz	26, 52	±17, ±70, ±71, ±124, ±151, ±204, ±205, ±258, ±259, ±312, ±313, ±366, ±393, ±446, ±447, ±500
	106	±17, ±124, ±151, ±258, ±259, ±366, ±393, ±500
	242, 484	none
	996	none

28.3.3.4 Pilot subcarriers

If pilot subcarriers are present in the HE-LTF field, the pilot subcarrier locations in the HE-LTF field and Data field shall be the same, except for the 1x HE-LTF. In the 1x HE-LTF, the pilot locations are the pilot subcarrier indices that are multiples of 4 of the pilot subcarriers for data field. All pilot subcarriers are at the even indices enumerated in Table 28-7 (Pilot subcarrier indices).

Table 28-7— Pilot subcarrier indices

Channel Width	RU Size	Pilot Subcarrier Indices
20 MHz	26, 52	±10, ±22, ±36, ±48, ±62, ±76, ±90, ±102, ±116
	106, 242	±22, ±48, ±90, ±116
40 MHz	26, 52	±10, ±24, ±36, ±50, ±64, ±78, ±90, ±104, ±116, ±130, ±144, ±158, ±170, ±184, ±198, ±212, ±224, ±238
	106, 242, 484	±10, ±36, ±78, ±104, ±144, ±170, ±212, ±238
80 MHz	26, 52	±10, ±24, ±38, ±50, ±64, ±78, ±92, ±104, ±118, ±130, ±144, ±158, ±172, ±184, ±198, ±212, ±226, ±238, ±252, ±266, ±280, ±292, ±306, ±320, ±334, ±346, ±360, ±372, ±386, ±400, ±414, ±426, ±440, ±454, ±468, ±480, ±494
	106, 242, 484	±24, ±50, ±92, ±118, ±158, ±184, ±226, ±252, ±266, ±292, ±334, ±360, ±400, ±426, ±468, ±494
	996	±24, ±92, ±158, ±226, ±266, ±334, ±400, ±468

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Table 28-7— Pilot subcarrier indices *(continued)*

160 MHz	26, 52, 106, 242, 484	{pilot subcarrier indices in 80 MHz –512, pilot subcarrier indices in 80 MHz +512}
	996	{for the first 80 MHz, pilot subcarrier indices in 80 MHz –512, for the second 80 MHz, pilot subcarrier indices in 80 MHz +512}

The pilot subcarriers locations for 160 MHz or 80+80 MHz shall use the same 80 MHz locations for both 80 MHz.

28.3.3.5 RU restriction rules when operating 20 MHz

A non-AP STA can operate with 20 MHz, because either it is a 20 MHz-only HE device (see 28.3.9 (Mathematical description of signals)), or it reduces operating channel width to 20 MHz by ROM (see 27.8 (Operating mode indication)). When a 20 MHz operating non-AP STA is either a recipient of 40, 80, 80+80 or 160 MHz DL-OFDMA, or one of transmitters of 40, 80, 80+80 or 160 MHz UL-OFDMA, RU tone mapping in 20 MHz is not aligned with 40, 80, 80+80 or 160 MHz RU tone mapping (see 28.3.3.2 (Resource unit, guard and DC subcarriers)). Due to misalignment of these RU locations, some of these RUs may cause significant performance penalty or interference to neighbor RUs. To improve the throughput and interoperability, some RUs in 20 MHz operating STAs are restricted to be used in 40, 80, 80+80 or 160 MHz OFDMA operation.

An AP shall not assign the following RUs to 20 MHz operating STAs

— For 26-tone RUs, [Table 28-4 (Subcarrier indices for RUs in a 40 MHz HE PPDU) and Table 28-5 (Subcarrier indices for RUs in an 80 MHz HE PPDU)]
  - RU 5 and 14 in 40 MHz DL/UL OFDMA (2 26-tone RUs are restricted)
  - RU 5, 10, 14, 19, 24, 28, 33 in 80 MHz DL/UL OFDMA (7 26-tone RUs are restricted)
  - RU 5, 10, 14, 19, 24, 28, 33 in lower 80 MHz and upper 80 MHz, in 80+80 or 160 MHz DL/UL OFDMA (14 26-tone RUs are restricted)

— For 52-tone RUs, [Table 28-4 (Subcarrier indices for RUs in a 40 MHz HE PPDU) and Table 28-5 (Subcarrier indices for RUs in an 80 MHz HE PPDU)]
  - RU 5, 12 in 80 MHz DL/UL OFDMA (2 of 52-tone RUs are restricted)
  - RU 5, 12 in lower 80 MHz and upper 80 MHz, in 80+80 or 160 MHz DL/UL OFDMA (4 of 52-tone RUs are restricted)

— For 106-tone RUs, [Table 28-4 (Subcarrier indices for RUs in a 40 MHz HE PPDU) and Table 28-5 (Subcarrier indices for RUs in an 80 MHz HE PPDU)]
  - RU 3, 6 in 80MHz DL/UL OFDMA (2 of 106-tone RUs are restricted)
  - RU 3, 6 in lower 80 MHz and upper 80 MHz, in 80+80 or 160 MHz DL/UL OFDMA (4 of 106-tone RUs are restricted)

Center 26-tone RU in primary 20 channel shall not be assigned to any STAs where 20 MHz operating STAs are recipients of 40/80/160/80+80 OFDMA.

It is optional whether all 242-tone RUs of 20 MHz operating STAs to be supported in 40/80/160/80+80 MHz DL-OFDMA. If supported, there is no restriction on 242-tone RUs. A 242-tone RU shall not be allocated to 20 MHz operating STAs in 40/80/160/80+80 for UL-OFDMA.

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28.3.3.6 20 MHz only HE STAs

A 20 MHz only HE STA operates with 20 MHz channel width only, in frequency bands between 1 GHz and 6 GHz. A 20 MHz only HE STA operates in the primary 20 MHz channel as a mandatory mode. The supported channel bandwidth is indicated in the Channel Width Set field in the HE Capabilities element. Only a non-AP HE STA can be a 20 MHz-only STA.

An HE AP in 5 GHz shall be 80 MHz capable and operate for both 80 MHz capable non-AP HE STAs and 20 MHz only non-AP HE STAs.

A 20 MHz only non-AP HE STA supports tone mapping of 26-tone RU, 52-tone RU, 106-tone RU and 242-tone RU, for 20 MHz and 40 MHz OFDMA in 2.4 GHz and 5 GHz frequency band, and for 80 MHz, 80+80 MHz and 160 MHz OFDMA in 5 GHz frequency band, where some of RUs are restricted to operate (see 28.3.3.5 (RU restriction rules when operating 20 MHz)).

28.3.3.7 DL MU transmission

DL MU transmission allows an AP to simultaneously transmit to more than one non-AP STA. The AP uses the HE MU PPDU for DL MU transmission.

28.3.3.8 DL MU-MIMO

28.3.3.8.1 Minimum RU size in DL MU-MIMO

A STA capable of receiving DL MU-MIMO transmission on an RU that does not span the entire PPDU bandwidth in an HE MU PPDU shall support reception of DL MU-MIMO transmissions for all RU sizes greater than or equal to 106-tones.

28.3.3.8.2 Maximum number of spatial streams in an HE MU PPDU

An HE STA shall support reception of DL MU-MIMO transmissions on full bandwidth with maximum number of space-time streams (per user) equal to minimum of 4 and the maximum number of space-time streams supported for reception of HE SU PPDUs. The maximum number of space-time streams supported for reception of HE SU PPDUs is indicated for various bandwidths in Tx Rx HE MCS Support field in the HE Capabilities element.

An HE STA shall support reception of DL MU-MIMO transmissions on full bandwidth with the total number of space-time streams (across NUM_USERS) less than or equal to a maximum value indicated by the Nsts_Total support for BW <= 80 MHz and Nsts_Total support for BW > 80 MHz fields in the HE Capabilities element.

All of the aforementioned restrictions on the per-user and total number of space-time-streams are also applicable to an MU-MIMO transmission on an RU in an HE MU PPDU where the RU does not span the entire PPDU bandwidth.

28.3.3.8.3 Resource indication and STA self-identification in an HE MU PPDU

An AP that transmits an HE MU PPDU shall set the UL/DL field in the HE-SIG-A field to 0. A full bandwidth MU-MIMO transmission using HE MU PPDU format has a value of 1 for the SIGB Compression field in HE-SIG-A and the SIGB Common field is not present. If the value of SIGB Compression field in HE-SIG-A is 0, the RU allocation signaling in the HE-SIG-B common field indicates the combination of RUs in current PPDU bandwidth and the number of STAs on each RU for SU/MU-MIMO transmission. The number of users in RU r for MU-MIMO transmission, $N_{user,r}$ is indicated together with the RU allocation as defined in Table 28-21 (RU allocation signaling: arrangement and number of MU-MIMO allocations). If the

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value of the SIGB Compression field in HE-SIG-A is 1, there is no RU allocation signaling in HE-SIG-B Common field and HE-SIG-B contains only User specific fields. The number of STAs in the MU-MIMO group is indicated in the Number Of HE-SIG-B Symbols Or MU-MIMO Users field in HE-SIG-A. For bandwidths larger than 20 MHz, the User block fields are split equitably between two SIG-B channels, i.e., for a *k* user MU-MIMO PPDU, 1, …., ceil(k/2) User block fields are carried in HE-SIG-B content channel 1 and ceil(*k*/2) + 1, …, *k* User block fields in HE-SIG-B content channel 2. The number of spatial streams, $N_{SS,r,u}$, is indicated by the NSTS field in user specific block as defined in Table 28-22 (Fields of the HE-SIG-B user field for an non-MU-MIMO allocation) and Table 28-23 (Fields of the HE-SIG-B user field for an MU-MIMO allocation). The allocated spatial streams for a designated MU-MIMO user and the total number of spatial streams on the RU are indicated in spatial configuration field of user specific block containing the STA ID of designated MU-MIMO STA as defined in Table 28-24 (Spatial Configuration subfield encoding).

When processing the HE-SIG-B, a STA will look at information of each RU to find out its membership status, i.e., if it belongs to a beamformee group in a certain RU. If $N_{user,r}$ STAs are scheduled in RU *r*, there are $N_{user,r}$ user specific blocks for RU *r*. Each user specific block has an 11-bit field indicating the STA ID. A STA identifies itself as a member in the beamformee group in the RU, if its STA ID matches one of the STA IDs. The user position is indicated by the block index. From a multiplexing information lookup table for $N_{user,r}$, the ordered number of spatial streams for all members in the beamformee group in RU *r*, $N_{SS,r,u}$, $u = 1, \ldots, N_{user,r}$ is obtained. The spatial streams of different users are ordered in accordance to user position values, i.e., the spatial streams for the user in user position 0 come first, followed by the spatial streams for the user in position 1, followed by the spatial streams for the user in position 2, and followed by the spatial streams for the user in position 3, and so on.

A STA is also able to identify the space-time streams intended for other STAs that act as interference. HE-LTF symbols in the DL HE MU PPDU are used to measure the channel for the space-time streams intended for the STA and can also be used to measure the channel for the interfering space-time streams. To successfully demodulate the space-time streams intended for the STA, it is recommended that the STA uses the channel knowledge for all space-time streams to reduce the effect of interfering space-time streams.

If a STA finds that it is a member of the beamformee group in RU r, its corresponding $N_{STS,r,u}$ interpreted from the HE-SIG-B user specific blocks shall not be zero for the STA in the PPDU. If a STA finds that it is not a member of the beamformee group in RU *r*, then the STA may elect not to process RU *r* in the remainder of the PPDU.

28.3.3.9 UL MU transmission

28.3.3.9.1 Introduction

UL MU transmissions allow an AP to receive simultaneous frames from more than one non-AP STA. UL MU transmissions are preceded by a Trigger frame from the AP. The non-AP STA uses the HE trigger-based PPDU for UL MU transmission.

28.3.3.10 UL MU-MIMO

28.3.3.10.1 Introduction

UL MU-MIMO is a technique to allow multiple STAs to transmit simultaneously over the same frequency resource to the receiver. The concept is very similar to SU-MIMO where multiple space-time streams are transmitted simultaneously over the same frequency resource utilizing spatial multiplexing through multiple antennas at the transmitter and receiver. The key difference from SU-MIMO is that in UL MU-MIMO, the transmitted streams originate from multiple STAs.

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28.3.3.10.2 Minimum RU size in UL MU-MIMO

A STA capable of an UL MU-MIMO transmission on an RU that does not span the entire PPDU bandwidth in an HE trigger-based PPDU shall support UL MU-MIMO transmission for all RU sizes greater than or equal to 106 subcarriers.

28.3.3.10.3 MU-MIMO LTF Mode

A STA capable of UL MU-MIMO transmission on full bandwidth shall support single stream pilot and masking LTF sequence of each spatial stream by a distinct orthogonal code.

A STA capable of UL OFDMA with MU-MIMO transmission on an RU in an HE trigger-based PPDU shall support single stream pilot for any UL OFDMA transmission, including UL OFDMA with MU-MIMO transmission on an RU in an HE trigger-based PPDU.

28.3.3.10.4 Maximum number of spatial streams in an HE trigger-based PPDU

A STA capable of UL MU-MIMO transmission shall support UL MU-MIMO transmissions on full bandwidth with maximum number of space-time streams (per user) equal to minimum of 4 and the maximum number of space-time streams supported for transmission of HE SU PPDUs. The maximum number of space-time streams supported for transmission of HE SU PPDUs is indicated for various bandwidths in Tx Rx HE MCS Support field in the HE Capabilities element.

A STA capable of UL MU-MIMO transmission on the full bandwidth shall support a total of up to 8 space-time streams in the UL MU-MIMO transmission.

All of the aforementioned restrictions on the per-user and total number of space-time-streams are also applicable to an MU-MIMO transmission on an RU in an HE MU PPDU where the RU does not span the entire PPDU bandwidth.

28.3.3.10.5 Resource allocation for an HE trigger-based PPDU

UL MU transmissions are preceded by a Trigger frame from the AP. The Trigger frame indicates the transmitting STAs in the Common Info field about when to transmit the UL MU-MIMO PPDUs, the duration of the payload, and packet-extension. The GI duration for UL OFDMA/MU-MIMO transmissions shall also be explicitly indicated by AP in the Trigger frame. The value of GI duration for all users addressed by the Trigger frame shall be the same. The Trigger frame indicates whether the UL MU transmission following it uses single stream pilots or a mask on each spatial stream of the LTF sequence by a distinct orthogonal code. When single stream pilot is used, no masking is applied to the HE-LTF. Single stream pilot is used for any UL OFDMA transmission, including UL OFDMA with MU-MIMO transmissions. The appropriate MU-MIMO LTF mode indicated by the Trigger frame is used for full bandwidth UL MU-MIMO transmission. The allocated RU and spatial streams are carried in the fields of RU allocation info and SS allocation of User Info field, where Address field is set as the AID of designated MU-MIMO STA.

If a STA finds that there is no User Info field in Trigger frame carrying the STA's AID in the Address field, then the STA will not transmit in the following HE trigger-based PPDU.

28.3.4 HE PPDU formats

Four HE PPDU formats are defined: HE SU PPDU, HE MU PPDU, HE extended range SU PPDU and HE trigger-based PPDU.

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The format of the HE SU PPDU is defined as in Figure 28-5 (HE SU PPDU format). This PPDU format is used for SU transmission and, in this format, the HE-SIG-A field is not repeated.

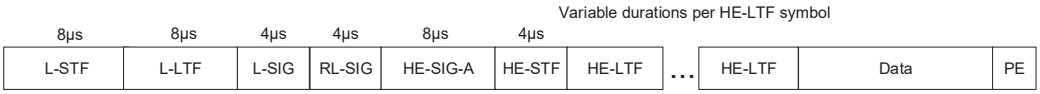

Figure 28-5—HE SU PPDU format

The format of the HE MU PPDU is defined as in Figure 28-6 (HE MU PPDU format). This format is used for transmission to one or more users that is not a response of a Trigger frame. The HE-SIG-B field is present in this format.

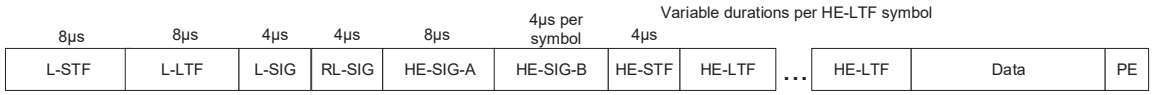

Figure 28-6—HE MU PPDU format

The format of the HE extended range SU PPDU is defined as in Figure 28-7 (HE extended range SU PPDU format). This format is used for SU transmission and, in this format, the HE-SIG-A field is repeated.

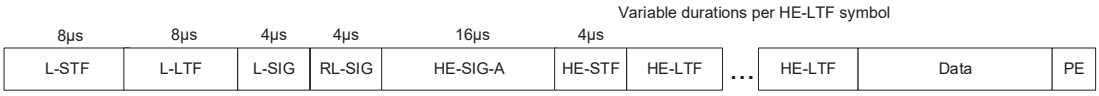

Figure 28-7—HE extended range SU PPDU format

The format of the HE trigger-based PPDU is defined as in Figure 28-8 (HE trigger-based PPDU format). This format is used for a transmission that is a response to a Trigger frame. The HE trigger-based PPDU format is identical to the HE SU PPDU format for the L-STF, L-LTF, L-SIG, RL-SIG, HE-SIG-A fields. The duration of the HE-STF field is 8 μs.

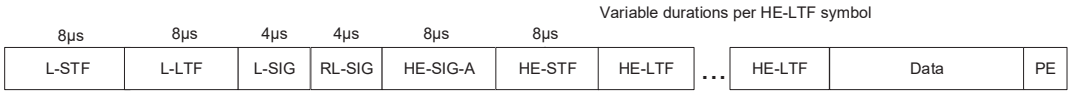

Figure 28-8—HE trigger-based PPDU format

The fields of the HE PPDU formats are summarized in Figure 28-8 (HE PPDU fields).

Table 28-8—HE PPDU fields

Field	Description
L-STF	Non-HT Short Training field
L-LTF	Non-HT Long Training field

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Table 28-8—HE PPDU fields *(continued)*

L-SIG	Non-HT SIGNAL field
RL-SIG	Repeated Non-HT SIGNAL field
HE-SIG-A	HE Signal A field
HE-SIG-B	HE Signal B field
HE-STF	HE Short Training field
HE-LTF	HE Long Training field
Data	The Data field carrying the PSDU(s)
PE	Packet Extension field

The RL-SIG, HE-SIG-A, HE-SIG-B, HE-STF, HE-LTF, and PE fields exist only in HE PPDUs. The HE-SIG-B field is present only in the HE MU PPDU. The duration of the PE field is determined by the TXVECTOR parameter PE_DURATION.

The L-STF, L-LTF, L-SIG, RL-SIG, HE-SIG-A, HE-SIG-A-R, and HE-SIG-B fields are referred to as the Pre-HE modulated fields, while the HE-STF, HE-LTF and Data fields are referred to as the HE modulated fields.

28.3.5 Transmitter block diagram

The generation of each field in an HE PPDU uses many of the following blocks:

a) pre-FEC PHY padding
b) Scrambler
c) FEC (BCC or LDPC) encoders
d) post-FEC PHY padding
e) Stream parser
f) Segment parser (for contiguous 160 MHz and noncontiguous 80+80 MHz transmissions)
g) BCC interleaver
h) Constellation mapper
i) DCM tone mapper
j) Pilot insertion
k) Replicate over multiple 20 MHz (if BW > 20 MHz)
l) Multiply by 1st column of $P_{HE\text{-}LTF}$
m) LDPC tone mapper
n) Segment deparser
o) Space time block code (STBC) encoder
p) Cyclic shift diversity (CSD) per STS insertion
q) Spatial mapper
r) Spatial and frequency mapping
s) Inverse discrete Fourier transform (IDFT)
t) Cyclic shift diversity (CSD) per chain insertion

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u) Guard interval (GI) insertion

v) Windowing

Figure 28-9 (Transmitter block diagram for the L-SIG, RL-SIG and HE-SIG-A fields for an HE SU PPDU and HE extended range SU PPDU when the Beam Change field is 1 and the HE MU PPDU) to Figure 28-17 (Transmitter block diagram for the Data field of an HE SU PPDU in 80+80 MHz with LDPC encoding) show example transmitter block diagrams. The actual structure of the transmitter is implementation dependent.

In particular, Figure 28-9 (Transmitter block diagram for the L-SIG, RL-SIG and HE-SIG-A fields for an HE SU PPDU and HE extended range SU PPDU when the Beam Change field is 1 and the HE MU PPDU) shows the transmit process for the L-SIG, RL-SIG, and HE-SIG-A fields of an HE PPDU using one frequency segment, when the Beam Change subfield in HE-SIG-A field is set to 1. These transmit blocks are also used to generate the L-STF and L-LTF fields of the HE PPDU when the Beam Change subfield in HE-SIG-A field is set to 1, with the following exceptions:

— The BCC encoder and interleaver as well as constellation mapper are not used when generating the L-STF and L-LTF fields.

— The BCC interleaver is not applied in the repeated HE-SIG-A symbols (i.e. the 2nd and the 4th OFDM symbols of HE-SIG-A field) in the HE extended range SU PPDU.

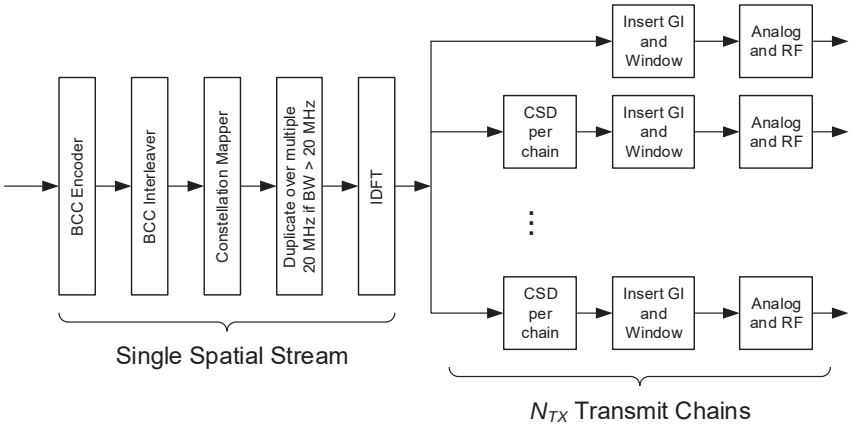

Figure 28-9—Transmitter block diagram for the L-SIG, RL-SIG and HE-SIG-A fields for an HE SU PPDU and HE extended range SU PPDU when the Beam Change field is 1 and the HE MU PPDU

Figure 28-10 (Transmitter block diagram for the L-SIG, RL-SIG and HE-SIG-A fields for an HE SU PPDU and HE extended range SU PPDU when the Beam Change field is 0) shows the transmit process for the L-SIG, RL-SIG, and HE-SIG-A fields of an HE PPDU using one frequency segment, when the Beam Change subfield in HE-SIG-A field is set to 0. These transmit blocks are also used to generate the L-STF and L-LTF fields of the HE PPDU when the Beam Change subfield in HE-SIG-A field is set to 0, with the following exceptions:

— The BCC encoder and interleaver as well as constellation mapper are not used when generating the L-STF and L-LTF fields.

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— The BCC interleaver is not applied in the repeated HE-SIG-A field OFDM symbols (i.e., the 2nd and the 4th OFDM symbols of HE-SIG-A field) in the HE extended range SU PPDU.

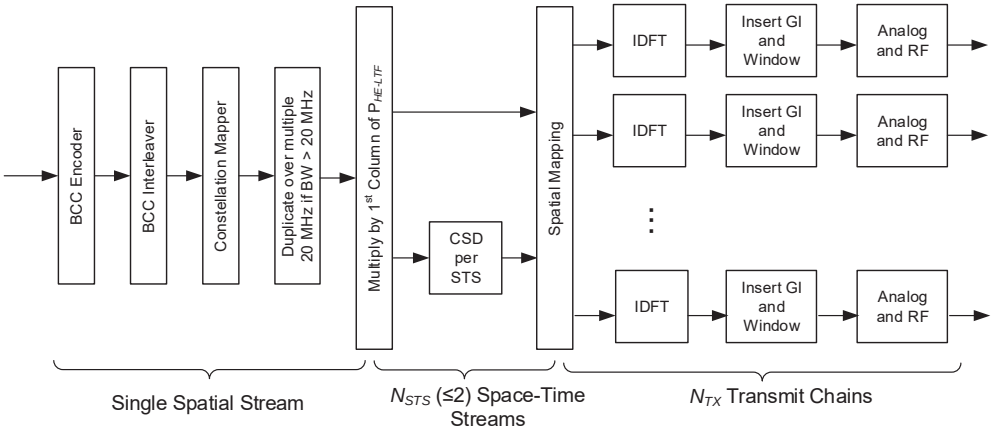

Figure 28-10—Transmitter block diagram for the L-SIG, RL-SIG and HE-SIG-A fields for an HE SU PPDU and HE extended range SU PPDU when the Beam Change field is 0

Figure 28-11 (Transmitter block diagram for the L-SIG, RL-SIG and HE-SIG-A fields of an HE trigger-based PPDU) shows the transmit process for the L-SIG, RL-SIG and HE-SIG-A fields of an HE trigger-based PPDU using one frequency segment. In the HE trigger-based PPDU, the pre-HE-STF preamble, which includes legacy preamble, RL-SIG and HE-SIG-A fields, is sent only on the 20 MHz channels where the STA's HE modulated fields are located. When the HE modulated fields are located in more than one 20 MHz channel, the pre-HE-STF preamble is duplicated over the multiple 20 MHz channels. The BCC encoder and interleaver are not used when generating the L-STF and L-LTF fields.

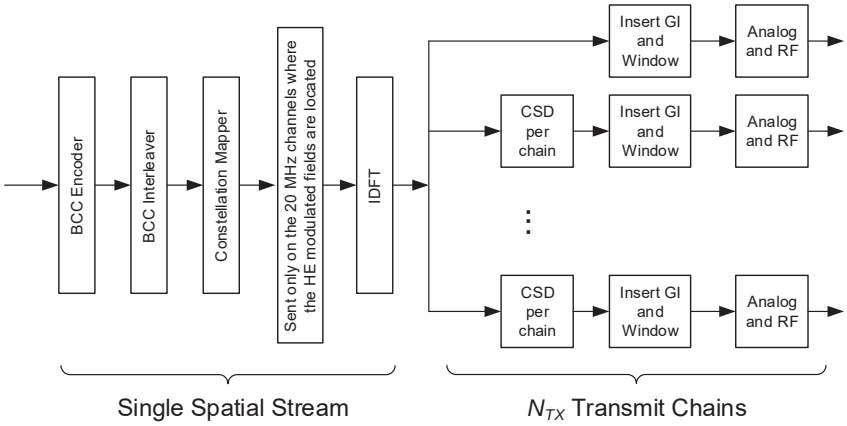

Figure 28-11—Transmitter block diagram for the L-SIG, RL-SIG and HE-SIG-A fields of an HE trigger-based PPDU

Figure 28-12 (Transmitter block diagram for the HE-SIG-B field) shows the transmit process for the HE-SIG-B field of an HE MU PPDU using one frequency segment. This block diagram is for transmitting HE-SIG-B in one 20 MHz subchannel. Refer to 28.3.10.8.1 (Encoding and modulation) for the methods of

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transmitting HE-SIG-B in 40 MHz, 80 MHz and 160 MHz. The DCM tone mapper is applied only if the DCM indication in HE-SIG-A field is set to 1.

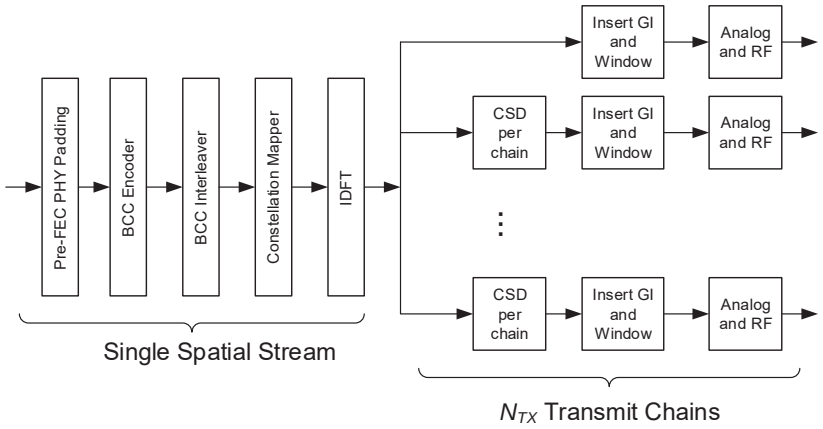

Figure 28-12—Transmitter block diagram for the HE-SIG-B field

Figure 28-13 (Transmitter block diagram for the Data field of an HE SU transmission in a 26-, 52-, 106- or 242-tone RU with BCC encoding) shows the transmitter blocks used to generate the Data field of a single user HE transmission within a 26-, 52-, 106-, or 242-tone RU with BCC encoding for a single frequency segment when the number of spatial stream is less than or equal to 4. This also includes the SU transmission in an RU that is part of a downlink or uplink OFDMA PPDU, and a transmission from one STA that is part of an UL MU-MIMO transmission in current RU. The STBC block may be applied only for single spatial stream and only when DCM is not applied. The DCM tone mapper is applied only when the DCM indication for the RU is set to 1. A subset of these transmitter blocks consisting of the constellation mapper and CSD blocks, as well as the blocks to the right of, and including, the spatial mapping block, are also used to generate the HE-LTF fields. This is illustrated in Figure 28-26 (Generation of HE-LTF symbols per frequency segment in an HE SU PPDU, HE MU PPDU, HE extended range SU PPDU and HE trigger-based PPDU). A subset of these transmitter blocks consisting of the constellation mapper and CSD blocks, as well as the blocks to the right of, and including, the spatial and frequency mapping block of Figure 28-13 (Transmitter block diagram for the Data field of an HE SU transmission in a 26-, 52-, 106- or 242-tone RU

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with BCC encoding), are also used to generate the HE-STF field. This figure also applies to the data field with BCC encoding in an HE trigger-based PPDU.

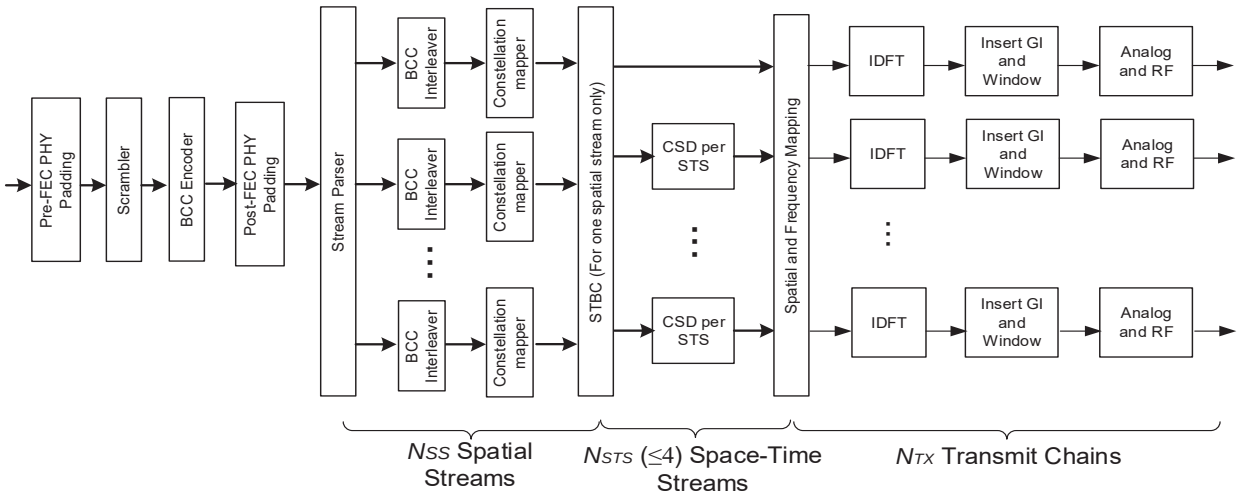

Figure 28-13—Transmitter block diagram for the Data field of an HE SU transmission in a 26-, 52-, 106- or 242-tone RU with BCC encoding

Figure 28-14 (Transmitter block diagram for the Data field of an HE SU transmission in 26-, 52-, 106-, 242-, 484- or 996-tone RU with LDPC encoding) shows the transmitter blocks used to generate the Data field of a single user HE transmission within a 26-, 52-, 106-, 242-, 484-, or 996-tone RU with LDPC encoding for a single frequency segment. This also includes the SU transmission in an RU that is part of a downlink or uplink OFDMA PPDU, and a transmission from one STA that is part of an UL MU-MIMO transmission in current RU. The STBC block may be applied only for single spatial stream and only when DCM is not applied. The DCM tone Mapper is applied only when the DCM indication for the RU is set to 1. This figure also applies to the data field with LDPC encoding in an HE trigger-based PPDU.

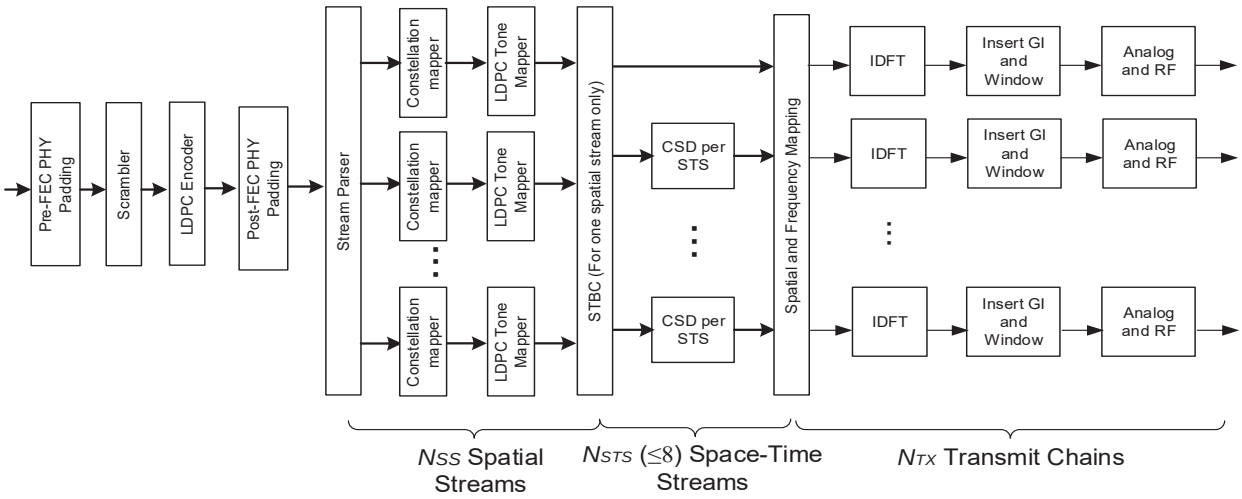

Figure 28-14—Transmitter block diagram for the Data field of an HE SU transmission in 26-, 52-, 106-, 242-, 484- or 996-tone RU with LDPC encoding

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Figure 28-15 (Transmitter block diagram for the Data field of an HE downlink MU-MIMO transmission in 106-, 242-, 484- or 996-tone RU with LDPC encoding) shows the transmitter blocks used to generate the Data field of an HE downlink MU-MIMO transmission within a 106-, 242-, 484-, or 996-tone RU with LDPC encoding. This also includes the downlink MU-MIMO transmission in an RU that is part of a downlink OFDMA PPDU.

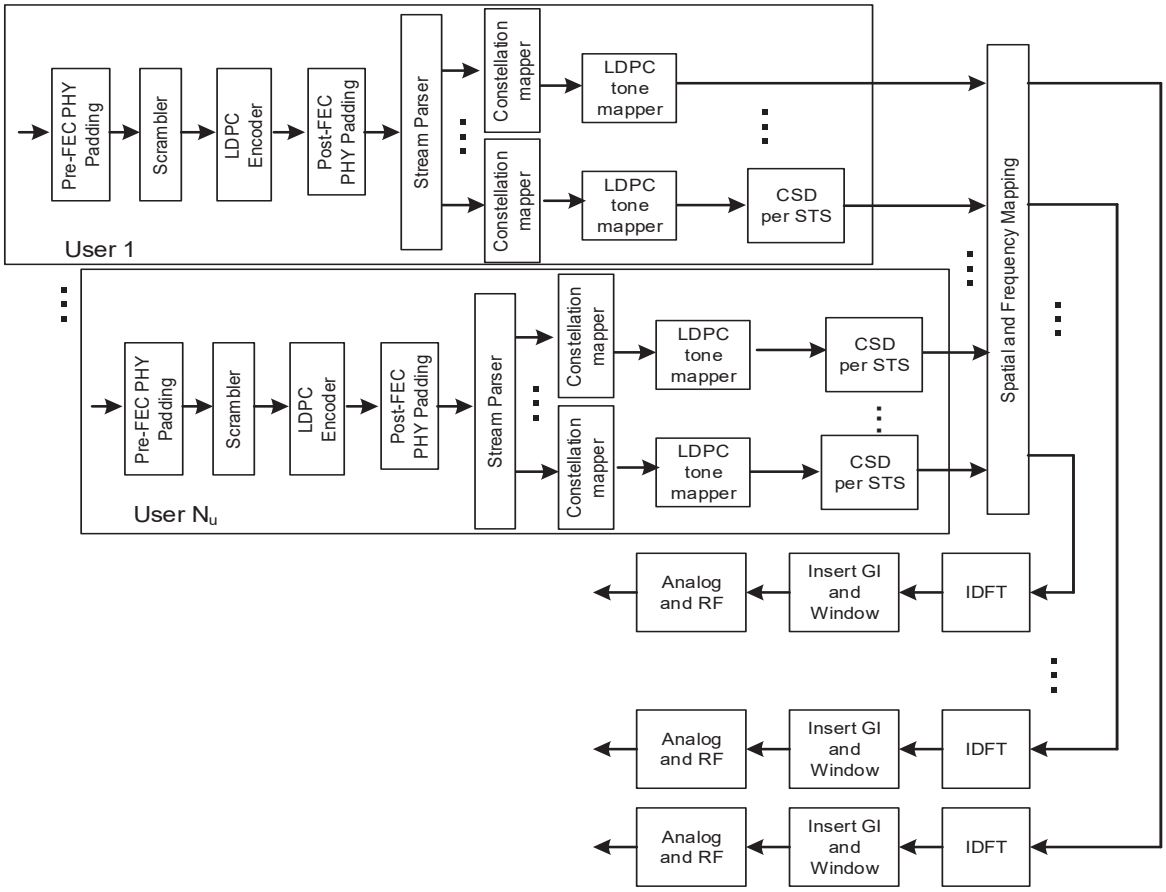

Figure 28-15—Transmitter block diagram for the Data field of an HE downlink MU-MIMO transmission in 106-, 242-, 484- or 996-tone RU with LDPC encoding

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Figure 28-16 (Transmitter block diagram for the Data field of an HE SU PPDU in 160 MHz with LDPC encoding) shows the transmitter blocks used to generate the Data field of a single-user HE transmission in 160 MHz with LDPC encoding.

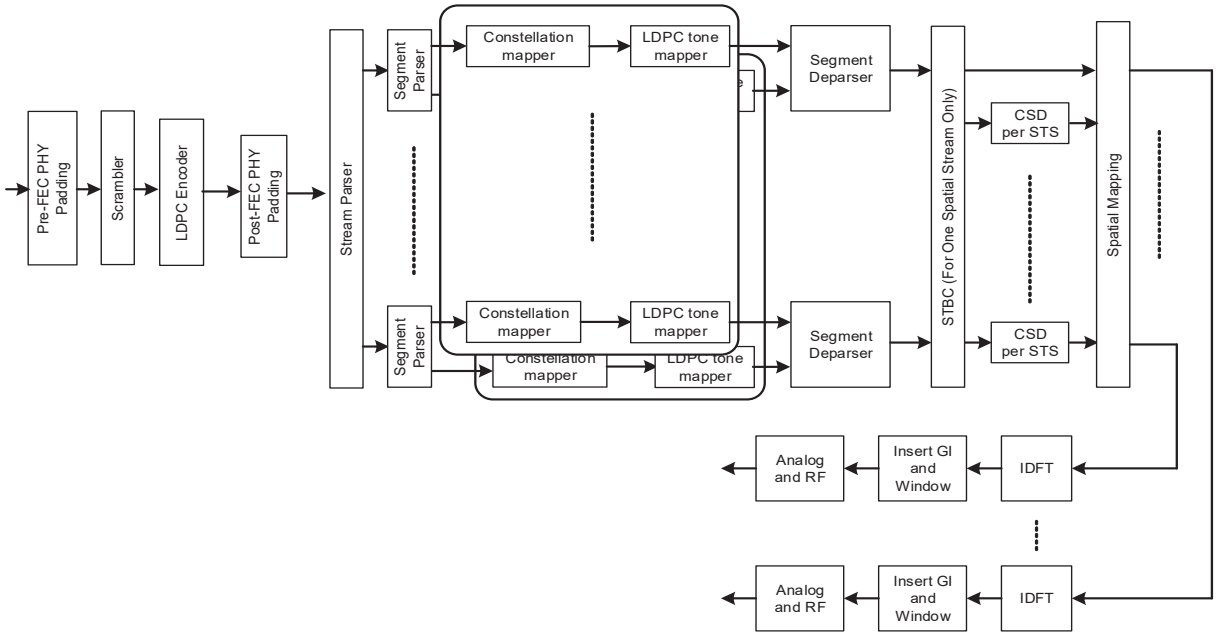

Figure 28-16—Transmitter block diagram for the Data field of an HE SU PPDU in 160 MHz with LDPC encoding

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Figure 28-17 (Transmitter block diagram for the Data field of an HE SU PPDU in 80+80 MHz with LDPC encoding) shows the transmitter blocks used to generate the Data field of a single-user HE transmission in 80+80 MHz with LDPC encoding.

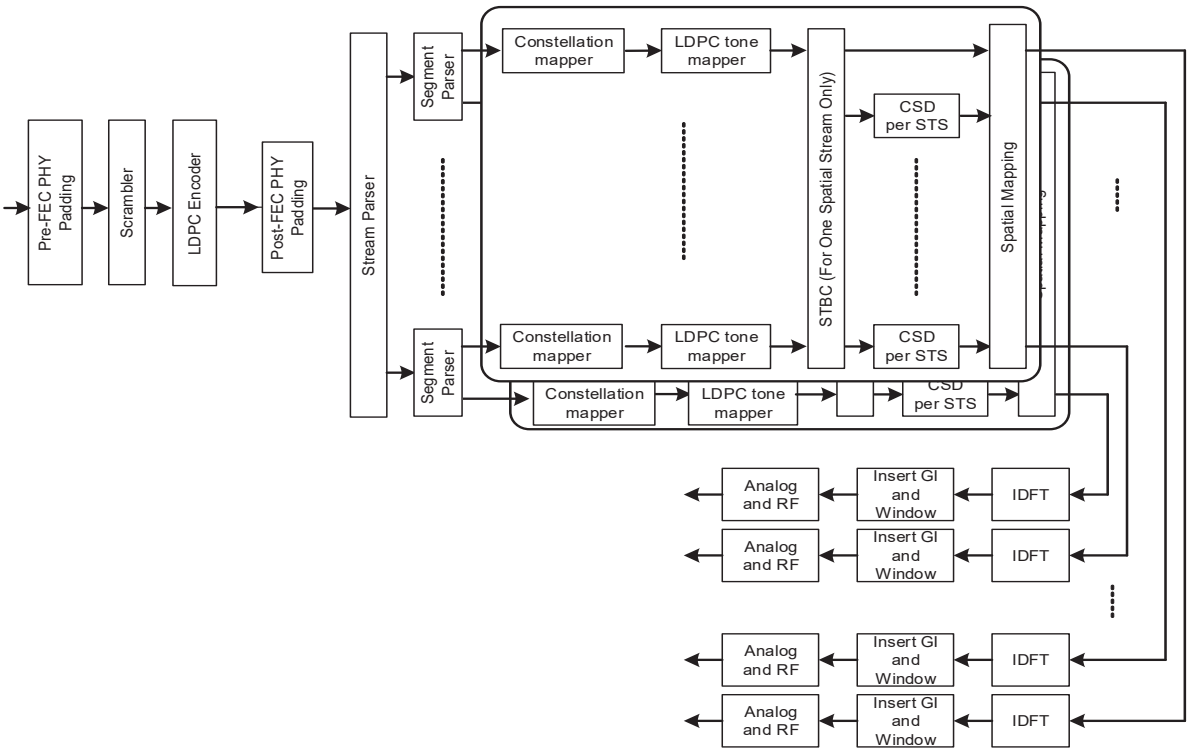

Figure 28-17—Transmitter block diagram for the Data field of an HE SU PPDU in 80+80 MHz with LDPC encoding

28.3.6 Overview of the PPDU encoding process

28.3.6.1 General

This subclause provides an overview of the HE PPDU encoding process.

28.3.6.2 Construction of L-STF

Construct the L-STF field as defined in 28.3.10.3 (L-STF) with the following highlights:

a) Determine the channel bandwidth from the TXVECTOR parameter CH_BANDWIDTH.

b) Sequence generation: Generate the L-STF sequence over the channel bandwidth as described in 28.3.10.3 (L-STF).

c) Phase rotation: Apply appropriate phase rotation for each 20 MHz subchannel as described in 28.3.9 (Mathematical description of signals) and 21.3.7.5 (Definition of tone rotation).

d) IDFT: Compute the inverse discrete Fourier transform.

e) CSD: Apply CSD for each transmit chain and frequency segment as described in 28.3.10.2.1 (Cyclic shift for pre-HE modulated fields).

f) Insert GI and apply windowing: Prepend a GI ($T_{GI,\text{LegacyPreamble}}$) and apply windowing as described in 28.3.9 (Mathematical description of signals).

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g) Analog and RF: Upconvert the resulting complex baseband waveform associated with each transmit chain to an RF signal according to the center frequency of the desired channel and transmit. Refer to 28.3.9 (Mathematical description of signals) and 28.3.10 (HE preamble) for details.

28.3.6.3 Construction of L-LTF

Construct the L-LTF field as defined in 28.3.10.4 (L-LTF) with the following highlights:

a) Determine the channel bandwidth from the TXVECTOR parameter CH_BANDWIDTH.

b) Sequence generation: Generate the L-LTF sequence over the channel bandwidth as described in 28.3.10.4 (L-LTF).

c) Phase rotation: Apply appropriate phase rotation for each 20 MHz subchannel as described in 28.3.9 (Mathematical description of signals) and 21.3.7.5 (Definition of tone rotation).

d) IDFT: Compute the inverse discrete Fourier transform.

e) CSD: Apply CSD for each transmit chain and frequency segment as described in 28.3.10.2.1 (Cyclic shift for pre-HE modulated fields).

f) Insert GI and apply windowing: Prepend a GI ($T_{GI,\text{L-LTF}}$) and apply windowing as described in 28.3.9 (Mathematical description of signals).

g) Analog and RF: Upconvert the resulting complex baseband waveform associated with each transmit chain to an RF signal according to the carrier frequency of the desired channel and transmit. Refer to 28.3.9 (Mathematical description of signals) and 28.3.10 (HE preamble) for details.

28.3.6.4 Construction of L-SIG

Construct the L-SIG field as the SIGNAL field defined in 28.3.10.5 (L-SIG) with the following highlights:

a) Set the RATE subfield in the SIGNAL field to 6 Mb/s. Set the Length, Parity, and Tail bits in the SIGNAL field as described in 28.3.10.5 (L-SIG).

b) BCC encoder: Encode the SIGNAL field by a convolutional encoder at the rate of R = ½ as described in 28.3.11.5.1 (Binary convolutional coding and puncturing).

c) BCC interleaver: Interleave as described in 28.3.11.8 (BCC interleavers).

d) Constellation Mapper: BPSK modulate as described in 28.3.11.9 (Constellation mapping).

e) Pilot insertion: Insert pilots as described in 28.3.10.5 (L-SIG).

f) Extra tone insertion: Four extra tones are inserted in subcarriers $k \in \{-28, -27, 27, 28\}$ for channel estimation purpose and the values on these four extra tones are $\{-1, -1, -1, 1\}$, respectively.

g) Duplication and phase rotation: Duplicate the L-SIG field over each 20 MHz subchannel of the channel bandwidth. Apply appropriate phase rotation for each 20 MHz subchannel as described in 228.3.9 (Mathematical description of signals) and 21.3.7.5 (Definition of tone rotation).

h) IDFT: Compute the inverse discrete Fourier transform.

i) CSD: Apply CSD for each transmit chain and frequency segment as described in 28.3.10.2.1 (Cyclic shift for pre-HE modulated fields).

j) Insert GI and apply windowing: Prepend a GI ($T_{GI,\text{LegacyPreamble}}$) and apply windowing as described in 28.3.9 (Mathematical description of signals).

k) Analog and RF: Upconvert the resulting complex baseband waveform associated with each transmit chain. Refer to 28.3.9 (Mathematical description of signals) and 28.3.10 (HE preamble) for details.

28.3.6.5 Construction of RL-SIG

Construct the RL-SIG field as the repeat SIGNAL field defined in 28.3.10.6 (RL-SIG) with the following highlights:

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a) Set the RATE subfield in the repeat SIGNAL field to 6 Mb/s. Set the Length Parity, and Tail bits in the repeat SIGNAL field as described in 28.3.10.6 (RL-SIG).

b) BCC encoder: Encode the repeat SIGNAL field by a convolutional encoder at the rate of R = ½ as described in 28.3.11.5.1 (Binary convolutional coding and puncturing).

c) BCC interleaver: Interleave as described in 28.3.11.8 (BCC interleavers).

d) Constellation Mapper: BPSK modulate as described in 28.3.11.9 (Constellation mapping).

e) Pilot insertion: Insert pilots as described in 28.3.10.6 (RL-SIG).

f) Extra tone insertion: Four extra tones are inserted in subcarriers $k \in \{-28, -27, 27, 28\}$ for channel estimation purpose and the values on these four extra tones are $\{-1, -1, -1, 1\}$, respectively.

g) Duplication and phase rotation: Duplicate the RL-SIG field over each 20 MHz subchannel of the channel bandwidth. Apply appropriate phase rotation for each 20 MHz subchannel as described in 28.3.9 (Mathematical description of signals) and 21.3.7.5 (Definition of tone rotation).

h) IDFT: Compute the inverse discrete Fourier transform.

i) CSD: Apply CSD for each transmit chain and frequency segment as described in 28.3.10.2.1 (Cyclic shift for pre-HE modulated fields).

j) Insert GI and apply windowing: Prepend a GI ($T_{GI,\text{LegacyPreamble}}$) and apply windowing as described in 28.3.9 (Mathematical description of signals).

k) Analog and RF: Upconvert the resulting complex baseband waveform associated with each transmit chain. Refer to 28.3.9 (Mathematical description of signals) and 28.3.10 (HE preamble) for details.

28.3.6.6 Construction of HE-SIG-A

For an HE SU PPDU, HE MU PPDU, and HE trigger-based PPDU, the HE-SIG-A field consists of two symbols, HE-SIG-A1 and HE-SIG-A2 as defined in 28.3.10.7 (HE-SIG-A) and is constructed as follows:

a) Obtain the HE-SIG-A field values from the TXVECTOR. Add the reserved bits, append the calculated CRC, and then append the N_{tail} tail bits as shown in 28.3.10.7 (HE-SIG-A). This results in 52 uncoded bits.

b) BCC encoder: Encode the data by a convolution encoder at the rate of R = ½ as described in 17.3.5.6 (Convolution encoder).

c) BCC interleaver: Interleave as described in 17.3.5.7 (Data interleaving).

d) Constellation mapper: BPSK modulate the first 52 interleaved bits as described in 17.3.5.8 (Subcarrier modulation mapping) to form the first symbol of HE-SIG-A. BPSK modulate the second 52 interleaved bits to form the second symbol of HE-SIG-A.

e) Pilot insertion: Insert pilots as described in 17.3.5.9 (Pilot subcarriers).

f) Duplicate and phase rotation: Duplicate HE-SIG-A1 and HE-SIG-A2 over each 20 MHz subchannel of the channel width. Apply the appropriate phase rotation for each 20 MHz subchannel as described in 28.3.9 (Mathematical description of signals) and 21.3.7.5 (Definition of tone rotation).

g) IDFT: Compute the inverse Fourier transform.

h) CSD: Apply CSD for each transmit chain and frequency segment as described in 28.3.10.2.1 (Cyclic shift for pre-HE modulated fields).

i) Insert GI and apply windowing: Prepend a GI ($T_{GI,\text{LegacyPreamble}}$) and apply windowing as described in 28.3.9 (Mathematical description of signals).

j) Analog and RF: Upconvert the resulting complex baseband waveform associated with each transmit chain to an RF signal according to the center frequency of the desired channel and transmit. Refer to 28.3.9 (Mathematical description of signals) and 28.3.10 (HE preamble) for details.

For an HE extended range SU PPDU, the HE-SIG-A field consists of four symbols, HE-SIG-A1, HE-SIG-A2, HE-SIG-A3, and HE-SIG-A4. HE-SIG-A1 and HE-SIG-A2 have the same data bits while

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HE-SIG-A3 and HE-SIG-A4 have the same data bits as defined in 28.3.10.7 (HE-SIG-A). The HE-SIG-A field is constructed as follows:

a) Obtain the HE-SIG-A fields from the TXVECTOR. Add the reserved bits, append the calculated CRC, and then append the N_{tail} tail bits as shown in 28.3.10.7 (HE-SIG-A). This results in 52 uncoded bits.

b) BCC encoder: Encode the data by a convolution encoder at the rate of R = ½ as described in 17.3.5.6 (Convolution encoder).

c) BCC interleaver: Interleave the data bits of HE-SIG-A1 and HE-SIG-A3 as described in 17.3.5.7 (Data interleaving). The data bits of HE-SIG-A2 and HE-SIG-A4 are not interleaved.

d) Constellation mapper: BPSK modulate the HE-SIG-A1, HE-SIG-A3, and HE-SIG-A4 data bits as described in 17.3.5.8 (Subcarrier modulation mapping) to form the first, third, and fourth symbol of HE-SIG-A, respectively. QBPSK modulate the HE-SIG-A2 encoded data bits to form the second symbol of HE-SIG-A.

e) Pilot insertion: Insert pilots as described in 17.3.5.9 (Pilot subcarriers).

f) IDFT: Compute the inverse Fourier transform.

g) CSD: Apply CSD for each transmit chain and frequency segment as described in 28.3.10.2.1 (Cyclic shift for pre-HE modulated fields).

h) Insert GI and apply windowing: Prepend a GI ($T_{GI,\mathrm{LegacyPreamble}}$) and apply windowing as described in 28.3.9 (Mathematical description of signals).

i) Analog and RF: Upconvert the resulting complex baseband waveform associated with each transmit chain to an RF signal according to the center frequency of the desired channel and transmit. Refer to 28.3.9 (Mathematical description of signals) and 28.3.10 (HE preamble) for details.

28.3.6.7 Construction of HE-SIG-B

For an HE MU PPDU, the HE-SIG-B field consists of a Common Block field followed by a User Specific field as defined in 28.3.10.8 (HE-SIG-B) and is constructed as follows:

a) Obtain the subfield values for the HE-SIG-B field from the TXVECTOR. Add the reserved bits, append the calculated CRC, and then append the N_{tail} tail bits as shown in 28.3.10.8 (HE-SIG-B).

b) BCC encoder: Encode the Common Block field data and User Specific field data by a convolution encoder as described in 28.3.11.5.1 (Binary convolutional coding and puncturing).

c) BCC interleaver: Interleave as described in 17.3.5.7 (Data interleaving).

d) Constellation mapper: Obtain MCS_SIG_B from the TXVECTOR and use it to modulate the interleaved bits as described in 17.3.5.8 (Subcarrier modulation mapping) to form the HE-SIG-B symbols.

e) Pilot insertion: Insert pilots as described in 17.3.5.9 (Pilot subcarriers).

f) Duplicate and phase rotation: Duplicate HE-SIG-B symbols over each 20 MHz of the CH_BANDWIDTH as described in 28.3.10.8.1 (Encoding and modulation). Apply the appropriate phase rotation for each 20 MHz subchannel as described in 28.3.9 (Mathematical description of signals) and 21.3.7.5 (Definition of tone rotation).

g) IDFT: Compute the inverse Fourier transform.

h) CSD: Apply CSD for each transmit chain and frequency segment as described in 28.3.10.2.1 (Cyclic shift for pre-HE modulated fields).

i) Insert GI and apply windowing: Prepend a GI ($T_{GI,\mathrm{LegacyPreamble}}$) and apply windowing as described in 28.3.9 (Mathematical description of signals).

j) Analog and RF: Upconvert the resulting complex baseband waveform associated with each transmit chain to an RF signal according to the center frequency of the desired channel and transmit. Refer to 28.3.9 (Mathematical description of signals) and 28.3.10 (HE preamble) for details.

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28.3.6.8 Construction of HE-STF

The HE-STF field is defined in 28.3.10.9 (HE-STF) and is constructed as follows:

a) Sequence generation: Generate the HE-STF in the frequency domain over the bandwidth indicated by the TXVECTOR parameter CH_BANDWIDTH as described in 28.3.10.9 (HE-STF).

b) Phase rotation: Apply appropriate phase rotation for each 20 MHz subchannel as described in 28.3.9 (Mathematical description of signals) and 21.3.7.5 (Definition of tone rotation).

c) CSD: Apply CSD for each space-time stream and frequency segment as described in 28.3.10.2.2 (Cyclic shift for HE modulated fields).

d) Spatial mapping: Apply the Q matrix as described in 28.3.10.9 (HE-STF).

e) IDFT: Compute the inverse discrete Fourier transform.

f) Insert GI and apply windowing: Prepend a GI; $T_{GI1,\text{Data}}$ for HE SU PPDU, HE extended range SU PPDU, and HE MU PPDU and $T_{GI2,\text{Data}}$ for a HE trigger-based PPDU. Apply windowing as described in 28.3.9 (Mathematical description of signals).

g) Analog and RF: Upconvert the resulting complex baseband waveform associated with each transmit chain to an RF signal according to the center frequency of the desired channel and transmit. Refer to 28.3.9 (Mathematical description of signals) and 21.3.10 (HE preamble) for details.

28.3.6.9 Construction of HE-LTF

The HE-LTF field is defined in 28.3.10.10 (HE-LTF) and is constructed as follows:

a) Sequence generation: Generate the HE-LTF sequence in frequency domain over the bandwidth indicated by CH_BANDWIDTH as described in 28.3.10.10 (HE-LTF).

b) Phase rotation: Apply appropriate phase rotation for each 20 MHz subchannel as described in 28.3.9 (Mathematical description of signals) and 21.3.7.5 (Definition of tone rotation).

c) $A_{\text{HE-LTF}}$ matrix mapping: Apply the $P_{\text{HE-LTF}}$ matrix to the data tones of the HE-LTF sequence and apply the $R_{\text{HE-LTF}}$ or $P_{\text{HE-LTF}}$ matrix to pilot tones as described in 28.3.10.10 (HE-LTF).

d) CSD: Apply CSD for each space-time stream and frequency segment as described in 28.3.10.2.2 (Cyclic shift for HE modulated fields).

e) Spatial mapping: Apply the Q matrix as described in 28.3.10.10 (HE-LTF).

f) IDFT: Compute the inverse discrete Fourier transform.

g) Insert GI and apply windowing: Prepend a GI indicated by the TXVECTOR parameter GI_TYPE and apply windowing as described in 28.3.9 (Mathematical description of signals).

h) Analog and RF: Upconvert the resulting complex baseband waveform associated with each transmit chain to an RF signal according to the center frequency of the desired channel and transmit. Refer to 28.3.9 (Mathematical description of signals) and 21.3.10 (HE preamble) for details.

28.3.6.10 Construction of the Data field in an HE SU PPDU, HE extended range SU PPDU, and HE trigger-based PPDU

28.3.6.10.1 Using BCC

The construction of the Data field in an HE SU PPDU, HE extended range SU PPDU, and HE trigger-based PPDU with BCC encoding proceeds as follows:

a) The SERVICE field is described in 28.3.11.3 (SERVICE field) and append the PSDU to the SERVICE field.

b) Pre-FEC padding: Append the pre-FEC pad bits and tail bits as described in 28.3.11 (Data field).

c) Scrambler: Scramble the pre-FEC padded data.

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d) BCC encoder: BCC encode as described in 28.3.11.5.1 (Binary convolutional coding and puncturing).

e) Post-FEC padding: Append the post-FEC pad bits and packet extension field as described in 28.3.11 (Data field).

f) Stream parser: Rearrange the output of BCC encoder into blocks as described in 28.3.11.6 (Stream parser).

g) Segment parser (if needed): This block is bypassed for 20 MHz transmissions.

h) BCC interleaver: Interleave as described in 28.3.11.8 (BCC interleavers).

i) Constellation mapper: Map to BPSK, QPSK, 16-QAM, 64-QAM, or 256-QAM constellation points as described in 28.3.11.9 (Constellation mapping).

j) Segment deparser (if needed): This block is bypassed for 20 MHz transmissions.

k) STBC: Apply STBC as described in 28.3.11.10 (Space-time block coding).

l) Pilot insertion: Insert pilots following the steps described in 28.3.11.13 (Pilot subcarriers).

m) CSD: Apply CSD for each space-time stream and frequency segment as described in 28.3.10.2.2 (Cyclic shift for HE modulated fields).

n) Spatial mapping: Apply the *Q* matrix as described in 28.3.11.14 (OFDM modulation).

o) Phase rotation: Apply the appropriate phase rotations for each 20 MHz subchannel as described in 28.3.9 (Mathematical description of signals) and 21.3.7.5 (Definition of tone rotation).

p) IDFT: In an 80+80 MHz transmission, map each frequency subblock to a separate IDFT. Compute the inverse discrete Fourier transform.

q) Insert GI and apply windowing: Prepend a GI and apply windowing as described in 28.3.9 (Mathematical description of signals).

r) Analog and RF: Upconvert the resulting complex baseband waveform with each transmit chain to an RF signal according to the center frequency of the desired channel and transmit. Refer to 28.3.9 (Mathematical description of signals) and 28.3.10 (HE preamble) for details.

28.3.6.10.2 Using LDPC

The construction of the Data field in an HE SU PPDU, HE extended range SU PPDU, and HE trigger-based PPDU with LDPC encoding proceeds as follows:

a) The SERVICE field is described in 28.3.11.3 (SERVICE field) and append the PSDU to the SERVICE field.

b) Pre-FEC padding: Append the pre-FEC padding bits as described in 28.3.11 (Data field). There are no tail bits.

c) Scrambler: Scramble the pre-FEC padded data.

d) LDPC encoder: LDPC encode with APEP_LENGTH in the TXVECTOR as described in 28.3.11.5.2 (LDPC coding).

e) Post-FEC padding: Append the post-FEC pad bits and packet extension field as described in 28.3.11 (Data field).

f) Stream parser: Rearrange the output of LDPC encoder into blocks as described in 28.3.11.6 (Stream parser).

g) Segment parser (if needed): In a 160 MHz or 80+80 MHz transmission with a 2×996-tone RU, divide the output of each stream parser into two frequency subblocks as described in 28.3.11.6 (Stream parser). This block is bypassed for 20 MHz, 40 MHz, and 80 MHz transmissions.

h) Constellation mapper: Map to BPSK, QPSK, 16-QAM, 64-QAM, 256-QAM, or 1024-QAM constellation points as described in 28.3.11.9 (Constellation mapping).

i) LDPC tone mapper: the LDPC tone mapping shall be performed on all LDPC encoded streams as described in 28.3.11.11 (LDPC tone mapper).

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j) Segment deparser (if needed): In 160 MHz transmission, merge the two frequency subblocks into one frequency segment as described in 28.3.11.12 (Segment deparser). This block is bypassed for 20 MHz, 40 MHz, 80 MHz, and 80+80 MHz transmissions.

k) STBC: Apply STBC as described in 28.3.11.10 (Space-time block coding).

l) Pilot insertion: Insert pilots following the steps described in 28.3.11.13 (Pilot subcarriers).

m) CSD: Apply CSD for each space-time stream and frequency segment as described in 28.3.10.2.2 (Cyclic shift for HE modulated fields).

n) Spatial mapping: Apply the *Q* matrix as described in 28.3.11.14 (OFDM modulation).

o) Phase rotation: Apply the appropriate phase rotations for each 20 MHz subchannel as described in 28.3.9 (Mathematical description of signals) and 21.3.7.5 (Definition of tone rotation).

p) IDFT: In an 80+80 MHz transmission, map each frequency subblock to a separate IDFT. Compute the inverse discrete Fourier transform.

q) Insert GI and apply windowing: Prepend a GI and apply windowing as described in 28.3.9 (Mathematical description of signals).

r) Analog and RF: Upconvert the resulting complex baseband waveform with each transmit chain to an RF signal according to the center frequency of the desired channel and transmit. Refer to 28.3.9 (Mathematical description of signals) and 28.3.10 (HE preamble) for details.

28.3.6.11 Construction of the Data field in an HE MU PPDU

28.3.6.11.1 General

In an HE MU transmission, the PPDU encoding process is performed independently in an RU on a per user basis up to the input of the spatial mapping block, except that CSD is performed with knowledge of the space time streams starting index for that user. All user data in an RU is combined and mapped to the transmit chains in the spatial mapping block.

28.3.6.11.2 Using BCC

A Data field with BCC encoding is constructed using steps (a) to (l) in 28.3.6.10.1 (Using BCC), then applying CSD for an HE MU PPDU as described in 28.3.10.2.2 (Cyclic shift for HE modulated fields).

28.3.6.11.3 Using LDPC

A Data field with LDPC encoding is constructed using steps (a) to (l) in 28.3.6.10.2 (Using LDPC), then applying CSD for an HE MU PPDU as described in 28.3.10.2.2 (Cyclic shift for HE modulated fields).

28.3.6.11.4 Combining to form an HE MU PPDU

The per-user data is combined as follows:

a) Spatial mapping: The Q matrix is applied as described in 28.3.11.14 (OFDM modulation). The combining of all user data of an RU is done in this block.

b) Phase rotation: Apply the appropriate phase rotations for each 20 MHz subchannel as described in 28.3.9 (Mathematical description of signals) and 21.3.7.5 (Definition of tone rotation).

c) IDFT: Compute the inverse discrete Fourier transform.

d) Insert GI and apply windowing: Prepend a GI determined by the TXVECTOR parameter GI_TYPE and apply windowing as described in 28.3.9 (Mathematical description of signals).

e) Analog and RF: Upconvert the resulting complex baseband waveform with each transmit chain to an RF signal according to the center frequency of the desired channel and transmit. Refer to 28.3.9 (Mathematical description of signals) and 28.3.10 (HE preamble) for details.

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28.3.7 HE modulation and coding schemes (HE-MCSs)

The HE-MCS is a compact representation of the modulation and coding used in the Data field of the PPDU. For an HE SU PPDU and an HE extended range SU PPDU it is carried in the HE-SIG-A field. For an HE MU PPDU it is carried in the HE-SIG-B field. For an HE trigger-based PPDU, it is carried in the User Info fields of the Trigger frame.

The HE-SIG-B-MCS is a compact representation of the modulation and coding used in the HE-SIG-B field of the PPDU. For an HE MU PPDU, it is carried in the HE-SIG-A field. HE-SIG-B-MCS consists of indices 0 to 5 and each HE-SIG-B-MCS represents the same modulation and coding as the HE-MCS with the same index.

Rate dependent parameters for the full set of HE-MCSs are shown in Table 28-47 (HE-MCSs for mandatory 26-tone RU, NSS = 1) to Table 28-102 (HE-MCSs for optional non-OFDMA 160 MHz and 80+80 MHz, NSS = 8) (in 28.5 (Parameters for HE-MCSs)). These tables give rate-dependent parameters for HE-MCSs with indices 0 to 11, with number of spatial streams from 1 to 8, RU options of 26-tone, 52-tone, 106-tone, 242-tone, 484-tone and 996-tone, and bandwidth options of 20 MHz, 40 MHz, 80 MHz, and either 160 MHz or 80+80 MHz. HE-MCSs with indices 10 and 11 (1024-QAM) are optionally applied to the Data field of an HE PPDU with RUs equal to or larger than 242-tone. The HE extended range SU PPDU only supports a single 242-tone or 106-tone RU. The 242-tone RU can only be transmitted with the <HE-MCS, NSS> tuples <MCS 0, 1>, <MCS 1, 1> and <MCS 2, 1>. The 106-tone RU can only be transmitted with the <HE-MCS, NSS> tuple <MCS 0, 1>. The 106-tone RU location within the 20 MHz tone plan is fixed as the one that is higher in frequency.

DCM is an optional modulation scheme used for the HE-SIG-B field and the Data field in an HE PPDU. It is indicated in the HE-SIG-A field for the HE-SIG-B field in an HE MU PPDU and for the Data field in HE SU PPDU, HE trigger-based PPDU and HE extended range SU PPDU and indicated in the HE-SIG-B field for the Data field in an HE MU PPDU. It is only applied for the HE-MCSs with indices 0, 1, 3 and 4.

28.3.8 Timing-related parameters

Refer to Table 19-6 (Timing-related constants) and Table 21-5 (Timing-related constants) for timing-related parameters for non-HE PPDU formats.

Table 28-9 (Timing-related constants) defines the timing-related parameters for HE PPDU formats..

Table 28-9— Timing-related constants

Parameter	Values	Description
$\Delta_{F,\text{Pre-HE}}$	312.5 kHz	Subcarrier frequency spacing for the pre-HE modulated fields.
$\Delta_{F,\text{HE}}$	78.125 kHz	Subcarrier frequency spacing for the HE modulated fields.
$T_{DFT,\text{Pre-HE}}$	3.2 μs	IDFT/DFT period for the pre-HE modulated fields.
$T_{DFT,\text{HE}}$	12.8 μs	IDFT/DFT period for the HE Data field.
$T_{GI,\text{LegacyPreamble}}$	0.8 μs	Guard interval duration for the legacy preamble, RL-SIG, HE-SIG-A and HE-SIG-B
$T_{GI,\text{L-LTF}}$	1.6 μs	Guard interval duration for the L-LTF field.

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Table 28-9— Timing-related constants *(continued)*

$T_{GI,\text{HE-LTF}}$	$T_{GI1,Data}$, $T_{GI2,Data}$ or $T_{GI4,Data}$ depending on the GI used for data	Guard interval duration for the HE-LTF field, same as $T_{GI,Data}$
$T_{GI,Data}$	$T_{GI1,Data}$, $T_{GI2,Data}$ or $T_{GI4,Data}$ depending on the GI used for data	Guard interval duration for the HE-Data field
$T_{GI1,Data}$	0.8 μs	Base guard interval duration for the HE-Data field.
$T_{GI2,Data}$	1.6 μs	Double guard interval duration for the HE-Data field.
$T_{GI4,Data}$	3.2 μs	Quadruple guard interval duration for the HE-Data field.
T_{SYM1}	13.6 μs = $T_{DFT,\text{HE}} + T_{GI1,Data} = 1.0625 \times T_{DFT,HE}$	OFDM symbol duration with base GI
T_{SYM2}	14.4 μs = $T_{DFT,\text{HE}} + T_{GI2,Data} = 1.125 \times T_{DFT,HE}$	OFDM symbol duration with double GI
T_{SYM4}	16 μs = $T_{DFT,\text{HE}} + T_{GI4,Data} = 1.25 \times T_{DFT,\text{HE}}$	OFDM symbol duration with quadruple GI
T_{SYM}	T_{SYM1}, T_{SYM2}, or T_{SYM4} depending on the GI used (see Table 28-14 (Tone scaling factor and guard interval duration values for HE PPDU fields))	Symbol interval
$T_{\text{L-STF}}$	8 μs = 10 × $T_{DFT,\text{Pre-HE}}$ /4	Non-HT Short Training field duration
$T_{\text{L-LTF}}$	8 μs = 2 × $T_{DFT,\text{Pre-HE}} + T_{GI,\text{L-LTF}}$	Non-HT Long Training field duration
$T_{\text{L-SIG}}$	4 μs	Non-HT SIGNAL field duration
$T_{\text{RL-SIG}}$	4 μs	Repeated non-HT SIGNAL field duration
$T_{\text{HE-SIG-A}}$	8 μs = 2 × 4 μs	HE-SIG-A field duration in an HE SU PPDU, HE MU PPDU and HE trigger-based PPDU
$T_{\text{HE-SIG-A-R}}$	16 μs = 4 × 4 μs	HE-SIG-A field duration in an HE extended range SU PPDU
$T_{\text{HE-STF-T}}$	8 μs = 5 × 1.6 μs	HE-STF field duration for an HE trigger-based PPDU
$T_{\text{HE-STF-NT}}$	4 μs = 5 × 0.8 μs	HE-STF field duration for an HE SU PPDU, HE extended range SU PPDU and HE MU PPDU
$T_{\text{HE-LTF-1X}}$	3.2 μs	Duration of each 1x HE-LTF OFDM symbol without GI
$T_{\text{HE-LTF-2X}}$	6.4 μs	Duration of each 2x HE-LTF OFDM symbol without GI
$T_{\text{HE-LTF-4X}}$	12.8 μs	Duration of each 4x HE-LTF OFDM symbol without GI
$T_{\text{HE-LTF}}$	$T_{\text{HE-LTF-1X}}$, $T_{\text{HE-LTF-2X}}$ or $T_{\text{HE-LTF-4X}}$ depending upon the LTF duration used	Duration of each OFDM symbol without GI in the HE-LTF field
$T_{\text{HE-LTF-SYM}}$	sum of $T_{\text{HE-LTF}}$ and $T_{GI,\text{HE-LTF}}$	Duration of each OFDM symbol including GI in the HE-LTF field
$T_{\text{HE-SIG-B}}$	4 μs = $T_{DFT,\text{Pre-HE}} + T_{GI,\text{LegacyPreamble}}$	Duration of each OFDM symbol in the HE-SIG-B field

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Table 28-9— Timing-related constants *(continued)*

$N_{service}$	16	Number of bits in the SERVICE field
N_{tail}	6 for BCC encoder, 0 for LDPC encoder	Number of tail bits per encoder
T_{SYML}	4 μs	Symbol duration including GI prior to the HE-STF field
T_{PE}	0, 4 μs, 8 μs, 12 μs or 16 μs depending on the actual extension duration used	Duration of the Packet Extension field

Table 28-10 (Tone allocation related constants for Data field in a non-OFDMA HE PPDU) defines tone allocation related parameters for a non-OFDMA HE PPDU.

Table 28-10—Tone allocation related constants for Data field in a non-OFDMA HE PPDU

Parameter	CBW20	CBW40	CBW80	CBW80+80	CBW160	Description
N_{SD}	234	468	980	980	1960	Number of complex data numbers per frequency segment
N_{SP}	8	16	16	16	32	Number of pilot values per frequency segment
N_{ST}	242	484	996	996	1992	Total number of subcarriers per frequency segment
N_{SR}	122	244	500	500	1012	Highest data subcarrier index per frequency segment
N_{Seg}	1	1	1	2	1	Number of frequency segments
N_{DC}	3	5	5	5	23	Number of null tones at DC per segment
$N_{Guard,Left}$	6	12	12	12	12	Number of guard tones at the lower side of the spectrum
$N_{Guard,Right}$	5	11	11	11	11	Number of guard tones at the higher end of the spectrum
NOTE: $N_{ST} = N_{SD} + N_{SP}$						

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Table 28-11 (Tone allocation related constants for RUs in an OFDMA HE PPDU) defines tone allocation related parameters for a OFDMA HE PPDU.

Table 28-11—Tone allocation related constants for RUs in an OFDMA HE PPDU

Parameter	RU Size (tones)							Description
	26	52	106	242	484	996	2×996	
N_{SD}	24	48	102	234	468	980	1960	Number of complex data numbers per RU
N_{SP}	2	4	4	8	16	16	32	Number of pilot values per RU
N_{ST}	26	52	106	242	484	996	1992	Total number of subcarriers per RU
NOTE: $N_{ST} = N_{SD} + N_{SP}$								

Table 28-12 (Frequently used parameters) defines parameters used frequently in Clause 28.

Table 28-12—Frequently used parameters

Symbol	Explanation
N_{CBPS}, $N_{CBPS,u}$	Number of coded bits per symbol for user u, $u = 0, ..., N_{user,total} - 1$. For an HE SU PPDU, $N_{CBPS} = N_{CBPS,0}$ For an HE MU PPDU, N_{CBPS} is undefined
N_{CBPSS}, $N_{CBPSS,u}$	Number of coded bits per symbol per spatial stream. For the Data field, $N_{CBPSS,r,u}$ equals the number of coded bits per symbol per spatial stream for user u, $u = 0, ..., N_{user,total} - 1$. For the Data field of an HE SU PPDU, $N_{CBPSS} = N_{CBPSS,0}$ For the Data field of an HE MU PPDU, N_{CBPSS} is undefined
N_{DBPS}, $N_{DBPS,u}$	Number of data bits per symbol for user u, $u = 0, ..., N_{user,total} - 1$. For an HE SU PPDU, $N_{DBPS} = N_{DBPS,0}$ For an HE MU PPDU, N_{DBPS} is undefined
N_{BPSCS}, $N_{BPSCS,u}$	Number of coded bits per subcarrier per spatial stream for user u, $u = 0, ..., N_{user,total} - 1$. For an HE SU PPDU, $N_{BPSCS} = N_{BPSCS,0}$ For an HE MU PPDU, N_{BPSCS} is undefined
N_{RX}	Number of receive chains
N_{RU}	For pre-HE modulated fields, $N_{RU} = 1$. For HE modulated fields, N_{RU} represents the number of RUs in the transmission (equal to the TXVECTOR parameter NUM_RUS).

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Table 28-12—Frequently used parameters *(continued)*

$N_{user,r}$	For pre-HE modulated fields, $N_{user,r} = 1$. For HE modulated fields, $N_{user,r}$ represents the total number of users in the r-th RU of the transmission (summing over all RUs equals to the TXVECTOR parameter NUM_USERS_TOTAL).
N_{STS}, $N_{STS,r,u}$	For pre-HE modulated fields, $N_{STS,r,u} = 1$ (see NOTE). For HE modulated fields, $N_{STS,r,u}$ represents the number of space-time streams at r-th RU for user u, $u = 0, ..., N_{user,r} - 1$. In case of STBC, $N_{STS,r,u} = 2$ For an HE SU PPDU, $N_{STS} = N_{STS,0,0}$ For an HE MU PPDU, $N_{STS} = max_{r=0}^{N_{RU}-1} N_{STS,r,total}$
$N_{STS,r,total}$	For HE modulated fields, $N_{STS,r,total}$ is the total number of space-time streams at the r-th RU in a PPDU. $N_{STS,r,total} = \sum_{u=0}^{N_{user,r}-1} N_{STS,r,u}$ For pre-HE modulated fields, $N_{STS,r,total}$ is undefined when the TXVECTOR parameter BEAM_CHANGE is 1 and $N_{STS,r,total} = N_{STS}$ when BEAM_CHANGE is 0. Note that $N_{STS,r,total} = N_{STS}$ for an HE SU PPDU.
N_{SS}, $N_{SS,r,u}$, $N_{SS,u}$	Number of spatial streams. For the Data field, $N_{SS,r,u}$ is the number of spatial streams at r-th RU for user u, $u = 0, ..., N_{user,r} - 1$ and $N_{SS,u}$ is the number of spatial streams for user u, $u = 0, ..., N_{user,total} - 1$. For the Data field of an HE SU PPDU, $N_{SS} = N_{SS,0,0}$ For the Data field of an HE MU PPDU, $N_{SS} = max_{r=0}^{N_{RU}-1} N_{SS,r,total}$
$N_{SS,r,total}$	For HE modulated fields, $N_{SS,r,total}$ is the total number of spatial streams at r-th RU in a PPDU. $N_{SS,r,total} = \sum_{u=0}^{N_{user,r}-1} N_{SS,r,u}$ For pre-HE modulated fields, $N_{SS,r,total}$ is undefined. Note that $N_{SS,r,total} = N_{SS}$ for an HE SU PPDU.
N_{TX}	Number of transmit chains
N_{HE-LTF}	The number of OFDM symbols in the HE-LTF field (see 28.3.10.10 (HE-LTF))
$N_{HE-SIG-B}$	The number of OFDM symbols in the HE-SIG-B field
K_r	Set of subcarrier indices in the r-th RU

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Table 28-12—Frequently used parameters *(continued)*

R, R_u	R_u is the coding rate for user u, $u = 0, ..., N_{user,total} - 1$. For an HE SU PPDU, $R = R_0$ For an HE MU PPDU, R is undefined
$M_{r,u}$	For pre-HE modulated fields, $M_{r,u} = 0$. For HE modulated fields, $M_{r,0} = 0$ for $u = 0$ and $M_{r,u} = \sum_{u'=0}^{u-1} N_{STS,r,u'}$ for u, $u = 1, ..., N_{user,r} - 1$.
NOTE—For pre-HE modulated fields, u and r are zeros only since $N_{user,r} = 1$ and $N_{RU} = 1$.	

28.3.9 Mathematical description of signals

For a description of the conventions used for the mathematical description of the signals, see 17.3.2.5 (Mathematical conventions in the signal descriptions). In addition, the following notational conventions are used in Clause 28:

$[Q]_{m,n}$ indicates the element in row m and column n of matrix, where $1 \le m \le N_{row}$ and $1 \le n \le N_{col}$

N_{row} and N_{col} are the number of rows and columns, respectively, of the matrix Q.

$[Q]_{m:n}$ indicates a matrix consisting of columns m to n of matrix Q.

For a description on subcarrier indices over which the signal is transmitted for non-HT, HT and VHT PPDUs, see 22.3.7 (Mathematical description of signals).

For a 20 MHz non-OFDMA HE PPDU transmission, the 20 MHz is divided into 256 subcarriers. The signal is transmitted on subcarriers –122 to –2 and 2 to 122, with 0 being the center (DC) subcarrier.

For a 20 MHz OFDMA HE PPDU transmission, the 20 MHz is divided into 256 subcarriers. The signal is transmitted on subcarriers –122 to –4 and 4 to 122, with 0 being the center (DC) subcarrier.

For a 40 MHz non-OFDMA and OFDMA HE PPDU transmission, the 40 MHz is divided into 512 subcarriers. The signal is transmitted on subcarriers –244 to –3 and 3 to 244.

For an 80 MHz non-OFDMA HE PPDU transmission, the 80 MHz is divided into 1024 subcarriers. The signal is transmitted on subcarriers –500 to –3 and 3 to 500.

For an 80 MHz OFDMA HE PPDU transmission, the 80 MHz is divided into 1024 subcarriers. The signal is transmitted on subcarriers –500 to –4 and 4 to 500.

For a 160 MHz HE PPDU transmission or a noncontiguous 80+80 MHz transmission, and each half 80 MHz bandwidth is divided into 1024 subcarriers, and the subcarriers on which the signal is transmitted in each 80 MHz bandwidth is identical to an 80 MHz HE PPDU transmission, depending on non-OFDMA or OFDMA transmission within the corresponding 80 MHz.

The transmitted signal is described in complex baseband signal notation. The actual transmitted signal on transmit chain i_{TX} and frequency segment i_{Seg} is related to the complex baseband signal by the relation shown in Equation (28-1).

$$r_{RF}^{(i_{Seg}, i_{TX})}(t) = \mathrm{Re}\left\{ \frac{1}{\sqrt{N_{Seg}}} r_{PPDU}^{(i_{Seg}, i_{TX})}(t) \exp\left(j2\pi f_c^{(i_{Seg})} t\right) \right\}, \quad i_{Seg} = 0, \ldots, N_{Seg} - 1; \; i_{TX} = 1, \ldots, N_{TX} \quad (28\text{-}1)$$

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where

N_{Seg} represents the number of frequency segments in the transmit signal as defined in Table 28-10 (Tone allocation related constants for Data field in a non-OFDMA HE PPDU)

$r_{PPDU}^{(i_{Seg}, i_{TX})}$ represents the complex baseband signal of frequency segment i_{Seg} and transmit chain i_{TX}

$f_c^{(i_{Seg})}$ represents the center frequency of frequency segment i_{Seg}

The transmitted RF signal is derived by up-converting the complex baseband signal, which consists of several fields. The timing boundaries for the various fields are shown in Figure 28-18 (Timing boundaries for HE PPDU fields), where $N_{\text{HE-LTF}}$ is the number of HE-LTF symbols and is defined in Table 28-12 (Frequently used parameters), $N_{\text{HE-SIG-B}}$ is the number of symbols in the HE-SIG-B field, and N_{SYM} is the number of symbols in the Data field.

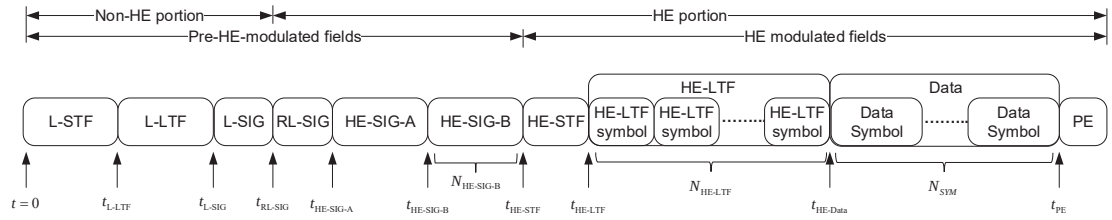

Figure 28-18—Timing boundaries for HE PPDU fields

The time offset, t_{Field}, determines the starting time of the corresponding field relative to the start of L-STF ($t = 0$).

The signal transmitted on frequency segment i_{Seg} of transmit chain i_{TX} shall be as shown in Equation (28-2).

$$\begin{aligned} r_{PPDU}^{(i_{Seg}, i_{TX})}(t) = {} & r_{\text{L-STF}}^{(i_{Seg}, i_{TX})}(t) + r_{\text{L-LTF}}^{(i_{Seg}, i_{TX})}(t - t_{\text{L-LTF}}) \\ & + r_{\text{L-SIG}}^{(i_{Seg}, i_{TX})}(t - t_{\text{L-SIG}}) + r_{\text{RL-SIG}}^{(i_{Seg}, i_{TX})}(t - t_{\text{RL-SIG}}) + r_{\text{HE-SIG-A}}^{(i_{Seg}, i_{TX})}(t - t_{\text{HE-SIG-A}}) + r_{\text{HE-SIG-B}}^{(i_{Seg}, i_{TX})}(t - t_{\text{HE-SIG-B}}) \\ & + r_{\text{HE-STF}}^{(i_{Seg}, i_{TX})}(t - t_{\text{HE-STF}}) + r_{\text{HE-LTF}}^{(i_{Seg}, i_{TX})}(t - t_{\text{HE-LTF}}) + r_{\text{HE-Data}}^{(i_{Seg}, i_{TX})}(t - t_{\text{HE-Data}}) + r_{\text{HE-PE}}^{(i_{Seg}, i_{TX})}(t - t_{\text{HE-PE}}) \end{aligned} \quad (28\text{-}2)$$

where

$r_{\text{HE-SIG-B}}^{(i_{Seg}, i_{TX})}(t - t_{\text{HE-SIG-B}})$ is only applicable to an HE MU PPDU

$0 \le i_{Seg} \le N_{Seg} - 1$

$1 \le i_{TX} \le N_{TX}$

$t_{\text{L-LTF}} = T_{\text{L-STF}}$

$t_{\text{L-SIG}} = t_{\text{L-LTF}} + T_{\text{L-LTF}}$

$t_{\text{RL-SIG}} = t_{\text{L-SIG}} + T_{\text{L-SIG}}$

$t_{\text{HE-SIG-A}} = t_{\text{RL-SIG}} + T_{\text{RL-SIG}}$

$$t_{\text{HE-SIG-B}} = \begin{cases} t_{\text{HE-SIG-A}} + T_{\text{HE-SIG-A}}, & \text{for an HE MU PPDU} \\ undefined, & \text{otherwise} \end{cases}$$

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$$t_{\text{HE-STF}} = \begin{cases} t_{\text{HE-SIG-A}} + T_{\text{HE-SIG-A}}, & \text{for an HE SU PPDU and HE trigger-based PPDU} \\ t_{\text{HE-SIG-A}} + T_{\text{HE-SIG-A-R}}, & \text{for an HE extended range SU PPDU} \\ t_{\text{HE-SIG-B}} + N_{\text{HE-SIG-B}} T_{\text{HE-SIG-B}}, & \text{for an HE MU PPDU} \end{cases}$$

where $N_{HE\text{-}SIG\text{-}B}$ is the number of OFDM symbols in the HE-SIG-B field

$$t_{\text{HE-LTF}} = \begin{cases} t_{\text{HE-STF}} + T_{\text{HE-STF-T}}, & \text{for an HE trigger-based PPDU} \\ t_{\text{HE-STF}} + T_{\text{HE-STF-NT}}, & \text{otherwise} \end{cases}$$

$$t_{\text{HE-Data}} = \begin{cases} t_{\text{HE-LTF}} + N_{\text{HE-LTF}} \cdot (T_{\text{HE-LTF-1X}} + T_{\text{GI,HE-LTF}}), & \text{for 1x HE-LTF} \\ t_{\text{HE-LTF}} + N_{\text{HE-LTF}} \cdot (T_{\text{HE-LTF-2X}} + T_{\text{GI,HE-LTF}}), & \text{for 2x HE-LTF} \\ t_{\text{HE-LTF}} + N_{\text{HE-LTF}} \cdot (T_{\text{HE-LTF-4X}} + T_{\text{GI,HE-LTF}}), & \text{for 4x HE-LTF} \end{cases}$$

$$t_{\text{HE-PE}} = t_{\text{HE-Data}} + N_{SYM} T_{SYM}$$

In an HE SU PPDU, HE MU PPDU and HE extended range SU PPDU, for each field excluding the PE field, $r_{Field}^{(i_{Seg}, i_{TX})}(t)$ is defined in Equation (28-3) as the summation of one or more subfields. Each subfield is defined to be an inverse discrete Fourier transform.

$$r_{Field}^{(i_{Seg}, i_{TX})}(t) = w_{T_{Field}}(t) \sum_{r=0}^{N_{RU}-1} \frac{\alpha_r \beta_r^{Field}}{\sqrt{N_{Norm,r}}} \sum_{k \in K_r} \eta_{Field,k} \sum_{u=0}^{N_{user,r}-1} \sum_{m=1}^{N_{STS,r,u}} \left[Q_k^{(i_{Seg})} \right]_{i_{TX}, (M_{r,u}+m)} \Upsilon_{k,BW} \quad (28\text{-}3)$$

$$X_{k,r,u}^{i_{Seg}, m} \exp(j2\pi k \Delta_{F,Field}(t - T_{GI,Field} - T_{CS,\text{HE}}(M_{r,u} + m)))$$

In an HE trigger-based PPDU, transmitted by user-u in the r-th RU, each field, $r_{Field}^{(i_{Seg}, i_{TX})}(t)$, is defined in Equation (28-4).

$$r_{Field}^{(i_{Seg}, i_{TX})}(t) = \frac{\beta_r^{Field}}{\sqrt{N_{Norm,r}}} w_{T_{Field}}(t) \sum_{k \in K_r} \eta_{Field,k} \sum_{m=1}^{N_{STS,r,u}} \left[Q_k^{(i_{Seg})} \right]_{i_{TX}, (M_{r,u}+m)} \Upsilon_{k,BW} \quad (28\text{-}4)$$

$$X_{k,r,u}^{(i_{Seg}, m)} \exp(j2\pi k \Delta_{F,Field}(t - T_{GI,Field} - T_{CS,\text{HE}}(M_{r,u} + m)))$$

In the remainder of this subclause, pre-HE modulated fields refer to the L-STF, L-LTF, L-SIG, RL-SIG, HE-SIG-A, and HE-SIG-B fields, while HE modulated fields refer to the HE-STF, HE-LTF, Data, and PE fields, as shown in Figure 28-18 (Timing boundaries for HE PPDU fields). The total power of the time domain HE modulated field signals summed over all transmit chains should not exceed the total power of the time domain pre-HE modulated field signals summed over all transmit chains. For notational simplicity, the parameter BW is omitted from some bandwidth dependent terms.

In Equation (28-3) the following notations are used:

$N_{Norm,r}$ If the TXVECTOR parameter BEAM_CHANGE is 1, then for pre-HE modulated fields, $N_{Norm,r} = N_{TX}$. If the TXVECTOR parameter BEAM_CHANGE is 0, then for pre-HE modulated fields $N_{Norm,r} = N_{STS,r,total}$, where $N_{STS,r,total}$ is given in Table 28-12 (Frequently used parameters). For HE modulated fields $N_{Norm,r} = N_{STS,r,total}$.

$w_{T_{Field}}(t)$ is a windowing function. An example function, $w_{T_{Field}}(t)$, is given in 18.3.2.5 (Mathematical conventions in the signal descriptions).

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K_r For pre-HE modulated fields, K_r is the set of subcarriers indices from $-N_{SR}$ to N_{SR} as defined in Table 28-13 (Highest data subcarrier index NSR for pre-HE modulated fields) excluding DC subcarriers. For HE modulated fields in a non-OFDMA HE PPDU, K_r is the set of subcarriers indices from $-N_{SR}$ to N_{SR} as defined in Table 28-10 (Tone allocation related constants for Data field in a non-OFDMA HE PPDU) excluding DC subcarriers. For HE modulated fields in an OFDMA HE PPDU, K_r is the set of subcarrier indices for the tones in the *r*-th RU as defined in Table 28-3 (Subcarrier indices for RUs in a 20 MHz HE PPDU), Table 28-4 (Subcarrier indices for RUs in a 40 MHz HE PPDU) and Table 28-5 (Subcarrier indices for RUs in an 80 MHz HE PPDU) excluding DC subcarriers.

Table 28-13—Highest data subcarrier index N_{SR} for pre-HE modulated fields

Field	N_{SR} as a function of bandwidth			
	20 MHz	40 MHz	80 MHz	160 MHz
L-STF	26	58	122	250
L-LTF	26	58	122	250
L-SIG	28	60	124	252
RL-SIG	28	60	124	252
HE-SIG-A	28	60	124	252
HE-SIG-B	28	60	124	252

$\eta_{Field,k}$ is the power boost factor of the *k*-th subcarrier of a given field within an OFDM symbol, which is $\sqrt{2}$ all the subcarriers of the L-STF, L-LTF, HE-STF and HE-LTF fields in the HE extended range SU PPDU. For the L-SIG and RL-SIG fields,

$$\eta_{Field,k} = \begin{cases} \sqrt{2}, k = -28, -27, 27, 28 & \text{for an HE extended range SU PPDU} \\ 1, & \text{otherwise} \end{cases}$$

and 1 otherwise.

α_r is the power boost factor for the *r*-th RU in an HE PPDU. For a DL HE MU PPDU, a STA shall support α_r in the range [0.7, $\sqrt{2}$] and a STA may support α_r in the range [0.5, 2].For an HE SU PPDU, HE extended range SU PPDU and HE trigger-based PPDU, α_r is always set to 1.

β_r^{Field} is the power normalization factor and is defined in Equation (28-5)

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$$\beta_r^{Field} = \begin{cases} \frac{\varepsilon_{Field}}{\sqrt{N_{Field}^{\text{Tone}}}}, \text{ for pre-HE modulated fields} \\ \frac{1}{\sqrt{K_r^{Field}}}, \text{ for HE trigger-based PPDU HE fields} \\ \sqrt{\frac{|K_r|}{|K_r^{Field}|}} \Big/ \sqrt{\sum_{r=0}^{N_{RU}-1} \alpha_r^2 |K_r|}, \text{ otherwise} \end{cases} \quad (28\text{-}5)$$

$|K_r|$ is the cardinality of the set of subcarriers K_r

$|K_r^{Field}|$ is the cardinality of the set of subcarriers modulated with data within K_r for the HE-STF and Data fields. For the HE-LTF field,

$$|K_r^{\text{HE-LTF}}| = \begin{cases} |K_r|, \text{ for a 4x HE-LTF} \\ |K_r|/2, \text{ for a 2x HE-LTF} \\ |K_r|/4, \text{ for a 1x HE-LTF} \end{cases}$$

N_{Field}^{Tone} Table 28-14 (Tone scaling factor and guard interval duration values for HE PPDU fields) summarizes the various values of N_{Field}^{Tone} as a function of bandwidth per frequency segment. In the case of an HE OFDMA PPDU, the N_{Field}^{Tone} value of HE-STF, HE-LTF and HE-Data fields is variable, and is determined by which RUs of the current full bandwidth are transmitted in the PPDU.

Table 28-14—Tone scaling factor and guard interval duration values for HE PPDU fields

Field	N_{Field}^{Tone} as a function of bandwidth, and RU size per frequency segment				Guard interval duration
	20 MHz	40 MHz	80 MHz	160 MHz	
L-STF	12	24	48	96	-
L-LTF	52	104	208	416	$T_{GI2,\text{L-LTF}}$
L-SIG in an HE PPDU	56	112	224	448	$T_{GI,\text{LegacyPreamble}}$
L-SIG in a non-HT duplicate PPDU	-	104	208	416	
RL-SIG	56	112	224	448	$T_{GI,\text{LegacyPreamble}}$
HE-SIG-A	56	112	224	448	$T_{GI,\text{LegacyPreamble}}$
HE-SIG-B	56	112	224	448	$T_{GI,\text{LegacyPreamble}}$
HE-STF not in an HE trigger-based PPDU	14	30	62	124	-
HE-STF in an HE trigger-based PPDU	30	60	124	248	-

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Table 28-14—Tone scaling factor and guard interval duration values for HE PPDU fields

HE-LTF 1x Duration	60	122	250	500	$T_{GI,\text{HE-LTF1}}$
HE-LTF 2x Duration	122	242	498	996	$T_{GI,\text{HE-LTF2}}$
HE-LTF 4x Duration	242	484	996	1992	$T_{GI,\text{HE-LTF4}}$
HE-Data	242	484	996	1992	$T_{GI,Data}$
NON_HT_DUP_OFDM-Data	-	104	208	416	$T_{GI,\text{LegacyPreamble}}$
NOTE—in the case of an HE OFDMA PPDU, the N_{Field}^{Tone} value of HE-STF, HE-LTF and HE-Data fields is variable, and is determined by which RUs of the current full bandwidth are transmitted in the PPDU.					

$$\varepsilon_{Field} = \begin{cases} \sqrt{\dfrac{N_{\text{L-LTF}}^{\text{Tone}}}{N_{\text{L-SIG}}^{\text{Tone}}}}, \text{ For the L-STF and L-LTF fields} \\ 1, \text{ otherwise} \end{cases}$$

$Q_k^{(i_{Seg})}$ is the spatial mapping matrix for the subcarrier k in frequency segment i_{Seg}. For HE modulated fields, $Q_k^{(i_{Seg})}$ is a matrix with N_{TX} rows and $N_{STS,r,total}$ columns. If the TXVECTOR parameter BEAM_CHANGE is 1, then for pre-HE modulated fields $Q_k^{(i_{Seg})}$ is a column vector with N_{TX} elements with element i_{TX} being $\exp(-j2\pi k\Delta_{F,\text{ Pre-HE}}T_{CS}^{i_{TX}})$, where $T_{CS}^{i_{TX}}$ represents the cyclic shift for the transmitter chain whose values are defined in 28.3.10.2.1 (Cyclic shift for pre-HE modulated fields); otherwise it is identical to the spatial mapping $Q_k^{(i_{Seg})}$ for HE modulated fields.

$\Delta_{F,Field}$ is the subcarrier frequency spacing. For pre-HE modulated fields, $\Delta_{F,Field} = \Delta_{F,\text{ Pre-HE}}$ given in Table 28-9 (Timing-related constants). For HE modulated fields, $\Delta_{F,Field} = \Delta_{F,\text{ HE}}$ given in Table 28-9 (Timing-related constants).

$X_{k,r,u}^{(i_{Seg},m)}$ is the frequency-domain symbol in subcarrier k of user u in the r-th RU for frequency segment i_{Seg} of space-time stream m. Some of the $X_{k,r,u}^{(i_{Seg},m)}$ within $-N_{SR} \le k \le N_{SR}$ have a value of zero. Examples of such cases include the DC tones, guard tones on each side of the transmit spectrum, the null subcarriers in an HE OFDMA PPDU, as well as the unmodulated tones of L-STF, HE-STF, and HE-LTF fields. Note that the multiplication matrices $A_{\text{HE-LTF}}^{k}$ are included in the calculation of $X_{k,r,u}^{(i_{Seg},m)}$ for the HE-STF and HE-LTF fields. When the TXVECTOR parameter BEAM_CHANGE is 0, the first column of the multiplication matrices $A_{\text{HE-LTF}}^{k}$ are included in the calculation of $X_{k,r,u}^{(i_{Seg},m)}$ for the pre-HE modulated fields.

$T_{GI,Field}$ is the guard interval duration used for each OFDM symbol in the field. The value for each field is as defined in Table 28-9 (Timing-related constants).

$T_{CS,\text{HE}}(l)$ For pre-HE modulated fields, $T_{CS,\text{HE}}(l) = 0$. For HE modulated fields, $T_{CS,\text{HE}}(l)$ represents the cyclic shift per space-time stream, whose value is defined in 28.3.10.2.2 (Cyclic shift for HE modulated fields).

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$\Upsilon_{k,BW}$ is used to represent tone rotation. *BW* in $\Upsilon_{k,BW}$ is determined by the TXVECTOR parameter CH_BANDWIDTH as defined in Table 28-15 (CH_BANDWIDTH and for pre-HE modulated fields). In HE modulated fields, $\Upsilon_{k,BW} = 1$ in all the subcarriers. In pre-HE modulated fields, $\Upsilon_{k,BW}$ is defined as in 21.3.7.5 (Definition of tone rotation) when TXVECTOR parameter BEAM_CHANGE is set to 1 and $\Upsilon_{k,BW} = 1$ for all the tones when TXVECTOR parameter BEAM_CHANGE is set to 0. When the TXVECTOR parameter BEAM_CHANGE is not present (such as in an HE MU PPDU and HE trigger-based PPDU), BEAM_CHANGE is assumed to be set to 1.

Table 28-15—CH_BANDWIDTH and $\Upsilon_{k,BW}$ for pre-HE modulated fields

CH_BANDWIDTH	$\Upsilon_{k,\mathrm{BW}}$
CBW20	$\Upsilon_{k,20}$
CBW40	$\Upsilon_{k,40}$
CBW80	$\Upsilon_{k,80}$
CBW160	$\Upsilon_{k,160}$
CBW80+80	$\Upsilon_{k,80}$ per frequency segment

28.3.10 HE preamble

28.3.10.1 Introduction

The HE portion of HE format preamble consists of pre-HE modulated fields and HE modulated fields. The HE modulated fields consist of HE-STF, HE-LTF and Data fields. The pre-HE modulated fields for the various HE PPDU formats are the following:

- RL-SIG and HE-SIG-A fields of an HE SU PPDU
- RL-SIG, HE-SIG-A and HE-SIG-B fields of an HE MU PPDU
- RL-SIG, HE-SIG-A and repeated HE-SIG-A fields of an HE extended range SU PPDU
- RL-SIG and HE-SIG-A fields of an HE trigger-based PPDU

28.3.10.2 Cyclic shift

28.3.10.2.1 Cyclic shift for pre-HE modulated fields

When the TXVECTOR parameter BEAM_CHANGE is 1, the cyclic shift value $T_{CS}^{i_{TX}}$ for the L-STF, L-LTF, L-SIG, RL-SIG and HE-SIG-A fields of the PPDU for transmit chain i_{TX} out of a total of N_{TX} are defined in Table 21-10 (Cyclic shift values for L-STF, L-LTF, L-SIG, and VHT-SIG-A fields of the PPDU). In UL MU transmission the cyclic shift value $T_{CS}^{i_{TX}}$ is based on the transmit chain index of each STA.

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When the TXVECTOR parameter BEAM_CHANGE is 0, the cyclic shift value $T_{CS}^{i_{TX}}$ for the L-STF, L-LTF, L-SIG, RL-SIG, and HE-SIG-A fields is not specified.

28.3.10.2.2 Cyclic shift for HE modulated fields

The cyclic shift values defined in this subclause apply to the HE-STF, HE-LTF and Data fields of the HE PPDU when the TXVECTOR parameter BEAM_CHANGE is 1, and apply to the entire PPDU when the TXVECTOR parameter BEAM_CHANGE is 0.

Throughout the HE modulated fields of the preamble, cyclic shifts are applied to prevent unintended beamforming when correlated signals are transmitted in multiple space-time streams. The same cyclic shift is also applied to these streams during the transmission of the Data field of the HE PPDU. For the *r*-th RU, the cyclic shift value $T_{CS,\,\mathrm{HE}}(n)$ for the HE modulated fields for space-time stream *n* out of $N_{STS,r,total}$ total space-time streams is shown in Table 21-11 (Cyclic shift values for the VHT modulated fields of a PPDU).

28.3.10.3 L-STF

If the TXVECTOR parameter BEAM_CHANGE is 1, the time domain representation of the L-STF field shall be as specified in Equation (28-6). The equation applies to all contiguous signals up to 160 MHz and non contiguous 80+80 MHz.

$$r_{\text{L-STF}}^{(i_{Seg}i_{TX})}(t) = \frac{\varepsilon}{\sqrt{N_{TX}\cdot N_{\text{L-STF}}^{\text{Tone}}}} w_{T_{\text{L-STF}}}(t) \sum_{i_{BW}\in\Omega_{20\text{MHz}}} \sum_{k=-26}^{26} \eta_{\text{L-STF},k} \left(\Upsilon_{(k-K_{\text{Shift}}(i_{BW})),\,\text{BW}} S_{k,\,20} \cdot \exp(j2\pi(k-K_{\text{Shift}}(i_{\text{BW}}))\Delta_{F,\,\text{Pre-HE}}(t-T_{CS}^{i_{TX}})) \right) \quad (28\text{-}6)$$

where

ε is a power scaling factor with the value $\varepsilon = \sqrt{\frac{N_{\text{Tone}}^{\text{L-LTF}}}{N_{\text{Tone}}^{\text{L-SIG}}}}$

$\eta_{\text{L-STF},k}$ is a PPDU format dependent scaling factor for the L-STF field on tone index *k* with the following value

$$\eta_{\text{L-STF},k} = \begin{cases} \sqrt{2}, & \text{for an HE extended range SU PPDU} \\ 1, & \text{otherwise} \end{cases} \quad (28\text{-}7)$$

$N_{20\text{MHz}}$ is defined in 22.3.8.3.4 (L-SIG definition)

$K_{Shift}(i) = (N_{20\text{MHz}} - 1 - 2i)\cdot 32$

$T_{CS}^{i_{TX}}$ represents the cyclic shift for transmit chain i_{TX} with a value given in 28.3.10.2.1 (Cyclic shift for pre-HE modulated fields).

$N_{\text{L-STF}}^{\text{Tone}}$ has the value given in Table 28-14 (Tone scaling factor and guard interval duration values for HE PPDU fields).

$\Omega_{20\text{MHz}}$ is a set of 20 MHz channels that contains the channels where pre-HE modulated fields are located and the channel indices are within 0 to $N_{20\text{MHz}} - 1$ in an HE trigger-based PPDU or HE MU PPDU with preamble puncturing, or equal to $\{0, 1, \ldots, N_{20\text{MHz}} - 1\}$ otherwise.

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$S_{k,20}$ is defined as $S_{-26,26}$ in Equation (19-8).

If the TXVECTOR parameter BEAM_CHANGE is 0, the time domain representation of the L-STF field of contiguous 20 MHz, 40 MHz, 80 MHz and 160 MHz transmission shall be as specified in Equation (28-8). The equation applies to all contiguous signals up to 160 MHz and non contiguous 80+80 MHz.

$$r_{\text{L-STF}}^{(i_{Seg}i_{TX})}(t) = \frac{\varepsilon}{\sqrt{N_{STS} \cdot N_{\text{L-STF}}^{\text{Tone}}}} w_{T_{\text{L-STF}}}(t) \sum_{i_{BW}=0}^{N_{20\text{MHz}}-1} \sum_{k=-26}^{26} \sum_{m=1}^{N_{STS}} \eta_{\text{L-STF},k} \left(\left[Q_{4(k-K_{\text{Shift}}(i_{BW}))}^{(i_{Seg})} \right]_{i_{TX},m} \left[A_{\text{HE-LTF}}^{4(k-K_{\text{Shift}}(i_{BW}))} \right]_{m,1} S_{k,20} \cdot \exp(j2\pi(k-K_{\text{Shift}}(i_{\text{BW}}))\Delta_{F,\text{Pre-HE}}(t-T_{CS,\text{HE}}(m))) \right) \quad (28\text{-}8)$$

where

$T_{CS,\text{HE}}(m)$ represents the cyclic shift for space time stream m as defined in 28.3.10.2.2 (Cyclic shift for HE modulated fields)

$Q_k^{(i_{Seg})}$ is the spatial mapping/steering matrix for subcarrier k, in frequency segment i_{Seg} on the data symbols over tone spacing $\Delta_{F,\text{HE}}$ as defined in Table 28-9 (Timing-related constants). Refer to the descriptions in 22.3.10.11.1 (Transmission in VHT format) for examples of $Q_k^{(i_{Seg})}$.

$A_{\text{HE-LTF}}^k$ is defined in Equation (28-55)

28.3.10.4 L-LTF

If the TXVECTOR parameter BEAM_CHANGE is 1, the time domain representation of the L-LTF field shall be as specified in Equation (28-9). The equation applies to all contiguous signals up to 160 MHz and non contiguous 80+80 MHz.

$$r_{\text{L-LTF}}^{(i_{Seg}i_{TX})}(t) = \frac{\varepsilon}{\sqrt{N_{TX} \cdot N_{\text{L-LTF}}^{\text{Tone}}}} w_{T_{\text{L-LTF}}}(t) \sum_{i_{BW} \in \Omega_{20\text{MHz}}} \sum_{k=-26}^{26} \eta_{\text{L-LTF},k} \left(\Upsilon_{(k-K_{\text{Shift}}(i_{BW})),\text{BW}} L_{k,20} \cdot \exp(j2\pi(k-K_{\text{Shift}}(i_{\text{BW}}))\Delta_{F,\text{Pre-HE}}(t-T_{GI,\text{L-LTF}}-T_{CS}^{i_{TX}})) \right) \quad (28\text{-}9)$$

$\eta_{\text{L-LTF},k}$ is a PPDU format dependent scaling factor for the L-LTF field on tone index k with the same value as $\eta_{\text{L-STF},k}$.

$N_{20\text{MHz}}$ is defined in 21.3.7.3 (Channel frequencies)

$K_{Shift}(i) = (N_{20\text{MHz}} - 1 - 2i) \cdot 32$

$T_{CS}^{i_{TX}}$ represents the cyclic shift for transmit chain i_{TX} with a value given in 28.3.10.2.1 (Cyclic shift for pre-HE modulated fields).

$N_{\text{L-LTF}}^{\text{Tone}}$ has the value given in Table 28-14 (Tone scaling factor and guard interval duration values for HE PPDU fields).

$L_{k,20}$ is defined as $L_{-26,26}$ in Equation (18-8).

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If the TXVECTOR parameter BEAM_CHANGE is 0, the time domain representation of the L-LTF field of contiguous 20 MHz, 40 MHz, 80 MHz and 160 MHz transmission shall be as specified in Equation (28-10). The equation applies to all contiguous signals up to 160 MHz and non contiguous 80+80 MHz.

$$r_{\text{L-LTF}}^{(i_{Seg} i_{TX})}(t) = \frac{\varepsilon}{\sqrt{N_{STS} \cdot N_{\text{L-LTF}}^{\text{Tone}}}} w_{T_{\text{L-LTF}}}(t) \sum_{i_{BW}=0}^{N_{20\text{MHz}}} \sum_{k=-26}^{26} \sum_{m=1}^{N_{STS}} \eta_{\text{L-LTF},k} \left(\left[Q_{4(k-K_{\text{Shift}}(i_{BW}))}^{(i_{Seg})} \right]_{i_{TX},m} \left[A_{\text{HE-LTF}}^{4(k-K_{\text{Shift}}(i_{BW}))} \right]_{m,1} L_{k,20} \cdot \exp(j2\pi(k-K_{\text{Shift}}(i_{\text{BW}}))\Delta_{F,\text{Pre-HE}}(t - T_{GI,\text{LegacyPreamble}} - T_{CS,\text{HE}}(m))) \right) \quad (28\text{-}10)$$

where

$T_{CS,\text{HE}}(m)$ represents the cyclic shift for space time stream m as defined in 28.3.10.2.2 (Cyclic shift for HE modulated fields)

$Q_k^{(i_{Seg})}$ is defined in 28.3.9 (Mathematical description of signals)

$A_{\text{HE-LTF}}^k$ is defined in Equation (28-55)

28.3.10.5 L-SIG

The L-SIG field is used to communicate rate and length information. The structure of the L-SIG field is defined in Figure 17-5 (SIGNAL field bit assignment).

In an HE PPDU, the RATE field shall be set to the value representing 6 Mb/s in the 20 MHz channel spacing column of Table 17-6 (Contents of the SIGNAL field). In a non-HT duplicate PPDU, the RATE field is defined in 17.3.4.2 (RATE field) using the L_DATARATE parameter in the TXVECTOR.

The LENGTH field shall be set to the value given by Equation (28-11).

$$\text{Length} = \left\lceil \frac{\text{TXTIME} - \textit{SignalExtension} - 20}{4} \right\rceil \times 3 - 3 - m \quad (28\text{-}11)$$

where

TXTIME (in μs) is defined in 28.4.2 (TXTIME and PSDU_LENGTH calculation).

m is 1 for an HE MU PPDU and HE extended range SU PPDU, and 2 otherwise

SignalExtension is 0 μs when the TXVECTOR parameter NO_SIG_EXTN is true and is aSignalExtension as defined in Table 19-25 (HT PHY characteristics) when TXVECTOR parameter NO_SIG_EXTN is false

The LSB of the binary expression of the Length value shall be mapped to B5. In a non-HT duplicate PPDU, the LENGTH field is defined in 17.3.4.3 (LENGTH field) using the L_LENGTH parameter in the TXVECTOR.

The Reserved (R) field shall be set to 0.

The Parity (P) field has the even parity of bits 0-16.

The SIGNAL TAIL field shall be set to 0.

The L-SIG field shall be encoded, interleaved, and mapped following the steps described in 17.3.5.6 (Convolutional encoder), 17.3.5.7 (Data interleaving), and 17.3.5.8 (Subcarrier modulation mapping). The

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stream of 48 complex numbers generated by these steps is denoted by $d_k, k = 0, \ldots, 47$. Pilots shall be inserted as described in 17.3.5.9 (Pilot subcarriers). Extra 4 BPSK modulated tones are added. The 4 extra tones [–28, –27, 27, 28] of L-SIG in 20 MHz HE PPDU is [–1, –1, –1, 1].

If the TXVECTOR parameter BEAM_CHANGE is 1, the time domain waveform of the L-SIG field shall be as given by Equation (28-12).

$$r_{\text{L-SIG}}^{(i_{Seg} i_{TX})}(t) = \frac{1}{\sqrt{N_{TX} \cdot N_{\text{L-SIG}}^{\text{Tone}}}} w_{T_{\text{L-SIG}}}(t) \sum_{i_{BW} \in \Omega_{20\text{MHz}}} \sum_{k=-28}^{28} \left(\begin{array}{l} \Upsilon_{(k - K_{\text{Shift}}(i_{BW})), \text{BW}} \eta_{\text{L-SIG}, k} (D_{k,20} + p_0 P_k) \\ \cdot \exp(j2\pi(k - K_{\text{Shift}}(i_{\text{BW}})) \Delta_{F, \text{Pre-HE}} (t - T_{GI, \text{LegacyPreamble}} - T_{CS}^{i_{TX}})) \end{array} \right) \quad (28\text{-}12)$$

where

$\eta_{\text{L-SIG}, k}$ is a PPDU dependent scaling factor for the L-SIG field on the subcarrier k defined as follows:

$$\eta_{\text{L-SIG}, k} = \begin{cases} \sqrt{2}, & k = \pm 28, \pm 27 \text{ for an HE extended range SUPPDU} \\ 1, & \text{otherwise} \end{cases}$$

$N_{20\text{MHz}}$ is defined in 21.3.7.3 (Channel frequencies)

$K_{Shift}(i) = (N_{20\text{MHz}} - 1 - 2i) \cdot 32$

$$D_{k,20} = \begin{cases} 0, k = 0, \pm 7, \pm 21 \\ -1, k = -28, -27, 27 \\ 1, k = 28 \\ d_{M_{20}^r(k)}, \text{otherwise} \end{cases}$$

$$M_{20}^r(k) = \begin{cases} k + 26, -26 \le k \le -22 \\ k + 25, -20 \le k \le -8 \\ k + 24, -6 \le k \le -1 \\ k + 23, 1 \le k \le 6 \\ k + 22, 8 \le k \le 20 \\ k + 21, 22 \le k \le 26 \end{cases}$$

P_k is defined in 17.3.5.10 (OFDM modulation)

P_0 is the first pilot value in the sequence defined in 17.3.5.10 (OFDM modulation)

$N_{\text{L-SIG}}^{\text{Tone}}$ is defined in Table 28-14 (Tone scaling factor and guard interval duration values for HE PPDU fields)

$T_{CS}^{i_{TX}}$ represents the cyclic shift for transmit chain i_{TX} with a value given in 28.3.10.2.1 (Cyclic shift for pre-HE modulated fields).

NOTE—$M_{20}^r(k)$ is a "reverse" function of the function $M(k)$ defined in 17.3.5.10 (OFDM modulation).

If the TXVECTOR parameter BEAM_CHANGE is 0, the time domain waveform of the L-SIG field shall be as given by Equation (28-13).

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$$r_{\text{L-SIG}}^{(i_{Seg} i_{TX})}(t) = \frac{1}{\sqrt{N_{STS} \cdot N_{\text{L-SIG}}^{\text{Tone}}}} w_{T_{\text{L-SIG}}}(t) \quad (28\text{-}13)$$

$$\sum_{i_{BW}=0}^{N_{20\text{MHz}}} \sum_{k=-28}^{28} \sum_{m=1}^{N_{STS}} \left(\begin{array}{l} \left[Q_{4(k-K_{\text{Shift}}(i_{BW}))}^{(i_{Seg})} \right]_{i_{TX}, m} \left[A_{\text{HE-LTF}}^{4(k-K_{\text{Shift}}(i_{BW}))} \right]_{m, 1} \eta_{\text{L-SIG}, k} (D_{k, 20} + p_0 P_k) \\ \cdot \exp(j2\pi(k - K_{\text{Shift}}(i_{\text{BW}}))\Delta_{F, \text{ Pre-HE}}(t - T_{GI, \text{ LegacyPreamble}} - T_{CS, \text{ HE}}(m))) \end{array} \right)$$

where

$T_{CS, \text{ HE}}(m)$ represents the cyclic shift for space time stream m as defined in 28.3.10.2.2 (Cyclic shift for HE modulated fields)

$Q_k^{(i_{Seg})}$ is defined in 28.3.9 (Mathematical description of signals)

$A_{\text{HE-LTF}}^k$ is defined in Equation (28-55)

28.3.10.6 RL-SIG

The RL-SIG field is used to identify an HE PPDU.

If the TXVECTOR parameter BEAM_CHANGE is 1, the time domain waveform of the RL-SIG field shall be as given by Equation (28-14).

$$r_{\text{RL-SIG}}^{(i_{Seg} i_{TX})}(t) = \frac{1}{\sqrt{N_{TX} \cdot N_{\text{RL-SIG}}^{\text{Tone}}}} w_{T_{\text{RL-SIG}}}(t) \quad (28\text{-}14)$$

$$\sum_{i_{BW} \in \Omega_{20\text{MHz}}} \sum_{k=-28}^{28} \eta_{\text{L-SIG}, k} \left(\begin{array}{l} \Upsilon_{(k-K_{\text{Shift}}(i_{BW})), \text{ BW}}(D_{k, 20} + p_1 P_k) \\ \cdot \exp(j2\pi(k - K_{\text{Shift}}(i_{\text{BW}}))\Delta_{F, \text{ Pre-HE}}(t - T_{GI, \text{ LegacyPreamble}} - T_{CS}^{i_{TX}})) \end{array} \right)$$

If the TXVECTOR parameter BEAM_CHANGE is 0, the time domain waveform of the RL-SIG field shall be as given by Equation (28-15).

$$r_{\text{L-SIG}}^{(i_{Seg} i_{TX})}(t) = \frac{1}{\sqrt{N_{STS} \cdot N_{\text{RL-SIG}}^{\text{Tone}}}} w_{T_{\text{RL-SIG}}}(t) \quad (28\text{-}15)$$

$$\sum_{i_{BW}=0}^{N_{20\text{MHz}}-1} \sum_{k=-28}^{28} \eta_{\text{L-SIG}, k} \sum_{m=1}^{N_{STS}} \left(\begin{array}{l} \left[Q_{4(k-K_{\text{Shift}}(i_{BW}))}^{(i_{Seg})} \right]_{i_{TX}, m} \left[A_{\text{HE-LTF}}^{4(k-K_{\text{Shift}}(i_{BW}))} \right]_{m, 1} (D_{k, 20} + p_1 P_k) \\ \cdot \exp(j2\pi(k - K_{\text{Shift}}(i_{\text{BW}}))\Delta_{F, \text{ Pre-HE}}(t - T_{GI, \text{ LegacyPreamble}} - T_{CS, \text{ HE}}(m))) \end{array} \right)$$

28.3.10.7 HE-SIG-A

28.3.10.7.1 General

The HE-SIG-A field carries information required to interpret HE PPDUs.

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28.3.10.7.2 Content

The HE-SIG-A field for an HE SU PPDU or an HE extended range SU PPDU contains the fields listed in Table 28-16 (HE-SIG-A field of an HE SU PPDU and HE extended range SU PPDU).

Table 28-16—HE-SIG-A field of an HE SU PPDU and HE extended range SU PPDU

Two Parts of HE-SIG-A	Bit	Field	Number of bits	Description
HE-SIG-A1	B0	Format	1	Differentiate an HE SU PPDU from an HE trigger-based PPDU: Set to 0 for HE trigger-based PPDU Set to 1 for HE SU PPDU This field is reserved and set to 1 for an HE extended range SU PPDU.
	B1	Beam Change	1	Set to 1 indicates that the pre-HE-STF portion of the PPDU is spatially mapped differently from HE-LTF1. Set to 0 indicates that the pre-HE-STF portion of the PPDU is spatially mapped the same way as HE-LTF1 on each tone.
	B2	UL/DL	1	Indicates whether the PPDU is sent UL or DL: Set to 0 for DL Set to 1 for UL This field indicates DL for TDLS, mesh and IBSS. NOTE—The TDLS peer can identify the TDLS frame by To DS and From DS fields in the MAC header of the MPDU.
	B3-B6	MCS	4	For an HE SU PPDU: Set to *n* for MCS*n*, where *n* = 0, 1, 2, …., 11 Values 12-15 are reserved For HE extended range SU PPDU with Bandwidth field set to 0 (242-tone RU): Set to *n* for MCS*n*, where *n* = 0, 1, 2 Values 3-15 are reserved For HE extended range SU PPDU with Bandwidth field set to 1 (right 106-tone RU in P20): Set to 0 for MCS 0 Values 1-15 are reserved
	B7	DCM	1	Indicates whether or not DCM is applied to the Data field for the MCS indicated. Set to 1 to indicate that DCM is applied to the Data field Set to 0 to indicate that DCM is not applied to the Data field. DCM is only applied for MCS0, MCS1, MCS3 and MCS4. DCM is only applied for 1 and 2 spatial streams. DCM is not applied when STBC is used.
	B8-B13	BSS Color	6	The BSS Color field is an identifier of the BSS

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Table 28-16—HE-SIG-A field of an HE SU PPDU and HE extended range SU PPDU *(contin-*

	B14	Reserved	1	Reserved and set to 1
	B15-B18	Spatial Reuse	4	Set to SR Disallowed to disallow SRP-based spatial reuse (see 27.9 (Spatial reuse operation) and 27.11.6 (SPATIAL_REUSE)). NOTE—This part needs further development. Set to SR_Delay to delay the starting time of spatial reuse transmission (see 27.9.2.1 (General) and 27.11a (TXVECTOR parameters SPATIAL_REUSE for an HE PPDU)).
	B19-B20	Bandwidth	2	For an HE SU PPDU: Set to 0 for 20 MHz Set to 1 for 40 MHz Set to 2 for 80 MHz Set to 3 for 160 MHz and 80+80 MHz For an HE extended range SU PPDU: Set to 0 for 242-tone RU Set to 1 for right 106-tone RU within the primary 20 MHz
	B21-B22	GI+LTF Size	2	Indicates the GI duration and HE-LTF size. Set to 0 to indicate a 1x HE-LTF and 0.8 μs GI Set to 1 to indicate a 2x HE-LTF and 0.8 μs GI Set to 2 to indicate a 2x HE-LTF and 1.6 μs GI Set to 3 to indicate — a 4x HE-LTF and 0.8 μs GI when both the DCM and STBC fields are 1. Neither DCM nor STBC shall be applied when both the DCM and STBC are set to 1. — a 4x HE-LTF and 3.2 μs GI otherwise
	B23-B25	Nsts	3	Indicates the number of space time streams. For an HE SU PPDU: Set to the number of space time streams minus 1 For an HE extended range SU PPDU: Set to 0 for one space time stream when STBC field is set to 0 Set to 1 for two space time streams when STBC field is set to 1 Values 2-7 are reserved
HE-SIG-A2 (HE SU PPDU) or HE-SIG-A3 (HE extended range SU PPDU)	B0-B6	TXOP Duration	7	Set to 127 to indicate no duration information. Set to value other than 127 to indicate duration information for NAV setting and protection of the TXOP. NOTE—The encoding of TXOP Duration field is the same as the TXOP_DURATION parameter in Table 28-1 (TXVECTOR and RXVECTOR parameters).

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Table 28-16—HE-SIG-A field of an HE SU PPDU and HE extended range SU PPDU *(contin-*

	B7	Coding	1	Indicates whether BCC or LDPC is used: Set to 0 to indicate BCC Set to 1 to indicate LDPC
	B8	LDPC Extra Symbol Segment	1	Indicates the presence of the extra OFDM symbol for LDPC. Set to 1 if an extra OFDM symbol for LDPC is present Set to 0 if an extra OFDM symbol for LDPC is present Reserved and set to 1 when the Coding field is 0.
	B9	STBC	1	Set to 1 if space time block coding is used Set to 0 otherwise
	B10	TxBF	1	Set to 1 if a Beamforming steering matrix is applied to the waveform in an SU transmission Set to 0 otherwise
	B11-B12	Pre-FEC Padding Factor	2	Indicates the pre-FEC padding factor value as defined in Table 28-39 (Pre-FEC Padding Factor subfield encoding).
	B13	PE Disambiguity	1	Indicate PE Disambiguity as defined in 28.3.12 (Packet extension).
	B14	Reserved	1	Reserved and set to 1
	B15	Doppler	1	Set to 0 if Doppler mode is not used Set to 1 if Doppler mode is used
	B16-B19	CRC	4	CRC for bits 0-41 of the HE-SIG-A field (see 28.3.10.7.3 (CRC computation)).
	B20-B25	Tail	6	Used to terminate the trellis of the convolutional decoder. Set to 0.

NOTE—Integer fields are transmitted in unsigned binary format, LSB first, where the LSB is in the lowest numbered bit position.

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The HE-SIG-A field of an HE MU PPDU contains the fields listed in Table 28-17 (HE-SIG-A field of an HE MU PPDU).

Table 28-17—HE-SIG-A field of an HE MU PPDU

Two Parts of HE-SIG-A	Bit	Field	Number of bits	Description
HE-SIG-A1	B0	UL/DL	1	Indicates whether the PPDU is sent UL or DL: Set to 0 for DL Set to 1 for UL This field indicates DL for TDLS, mesh and IBSS. NOTE—The TDLS peer can identify the TDLS frame by To DS and From DS fields in the MAC header of the MPDU.
	B1-B3	SIGB MCS	3	Indicates the MCS of the HE-SIG-B field: Set to 0 for MCS 0 Set to 1 for MCS 1 Set to 2 for MCS 2 Set to 3 for MCS 3 Set to 4 for MCS 4 Set to 5 for MCS 5 The values 6 and 7 are reserved
	B4	SIGB DCM	1	Set to 1 indicates that the HE-SIG-B is modulated with dual sub-carrier modulation for the MCS. Set to 0 indicates that the HE-SIB-B is not modulated with dual sub-carrier modulation for the MCS. DCM is only applicable to MCS0, MCS1, MCS3, and MCS4.
	B5-B10	BSS Color	6	The BSS Color field is an identifier of the BSS
	B11-B14	Spatial Reuse	4	Set to SR Disallowed to disallow SRP-based spatial reuse (see 27.9 (Spatial reuse operation) and 27.11.6 (SPATIAL_REUSE)). NOTE—This part needs further development. Set to SR_Restricted to restrict the spatial reuse transmission (see 27.9.2.1 (General) and 27.11a (TXVECTOR parameters SPATIAL_REUSE for an HE PPDU)).

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Table 28-17—HE-SIG-A field of an HE MU PPDU *(continued)*

	B15-B17	Bandwidth	3	Set to 0 for full 20 MHz Set to 1 for full 40 MHz Set to 2 for full 80 MHz Set to 3 for full 160 MHz and 80+80 MHz Set to 4 for preamble puncturing in 80 MHz, where in the preamble only the secondary 20 MHz is punctured Set to 5 for preamble puncturing in 80 MHz, where in the preamble only one of the two 20 MHz sub-channels in secondary 40 MHz is punctured Set to 6 for preamble puncturing in 160 MHz or 80+80 MHz, where in the primary 80 MHz of the preamble only the secondary 20 MHz is punctured Set to 7 for preamble puncturing in 160 MHz or 80+80 MHz, where in the primary 80 MHz of the preamble the primary 40 MHz is present.
	B18-B21	Number Of HE-SIG-B Symbols Or MU-MIMO Users	4	If the SIGB Compression field is 0, indicates the number of OFDM symbols in the HE-SIG-B field minus 1. If the SIGB Compression field is 1, indicates the number of MU-MIMO users minus 1.
	B22	SIGB Compression	1	Set to 1 for full BW MU-MIMO. Set to 0 otherwise.
	B23-B24	GI+LTF Size	2	Indicates the GI duration and HE-LTF size: Set to 0 to indicate a 4x HE-LTF and 0.8 μs GI Set to 1 to indicate a 2x HE-LTF and 0.8 μs GI Set to 2 to indicate a 2x HE-LTF and 1.6 μs GI Set to 3 to indicate a 4x HE-LTF and 3.2 μs GI
	B25	Doppler	1	Set to 0 if Doppler mode is not used Set to 1 if Doppler mode is used
HE-SIG-A2	B0-B6	TXOP Duration	7	Set to 127 to indicate no duration information. Set to value other than 127 to indicate duration information for NAV setting and protection of the TXOP. NOTE—The encoding of TXOP Duration field is the same as the TXOP_DURATION parameter in Table 28-1 (TXVECTOR and RXVECTOR parameters).
	B7	Reserved	1	Reserved and set to 1
	B8-B10	Number of HE-LTF Symbols	3	Indicates the number of HE-LTF symbols: Set to 0 for 1 HE-LTF symbol Set to 1 for 2 HE-LTF symbols Set to 2 for 4 HE-LTF symbols Set to 3 for 6 HE-LTF symbols Set to 4 for 8 HE-LTF symbols Other values are reserved.
	B11	LPDC Extra Symbol	1	Indication of the presence of the extra OFDM symbol for LDPC.

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Table 28-17—HE-SIG-A field of an HE MU PPDU *(continued)*

	B12	STBC	1	In an HE MU PPDU where each RU includes no more than 1 user, set to 1 to indicate all RUs are STBC encoded in the payload, set to 0 to indicate all RUs are not STBC encoded in the payload. STBC is not applied in MU-MIMO RUs. STBC doesn't apply to HE-SIG-B.
	B13-B14	Pre-FEC Padding Factor	2	Indicates the pre-FEC padding factor value as defined in Table 28-39 (Pre-FEC Padding Factor subfield encoding).
	B15	PE Disambiguity	1	Indicate PE Disambiguity as defined in 28.3.12 (Packet extension).
	B16-B19	CRC	4	CRC for bits 0-41 of the HE-SIG-A field (see 28.3.10.7.3 (CRC computation)).
	B20-B25	Tail	6	Used to terminate the trellis of the convolutional decoder. Set to 0.
NOTE—Integer fields are transmitted in unsigned binary format, LSB first, where the LSB is in the lowest numbered bit position.				

When the Bandwidth field is set to 5 or 7, the HE-SIG-B field may indicate which 20 MHz sub-channel(s) in the preamble of secondary 40 MHz channel are punctured by its RU allocation signaling; when the Bandwidth field is set to 6 or 7, the HE-SIG-B field may indicate which 20 MHz sub-channel(s) in the preamble of secondary 80 MHz channel are punctured by its RU allocation signaling. See 28.3.10.8 (HE-SIG-B) for the RU allocation signaling.

It is optional for an HE STA to receive a preamble-punctured HE MU PPDU with the Bandwidth field in HE-SIG-A setting to a values 4 to 7. Whether or not an HE STA is capable of receiving preamble-punctured HE MU PPDU with the Bandwidth field of HE-SIG-A field setting to 4, 5, 6, 7 are indicated by the Preamble Puncturing Receive Capable subfield in the HE Capabilities field (see 9.4.2.218 (HE Capabilities element)).

The HE-SIG-A field for an HE trigger-based PPDU contains the fields listed in Table 28-18 (HE-SIG-A field of an HE trigger-based PPDU).

Table 28-18—HE-SIG-A field of an HE trigger-based PPDU

Two Parts of HE-SIG-A	Bit	Field	Number of bits	Description
HE-SIG-A1	B0	Format	1	Differentiate an HE SU PPDU from an HE trigger-based PPDU: Set to 0 for HE trigger-based PPDU Set to 1 for HE SU PPDU
	B1-B6	BSS Color	6	The BSS Color field is an identifier of the BSS

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Table 28-18—HE-SIG-A field of an HE trigger-based PPDU *(continued)*

B7-B10	Spatial Reuse 1	4	If the Bandwidth field indicates 20 MHz, 40 MHz, or 80 MHz: Spatial Reuse field for the first 20 MHz subband (see NOTE 1) If the Bandwidth field indicates 160/80+80 MHz: Spatial Reuse field for first 40 MHz subband of the 160 MHz operating band. (see NOTE 1) Set to 0 (SR disallowed Entry) to disallow SRP-based spatial reuse (see 27.9 (Spatial reuse operation) and 27.11.6 (SPATIAL_REUSE)). Set to value 1 to 14 corresponding to SRP value (see Table 28-19 (Spatial Reuse subfield encoding)) for SRP-based SR operation. The value 15 is reserved.
B11-B14	Spatial Reuse 2	4	If the Bandwidth field indicates 20 MHz, 40 MHz, or 80 MHz: Spatial Reuse field for the second 20 MHz subband (see NOTE 1) When operating 20 MHz, this field is set to same value as Spatial Reuse 1 field. When operating 40 MHz in 2.4 GHz band, this field is set to same value as Spatial Reuse 1 field If the Bandwidth field indicates 160/80+80 MHz: Spatial Reuse field for second 40 MHz subband of the 160 MHz operating band. (see NOTE 1) Set to 0 (SR disallowed Entry) to disallow SRP-based spatial reuse (see 27.9 (Spatial reuse operation) and 27.11.6 (SPATIAL_REUSE)). Set to value 1 to 14 corresponding to SRP value (see Table 28-19 (Spatial Reuse subfield encoding)) for SRP-based SR operation. The value 15 is reserved.

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Table 28-18—HE-SIG-A field of an HE trigger-based PPDU *(continued)*

B15-B18	Spatial Reuse 3	4	If the Bandwidth field indicates 20 MHz, 40 MHz or 80 MHz: Spatial Reuse field for the third 20 MHz subband (see NOTE 1) When operating in 20 MHz or 40 MHz, this field is set to same value as Spatial Reuse 1 field. If the Bandwidth field indicates 160/80+80 MHz: Spatial Reuse field for third 40 MHz subband of the 160 MHz operating band. (see NOTE 1) When operating in 80+80 MHz, this field is set to same value as Spatial Reuse 1 field. Set to 0 (SR disallowed Entry) to disallow SRP-based spatial reuse (see 27.9 (Spatial reuse operation) and 27.11.6 (SPATIAL_REUSE)). Set to value 1 to 14 corresponding to SRP value (see Table 28-19 (Spatial Reuse subfield encoding)) for SRP-based SR operation. The value 15 is reserved.
B19-B22	Spatial Reuse 4	4	If the Bandwidth field indicates 20 MHz, 40 MHz or 80 MHz: Spatial Reuse field for the fourth 20 MHz subband (see NOTE 1) When operating in 20 MHz, this field is set to same value as Spatial Reuse 1 field. When operating in 40 MHz, this field is set to same value as Spatial Reuse 2 field. If the Bandwidth field indicates 160/80+80 MHz: Spatial Reuse field for fourth 40 MHz subband of the 160 MHz operating band. (see NOTE 1) When operating in 80+80 MHz, this field is set to same value as Spatial Reuse 2 field Set to 0 (SR disallowed Entry) to disallow SRP-based spatial reuse (see 27.9 (Spatial reuse operation) and 27.11.6 (SPATIAL_REUSE)). Set to value 1 to 14 corresponding to SRP value (see Table 28-19 (Spatial Reuse subfield encoding)) for SRP-based SR operation. The value 15 is reserved.
B23	Reserved	1	Reserved and set to 1. NOTE—Unlike other Reserved fields in HE-SIG-A of the HE trigger-based PPDU, B23 does not have a corresponding bit in the Trigger frame.
B24-B25	Bandwidth	2	For HE trigger-based PPDU: Set to 0 for 20 MHz Set to 1 for 40 MHz Set to 2 for 80 MHz Set to 3 for 160 MHz and 80+80 MHz

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Table 28-18—HE-SIG-A field of an HE trigger-based PPDU *(continued)*

HE-SIG-A2	B0-B6	TXOP Duration	7	Set to 127 to indicate no duration information. Set to value other than 127 to indicate duration information for NAV setting and protection of the TXOP. NOTE—The encoding of TXOP Duration field is the same as the TXOP_DURATION parameter in Table 28-1 (TXVECTOR and RXVECTOR parameters).
	B7-B15	Reserved	9	Reserved and set to value indicated in the Trigger frame
	B16-B19	CRC	4	CRC of bits 0-41 of the HE-SIG-A field. See 28.3.10.7.3 (CRC computation).
	B20-B25	Tail	6	Used to terminate the trellis of the convolutional decoder. Set to 0.

NOTE 1—The four Spatial Reuse fields, 1, 2, 3, and 4, are arranged in increasing order of frequency and correspond to:

— For 20 MHz one Spatial Reuse field corresponding to the entire 20 MHz (other 3 fields indicate identical values)

— For 40 MHz two Spatial Reuse fields for each 20 MHz sub-band (other 2 fields indicate identical values)

— For 80 MHz four Spatial Reuse fields for each 20 MHz sub-band

- For an OFDMA transmission of a given BW, each of the Spatial Reuse fields that corresponds to a 20 MHz sub-band is also applicable to the 242-tone RU which is most closely aligned in frequency (in the tone-plan of that BW) with the aforementioned 20 MHz sub-band. The correspondence from an Spatial Reuse field to a 242-tone RU also holds for any RU within the 242-tone RU. The above also implies that a 20 MHz OBSS STA uses the Spatial Reuse field corresponding to its 20 MHz channel, a 40 MHz OBSS STA located on the lower frequency half of the 80 MHz BSS uses Spatial Reuse 1 field, Spatial Reuse 2 field values and a 40 MHz OBSS STA located on the upper frequency half of the 80 MHz BSS uses Spatial Reuse 3 field, Spatial Reuse 4 field values

— For 160 MHz and 80+80 MHz four Spatial Reuse fields for each 40 MHz sub-band

- For an OFDMA transmission of a given BW, each of the Spatial Reuse fields that corresponds to a 40 MHz sub-band is also applicable to the 484-tone RU which is most closely aligned in frequency (in the tone-plan of that BW) with the aforementioned 40 MHz sub-band. The correspondence from an Spatial Reuse field to a 484-tone RU also holds for any RU within the 484-tone RU.

NOTE 2—Integer fields are transmitted in unsigned binary format, LSB first, where the LSB is in the lowest numbered bit position.

Table 28-19 (Spatial Reuse subfield encoding) defines the encoding for the Spatial Reuse 1, Spatial Reuse 2, Spatial Reuse 3 and Spatial Reuse 4 subfields.

Table 28-19—Spatial Reuse subfield encoding

Value	Meaning
0	SR disallow
1	SRP = –80 dBm
2	SRP = –74 dBm
3	SRP = –68 dBm

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Table 28-19—Spatial Reuse subfield encoding *(continued)*

Value	Meaning
4	SRP = –62 dBm
5	SRP = –56 dBm
6	SRP = –50 dBm
7	SRP = –47 dBm
8	SRP = –44 dBm
9	SRP = –41 dBm
10	SRP = –38 dBm
11	SRP = –35 dBm
12	SRP = –32 dBm
13	SRP = –29 dBm
14	SRP = –26 dBm
15	Reserved

SRP = TX PWR_{AP} + Acceptable Receiver Interference $level_{AP}$

Adjustment range for parameters (referenced to the antenna connector and normalized to 20 MHz bandwidth):

— TX $PWR_{AP} \geq -10$ dBm

— Acceptable Receiver Interference $Level_{AP}$: –82dBm to –36 dBm

If SRP is below < –80 dBm, set Spatial Reuse to 1, if SRP is above –26 dBm, set Spatial Reuse to 14. Same table is used for AP and STA.

28.3.10.7.3 CRC computation

The CRC computation defined in this subclause applies to HE-SIG-A, the Common field of HE-SIG-B and the User Specific field of HE-SIG-B.

The CRC is calculated over bits 0 to 41 of the HE-SIG-A field and over bits 0 to L of the HE-SIG-B field ($L = x$ for each HE-SIG-B common block field where $x = N \times 8$ when the Center 26-tone RU subfield is present, and $x = N \times 8 - 1$ otherwise, and $L = 20$ for the HE-SIG-B user specific fields). Refer to Table 28-20 (Common Block field) for N and the conditions under which the Center 26-tone RU subfield is present.

The value of the CRC field shall be the 1s complement of

$$crc(D) = (M(D) + I(D))D^8 mod\ G(D)$$

where

$$M(D) = \sum_{i=0}^{L} m_{L-i} D^i$$

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where

$$I(D) = \sum_{i=L-7}^{L} D^i$$

$G(D)$ is defined in Equation (19-18)

The CRC field is transmitted from *c4* to *c7* with *c7* first.

Figure 19-8 (HT-SIG CRC calculation) shows the operation of the CRC, where the serial input are from m_L to m_0, and the output is stopped at *c4*.

28.3.10.7.4 Encoding and modulation

For an HE SU PPDU, HE MU PPDU and HE trigger-based PPDU, the HE-SIG-A field is composed of two parts, HE-SIG-A1 and HE-SIG-A2, each containing 26 data bits. HE-SIG-A1 is transmitted before HE-SIG-A2. The HE-SIG-A symbols shall be BCC encoded at rate, R = 1/2, interleaved, mapped to a BPSK constellation, and have pilots inserted following the steps described in 17.3.5.6 (Convolutional encoder), 28.3.11.8 (BCC interleavers), 17.3.5.8 (Subcarrier modulation mapping), and 17.3.5.9 (Pilot subcarriers), respectively. The constellation mappings of HE-SIG-A in HE SU PPDU, HE MU PPDU and HE trigger-based PPDU are shown in Figure 28-19 (Data tone constellation of HE-SIG-A symbols). The first and second half of the stream of 104 complex numbers generated by these steps (before pilot insertion) is divided into two groups of 52 complex numbers, where respectively, the first 52 complex numbers form the first symbol of HE-SIG-A and the second 52 complex numbers form the second symbol of HE-SIG-A. If the TXVECTOR parameter BEAM_CHANGE is 1, the time domain waveform for the HE-SIG-A field of an HE SU PPDU, HE MU PPDU and HE trigger-based PPDU shall be as specified in Equation (28-16).

$$r_{\text{HE-SIG-A}}^{(i_{Seg} i_{TX})}(t) = \frac{1}{\sqrt{N_{TX} \cdot N_{\text{HE-SIG-A}}^{\text{Tone}}}} \sum_{n=0}^{1} w_{T_{SYML}}(t - nT_{SYML}) \quad (28\text{-}16)$$
$$\sum_{i_{BW} \in \Omega_{20\text{MHz}}} \sum_{k=-28}^{28} \left(\begin{array}{l} \Upsilon_{(k - K_{\text{Shift}}(i_{BW})),\, \text{BW}}(D_{k,\,n,\,20} + p_{n+2} P_k) \\ \cdot \exp(j2\pi(k - K_{\text{Shift}}(i_{\text{BW}}))\Delta_{F,\,\text{Pre-HE}}(t - nT_{SYML} - T_{GI,\,\text{LegacyPreamble}} - T_{CS}^{i_{TX}})) \end{array} \right)$$

$N_{20\text{MHz}}$ is defined in 21.3.7.3 (Channel frequencies)

$$K_{\text{Shift}}(i) = (N_{20\text{MHz}} - 1 - 2i) \cdot 32$$

$$D_{k,\,n,\,20} = \begin{cases} 0, k = 0, \pm 7, \pm 21 \\ d_{M_{20}^r(k),\,n}, \text{otherwise} \end{cases}$$

$$M_{20}^r(k) = \begin{cases} k + 28, -28 \le k \le -22 \\ k + 27, -20 \le k \le -8 \\ k + 26, -6 \le k \le -1 \\ k + 25, 1 \le k \le 6 \\ k + 24, 8 \le k \le 20 \\ k + 23, 22 \le k \le 28 \end{cases}$$

P_k and p_n are defined in 17.3.5.10 (OFDM modulation)

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$N_{\text{HE-SIG-A}}^{\text{Tone}}$ is defined in Table 28-14 (Tone scaling factor and guard interval duration values for HE PPDU fields)

$T_{CS}^{i_{TX}}$ represents the cyclic shift for transmit chain i_{TX} with a value given in 28.3.10.2.1 (Cyclic shift for pre-HE modulated fields).

If the TXVECTOR parameter BEAM_CHANGE is 0, the time domain waveform of the HE-SIG-A field shall be as given by Equation (28-17).

$$r_{\text{HE-SIG-A}}^{(i_{Seg} i_{TX})}(t) = \frac{1}{\sqrt{N_{STS} \cdot N_{\text{HE-SIG-A}}^{\text{Tone}}}} \sum_{n=0}^{1} w_{T_{SYML}}(t - nT_{SYML}) \sum_{i_{BW}=0}^{N_{20\text{MHz}}-1} \sum_{k=-28}^{28} \sum_{m=1}^{N_{STS}} \left(\begin{array}{l} \left[Q_{4(k-K_{\text{Shift}}(i_{BW}))}^{(i_{Seg})} \right]_{i_{TX}, m} \left[A_{\text{HE-LTF}}^{4(k-K_{\text{Shift}}(i_{BW}))} \right]_{m,1} (D_{k,n,20} + p_{n+2} P_k) \\ \cdot \exp(j2\pi(k - K_{\text{Shift}}(i_{\text{BW}}))\Delta_{F,\text{ Pre-HE}}(t - nT_{SYML} - T_{\text{GI, LegacyPreamble}} - T_{CS,HE}(m))) \end{array} \right) \quad (28\text{-}17)$$

where

$T_{CS,\text{ HE}}(m)$ represents the cyclic shift for space time stream m as defined in 28.3.10.2.2 (Cyclic shift for HE modulated fields)

$Q_k^{(i_{Seg})}$ is defined in 28.3.9 (Mathematical description of signals)

$A_{\text{HE-LTF}}^{k}$ is defined in Equation (28-55)

For an HE extended range SU PPDU, the HE-SIG-A field is composed of four parts, i.e. HE-SIG-A1, HE-SIG-A2, HE-SIG-A3 and HE-SIG-A4, each part containing 26 data bits. These four parts are transmitted sequentially from HE-SIG-A1 to HE-SIG-A4. HE-SIG-A1 and HE-SIG-A2 have the same data bits. HE-SIG-A3 and HE-SIG-A4 have same data bits. The data bits of HE-SIG-A1 and HE-SIG-A3 shall be BCC encoded at rate, $R = 1/2$, interleaved, mapped to a BPSK constellation, and have pilots inserted. HE-SIG-A2 shall be BCC encoded at rate, $R = 1/2$, mapped to a QBPSK constellation without interleaving and have pilots inserted. The constellation mappings of the HE-SIG-A field in an HE extended range SU PPDU is shown in Figure 28-19 (Data tone constellation of HE-SIG-A symbols). The QBPSK constellation on HE-SIG-A2 is used to differentiate between an HE extended range SU PPDU and an HE MU PPDU when $m = 1$ in Equation (28-11), which indicates HE MU PPDU or HE extended range SU PPDU. HE-SIG-A4 shall be BCC encoded at rate, $R = 1/2$, mapped to a BPSK constellation without interleaving and have pilots inserted. BCC encoding, Data interleaving, constellation mapping and pilot insertion follow

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the steps described in 17.3.5.6 (Convolutional encoder), 28.3.11.8 (BCC interleavers), 17.3.5.8 (Subcarrier modulation mapping), and 17.3.5.9 (Pilot subcarriers), respectively.

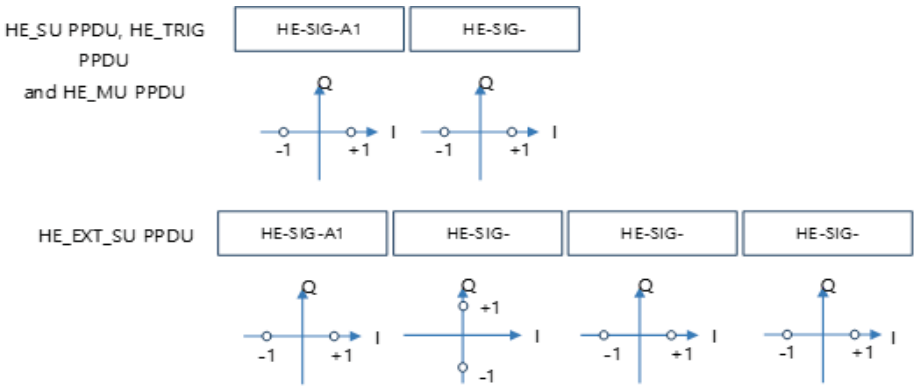

Figure 28-19—Data tone constellation of HE-SIG-A symbols

If the TXVECTOR parameter BEAM_CHANGE is 1, the time domain waveform for the HE-SIG-A field in an HE extended range SU PPDU, shall be as specified in Equation (28-18).

$$r_{\text{HE-SIG-A}}^{(i_{Seg}i_{TX})}(t) = \frac{1}{\sqrt{N_{TX}\cdot N_{\text{HE-SIG-A}}^{\text{Tone}}}}\sum_{n=0}^{3} w_{T_{\text{SYML}}}(t-nT_{SYML}) \quad (28\text{-}18)$$
$$\sum_{i_{BW}=0}^{N_{20\text{MHz}}-1}\sum_{k=-28}^{28}\left(\begin{array}{l}\Upsilon_{(k-K_{\text{Shift}}(i_{BW})),\,\text{BW}}(R_n D_{k,\,n,\,20}+p_{n+2}P_k)\\ \cdot\exp(j2\pi(k-K_{\text{Shift}}(i_{\text{BW}}))\Delta_{F,\,\text{Pre-HE}}(t-nT_{SYML}-T_{GI,\,\text{LegacyPreamble}}-T_{CS}^{i_{TX}}))\end{array}\right)$$

where

R_n is a phase rotation vector defined as [1, j, 1, 1]

If the TXVECTOR parameter BEAM_CHANGE is 0, the time domain waveform for the HE-SIG-A field in an HE extended range SU PPDU, shall be as specified in Equation (28-19).

$$r_{\text{HE-SIG-A}}^{(i_{Seg}i_{TX})}(t) = \frac{1}{\sqrt{N_{STS}\cdot N_{\text{HE-SIG-A}}^{\text{Tone}}}}\sum_{n=0}^{3} w_{T_{\text{SYML}}}(t-nT_{SYML}) \quad (28\text{-}19)$$
$$\sum_{i_{BW}=0}^{N_{20\text{MHz}}-1}\sum_{k=-28}^{28}\sum_{m=1}^{N_{STS}}\left(\begin{array}{l}\left[Q_{4(k-K_{\text{Shift}}(i_{BW}))}^{(i_{Seg})}\right]_{i_{TX},\,m}\left[A_{\text{HE-LTF}}^{4(k-K_{\text{Shift}}(i_{BW}))}\right]_{m,\,1}(R_n D_{k,\,n,\,20}+p_{n+2}P_k)\\ \cdot\exp(j2\pi(k-K_{\text{Shift}}(i_{\text{BW}}))\Delta_{F,\,\text{Pre-HE}}(t-nT_{SYML}-T_{\text{GI,\,LegacyPreamble}}-T_{CS,\,HE}(m)))\end{array}\right)$$

28.3.10.8 HE-SIG-B

28.3.10.8.1 Encoding and modulation

The HE-SIG-B field is separately encoded on each 20 MHz band. The encoding structure in one such 20 MHz band is shown in Figure 28-20 (HE-SIG-B field encoding structure in each 20 MHz). It consists of a

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Common Block field followed by a User Specific field which together are referred to as the HE-SIG-B content channel.

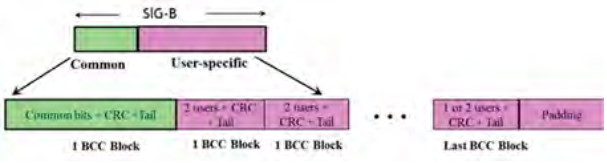

Figure 28-20—HE-SIG-B field encoding structure in each 20 MHz

The Common Block field of an HE-SIG-B content channel contains information regarding the resource unit allocation such as the RU assignment in frequency domain, the RUs allocated for MU-MIMO and the number of users in MU-MIMO allocations. The Common Block field is described in detail in 28.3.10.8.4 (HE-SIG-B common content).

The User Specific field of an HE-SIG-B content channel consists of one or more User Block fields. Each User Block field is made up of two user fields that contain information for two STAs to decode their payloads. The last User Block field may contain information for one or two STAs depending on the number of users indicated by the RU allocation signaling and the signaling of the center 26-tone RU. See 28.3.10.8.5 (HE-SIG-B per-user content) for a description of the contents of the User Block field.

When the SIGB Compression field in the HE-SIG-A field of an HE MU PPDU is set to 1 (indicating full bandwidth MU-MIMO transmission), the Common Block field is not present and the content channel consists of only the User Specific field.

28.3.10.8.2 Frequency domain mapping

The 20 MHz PPDU contains one content channel in which the Common Block field and User Specific field are carried as shown in Figure 28-21 (HE-SIG-B content channel for a 20 MHz PPDU). The Common Block field contains the RU allocation signaling for RUs that occur within the 242-tone RU boundary.

Figure 28-21—HE-SIG-B content channel for a 20 MHz PPDU

The 40 MHz PPDU contains two content channels, each occupying a 20 MHz segment. Each content channel contains a Common Block field followed by User Specific field as shown in Figure 28-22 (HE-SIG-B content channel for a 40 MHz PPDU). The content channels are ordered in increasing order of the absolute frequency i.e., the first content channel carries Common Block field and User Specific field corresponding to RUs whose subcarrier indices fall between [–244: –3] and the second content channel carries Common Block field and User Specific field corresponding to RUs whose subcarrier indices fall

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between [3:244]. If a 484-tone RU is signaled, both content channels will carry Common Block field and User Specific field corresponding to the 484-subcarrier RU.

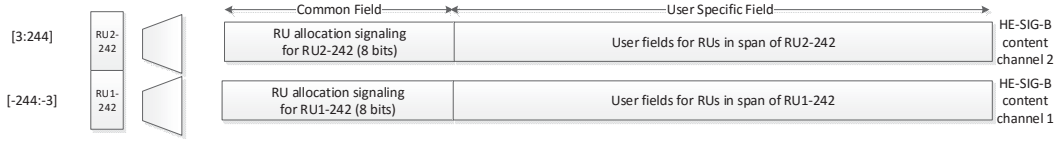

Figure 28-22—HE-SIG-B content channel for a 40 MHz PPDU

The 80 MHz PPDU contains two content channels each of which are duplicated once as shown in Figure 28-23 (Default mapping of the two HE-SIG-B channels and their duplication in an 80 MHz PPDU). The arrangement of the content channels are in increasing order of the absolute frequency where HE-SIG-B content channel 1 occupies the tones in the 20 MHz segment with the lowest subcarrier indices followed by the HE-SIG-B content channel 2 in the adjacent 20 MHz segment. This structure of the first content channel occupying the lower subcarrier index followed by the second content channel is repeated with content duplication in the remaining two 20 MHz segments, respectively. The first content channel appearing in the 20 MHz segments carries a Common Block field and User Specific field corresponding to RUs whose subcarriers indices overlap those segments. The Common Block field of content channel 1 contains the following: an RU allocation signaling field for RUs with subcarrier indices in the range [−500:−259], followed by a second RU allocation signaling field for RUs with subcarrier indices between [17:258] and 1 bit to indicate the presence of the user field corresponding to the center 26-tone RU that spans subcarriers [−16:−4, 4:16]. The second content channel carries a Common Block field and User Specific field corresponding to RUs whose subcarrier indices fall in those segments. The Common Block field of content channel 2 contains the following: an RU allocation signaling field for RUs whose subcarrier indices fall in the range [−258:−17], followed by a second RU allocation signaling field for RUs with subcarrier indices between [259:500] and 1 bit to indicate presence of the user field corresponding to the center 26-tone RU that spans subcarriers [−16:−4, 4:16]. The same value for the bit signaling presence of the center 26-tone RU is carried in both content channels. The user fields in the User Specific field that follow the common field are arranged in the same order as the RU allocation signaling. When assigned, the user field corresponding to the center 26-tone RU that spans subcarriers [−16:−4, 4:16] is carried as the last user field in the HE-SIG-B content channel 1. When RUs greater than 242 subcarriers are signaled in the RU allocation signaling in a portion of the bandwidth, the signaling is carried in both content channels placed in the order of the absolute subcarrier index.

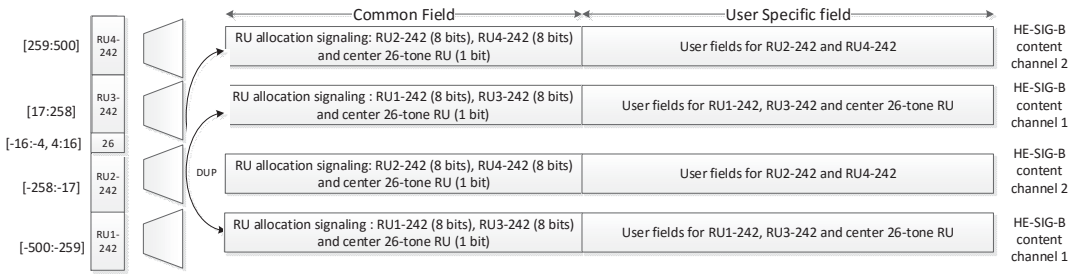

Figure 28-23—Default mapping of the two HE-SIG-B channels and their duplication in an 80 MHz PPDU

The 160 MHz PPDU contains two content channels each of which are duplicated four times as shown in Figure 28-24 (Default mapping of the two HE-SIG-B channels and their duplication in a 160 MHz PPDU). The arrangement of the content channels are in increasing order of the absolute frequency. The first content channel occupies the tones in the 20 MHz segment with the lowest subcarrier indices and the second content

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channel in the adjacent 20 MHz segment. This pattern of arranging HE-SIG-B content channel 1 and HE-SIG-B content channel 2 is duplicated over the other segments. The HE-SIG-B content channel 1 and HE-SIG-B content channel 2 carries RU allocation signaling at 242-tone RU granularity that overlap with the 20 MHz segments in which the content channels are carried (including duplication). The signaling for the presence of the User field corresponding to a center 26-tone RU in the 80 MHz segment with the lower subcarrier index is carried in HE-SIG-B content channel 1 as a 1-bit Center 26-tone RU field after the RU Allocation field in the Common field. Similarly, signaling for the center 26-tone RU in the 80 MHz segment with the higher subcarrier index is carried in HE-SIG-B content channel 2 as 1-bit Center 26-tone RU field after the RU Allocation field in the Common field. When assigned, the User field corresponding to the center 26-tone RU in the 80 MHz segments is carried as the last user field in their respective content channels. When RUs greater than 242 subcarriers are signaled in the RU Allocation field in a portion of the bandwidth, the signaling is carried in both content channels placed in the order of the absolute subcarrier index.

Figure 28-24—Default mapping of the two HE-SIG-B channels and their duplication in a 160 MHz PPDU

When the SIGB Compression field in the HE-SIG-A field of an HE MU PPDU is set to 0, for an MU-MIMO allocation of RU size greater than 242 subcarriers, the User fields are dynamically split between HE-SIG-B content channel 1 and HE-SIG-B content channel 2 and the split is decided by the AP (on a per case basis). See 28.3.10.8.4 (HE-SIG-B common content) and 28.3.10.8.5 (HE-SIG-B per-user content) for more details.

When preamble puncturing is present as indicated by values 4 to 7 in the Bandwidth field of HE-SIG-A field of an HE MU PPDU (see Table 28-17 (HE-SIG-A field of an HE MU PPDU)), the frequency domain structure of HE-SIG-B is the same as defined for the full bandwidth, i.e. the HE-SIG-B field frequency domain structure is solely dependent on the total bandwidth.

28.3.10.8.3 Time domain encoding

In each 20 MHz band, the bits in the Common Block field shall have CRC and tail bits added and then be BCC encoded at rate R = ½. The CRC bits are computed as described in 28.3.10.7.3 (CRC computation). Padding bits are not added after the common block.

In the User Specific field, in any 20 MHz band, the bits corresponding to two STAs (i.e. two User fields) are encoded together. Specifically, the STAs scheduled in the HE MU PPDU are split into groups of two. Each

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group of two User fields shall have CRC and tail bits added. If the number of User fields in the content channel is odd, CRC and tail bits are added after the last User field, which is not grouped. Padding bits are appended right after the tail bits corresponding to the last User Block field in each content channel to round up to the next multiple of number of data bits per HE-SIG-B symbol, as described in 17.3.5.4 (Pad bits (PAD)). Further padding bits are appended to each content channel so that the number of OFDM symbols after encoding and modulation in the content channel equals the Number Of HE-SIG-B Symbols Or MU-MIMO Users field in the HE-SIG-A field for an HE MU PPDU. Thus, padding ensures that the content channels in different 20 MHz bands end at the same OFDM symbol. For both the Common Block and User Specific fields, the information bits, tail bits and padding bits (if present) are BCC encoded at rate R = ½ using the encoder described in 17.3.5.6 (Convolutional encoder). When the code rate of the HE-SIG-B MCS is not equal to ½, the convolutional encoder output bits for each field are concatenated, then the concatenated bit streams are punctured as described in 17.3.5.6 (Convolutional encoder).

The coded bits are interleaved as in 28.3.11.8 (BCC interleavers). The interleaved bits are mapped to constellation points from the MCS specified in HE-SIG-A and have pilots inserted following the steps described in 17.3.5.8 (Subcarrier modulation mapping) and 17.3.5.9 (Pilot subcarriers), respectively.Each HE-SIG-B symbol shall have 52 data tones.

The guard interval used for HE-SIG-B shall be 0.8 μs.

The number of OFDM symbols in the HE-SIG-B field, denoted by $N_{SYM,\text{HE-SIG-B}}$, shall be signaled by the Number Of HE-SIG-B Symbols Or MU-MIMO Users field in the HE-SIG-A field of an HE MU PPDU (see 28.3.10.7.2 (Content)).

For the c-th content channel (c = 1 or 2), denote the sample on the k-th data subcarrier of the n-th symbol by $d_{k,n,c}$. The time domain waveform for the HE-SIG-B follows Equation (28-20).

$$r_{\text{HE-SIG-B}}^{(i_{Seg} i_{TX})}(t) = \frac{1}{\sqrt{N_{TX} \cdot N_{\text{HE-SIG-B}}^{\text{Tone}}}} \sum_{n=0}^{N_{SYM,\text{ HE-SIG_B}}} w_{T_{\text{HE-SIG-B}}}(t - nT_{SYML}) \quad (28\text{-}20)$$

$$\sum_{i_{BW} \in \Omega_{20\text{MHz}}} \sum_{k=-N_{SR}}^{N_{SR}} \left(\begin{array}{l} \Upsilon_{(k - K_{\text{Shift}}(i_{BW})),\, \text{BW}} \Gamma_{M_{20}^r(k)} (D_{k,\, n,\, i_{BW}}^{i_{Seg}} + p_{n+4} P_k) \\ \cdot \exp(j2\pi(k - K_{\text{Shift}}(i_{\text{BW}})) \Delta_{F,\, \text{Pre-HE}}(t - nT_{SYML} - T_{GI,\, \text{LegacyPreamble}} - T_{CS}^{i_{TX}})) \end{array} \right)$$

where

$\Gamma_{M_{20}^r(k)}$ is the phase rotation value for HE-SIG-B field PAPR reduction. When the HE-SIG-B field is modulated with MCS=0 and DCM=1, $\Gamma_{M_{20}^r(k)} = 1$. For all other modulation schemes of HE-SIG-B field,

$$\Gamma_{M_{20}^r(k)} = \begin{cases} 1 & 0 \le M_{20}^r(k) < 26 \\ (-1)^{M_{20}^r(k)} & 26 \le M_{20}^r(k) < 52 \end{cases}$$

$N_{20\text{MHz}}$ and $K_{\text{Shift}}(i)$ are defined in 21.3.8.2.4 (L-SIG definition)

$$D_{k,\, n,\, i_{BW}}^{i_{Seg}} = \begin{cases} 0, k = 0, \pm 7, \pm 21 \\ d_{M_{20}^r(k),\, n,\, (i_{BW} mod\ 2) + 1}, \text{otherwise} \end{cases}$$

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$$M_{20}^{r}(k) = \begin{cases} k+28, & -28 \le k \le -22 \\ k+27, & -20 \le k \le -8 \\ k+26, & -6 \le k \le -1 \\ k+25, & 1 \le k \le 6 \\ k+24, & 8 \le k \le 20 \\ k+23, & 22 \le k \le 28 \end{cases}$$

P_k and p_n are defined in 17.3.5.10 (OFDM modulation)

$N_{SYM,\text{HE-SIG-B}}$ his the number of OFDM symbols in the HE-SIG-B field

28.3.10.8.4 HE-SIG-B common content

The Common Block field in the HE-SIG-B field carries the RU allocation subfields. Depending on the PPDU bandwidth, the Common Block field can contain multiple RU Allocation subfields. The format of the Common Block field is defined in Table 28-20 (Common Block field).

Table 28-20—Common Block field

Subfield	Number of bits	Description
RU Allocation	*N* x 8	Indicates the RU assignment in the frequency domain. It also indicates the number of user fields in each RU. For RUs of size greater than or equal to 106-tones that support MU-MIMO, it indicates the number of users multiplexed using MU-MIMO. *N* = 1 for a 20 MHz and a 40 MHz HE MU PPDU *N* = 2 for an 80 MHz HE MU PPDU *N* = 4 for a 160 MHz or 80+80 MHz HE MU PPDU
Center 26-tone RU	1	This field is present only for full bandwidth 80 MHz, 160 MHz and 80+80 MHz. For full bandwidth 80 MHz: Set to 1 to indicate that the center 26-tone RU is allocated in the Common Block fields of both HE-SIG-B content channels with the same value. Set to 0, otherwise. For full bandwidth 160 MHz or 80+80 MHz: Set to 1 to indicate that the center 26-tone RU is allocated for one individual 80 MHz in the Common Block fields of both HE-SIG-B content channels. Set to 0, otherwise.
CRC	4	See 28.3.10.7.3 (CRC computation)
Tail	6	Used to terminate the trellis of the convolutional decoder. Set to 0
NOTE—Integer fields are transmitted in unsigned binary format, LSB first, where the LSB is in the lowest numbered bit position.		

An RU Allocation subfield in the Common Block field of HE-SIG-B consists of 8 bits that indicates the following for a 20 MHz PPDU BW:

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— The RU assignment in the frequency domain: indexes the size of the RUs and their placement in the frequency domain.

— The number of user fields in a 20 MHz BW within the HE-SIG-B content channel: the number of users multiplexed in the RUs indicated by the arrangement; for RUs of size greater than or equal to 106 tones that support MU-MIMO, it indicates the number of users multiplexed using MU-MIMO.

The mapping of the 8-bit RU Allocation subfield to the RU assignment and the number of user fields per RU is defined in the Table 28-21 (RU allocation signaling: arrangement and number of MU-MIMO allocations). In the table, the number of entries column refers to the number of 8-bit indices that refer to the same RU assignment in the frequency domain but differ in the number of users fields per RU. The RU assignment and the number of user fields per RU together indicate the number of user-fields in the User specific field of HE-SIG-B. Signaling for the center 26-tone RU in BW ≥ 80 MHz follows the RU Allocation subfields. For full BW 80 MHz, 1 bit is added to indicate if center 26-tone RU is allocated in the Common Block fields of both HE-SIG-B content channels with same value. For full BW 160 MHz, 1 bit is added to indicate if center 26-tone RU is allocated for one individual 80 MHz in common block fields of both HE-SIG-B content channels.

Table 28-21—RU allocation signaling: arrangement and number of MU-MIMO allocations

8 bits indices (B7 B6 B5 B4 B3 B2 B1 B0)	#1	#2	#3	#4	#5	#6	#7	#8	#9	Number of entries
00000000	26	26	26	26	26	26	26	26	26	1
00000001	26	26	26	26	26	26	26	52		1
00000010	26	26	26	26	26	52		26	26	1
00000011	26	26	26	26	26	52		52		1
00000100	26	26	52		26	26	26	26	26	1
00000101	26	26	52		26	26	26	52		1
00000110	26	26	52		26	52		26	26	1
00000111	26	26	52		26	52		52		1
00001000	52		26	26	26	26	26	26	26	1
00001001	52		26	26	26	26	26	52		1
00001010	52		26	26	26	52		26	26	1
00001011	52		26	26	26	52		52		1
00001100	52		52		26	26	26	26	26	1
00001101	52		52		26	26	26	52		1
00001110	52		52		26	52		26	26	1
00001111	52		52		26	52		52		1

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Table 28-21—RU allocation signaling: arrangement and number of MU-MIMO allocations

$00010y_2y_1y_0$	52		52		-	106							8
$00011y_2y_1y_0$	106				-	52		52					8
$00100y_2y_1y_0$	26	26	26	26	26	106							8
$00101y_2y_1y_0$	26	26	52		26	106							8
$00110y_2y_1y_0$	52		26	26	26	106							8
$00111y_2y_1y_0$	52		52		26	106							8
$01000y_2y_1y_0$	106				26	26	26	26	26				8
$01001y_2y_1y_0$	106				26	26	26	52					8
$01010y_2y_1y_0$	106				26	52		26	26				8
$01011y_2y_1y_0$	106				26	52		52					8
$0110y_1y_0z_1z_0$	106				-	106							16
01110000	52		52		-	52		52					1
01110001	242-tone RU empty												1
01110010	484-tone RU with zero HE-SIG-B User Specific field in the corresponding HE-SIG-B Content Channel												1
01110011	996-tone RU with zero HE-SIG-B User Specific field in the corresponding HE-SIG-B Content Channel												1
$011101x_1x_0$	Reserved												4
$011111x_1x_0$	Reserved												8
$10y_2y_1y_0z_2z_1z_0$	106				26	106							64
$11000y_2y_1y_0$	242												8
$11001y_2y_1y_0$	484												8
$11010y_2y_1y_0$	996												8

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Table 28-21—RU allocation signaling: arrangement and number of MU-MIMO allocations

$11011y_2y_1y_0$	2×996	8
$111x_4x_3x_2x_1x_0$	Reserved	32

$y_2y_1y_0$ = 000-111 indicates number of STAs multiplexed in the only 106-tone RU or the left 106-tone RU if there are two 106-tone RUs. The binary vector $y_2y_1y_0$ is indexed as [y[3]y[2]y[1]] indicates $2^2 \times y[3] + 2^1 \times y[2] + y[1] + 1$ STAs multiplexed in the RU.

$z_2z_1z_0$ = 000-111 indicates number of STAs multiplexed in the right 106-tone RU if there are two 106-tone RUs. The binary vector $z_2z_1z_0$ is indexed as [z[3]z[2]z[1]] indicates $2^2 \times z[3] + 2^1 \times z[2] + z[1] + 1$ STAs multiplexed in the RU.

Similarly, y_1y_0 = 00-11 indicates number of STAs multiplexed in the left 106-tone RU. The binary vector y_1y_0 is indexed as [y[2]y[1]] indicates $2^1 \times y[2] + y[1] + 1$ STAs multiplexed in the RU.

Similarly, z_1z_0 = 00-11 indicates the number of STAs multiplexed in the right 106-tone RU. The binary vector z_1z_0 is indexed as [z[2]z[1]] indicates $2^1 \times z[2] + z[1] + 1$ STAs multiplexed in the RU.

#1 to #9 (from left to the right) is ordered in increasing order of the absolute frequency.

x_1x_0 = 00-11, $x_4x_3x_2x_1x_0$ = 00000-11111.

'-' means no STA in that RU.

The number of RU Allocation subfields in the Common Block field depends on the PPDU bandwidth

— In the default mode when the SIGB Compression field in the HE-SIG-A field of an HE MU PPDU is set to 0, for a 20 MHz and a 40 MHz PPDU, each HE-SIG-B content channel contains one RU Allocation field in the Common field followed by multiple User fields. The position of the User field in the User Specific field together with the 8-bit RU Allocation field indicates the RU assignment to the user.

— In the default mode for an 80 MHz PPDU, each HE-SIG-B content channel contains two RU Allocation subfields for a total of 16 bits of RU allocation signaling, one each for the RUs in the two 20 MHz segments of the HE-SIG-B content channel. The position of the User field in the User Specific field together with the 8-bit RU Allocation field indicates the RU assignment to the user. The User fields corresponding to the first RU Allocation field are followed by the User fields indicated by the second RU Allocation field in the User Specific field.

— In the default mode for a 160 MHz PPDU, each HE-SIG-B content channel contains four RU Allocation subfields for a total of 32 bits of RU allocation signaling, one each for the RUs in the four 20 MHz segments of the HE-SIG-B content channel. The position of the User field in the Use Specific field together with the 8-bit RU Allocation field indicates the RU assignment to the user. The User fields for each of the 20 MHz segments in the content channel are arranged by the order in which their RU Allocation fields appear in the Common field.

28.3.10.8.5 HE-SIG-B per-user content

The User Specific field consists of multiple User fields. The User fields follow the Common field of HE-SIG-B. The RU Allocation field in the Common field and the position of the User field in the HE-SIG-B User Specific field together identify the RU used to transmit a STA's data. Multiple RU allocations addressed to a single STA shall not be allowed in 802.11ax. Therefore, the signaling that enables STAs to decode its data is carried in only one user field. An example for the mapping of the 8-bit RU allocation subfield and the position of the user field to an STA's data is illustrated in Figure 28-25 (Illustration for the mapping of the 8-bit RU allocation subfield and the position of the User field to the STA's assignment). The

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RU allocation signaling indicates an arrangement of 106-tone RU followed by five 26-tone RUs and that the 106-tone RU contains three user-fields, i.e., the 106-tone RU supports multiplexing of three users using MU-MIMO. The eight user fields in the HE-SIG-B user-specific field thus map to the 6 RUs, with the first three user fields indicating MU-MIMO allocations in the first 106-tone RU followed by user fields corresponding to the each of the five 26-tone RUs.

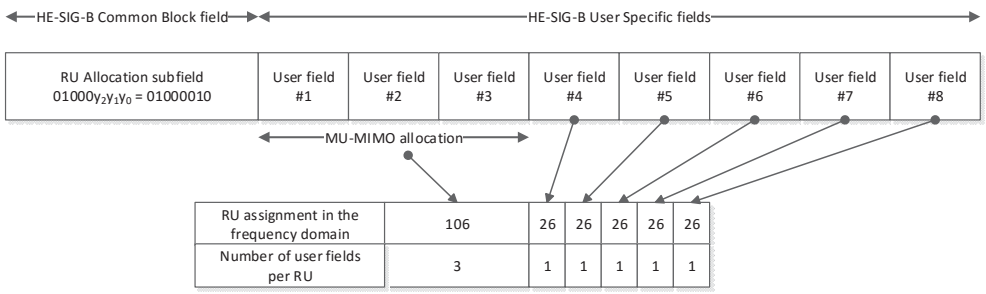

Figure 28-25—Illustration for the mapping of the 8-bit RU allocation subfield and the position of the User field to the STA's assignment

The contents of the User field differ based on whether the field addresses a single STA in an RU or a STA in an MU-MIMO allocation in an RU. Irrespective of whether the allocation is for a STA in an SU or an MU-MIMO allocation, the size of the user field is the same.

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The HE-SIG-B user field for an SU allocation contain the subfields shown in Table 28-22 (Fields of the HE-SIG-B user field for an non-MU-MIMO allocation).

Table 28-22—Fields of the HE-SIG-B user field for an non-MU-MIMO allocation

Bit	Field	Number of bits	Description
B0-B10	STA-ID	11	The STA-ID refers to the AID described in 9.4.1.8 (AID field). The 11 LSBs of the AID field are used to address the STAs in this field. For RUs that carry a broadcast allocation: — For single BSS AP, the STAID for broadcast will be 0 — For Multiple BSS AP, the STAID for broadcast to a specific BSS will follow the group addressed AID assignment in the TIM according to the existing Multi-BSSID TIM operation — For multiple BSS AP, the STAID for broadcast to all BSS of the AP is set to 2047 And further: — STAID value 2046 is used to indicate that the RU carries no data — When a STA transmits on the uplink using the HE MU PPDU format, the STA-ID field is populated by the AID of the transmitter assigned by the AP
B11-B13	NSTS	3	Number of spatial streams. Set to the number of space time streams minus 1.
B14	Tx Beam-forming	1	Use of transmit beamforming. Set to 1 if a beamforming steering matrix is applied to the waveform in an SU transmission. Set to 0 otherwise.
B15-B18	MCS	4	Modulation and coding scheme Set to *n* for MCS*n*, where *n* = 0, 1 ,2 …., 11 Values 12 to 15 are reserved

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Table 28-22—Fields of the HE-SIG-B user field for an non-MU-MIMO allocation *(continued)*

B19	DCM	1	Indicates whether or not dual carrier modulation is used. Set to 1 to indicate that the payload of the HE MU PPDU is modulated with dual carrier modulation for the MCS. Set to 0 indicates that the payload of the PPDU is not modulated with dual carrier modulation for the MCS.
B20	Coding	1	Indicates whether BCC or LDPC is used. Set to 0 for BCC Set to 1 for LDPC
NOTE—Integer fields are transmitted in unsigned binary format, LSB first, where the LSB is in the lowest numbered bit position.			

The HE-SIG-B user field for an STA in MU-MIMO allocation contain the subfields shown in Table 28-23 (Fields of the HE-SIG-B user field for an MU-MIMO allocation).

Table 28-23—Fields of the HE-SIG-B user field for an MU-MIMO allocation

Bit	Field	Number of bits	Description
B0-B10	STA-ID	11	The STA-ID refers to the AID described in 9.4.1.8 (AID field). The 11 LSBs of the AID field are used to address STAs in this field.
B11-B14	Spatial Configuration	4	Indication for the number of spatial streams for a STA in an MU-MIMO allocation. See Table 28-24 (Spatial Configuration subfield encoding).
B15-B18	MCS	4	Modulation and coding scheme. Set to n for MCS*n*, where *n* = 0, 1, 2,…..11 Values 12 to 15 are reserved
B19	DCM	1	Indicates whether or not dual carrier modulation is used. Set to 1 to indicate that the payload of the HE MU PPDU is modulated with dual carrier modulation for the MCS. Set to 0 indicates that the payload of the PPDU is not modulated with dual carrier modulation for the MCS.
B20	Coding	1	Indicates whether BCC or LDPC is used. Set to 0 for BCC Set to 1 for LDPC
NOTE—Integer fields are transmitted in unsigned binary format, LSB first, where the LSB is in the lowest numbered bit position.			

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A user field for an MU-MIMO allocation includes a Spatial Configuration subfield consisting of 4 bits that indicates the number of spatial streams for each STA and the total number of spatial streams in the MU-MIMO allocation. The subfield shown in Table 28-24 (Spatial Configuration subfield encoding) is constructed by using the entries corresponding to the value of number of users (N_{user}) multiplexed using MU-MIMO in an RU. When MU-MIMO is used in an RU of size less than or equal to 242 subcarriers, the number of users (N_{user}) in an MU-MIMO allocation is equal to the number of user fields per RU signaled for the RU in the RU allocation subfield of an HE-SIG-B Common block field. When MU-MIMO is used in RUs of size greater than 242 subcarriers, the number of users (N_{user}) in an MU-MIMO allocation is computed as the sum of the number of user-fields per RU indicated for the RU by the 8-bit RU allocation subfield in each HE-SIG-B content channel. For a given value of N_{user}, the four bits of the spatial configuration subfield are used as follows: A STA with a STA-ID that matches the 11-bit ID signaled in the user field for an MU-MIMO allocation derives the number of spatial streams allocated to it using the row corresponding to the signaled 4-bit spatial configuration subfield and the column corresponding to the position of the user field in the user-specific field. The starting stream index for the STA is computed by summing the Nsts in the columns prior to the column indicated by the STA's user-field position. In the case of load balancing for RUs of size greater than 242 subcarriers where user fields corresponding to the same MU-MIMO allocations are split into two HE-SIG-B content channels, the user-field positions are logically continuous with the first user field corresponding to the same RU in the second HE-SIG-B content channel updating its position (and therefore, column index) from that of the last user field in the first HE-SIG-B content channel.

Table 28-24—Spatial Configuration subfield encoding

N_{user}	B3...B0	Nsts [1]	Nsts [2]	Nsts [3]	Nsts [4]	Nsts [5]	Nsts [6]	Nsts [7]	Nsts [8]	Total Nsts	Number of entries
2	0000-0011	1-4	1							2-5	10
	0100-0110	2-4	2							4-6	
	0111-1000	3-4	3							6-7	
	1001	4	4							8	
3	0000-0011	1-4	1	1						3-6	13
	0100-0110	2-4	2	1						5-7	
	0111-1000	3-4	3	1						7-8	
	1001-1011	2-4	2	2						6-8	
	1100	3	3	2						8	
4	0000-0011	1-4	1	1	1					4-7	11
	0100-0110	2-4	2	1	1					6-8	
	0111	3	3	1	1					8	
	1000-1001	2-3	2	2	1					7-8	
	1010	2	2	2	2					8	

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Table 28-24—Spatial Configuration subfield encoding *(continued)*

5	0000-0011	1-4	1	1	1	1				5-8	6
	0100-0101	2-3	2	1	1	1				7-8	
6	0000-0010	1-3	1	1	1	1	1			6-8	4
	0011	2	2	1	1	1	1			8	
7	0000-0001	1-2	1	1	1	1	1	1		7-8	2
8	0000	1	1	1	1	1	1	1	1	8	1

When the SIGB Compression field in the HE-SIG-A field of an HE MU PPDU is set to 1 (indicating full bandwidth MU-MIMO transmission), the number of STAs in the MU-MIMO group is indicated in the SIGB Number of Symbols/Number of MU-MIMO Users field in the HE-SIG-A field. When the SIGB Compression field in the HE-SIG-A field of an HE MU PPDU is set to 1, for bandwidths larger than 20 MHz, the User fields are split equitably between two HE-SIG-B content channels, i.e., for a k user MU-MIMO PPDU, $1, \ldots, \lceil k/2 \rceil$ User fields are carried in HE-SIG-B content channel 1 and $\lceil k/2 \rceil + 1, \ldots, k$ User fields in HE-SIG-B content channel 2.

The total number of spatial streams (total N_{STS}) is computed by summing all columns for the row signaled by the spatial configuration subfield and is indicated in Table 28-24 (Spatial Configuration subfield encoding) under the column Total Nsts.

28.3.10.9 HE-STF

The main purpose of the HE-STF field is to improve automatic gain control estimation in a MIMO transmission. The duration of the HE-STF field for HE PPDUs except HE trigger-based PPDUs is $T_{\text{HE-STF-NT}}$ (periodicity of 0.8 μs with 5 periods) and the duration of the HE-STF field for an HE trigger-based PPDU is $T_{\text{HE-STF-T}}$ (periodicity of 1.6 μs with 5 periods). The tone indices for HE-STF field for HE PPDUs except HE trigger-based PPDUs is defined in Equation (28-21).

$$i_{STF} \bmod 16 = 0, \lfloor N_{DC}/2 \rfloor < |i_{STF}| \le N_{SR}$$
$$i_{STF} : \text{HE-STF tone index} \qquad (28\text{-}21)$$

The tone indices for HE-STF fields for an HE trigger-based PPDU are defined in Equation (28-22).

$$i_{STF} \bmod 8 = 0, \lfloor N_{DC}/2 \rfloor < |i_{STF}| \le N_{SR}$$
$$i_{STF} : \text{HE-STF tone index} \qquad (28\text{-}22)$$

For the HE-STF field, the M sequence is defined by Equation (28-23).

$$M = \{-1, -1, -1, 1, 1, 1, -1, 1, 1, 1, -1, 1, 1, -1, 1\} \qquad (28\text{-}23)$$

The HE-STF field is constructed from the M sequence(s) multiplied by $(1+j)/\sqrt{2}$ or $(-1-j)/\sqrt{2}$ and extra coefficients selected out of $(1+j)/\sqrt{2}$ or $(-1-j)/\sqrt{2}$ at tone indices which are null but shall have the HE-STF coefficients after mapping M sequences to each 20 MHz subchannel.

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For a 20 MHz transmission, the frequency domain sequence for HE PPDUs except HE trigger-based PPDUs is given by Equation (28-24).

$$HES_{-112:16:112} = \{M\} \cdot (1+j)/\sqrt{2}$$
$$HES_0 = 0 \quad (28\text{-}24)$$

where $HES_{a:b:c}$ means coefficients of the HE-STF on every b tone indices from a to c tone indices and coefficients on other tone indices are set to zero.

For a 40 MHz transmission, the frequency domain sequence for HE PPDUs except HE trigger-based PPDUs is given by Equation (28-25).

$$HES_{-240:16:240} = \{M, 0, -M\} \cdot (1+j)/\sqrt{2} \quad (28\text{-}25)$$

For an 80 MHz transmission, the frequency domain sequence for HE PPDUs except HE trigger-based PPDUs is given by Equation (28-26).

$$HES_{-496:16:496} = \{M, 1, -M, 0, -M, 1, -M\} \cdot (1+j)/\sqrt{2} \quad (28\text{-}26)$$

For a 160 MHz transmission, the frequency domain sequence for HE PPDUs except HE trigger-based PPDUs is given by Equation (28-27).

$$HES_{-1008:16:1008} = \{M, 1, -M, 0, -M, 1, -M, 0, -M, -1, M, 0, -M, 1, -M\} \cdot (1+j)/\sqrt{2} \quad (28\text{-}27)$$

For an 80+80 MHz transmission, the primary 80 MHz segment for HE PPDUs except HE trigger-based PPDUs shall use the HE-STF pattern for the 80 MHz defined in Equation (28-26).

For an 80+80 MHz transmission, the frequency domain sequence of the secondary 80 MHz segment for HE PPDUs except HE trigger-based PPDUs is given by Equation (28-28).

$$HES_{-496:16:496} = \{-M, -1, M, 0, -M, 1, -M\} \cdot (1+j)/\sqrt{2} \quad (28\text{-}28)$$

For a 20 MHz transmission, the frequency domain sequence for HE trigger-based PPDUs is given by Equation (28-29).

$$HES_{-120:8:120} = \{M, 0, -M\} \cdot (1+j)/\sqrt{2} \quad (28\text{-}29)$$

For a 40 MHz transmission, the frequency domain sequence for HE trigger-based PPDUs is given by Equation (28-30).

$$HES_{-248:8:248} = \{M, -1, -M, 0, M, -1, M\} \cdot (1+j)/\sqrt{2}$$
$$HES_{\pm 248} = 0 \quad (28\text{-}30)$$

For an 80 MHz transmission, the frequency domain sequence for HE trigger-based PPDUs is given by Equation (28-31).

$$HES_{-504:8:504} = \{M, -1, M, -1, -M, -1, M, 0, -M, 1, M, 1, -M, 1, -M\} \cdot (1+j)/\sqrt{2}$$
$$HES_{\pm 504} = 0 \quad (28\text{-}31)$$

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For a 160 MHz transmission, the frequency domain sequence for HE trigger-based PPDUs is given by Equation (28-32).

$$\begin{aligned} HES_{-1016:8:1016} = \{&M, -1, M, -1, -M, -1, M, 0, -M, 1, M, 1, -M, 1, -M, 0 \\ &-M, 1, -M, 1, M, 1, -M, 0, -M, 1, M, 1, -M, 1, -M\} \cdot (1+j)/\sqrt{2} \\ HES_{\pm 8} = 0,\ HES_{\pm 1016} = 0 \end{aligned} \tag{28-32}$$

For an 80+80 MHz transmission, the primary 80 MHz segment for HE trigger-based PPDUs shall use the HE-STF pattern for the 80 MHz defined in Equation (28-31).

For an 80+80 MHz transmission, the frequency domain sequence of the secondary 80 MHz segment for HE trigger-based PPDUs is given by Equation (28-33).

$$\begin{aligned} HES_{-504:8:504} &= \{-M, 1, -M, 1, M, 1, -M, 0, -M, 1, M, 1, -M, 1, -M\} \cdot (1+j)/\sqrt{2} \\ HES_{\pm 504} &= 0 \end{aligned} \tag{28-33}$$

For an OFDMA transmission, the coefficients in Equation (28-24) to Equation (28-33) are set to zero if those values are corresponding to tone indices for which no RUs are defined (see 28.3.9 (Mathematical description of signals)).

The time domain representation of the signal for an HE PPDU that is not an HE trigger-based PPDU on frequency segment i_{Seg} of transmit chain i_{TX} shall be as specified in Equation (28-34).

$$\begin{aligned} r_{\text{HE-STF}}^{(i_{Seg} i_{TX})}(t) = w_{T_{\text{HE-STF-NT}}}(t) \cdot \sum_{r=0}^{N_{RU}-1} \frac{\alpha_r \beta_r}{\sqrt{N_{STS,r,total}}} \\ \sum_{k \in K_r} \eta_{\text{HE-STF},k} \sum_{u=0}^{N_{user,r}-1} \sum_{m=1}^{N_{STS,r,u}} \left(\left[Q_k^{(i_{Seg})} \right]_{i_{TX}, M_{r,u}+m} HES_k \cdot \exp(j2\pi k \Delta_{F,\text{HE}}(t - T_{CS,HE}(M_{r,u}+m))) \right) \end{aligned} \tag{28-34}$$

where

α_r is the power boost factor for the r-th RU. A STA shall support α_r in the range [0.7, $\sqrt{2}$]. A STA may support α_r in the range [0.5, 2].

$\eta_{\text{HE-STF},k}$ is an HE PPDU format dependent scaling factor, defined by

$$\eta_{\text{HE-STF},k} = \begin{cases} \sqrt{2}, & \text{for an HE extended range SU PPDU} \\ 1, & \text{otherwise} \end{cases}$$

β_r is the per-RU power normalization factor and defined by

$$\beta_r = \left(\sqrt{\frac{|K_r|}{|K_r^{\text{HE-STF}}|}} \right) / \left(\sqrt{\sum_{r=1}^{N_{RU}} \alpha_r^2 |K_r|} \right)$$

$|K_r|$ is the cardinality of the set of subcarriers K_r

$K_r^{\text{HE-STF}}$ is the set of subcarriers that have non-zero values within K_r in the HE-STF field

$T_{CS,\text{HE}}(M_{r,u}+m)$ represents the cyclic shift for space time stream $M_{r,u}+m$ as defined in 28.3.10.2.2 (Cyclic shift for HE modulated fields)

$Q_k^{(i_{Seg})}$ is defined in 28.3.9 (Mathematical description of signals)

$w_{T_{\text{HE-STF-NT}}}$ is the windowing function for HE-STF field in the non-HE trigger-based PPDU

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The time domain representation of the signal for an HE trigger-based PPDU transmitted by user u in the r-th RU on frequency segment i_{Seg} of transmit chain i_{TX} shall be as specified in Equation (28-35).

$$r_{\text{HE-STF}}^{(i_{Seg} i_{TX})}(t) = \frac{1}{\sqrt{\left|K_r^{\text{HE-STF}}\right| N_{STS,\,r,\,total}}} w_{T_{\text{HE-STF-T}}}(t) \sum_{k \in K_r} \sum_{m=1}^{N_{STS,\,r,\,u}} \left(\left[Q_k^{(i_{Seg})} \right]_{i_{TX},\,(M_{r,\,u}+m)} HES_k \cdot \exp(j2\pi k \Delta_{F,\,\text{HE}}(t - T_{CS,\,HE}(M_{r,\,u}+m))) \right) \quad (28\text{-}35)$$

where

$w_{T_{\text{HE-STF-T}}}$ is the windowing function for HE-STF field in the HE trigger-based PPDU

28.3.10.10 HE-LTF

The HE-LTF field provides a means for the receiver to estimate the MIMO channel between the set of constellation mapper outputs (or, if STBC is applied, the STBC encoder outputs) and the receive chains. In an HE SU PPDU, HE extended range SU PPDU and HE MU PPDU, the transmitter provides training for $N_{STS,r,total}$ space-time streams (spatial mapper inputs) used for the transmission of the PSDU(s) in the r-th RU. In an HE trigger-based PPDU, the transmitter of user u in the r-th RU provides training for $N_{STS,r,u}$ space-time streams used for the transmission of the PSDU. For each tone in the r-th RU, the MIMO channel that can be estimated is an $N_{RX} \times N_{STS,r,total}$ matrix. An HE transmission has a preamble that contains HE-LTF symbols, where the data tones of each HE-LTF symbol are multiplied by entries belonging to a matrix $P_{\text{HE-LTF}}$, to enable channel estimation at the receiver. The pilot subcarriers of each HE-LTF symbol are multiplied by the entries of a matrix $R_{\text{HE-LTF}}$ defined in the following text. The multiplication of the pilot subcarriers in the HE-LTF symbol by the $R_{\text{HE-LTF}}$ matrix instead of the $P_{\text{HE-LTF}}$ matrix allows receivers to track phase and frequency offset during MIMO channel estimation using the HE-LTF. In an HE SU PPDU, HE extended range SU PPDU and HE MU PPDU with a single RU (the RU having an MU-MIMO allocation or an SU allocation), the number of HE-LTF symbols, $N_{\text{HE-LTF}}$, is a function of the total number of space-time streams N_{STS} as shown in Table 28-12 (Frequently used parameters). In an HE trigger-based PPDU, $N_{\text{HE-LTF}}$ is indicated in the Trigger frame that triggers the transmission of the PPDU. In an HE MU PPDU, $N_{\text{HE-LTF}}$ is indicated in the HE-SIG-A field. In an HE MU PPDU with more than one RU and in an HE trigger-based PPDU, $N_{\text{HE-LTF}}$ may take any value among one, two, four, six or eight, which is greater than or equal to the maximum value of the initial number of HE-LTF symbols for each RU r, which is calculated as a function of $N_{STS,r,total}$, separately based on Table 28-12 (Frequently used parameters).

An HE PPDU supports 3 HE-LTF modes, which are 1x HE-LTF, 2x HE-LTF and 4x HE-LTF. It is optional to support the 1x HE-LTF mode in an HE SU PPDU, HE extended range SU PPDU and HE MU PPDU. It is mandatory to support transmission of 1x HE-LTF in an UL MU-MIMO PPDU over the full bandwidth, for a STA declaring support for UL MU-MIMO. The 1x HE-LTF mode is disallowed in an HE MU PPDU and in an HE trigger-based PPDU with more than one RUs, and is also disallowed in an HE MU PPDU with one RU whenever the RU has an MU-MIMO allocation. In an HE SU PPDU, HE MU PPDU and HE extended range SU PPDU, the combination of HE-LTF modes and GI duration is indicated in HE-SIG-A field. In an HE trigger-based PPDU, the combination of HE-LTF modes and GI duration is indicated in the Trigger frame that triggers the transmission of the PPDU. The mandatory combinations of HE-LTF modes and GI duration are:

— 2x HE-LTF, $T_{GI1,Data}$
— 2x HE-LTF, $T_{GI2,Data}$
— 4x HE-LTF, $T_{GI4,Data}$

The optional combinations of HE-LTF mode and GI duration are:

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— 1x HE-LTF, $T_{GI1,Data}$ in an HE SU PPDU or HE extended SU PPDU

— 1x HE-LTF, $T_{GI1,Data}$ in a non-OFDMA, MU-MIMO HE MU PPDU

— 1x HE-LTF, $T_{GI2,Data}$ in a non-OFDMA, MU-MIMO HE trigger-based PPDU

The duration of each HE-LTF symbol excluding GI is $T_{\text{HE-LTF}}$ is defined in Equation (28-36). In an HE SU PPDU, HE MU PPDU or HE extended range SU PPDU, the HE-LTF symbol duration is indicated in HE-SIG-A field. In an HE trigger-based PPDU, the HE-LTF symbol duration is indicated in the Trigger frame that triggers the transmission of the PPDU.

$$T_{\text{HE-LTF}} = \begin{cases} T_{\text{HE-LTF-1X}}, \text{ if 1x HE-LTF} \\ T_{\text{HE-LTF-2X}}, \text{ if 2x HE-LTF} \\ T_{\text{HE-LTF-4X}}, \text{ if 4x HE-LTF} \end{cases} \quad (28\text{-}36)$$

where $T_{\text{HE-LTF-1X}}$, $T_{\text{HE-LTF-2X}}$, $T_{\text{HE-LTF-4X}}$ are defined in Table 28-9 (Timing-related constants).

In a 20 MHz transmission, the 1x HE-LTF sequence transmitted and located on subcarriers [−122:122] is given by Equation (28-37).

$$\begin{aligned} &HELTF_{-122,122} = \\ &\{0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, \\ &0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, \\ &-1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, \\ &0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, 0, 0, 0, \\ &0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0, \\ &0, 0, −1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, −1, \\ &0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, \\ &−1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0\} \end{aligned} \quad (28\text{-}37)$$

In a 20 MHz transmission, the 2x HE-LTF sequence transmitted and located on subcarriers [−122:122] is given by Equation (28-38).

$$\begin{aligned} &HELTF_{-122,122} = \\ &\{−1, 0, −1, 0, −1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, \\ &0, −1, 0, −1, 0, +1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, +1, \\ &0, −1, 0, −1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, \\ &0, +1, 0, −1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, +1, \\ &0, +1, 0, +1, 0, −1, 0, −1, 0, +1, 0, 0, 0, +1, 0, −1, 0, +1, 0, +1, 0, −1, 0, +1, 0, +1, 0, −1, \\ &0, +1, 0, +1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, +1, \\ &0, +1, 0, −1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, −1, \\ &0, −1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, \\ &0, −1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1\} \end{aligned} \quad (28\text{-}38)$$

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In a 20 MHz transmission, the 4x HE-LTF sequence transmitted and located on subcarriers [−122:122] is given by Equation (28-39).

$$
\begin{aligned}
&HELTF_{-122,122} = \\
&\{-1, -1, +1, -1, +1, -1, +1, +1, +1, -1, +1, +1, +1, -1, -1, +1, -1, -1, -1, -1, -1, +1, \\
&+1, -1, -1, -1, -1, +1, +1, -1, \ +1, -1, +1, +1, +1, +1, -1, +1, -1, -1, +1, +1, -1, +1, +1, \\
&+1, +1, -1, -1, +1, -1, -1, -1, +1, +1, +1, +1, -1, +1, +1, \ -1, -1, -1, -1, +1, -1, -1, +1, \\
&+1, -1, +1, -1, -1, -1, -1, +1, -1, +1, -1, -1, -1, -1, -1, -1, +1, +1, -1, -1, -1, -1, \ -1, \\
&+1, -1, -1, +1, +1, +1, -1, +1, +1, +1, -1, +1, -1, +1, -1, -1, -1, -1, -1, +1, +1, +1, -1, \\
&-1, -1, +1, -1, +1, +1, \ +1, 0, 0, 0, -1, +1, -1, +1, -1, +1, +1, -1, +1, +1, +1, -1, -1, +1, \\
&-1, -1, +1, -1, +1, -1, +1, +1, +1, -1, +1, +1, \ +1, -1, -1, +1, -1, -1, -1, -1, -1, +1, +1, \\
&-1, -1, -1, -1, -1, -1, +1, -1, +1, -1, -1, -1, -1, +1, -1, +1, +1, -1, -1, \ +1, -1, -1, -1, \\
&-1, +1, +1, -1, +1, +1, +1, +1, +1, +1, +1, -1, +1, +1, -1, -1, -1, -1, +1, -1, -1, +1, +1, \\
&-1, +1, -1, \ -1, -1, -1, +1, -1, +1, -1, -1, +1, +1, +1, +1, -1, -1, +1, +1, +1, +1, +1, -1, \\
&+1, +1, -1, -1, -1, +1, -1, -1, -1, +1, -1, +1, -1, +1, +1\}
\end{aligned}
\tag{28-39}
$$

In a 40 MHz transmission, the 1x HE-LTF sequence transmitted and located on subcarriers [−244:244] is given by Equation (28-40).

$$
\begin{aligned}
&HELTF_{-244,244} = \\
&\{+1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, \\
&0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, \\
&0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, \\
&0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, \\
&-1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, \\
&0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, \\
&0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, \\
&0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, 0, 0, 0, 0, +1, \\
&0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, \\
&+1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, \\
&0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, \\
&0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, \\
&0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, \\
&+1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, \\
&0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, \\
&0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1\}
\end{aligned}
\tag{28-40}
$$

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In a 40 MHz transmission, the 2x HE-LTF sequence transmitted and located on subcarriers [–244:244] is given by Equation (28-41).

$HELTF_{-244,244}$ =

{+1, 0, −1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0, +1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, −1,
0, −1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1,
0, −1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0, +1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, −1, 0, +1,
0, +1, 0, +1, 0, +1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1,
0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, +1, 0, +1,
0, +1, 0, +1, 0, +1, 0, −1, 0, −1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, +1,
0, +1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, −1,
0, −1, 0, −1, 0, +1, 0, +1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, +1,
0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, −1, 0, 0, 0, 0, 0, 0, 0, −1, 0, −1, 0, (28-41)
−1, 0, −1, 0, −1, 0, +1, 0, +1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0,
−1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, +1, 0, +1, 0,
+1, 0, +1, 0, −1, 0, −1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0,
−1, 0, +1, 0, −1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, +1, 0, +1, 0, +1, 0,
+1, 0, −1, 0, −1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, −1, 0,
+1, 0, +1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0,
−1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0,
+1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0,
−1, 0, −1, 0, +1, 0, −1, 0, +1, 0, −1, 0, +1}

In a 40 MHz transmission, the 4x HE-LTF sequence transmitted and located on subcarriers [–244:244] is given by Equation (28-42).

$HELTF_{-244,244}$ =

{+1, −1, −1, −1, −1, +1, −1, −1, +1, +1, −1, +1, −1, +1, −1, +1, +1, −1, +1, −1, −1, −1,
+1, +1, −1, −1, −1, −1, −1, −1, −1, +1, −1, −1, +1, +1, −1, +1, −1, −1, −1, −1, −1, +1, −1,
+1, +1, +1, −1, −1, +1, +1, +1, −1, −1, +1, +1, +1, +1, −1, +1, +1, −1, −1, +1, −1, +1, −1,
+1, −1, −1, +1, −1, +1, +1, +1, −1, −1, +1, +1, +1, −1, −1, −1, −1, +1, −1, −1, +1, +1, −1,
+1, −1, −1, −1, −1, −1, +1, −1, +1, +1, +1, −1, −1, +1, +1, +1, +1, +1, +1, +1, +1, −1, +1,
+1, −1, −1, +1, −1, +1, +1, +1, +1, +1, −1, +1, −1, −1, −1, +1, +1, −1, −1, −1, −1, −1, −1,
−1, −1, +1, −1, −1, +1, +1, −1, +1, −1, +1, −1, +1, +1, −1, +1, −1, −1, −1, +1, +1, −1, −1,
−1, −1, −1, −1, −1, +1, −1, −1, +1, +1, −1, +1, −1, −1, −1, −1, −1, +1, −1, +1, +1, +1, −1,
−1, +1, +1, +1, −1, −1, −1, −1, −1, −1, +1, −1, −1, +1, +1, −1, +1, −1, +1, −1, +1, +1, −1,
+1, −1, −1, −1, +1, +1, −1, −1, −1, +1, +1, +1, +1, −1, +1, +1, −1, −1, +1, −1, +1, +1, +1,
+1, +1, −1, +1, −1, −1, −1, +1, +1, −1, −1, −1, +1, 0, 0, 0, 0, 0, −1, +1, +1, +1, +1, −1, +1, (28-42)
+1, −1, −1, +1, −1, +1, −1, +1, −1, −1, +1, −1, +1, +1, +1, −1, −1, +1, +1, +1, +1, +1, +1,
+1, −1, +1, +1, −1, −1, +1, −1, +1, +1, +1, +1, +1, −1, +1, −1, −1, −1, +1, +1, −1, −1, −1,
+1, +1, −1, −1, −1, −1, +1, −1, −1, +1, +1, −1, +1, −1, +1, −1, +1, +1, −1, +1, −1, −1, −1,
+1, +1, −1, −1, −1, +1, +1, +1, +1, −1, +1, +1, −1, −1, +1, −1, +1, +1, +1, +1, +1, −1, +1,
−1, −1, −1, +1, +1, −1, −1, −1, +1, −1, −1, −1, −1, +1, −1, −1, +1, +1, −1, +1, −1, +1, −1,
+1, +1, −1, +1, −1, −1, −1, +1, +1, −1, −1, −1, +1, −1, −1, −1, −1, +1, −1, −1, +1, +1, −1,
+1, −1, +1, −1, +1, +1, −1, +1, −1, −1, −1, +1, +1, −1, −1, −1, −1, −1, −1, −1, +1, −1, −1,
+1, +1, −1, +1, −1, −1, −1, −1, −1, +1, −1, +1, +1, +1, −1, −1, +1, +1, +1, −1, +1, −1, −1,
−1, −1, +1, −1, −1, +1, +1, −1, +1, −1, +1, −1, +1, +1, −1, +1, −1, −1, −1, +1, +1, −1, −1,
−1, +1, +1, +1, +1, −1, +1, +1, −1, −1, +1, −1, +1, +1, +1, +1, +1, −1, +1, −1, −1, −1, +1,
+1, −1, −1, −1, −1}

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In an 80 MHz transmission, the 1x HE-LTF sequence transmitted and located on subcarriers [−500:500] is given by Equation (28-43).

$$
\begin{aligned}
HELTF_{-500,500} = \\
&\{-1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, \\
&0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, \\
&0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, \\
&0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, \\
&-1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, \\
&0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, \\
&0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, \\
&0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, \\
&-1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, \\
&0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, \\
&0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, +1, \\
&0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, \\
&+1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, \\
&0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0, \\
&0, 0, −1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, \\
&0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, \\
&−1, 0, 0, 0, 0, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, \\
&+1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, \\
&0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, −1, 0, \\
&0, 0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, \\
&0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, \\
&+1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, \\
&0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, \\
&0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, \\
&0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, \\
&−1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, \\
&0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, +1, 0, \\
&0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, \\
&0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, \\
&−1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, \\
&0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, −1, 0, \\
&0, 0, −1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, −1, \\
&0, 0, 0, +1, 0, 0, 0, +1\}
\end{aligned}
\tag{28-43}
$$

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In an 80 MHz transmission, the 2x HE-LTF sequence transmitted and located on subcarriers [−500:500] is given by Equation (28-44).

$$
\begin{aligned}
&HELTF_{-500,500} = \\
&\{+1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, +1, 0, -1, 0, -1, 0, -1,\\
&0, +1, 0, -1, 0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, -1, 0, -1, 0, -1, 0, +1,\\
&0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1,\\
&0, -1, 0, +1, 0, +1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0, -1,\\
&0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1,\\
&0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1,\\
&0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, +1, 0, -1, 0, -1, 0, -1, 0, -1, 0, +1, 0, +1, 0, -1,\\
&0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, -1, 0, +1,\\
&0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, -1, 0, -1, 0, -1, 0, +1,\\
&0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, -1, 0, +1,\\
&0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1,\\
&0, -1, 0, +1, 0, +1, 0, +1, 0, +1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0, +1, 0, +1, 0, -1,\\
&0, +1, 0, +1, 0, +1, 0, -1, 0, -1, 0, -1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, -1, 0, -1, 0, -1,\\
&0, +1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, -1, 0, +1, 0, +1, 0, +1,\\
&0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, +1,\\
&0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1,\\
&0, -1, 0, +1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1,\\
&0, -1, 0, +1, 0, +1, 0, +1, 0, +1, 0, -1, 0, -1, 0, -1, 0, -1, 0, +1, 0, +1, 0, +1, 0, +1, 0, +1, 0, 0, 0, 0, 0, 0, 0, 0,\\
&+1, 0, -1, 0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, +1, 0, +1, 0, +1, 0, +1, 0,\\
&-1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0,\\
&+1, 0, +1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0,\\
&+1, 0, -1, 0, +1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, -1, 0, -1, 0, -1, 0,\\
&+1, 0, +1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0,\\
&+1, 0, -1, 0, -1, 0, -1, 0, +1, 0, +1, 0, +1, 0, +1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0,\\
&+1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, +1, 0, +1, 0,\\
&-1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0,\\
&+1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0,\\
&-1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0,\\
&+1, 0, -1, 0, -1, 0, -1, 0, +1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0,\\
&-1, 0, -1, 0, -1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0,\\
&-1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0,\\
&-1, 0, +1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, +1, 0, +1, 0, -1, 0, -1, 0, +1, 0, -1, 0,\\
&-1, 0, -1, 0, +1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, +1, 0, -1, 0, -1, 0, +1, 0,\\
&-1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, +1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0,\\
&+1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1\}
\end{aligned}
\tag{28-44}
$$

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In an 80 MHz transmission, the 4x HE-LTF sequence transmitted and located on subcarriers [−500:500] is given by Equation (28-45).

$$
\begin{aligned}
HELTF_{-500,500} = \\
&\{+1, +1, -1, +1, -1, +1, -1, -1, -1, +1, -1, -1, -1, +1, +1, -1, +1, +1, +1, +1, +1, -1, \\
&-1, +1, +1, +1, +1, -1, +1, -1, +1, -1, -1, +1, +1, -1, +1, +1, +1, -1, -1, +1, -1, -1, -1, \\
&-1, +1, +1, +1, -1, -1, -1, -1, -1, -1, +1, +1, +1, +1, +1, +1, -1, +1, +1, +1, -1, +1, +1, \\
&-1, -1, -1, +1, -1, +1, -1, -1, +1, +1, -1, +1, -1, +1, +1, +1, +1, +1, -1, -1, +1, +1, +1, \\
&-1, +1, +1, -1, -1, -1, +1, -1, +1, +1, -1, +1, +1, -1, +1, -1, -1, +1, +1, +1, +1, -1, -1, \\
&+1, +1, +1, +1, +1, -1, +1, +1, -1, -1, -1, +1, -1, -1, -1, +1, -1, +1, -1, +1, +1, -1, +1, \\
&-1, +1, -1, +1, +1, +1, -1, +1, +1, +1, -1, -1, +1, -1, -1, -1, -1, -1, +1, +1, -1, -1, -1, \\
&-1, +1, -1, +1, -1, +1, +1, -1, -1, +1, -1, -1, -1, +1, +1, -1, +1, +1, +1, +1, -1, -1, -1, \\
&+1, +1, +1, +1, -1, +1, +1, +1, +1, +1, +1, +1, -1, +1, +1, +1, -1, +1, +1, -1, -1, -1, +1, \\
&-1, +1, -1, -1, +1, +1, -1, +1, -1, +1, +1, +1, +1, +1, -1, -1, +1, +1, +1, -1, +1, +1, -1, \\
&-1, -1, +1, -1, +1, +1, -1, +1, +1, -1, +1, -1, -1, +1, -1, +1, -1, +1, -1, +1, +1, +1, -1, \\
&+1, +1, +1, -1, -1, +1, -1, -1, -1, -1, -1, +1, +1, -1, -1, -1, -1, +1, -1, +1, -1, +1, +1, \\
&-1, -1, +1, -1, -1, -1, +1, +1, -1, +1, +1, +1, +1, -1, -1, -1, +1, +1, +1, +1, -1, +1, -1, \\
&-1, -1, -1, -1, -1, +1, -1, -1, -1, +1, -1, -1, +1, +1, +1, -1, +1, -1, +1, +1, -1, -1, +1, \\
&-1, +1, -1, -1, -1, -1, -1, +1, +1, -1, -1, -1, +1, -1, -1, +1, +1, +1, -1, +1, -1, -1, +1, \\
&-1, -1, +1, -1, +1, +1, +1, +1, +1, +1, -1, -1, +1, +1, +1, +1, +1, -1, +1, +1, -1, -1, -1, \\
&+1, -1, -1, -1, +1, -1, +1, -1, +1, +1, -1, +1, -1, +1, -1, +1, +1, +1, -1, +1, +1, +1, -1, \\
&-1, +1, -1, -1, -1, -1, -1, +1, +1, -1, -1, -1, -1, +1, -1, +1, -1, +1, +1, -1, -1, +1, -1, \\
&-1, -1, +1, +1, -1, +1, +1, +1, +1, -1, -1, -1, +1, +1, +1, +1, -1, -1, +1, +1, +1, +1, +1, \\
&+1, -1, +1, +1, +1, -1, +1, +1, -1, -1, -1, +1, -1, +1, -1, -1, +1, +1, -1, +1, -1, +1, +1, \\
&+1, +1, +1, -1, -1, +1, +1, +1, -1, +1, +1, -1, -1, -1, +1, -1, +1, +1, -1, +1, +1, -1, +1, \\
&-1, -1, -1, +1, -1, +1, -1, -1, -1, -1, +1, +1, +1, -1, -1, +1, 0, 0, 0, 0, 0, +1, -1, -1, -1, \\
&-1, -1, -1, +1, -1, +1, +1, -1, -1, +1, +1, -1, +1, -1, +1, +1, -1, -1, +1, -1, +1, -1, -1, \\
&-1, +1, +1, -1, +1, +1, +1, -1, +1, +1, +1, +1, +1, +1, +1, -1, +1, -1, -1, +1, -1, -1, +1, \\
&-1, +1, +1, +1, -1, -1, +1, -1, -1, -1, +1, +1, -1, -1, -1, -1, -1, +1, -1, -1, -1, -1, -1, \\
&+1, +1, -1, -1, -1, -1, -1, +1, -1, -1, +1, +1, +1, -1, +1, +1, +1, -1, +1, -1, +1, -1, -1, \\
&-1, -1, -1, +1, +1, +1, -1, -1, -1, -1, +1, -1, -1, +1, +1, +1, -1, +1, +1, -1, -1, +1, -1, \\
&+1, -1, -1, -1, -1, -1, -1, -1, -1, +1, +1, -1, -1, -1, +1, -1, -1, +1, +1, +1, -1, +1, -1, -1, \\
&+1, -1, -1, +1, -1, +1, +1, +1, -1, +1, -1, -1, +1, +1, -1, +1, -1, +1, +1, +1, -1, -1, +1, \\
&-1, -1, -1, +1, -1, -1, -1, -1, -1, -1, -1, +1, -1, +1, +1, -1, +1, +1, -1, +1, -1, -1, -1, \\
&+1, +1, -1, +1, +1, +1, -1, -1, +1, +1, +1, +1, +1, -1, +1, -1, -1, -1, -1, +1, +1, -1, -1, \\
&-1, -1, -1, +1, -1, -1, +1, +1, +1, -1, +1, +1, +1, -1, +1, -1, +1, -1, -1, -1, -1, -1, +1, \\
&+1, +1, -1, -1, -1, -1, +1, -1, -1, +1, +1, +1, -1, +1, +1, -1, -1, +1, -1, +1, -1, +1, +1, \\
&+1, -1, +1, -1, -1, +1, +1, -1, +1, -1, +1, +1, +1, -1, -1, +1, -1, -1, -1, +1, -1, -1, -1, \\
&-1, -1, -1, -1, +1, -1, +1, +1, -1, +1, +1, -1, +1, -1, -1, -1, +1, +1, -1, +1, +1, +1, -1, \\
&-1, +1, +1, +1, +1, +1, -1, +1, +1, +1, +1, +1, -1, -1, +1, +1, +1, +1, +1, -1, +1, +1, -1, \\
&-1, -1, +1, -1, -1, -1, +1, -1, +1, -1, +1, +1, +1, +1, +1, -1, -1, -1, +1, +1, +1, +1, -1, \\
&+1, +1, -1, -1, -1, +1, -1, -1, +1, +1, -1, +1, -1, +1, -1, -1, -1, -1, -1, -1, +1, +1, -1, \\
&-1, -1, +1, -1, -1, +1, +1, +1, -1, +1, -1, -1, +1, -1, -1, +1, -1, +1, -1, +1, -1, +1, -1, \\
&-1, +1, +1, -1, +1, -1, +1, +1, +1, -1, -1, +1, -1, -1, -1, +1, -1, -1, -1, -1, -1, -1, -1, \\
&+1, -1, +1, +1, -1, +1, +1, -1, +1, -1, -1, -1, +1, +1, -1, +1, +1, +1, -1, -1, +1, +1, +1, \\
&+1, +1, -1, +1, -1, -1, -1, -1, -1, +1, +1, -1, -1, -1, -1, -1, +1, -1, -1, +1, +1, +1, -1, +1, \\
&+1, +1, -1, +1, -1, +1, -1, -1, -1, -1, -1, +1, +1, +1, -1, -1, -1, -1, +1, -1, -1, +1, +1, \\
&+1, -1, +1, +1, -1, -1, +1, -1, +1, -1, +1\}
\end{aligned}
\tag{28-45}
$$

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In a 160 MHz transmission, the 1x HE-LTF sequence is given by Equation (28-46).

$$HELTF_{-1012,1012} = \{LTF_{80MHz_primary_1x},\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ LTF_{80MHz_secondary_1x}\} \quad (28\text{-}46)$$

where

$LTF_{80MHz_primary_1x} = \{LTF_{80MHz_left_1x}, 0, LTF_{80MHz_right_1x}\}$ and shall be used in the primary 80 MHz frequency segment

$LTF_{80MHz_secondary_1x} = \{LTF_{80MHz_left_1x}, 0, -LTF_{80MHz_right_1x}\}$ and shall be used in the secondary 80 MHz frequency segment

$LTF_{80MHz_left_1x} = \{-1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +

where

$$LTF_{80MHz_primary_2x} = \{LTF_{80MHz_part1_2x}, LTF_{80MHz_part2_2x}, LTF_{80MHz_part3_2x}, LTF_{80MHz_part4_2x}, LTF_{80MHz_part5_2x}\} \quad (28\text{-}48)$$

$$LTF_{80MHz_secondary_2x} = \{LTF_{80MHz_part1_2x}, -LTF_{80MHz_part2_2x}, LTF_{80MHz_part3_2x}, LTF_{80MHz_part4_2x}, -LTF_{80MHz_part5_2x}\} \quad (28\text{-}49)$$

$LTF_{80MHz_part1_2x}$ = {+1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, −1, 0, +1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, +1, 0, +1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, −1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0, −1, 0, −1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, +1, 0, +1, 0}

$LTF_{80MHz_part2_2x}$ = {+1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0, +1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, +1, 0, +1, 0}

$LTF_{80MHz_part3_2x}$ = {+1, 0, −1, 0, −1, 0, −1, 0, +1, 0, +1, 0, +1, 0, 0, 0, 0, 0, 0, 0, +1, 0, −1, 0, −1, 0, +1, 0, +1, 0, −1, 0, +1}

$LTF_{80MHz_part4_2x}$ = {0, −1, 0, −1, 0, −1, 0, +1, 0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, +1, 0, −1, 0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, +1, 0, +1, 0, −1, 0, −1, 0, +1, 0, +1, 0, +1, 0, +1, 0, +1, 0, −1, 0, −1, 0, +1, 0, +1, 0, +1, 0, +1, 0, +1, 0, −1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −

where

$$LTF_{80MHz_primary_4x} = \{LTF_{80MHz_left_4x}, 0, LTF_{80MHz_right_4x}\} \quad (28\text{-}51)$$

$$LTF_{80MHz_secondary_4x} = \{LTF_{80MHz_left_4x}, 0, -LTF_{80MHz_right_4x}\} \quad (28\text{-}52)$$

$LTF_{80MHz_left_4x}$ = {+1, +1, −1, +1, −1, +1, −1, −1, −1, +1, −1, −1, −1, +1, +1, −1, +1, +1, +1, +1, +1, −1,
−1, +1, +1, +1, +1, −1, +1, −1, +1, −1, −1, +1, +1, −1, +1, +1, +1, −1, −1, +1, −1, −1, −1, −1,
+1, +1, +1, −1, −1, −1, −1, −1, −1, +1, +1, +1, +1, +1, +1, −1, +1, +1, +1, −1, +1, +1, −1, −1,
−1, +1, −1, +1, −1, −1, +1, +1, −1, +1, −1, +1, +1, +1, +1, +1, −1, −1, +1, +1, +1, −1, +1, +1,
−1, −1, −1, +1, −1, +1, +1, −1, +1, +1, −1, +1, −1, −1, +1, +1, +1, +1, −1, −1, +1, +1, +1, +1,
+1, −1, +1, +1, −1, −1, −1, +1, −1, −1, −1, +1, −1, +1, −1, +1, +1, −1, +1, −1, +1, −1, +1, +1,
+1, −1, +1, +1, +1, −1, −1, +1, −1, −1, −1, −1, −1, +1, +1, −1, −1, −1, −1, +1, −1, +1, −1, +1,
+1, −1, −1, +1, −1, −1, −1, +1, +1, −1, +1, +1, +1, +1, −1, −1, −1, +1, +1, +1, +1, −1, +1, +1,
+1, +1, +1, +1, +1, −1, +1, +1, +1, −1, +1, +1, −1, −1, −1, +1, −1, +1, −1, −1, +1, +1, −1, +1,
−1, +1, +1, +1, +1, +1, −1, −1, +1, +1, +1, −1, +1, +1, −1, −1, −1, −1, −1, +1, +1, −1, −1, +1,
−1, +1, −1, −1, +1, −1, +1, −1, +1, −1, +1, +1, +1, −1, +1, +1, +1, −1, −1, +1, −1, −1, −1, −1,
−1, +1, +1, −1, −1, −1, −1, +1, −1, +1, −1, +1, +1, −1, −1, +1, −1, −1, −1, +1, +1, −1, +1, +1,
+1, +1, −1, −1, −1, +1, +1, +1, +1, −1, +1, −1, −1, −1, −1, −1, −1, +1, −1, −1, −1, +1, −1, −1,
+1, +1, +1, −1, +1, −1, +1, +1, −1, −1, +1, −1, +1, −1, −1, −1, −1, −1, +1, +1, −1, −1, −1, +1,
−1, −1, +1, +1, +1, −1, +1, −1, −1, +1, −1, −1, +1, −1, +1, +1, +1, +1, +1, +1, −1, −1, +1, +1,
+1, +1, +1, −1, +1, +1, −1, −1, −1, +1, −1, −1, −1, +1, −1, +1, −1, +1, +1, −1, +1, −1, +1, −1,
+1, +1, +1, −1, +1, +1, +1, −1, −1, +1, −1, −1, −1, −1, −1, +1, +1, −1, −1, −1, −1, +1, −1, +1,
−1, +1, +1, −1, −1, +1, −1, −1, −1, +1, +1, −1, +1, +1, +1, +1, −1, −1, −1, +1, +1, +1, +1, −1,
−1, +1, +1, +1, +1, +1, +1, −1, +1, +1, +1, −1, +1, +1, −1, −1, −1, +1, −1, +1, −1, −1, +1, +1,
−1, +1, −1, +1, +1, +1, +1, +1, −1, −1, +1, +1, +1, −1, +1, +1, −1, −1, −1, +1, −1, +1, +1, −1,
+1, +1, −1, +1, −1, −1, −1, +1, −1, +1, −1, −1, −1, −1, +1, +1, +1, −1, −1, +1, 0, 0}

$LTF_{80MHz_right_4x}$ = {0, 0, +1, −1, −1, −1, −1, −1, −1, +1, −1, +1, +1, −1, −1, +1, +1, −1, +1, −1, +1, +1,
−1, −1, +1, −1, +1, −1, −1, −1, +1, +1, −1, +1, +1, +1, −1, +1, +1, +1, +1, +1, +1, +1, −1, +1,
−1, −1, +1, −1, −1, +1, −1, +1, +1, +1, −1, −1, +1, −1, −1, −1, +1, +1, −1, −1, −1, −1, −1, +1,
−1, −1, −1, −1, −1, +1, +1, −1, −1, −1, −1, −1, +1, −1, −1, +1, +1, +1, −1, +1, +1, +1, −1, +1,
−1, +1, −1, −1, −1, −1, −1, +1, +1, +1, −1, −1, −1, −1, +1, −1, −1, +1, +1, +1, −1, +1, +1, −1,
−1, +1, −1, +1, −1, −1, −1, −1, −1, −1, −1, +1, +1, −1, −1, −1, +1, −1, −1, +1, +1, +1, −1, +1,
−1, −1, +1, −1, −1, +1, −1, +1, +1, +1, −1, +1, −1, −1, +1, +1, −1, +1, −1, +1, +1, +1, −1, −1,
+1, −1, −1, −1, +1, −1, −1, −1, −1, −1, −1, −1, −1, +1, −1, +1, +1, −1, +1, +1, −1, +1, −1, −1, −1,
+1, +1, −1, +1, +1, +1, −1, −1, +1, +1, +1, +1, +1, −1, +1, −1, −1, −1, −1, +1, +1, −1, −1, −1,
−1, −1, +1, −1, −1, +1, +1, +1, −1, +1, +1, +1, −1, +1, −1, +1, −1, −1, −1, −1, −1, +1, +1, +1,
−1, −1, −1, −1, +1, −1, −1, +1, +1, +1, −1, +1, +1, −1, −1, +1, −1, +1, −1, +1, +1, +1, −1, +1,
−1, −1, +1, +1, −1, +1, −1, +1, +1, +1, −1, −1, +1, −1, −1, −1, +1, −1, −1, −1, −1, −1, −1, −1,
+1, −1, +1, +1, −1, +1, +1, −1, +1, −1, −1, −1, +1, +1, −1, +1, +1, +1, −1, −1, +1, +1, +1, +1,
+1, −1, +1, +1, +1, +1, +1, −1, −1, +1, +1, +1, +1, +1, −1, +1, +1, −1, −1, −1, +1, −1, −1, −1,
+1, −1, +1, −1, +1, +1, +1, +1, +1, −1, −1, −1, +1, +1, +1, +1, −1, +1, +1, −1, −1, −1, +1, −1,
−1, +1, +1, −1, +1, −1, +1, −1, −1, −1, −1, −1, −1, +1, +1, −1, −1, −1, +1, −1, −1, +1, +1, +1,
−1, +1, −1, −1, +1, −1, −1, +1, −1, +1, −1, +1, −1, +1, −1, −1, +1, +1, −1, +1, −1, +1, +1, +1,
−1, −1, +1, −1, −1, −1, +1, −1, −1, −1, −1, −1, −1, −1, +1, −1, +1, +1, −1, +1, +1, −1, +1, −1,
−1, −1, +1, +1, −1, +1, +1, +1, −1, −1, +1, +1, +1, +1, +1, −1, +1, −1, −1, −1, −1, +1, +1, −1,
−1, −1, −1, −1, +1, −1, −1, +1, +1, +1, −1, +1, +1, +1, +1, −1, +1, −1, +1, −1, −1, −1, −1, +1,
+1, +1, −1, −1, −1, −1, +1, −1, −1, +1, +1, +1, −1, +1, +1, −1, −1, +1, −1, +1, −1, +1}

For an 80+80 MHz transmission, the primary 80 MHz frequency segment shall use the 80 MHz 1x HE-LTF sequence, $HELTF_{-500,500} = LTF_{80MHz_primary_1x}$, and the secondary 80 MHz frequency segment shall use the 80 MHz 1x HE-LTF sequence, $HELTF_{-500,500} = LTF_{80MHz_secondary_1x}$.

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For an 80+80 MHz transmission, the primary 80 MHz frequency segment shall use the 80 MHz 2x HE-LTF sequence, $HELTF_{-500,500} = LTF_{80\text{MHz_primary_2x}}$, and secondary 80 MHz frequency segment shall use the 80 MHz 2x HE-LTF sequence, $HELTF_{-500,500} = LTF_{80\text{MHz_secondary_2x}}$.

For an 80+80 MHz transmission, the primary 80 MHz frequency segment shall use the 80 MHz 4x HE-LTF sequence, $HELTF_{-500,500} = LTF_{80\text{MHz_primary_4x}}$, and secondary 80 MHz frequency segment shall use the 80 MHz 4x HE-LTF sequence, $HELTF_{-500,500} = LTF_{80\text{MHz_secondary_4x}}$.

In an UL MU-MIMO transmission not using single stream pilots, the generation of the HE-LTF sequence per frequency segment is to mask the non-zero elements in the common HE-LTF sequence repeatedly by a distinct orthogonal code as defined by Equation (28-53).

$$HELTF_k' = HELTF_k \cdot \left[P_{8\times 8}\right]_{M_{r,u}+m,\left(\left(\left\lceil \frac{k}{N_{\text{HE-LTF-Mode}}} \right\rceil - 1\right) \bmod 8\right)+1} \tag{28-53}$$

Where $HELTF_k$ is the k-th element of the common HE-LTF sequence generated by one of the equations from (Equation (28-38) to Equation (28-56) depending on the bandwidth and the HE-LTF mode (excluding the 1x HE-LTF which shall not be masked). $\left[P_{8\times 8}\right]$ is defined in Equation (22-46). $M_{r,u}+m$ is the row of the $\left[P_{8\times 8}\right]$ corresponding to the spatial time stream of user u in the r-th RU. Depending on the HE-LTF modes, $N_{\text{HE-LTF-Mode}}$ is defined in Equation (28-54).

$$N_{\text{HE-LTF-Mode}} = \begin{cases} 2, \text{ for 2x HE-LTF} \\ 1, \text{ for 4x HE-LTF} \end{cases} \tag{28-54}$$

The generation of the time domain HE-LTF symbols per frequency segment in an HE SU PPDU, HE MU PPDU, HE extended range SU PPDU, HE trigger-based PPDU is shown in Figure 28-26 (Generation of HE-LTF symbols per frequency segment in an HE SU PPDU, HE MU PPDU, HE extended range SU PPDU and HE trigger-based PPDU) where $A^k_{\text{HE-LTF}}$ is given by Equation (28-55).

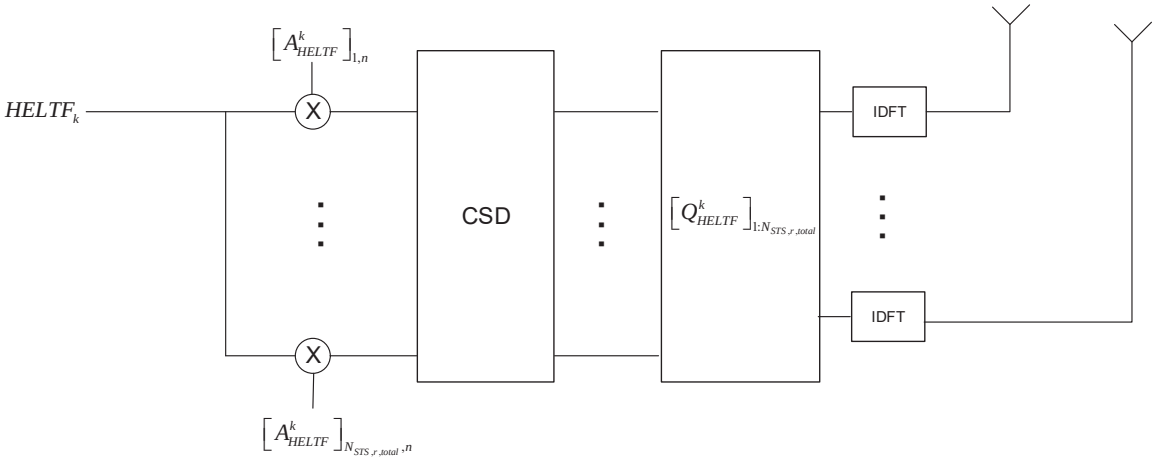

Figure 28-26—Generation of HE-LTF symbols per frequency segment in an HE SU PPDU, HE MU PPDU, HE extended range SU PPDU and HE trigger-based PPDU

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The generation of time domain symbol of 1x HE-LTF is equivalent to modulating every 4 tones in an OFDM symbol of 12.8 μs excluding GI, and then only transmit the first ¼ of the OFDM symbol in the time domain, as shown in Figure 28-27 (Generation of 1x HE-LTF symbols per frequency segment).

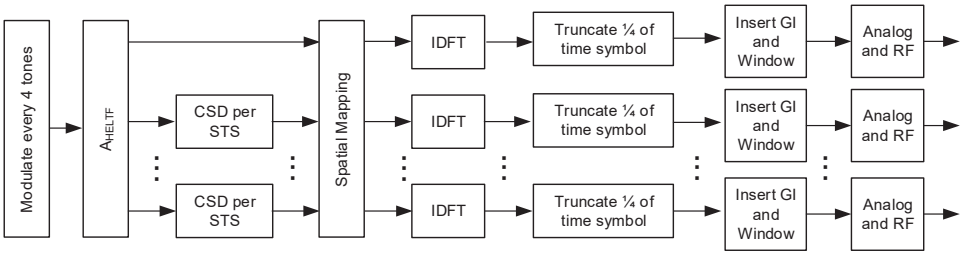

Figure 28-27—Generation of 1x HE-LTF symbols per frequency segment

The generation of time domain symbol of 2x HE-LTF is equivalent to modulating every other tone in an OFDM symbol of 12.8 μs excluding GI, and then only transmit the first half of the OFDM symbol in time domain, as shown in Figure 28-28 (Generation of 2x HE-LTF symbols per frequency segment).

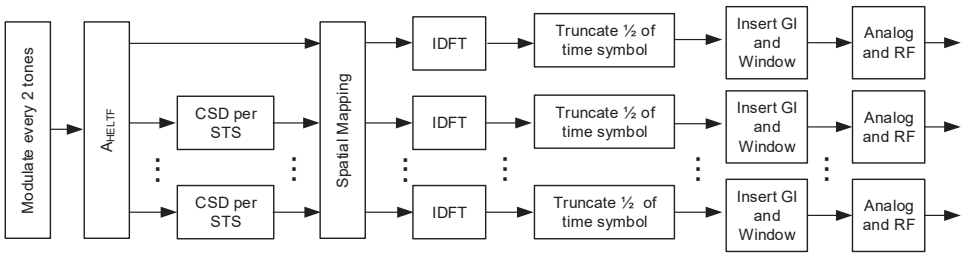

Figure 28-28—Generation of 2x HE-LTF symbols per frequency segment

$A^{k}_{\text{HE-LTF}}$ is given by Equation (28-55).

$$A^{k}_{\text{HE-LTF}} = \begin{cases} R_{\text{HE-LTF}}, \text{ if } k \in K_{\text{Pilot}} \text{ and single stream pilots are used} \\ P_{\text{HE-LTF}}, \text{ otherwise} \end{cases} \quad (28\text{-}55)$$

where

K_{Pilot} is the set of subcarrier indices for the pilot subcarriers as defined in 28.3.3.4 (Pilot subcarriers).

$R_{\text{HE-LTF}}$ is a $N_{\text{HE-LTF}} \times N_{\text{HE-LTF}}$ matrix whose elements are defined in Equation (28-56).

$$\left[R_{\text{HE-LTF}}\right]_{m,n} = \left[P_{\text{HE-LTF}}\right]_{1,n}, 1 \le m, n \le N_{\text{HE-LTF}} \quad (28\text{-}56)$$

$P_{\text{HE-LTF}}$ is defined in Equation (28-57).

$$P_{\text{HE-LTF}} = \begin{cases} P_{4\times 4}, N_{\text{HE-LTF}} \le 4 \\ P_{6\times 6}, N_{\text{HE-LTF}} = 5, 6 \\ P_{8\times 8}, N_{\text{HE-LTF}} = 7, 8 \end{cases} \quad (28\text{-}57)$$

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where $P_{4\times4}$ is defined in Equation (19-27), $P_{6\times6}$ is defined in Equation (21-45), and $P_{8\times8}$ is defined in Equation (22-46).

When the 1x HE-LTF is used for non-OFDMA UL MU-MIMO, neither masking by orthogonal code nor single stream pilot are not used.

In an HE SU PPDU, HE MU PPDU and HE extended range SU PPDU, the time domain representation of the waveform transmitted on frequency segment i_{Seg} of transmit chain i_{TX} shall be as described by Equation (28-58).

$$r_{\text{HE-LTF}}^{(i_{Seg}i_{TX})}(t) = \frac{1}{\sqrt{\sum_{r=0}^{N_{RU}-1}\alpha_r^2|K_r|}} \sum_{n=0}^{N_{\text{HE-LTF}}-1} w_{T_{\text{HE-LTF}}}(t-nT_{\text{HE-LTF}}) \sum_{r=0}^{N_{RU}-1} \frac{\alpha_r\sqrt{|K_r|}}{\sqrt{N_{STS,\,r,\,total}|K_r^{\text{HE-LTF}}|}} \sum_{k\in K_r}\eta_{\text{HE-LTF},\,k} \sum_{u=0}^{N_{user,\,r}-1}\sum_{m=1}^{N_{STS,\,r,\,u}} \left(\begin{array}{l} \left[Q_k^{(i_{Seg})}\right]_{i_{TX},\,(M_{r,\,u}+m)} \left[A_{\text{HE-LTF}}^{k}\right]_{(M_{r,\,u}+m),\,(n+1)} HELTF_k'' \\ \cdot \exp(j2\pi k\Delta_{F,\,\text{HE}}(t-nT_{\text{HE-LTF}}-T_{GI}-T_{CS,\,\text{HE}}(M_{r,\,u}+m))) \end{array} \right) \quad (28\text{-}58)$$

In an HE trigger-based PPDU, the time domain representation of the waveform of user u in the r-th RU, transmitted on frequency segment i_{Seg} of transmit chain i_{TX} shall be as described by Equation (28-59).

$$r_{\text{HE-LTF}}^{(i_{Seg}i_{TX})}(t) = \frac{1}{\sqrt{N_{STS,\,r,\,total}|K_r^{\text{HE-LTF}}|}} \sum_{n=0}^{N_{\text{HE-LTF}}-1} w_{T_{\text{HE-LTF}}}(t-nT_{\text{HE-LTF}}) \sum_{k\in K_r}\sum_{m=1}^{N_{STS,\,r,\,u}} \left(\begin{array}{l} \left[Q_k^{(i_{Seg})}\right]_{i_{TX},\,(M_{r,\,u}+m)} \left[A_{\text{HE-LTF}}^{k}\right]_{(M_{r,\,u}+m),\,(n+1)} HELTF_k'' \\ \cdot \exp(j2\pi k\Delta_{F,\,\text{HE}}(t-nT_{\text{HE-LTF}}-T_{GI}-T_{CS,\,\text{HE}}(M_{r,\,u}+m))) \end{array} \right) \quad (28\text{-}59)$$

where

$HELTF_k'' = HELTF_k$ if single stream pilots are used or when the 1x HE-LTF is used for non-OFDMA UL MU-MIMO, and $HELTF_k'' = HELTF_k'$ if single stream pilots are not used.

α_r is the power boost factor for the r-th RU. A STA shall support α_r in the range [0.7, $\sqrt{2}$]. A STA may support α_r in the range [0.5, 2].

$\eta_{\text{HE-LTF},k}$ is an HE PPDU format dependent scaling factor, defined by

$$\eta_{\text{HE-LTF},\,k} = \begin{cases} \sqrt{2}, & \text{for an HE extended range SU PPDU} \\ 1, & \text{otherwise} \end{cases}$$

$N_{\text{HE-LTF}}^{\text{Tone}}$ is defined in Table 28-14 (Tone scaling factor and guard interval duration values for HE PPDU fields)

$T_{CS,\,\text{HE}}(M_{r,\,u}+m)$ represents the cyclic shift for space time stream $M_{r,u}+m$ as defined in 28.3.10.2.2 (Cyclic shift for HE modulated fields)

$Q_k^{(i_{Seg})}$ is defined in 28.3.9 (Mathematical description of signals)

$A_{\text{HE-LTF}}^{k}$ is defined in Equation (28-55)

K_r is the set of subcarrier indices for the tones in the r-th RU as defined in 28.3.9 (Mathematical description of signals)

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When a 1x, 2x or 4x HE-LTF is transmitted, it is recommended that the spatial mapping matrix applied to HE-STF and beyond is chosen such that it preserves the smoothness of the physical channel, achieved by limiting the variation of each element's real and imaginary values in the spatial mapping matrix across successive tones within one RU.

28.3.11 Data field

28.3.11.1 General

The number of OFDM symbols in the Data field is determined by the Length field in L-SIG (see Equation (28-11)), the preamble duration and the settings of the GI+LTF Size, Pre-FEC Padding Factor and PE Disambiguity fields in the HE-SIG-A field (see 28.3.10.7 (HE-SIG-A)). Data symbols in an HE PPDU shall use a DFT period of 12.8 μs and subcarrier spacing of 78.125 kHz. Data symbols in an HE PPDU shall support guard interval durations of 0.8 μs, 1.6 μs and 3.2 μs. HE PPDUs shall have single stream pilots in the Data field. In UL MU-MIMO transmissions, all streams use the same pilot sequence.

When BCC encoding is used, the Data field shall consist of the SERVICE field, the PSDU, the tail bits, the post-FEC padding bits and the packet extension. When LDPC encoding is used, the Data field shall consist of the SERVICE field, the PSDU, the post-FEC padding bits and the packet extension. No tail bits are present when LDPC encoding is used.

The Data field of the HE PPDU contains data for one or more users.

28.3.11.2 Pre-FEC padding process

A two-step padding process is applied on all HE PPDUs. A pre-FEC padding with both MAC and PHY padding is applied before conducting FEC coding, and a post-FEC PHY padding is applied on the FEC encoded bits.

The pre-FEC padding may pad toward 4 possible boundaries in the last one (in the case of non STBC), or two (in the case of STBC) OFDM symbols of an HE PPDU, the 4 possible boundaries partition the FEC output bit stream of the last OFDM symbol(s) into 4 symbol segments. The 4 possible boundaries are represented by a pre-FEC padding factor parameter.

Figure 28-29 (HE PPDU padding process in the last OFDM symbol (non STBC) when a = 1) illustrates these 4 possible symbol segments in the last OFDM symbol of a non STBC case, and the general padding process assuming the desired pre-FEC padding boundary, pre-FEC padding factor, is 1. In the case of STBC,

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the FEC output bits and post-FEC padding bits are modulated into the last two OFDM symbols by STBC encoding, each with the same number of effective symbol segments.

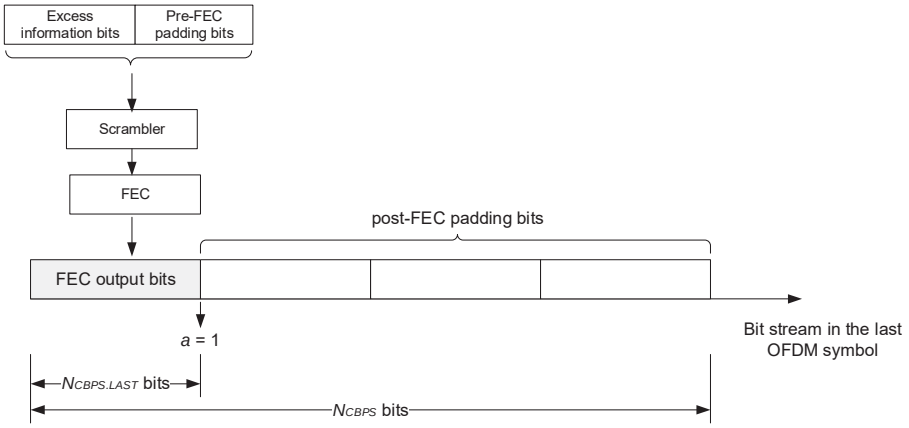

Figure 28-29—HE PPDU padding process in the last OFDM symbol (non STBC) when *a* = 1

The pre-FEC padding process is described in this subclause, and the encoding and post-FEC padding process are described in 28.3.11.5 (Coding). While this subclause describes the pre-FEC padding processing of an SU transmission, its extension to MU transmission is described in 28.3.11.5.4 (Encoding process for an HE MU PPDU).

In an HE SU PPDU transmission, the transmitter first computes the number of excess bits in the last OFDM symbol(s). Specifically, for HE SU PPDU, the number of excess bits is calculated based on Equation (28-60).

$$N_{Excess} = mod(8 \cdot \text{APEP_LENGTH} + N_{Tail} + N_{service}, m_{STBC} \cdot N_{DBPS}) \quad (28\text{-}60)$$

where

m_{STBC} is 2 when STBC is used, and 1 otherwise

APEP_LENGTH is the TXVECTOR parameter APEP_LENGTH

Based on N_{Excess}, compute the initial number of symbol segments in the last OFDM symbol(s), pre-FEC padding factor value or a_{init}, as shown in Equation (28-61).

$$a_{init} = \begin{cases} 4, & \text{if } N_{Excess} = 0 \\ \min\left(\left\lceil \dfrac{N_{Excess}}{m_{STBC} \cdot N_{DBPS,\,SHORT}} \right\rceil, 4\right), & \text{otherwise} \end{cases} \quad (28\text{-}61)$$

where

$N_{DBPS,\,SHORT} = N_{CBPS,\,SHORT} \cdot R$, in which R is the coding rate, and

$N_{CBPS,\,SHORT} = N_{SD,\,SHORT} \cdot N_{SS} \cdot N_{BPSCS}$;

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The parameter $N_{SD,SHORT}$ values for different RU sizes are as shown in Table 28-25 (NSD,SHORT values).

Table 28-25—$N_{SD,SHORT}$ values

RU Size	$N_{SD,SHORT}$	
	DCM = 0	DCM = 1
26-tone	6	2
52-tone	12	6
106-tone	24	12
242-tone	60	30
484-tone	120	60
996-tone	240	120
2×996-tone	492	246

Given the a_{init} values, the initial number of data bits per symbol and the initial number of coded bits per symbol in the last OFDM symbol(s) are defined in Equation (28-62).

$$N_{DBPS,\,LAST,\,init} = \begin{cases} a_{init} N_{DBPS,\,SHORT}, \text{ if } a_{init} < 4 \\ N_{DBPS}, \text{ if } a_{init} = 4 \end{cases}$$
$$N_{CBPS,\,LAST,\,init} = \begin{cases} a_{init} N_{CBPS,\,SHORT}, \text{ if } a_{init} < 4 \\ N_{CBPS}, \text{ if } a_{init} = 4 \end{cases} \quad (28\text{-}62)$$

For an HE SU PPDU, the number of pre-FEC pad bits is calculated using Equation (28-63).

$$N_{PAD,\,\text{Pre-FEC}} = (N_{SYM.init} - m_{STBC}) N_{DBPS} + m_{STBC} N_{DBPS,\,LAST,\,init} - 8 \cdot \text{APEP_LENGTH} - N_{Tail} - N_{service} \quad (28\text{-}63)$$

where $N_{SYM,init}$ is defined as in Equation (28-65) for BCC encoding, and Equation (28-70) for LDPC encoding.

Among the pre-FEC padding bits, the MAC delivers a PSDU that fills the available octets in the Data field of the HE PPDU, toward the desired pre-FEC padding boundary, represented by a_{init} value, in the last OFDM symbol(s). The number of pre-FEC pad bits added by MAC will always be a multiple of eight. The PHY then determines the number of remaining pad bits to add and appends them to the PSDU. The number of pre-FEC pad bits added by PHY will always be 0 to 7. The procedure is defined in Equation (28-64).

$$N_{PAD,\,\text{Pre-FEC,MAC}} = \left\lfloor \frac{N_{PAD,\,\text{Pre-FEC}}}{8} \right\rfloor \cdot 8$$
$$N_{PAD,\,\text{Pre-FEC,PHY}} = N_{PAD,\,\text{Pre-FEC}} \bmod 8 \quad (28\text{-}64)$$

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28.3.11.3 SERVICE field

The SERVICE field of HE PPDU is as shown in Table 28-26 (SERVICE field).

Table 28-26—SERVICE field

Bits	Field	Description
B0-B6	Scrambler Initialization	Set to 0
B7-B15	Reserved	Set to 0

28.3.11.4 Scrambler

The SERVICE field, PSDU, and PHY padding of the Data field shall be scrambled by the scrambler defined in 17.3.5.5 (PHY DATA scrambler and descrambler). The Clause 17 (Orthogonal frequency division multiplexing (OFDM) PHY specification) TXVECTOR parameters CH_BANDWIDTH_IN_NON_HT and DYN_BANDWIDTH_IN_NON_HT are not present and therefore the initial state of the scrambler is set to a nonzero pseudorandom seed. A different nonzero pseudorandom seed may be used for each user in an HE MU PPDU.

28.3.11.5 Coding

The Data field shall be encoded using either the binary convolutional code (BCC) defined in 28.3.11.5.1 (Binary convolutional coding and puncturing) or the low density parity check (LDPC) code defined in 28.3.11.5.2 (LDPC coding). The encoder is selected by the Coding field in HE-SIG-A in an HE SU PPDU or an HE extended range SU PPDU, or HE-SIG-B per-user subfield(s) in an HE MU PPDU, as defined in 28.3.10.7 (HE-SIG-A) and 28.3.10.8 (HE-SIG-B) respectively.

When conducting BCC FEC encoding for an HE PPDU, the number of encoders is always 1.

LDPC is the only FEC coding scheme in the HE PPDU Data field for a 484-, 996-, and 2×996-tone RU. LDPC is the only FEC coding scheme in the HE PPDU Data field for MCS10 and MCS11 in a 242- 484-, 996- and 2×996-tone RU. Support of BCC code is limited to less than or equal to four spatial streams and MCS0 to MCS9 (per user in case of MU-MIMO), and is mandatory (for both transmit and receive) for RU sizes less than or equal to a 242-tone RU(#838). Support of LDPC code (for both transmit and receive) is mandatory for HE STAs declaring support for at least one of HE 40/80/160/80+80 SU PPDU bandwidths, for HE STAs declaring support for more than 4 spatial streams, or for HE STAs declaring support for MCS10 and MCS11, according to HE capabilities field as defined in 9.4.2.218 (HE Capabilities element). Otherwise, support of LDPC code for either transmit or receive is optional.

28.3.11.5.1 Binary convolutional coding and puncturing

The information bits and pre-FEC padding bits of user u are encoded by a rate R = ½ convolutional encoder defined in 17.3.5.6 (Convolutional encoder). After encoding, the encoded data is punctured by the method defined in 17.3.5.6 (Convolutional encoder) (except for rate 5/6), to achieve the rate selected by the modulation and coding scheme. In the case that rate 5/6 coding is selected, the puncturing scheme will be the same as described in 21.3.10.5.3 (Binary convolutional coding and puncturing).

The initial number of OFDM symbols in the Data field with BCC encoding in an HE SU PPDU is calculated using Equation (28-65).

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$$N_{SYM,\,init} = m_{STBC} \cdot \left\lceil \frac{8 \cdot \text{APEP_LENGTH} + N_{Tail} + N_{service}}{m_{STBC} N_{DBPS}} \right\rceil \quad (28\text{-}65)$$

For an HE SU PPDU with BCC encoding,

$$N_{SYM} = N_{SYM,init} \quad (28\text{-}66)$$

and

$$a = a_{init} \quad (28\text{-}67)$$

The number of data bits per symbol in the last OFDM symbol(s) of an HE SU PPDU is $N_{DBPS,LAST} = N_{DBPS,LAST,init}$.

The number of coded bits per symbol in the last OFDM symbol(s) of an HE SU PPDU is given by Equation (28-68).

$$N_{CBPS,\,LAST} = \begin{cases} a \cdot N_{CBPS,\,SHORT}, & \text{if } a < 4 \\ N_{CBPS}, & \text{if } a = 4 \end{cases} \quad (28\text{-}68)$$

28.3.11.5.2 LDPC coding

For an HE SU PPDU using LDPC coding to encode the Data field, the LDPC code and encoding process described in 19.3.11.7 (LDPC codes) shall be used with the following modifications. First, all bits in the Data field including the scrambled SERVICE, PSDU, and pre-FEC pad bits are encoded, i.e., $N_{pld} = N_{service} + 8 \times \text{APEP_LENGTH} + N_{PAD,Pre\text{-}FEC}$. Thus, N_{pld} for HE PPDUs shall be computed using Equation (28-69) instead of Equation (20-35).

$$N_{pld} = (N_{SYM,\,init} - m_{STBC}) N_{DBPS} + m_{STBC} N_{DBPS,\,LAST,\,init} \quad (28\text{-}69)$$

where

$$N_{SYM.init} = m_{STBC} \cdot \left\lceil \frac{8 \cdot \text{APEP_LENGTH} + N_{service}}{m_{STBC} \cdot N_{DBPS}} \right\rceil \quad (28\text{-}70)$$

Following the calculation of N_{pld}, N_{avbits} shall be computed using Equation (28-71) instead of Equation (20-36).

$$N_{avbits} = (N_{SYM,\,init} - m_{STBC}) \cdot N_{CBPS} + m_{STBC} \cdot N_{CBPS,\,LAST,\,init} \quad (28\text{-}71)$$

In addition, in step d) of LDPC encoding process as described in 19.3.11.7.5 (LDPC PPDU encoding process), if the following condition is met:

$(N_{punc} > 0.1 \times N_{CW} \times L_{LDPC} \times (1 - R))$ AND $\left(N_{shrt} < 1.2 \times N_{punc} \times \frac{R}{1 - R}\right)$ is true OR if

$N_{punc} > 0.3 \times N_{CW} \times L_{LDPC} \times (1 - R)$ is true,

then the LDPC Extra Symbol Segment field of HE-SIG-A shall be set to 1, and increment N_{avbits} by the following Equation (28-72) instead of Equations (19-39), followed by recomputing N_{punc} as in Equation (19-40):

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$$N_{avbits} = \begin{cases} N_{avbits} + m_{STBC} \cdot (N_{CBPS} - 3N_{CBPS,SHORT}), & \text{if } a_{init} = 3 \\ N_{avbits} + m_{STBC} \cdot N_{CBPS,SHORT}, & \text{otherwise} \end{cases} \quad (28\text{-}72)$$

and then update a and N_{SYM} values by the following Equation (28-73):

$$\begin{cases} N_{SYM} = N_{SYM,init} + m_{STBC} \text{ and } a = 1, & \text{if } a_{init} = 4 \\ N_{SYM} = N_{SYM,init} \text{ and } a = a_{init} + 1, & \text{otherwise} \end{cases} \quad (28\text{-}73)$$

If in step d) of LDPC encoding process as described in 19.3.11.7.5 (LDPC PPDU encoding process), the above mentioned condition is not met, then the LDPC Extra Symbol Segment field in HE-SIG-A shall be set to 0, and

$$\begin{aligned} N_{SYM} &= N_{SYM,init} \\ a &= a_{init} \end{aligned} \quad (28\text{-}74)$$

With the final pre-FEC padding factor value a, update the N_{CBPS} of the last symbol as:

$$N_{CBPS,LAST} = \begin{cases} a \cdot N_{CBPS,SHORT}, & \text{if } a < 4 \\ N_{CBPS}, & \text{if } a = 4 \end{cases} \quad (28\text{-}75)$$

For completeness, the number of data bits of the last symbol $N_{DBPS,LAST} = N_{DBPS,LAST,init}$.

LDPC codes used in HE MU PPDUs shall also follow the definitions in 19.3.11.7 (LDPC codes). Refer to 28.3.11.5.4 (Encoding process for an HE MU PPDU) for a description of the LDPC encoding process for HE MU PPDUs.

28.3.11.5.3 Post-FEC padding

The number of post-FEC padding bits in each of the last m_{STBC} symbol(s) is computed by:

$$N_{PAD,POST\text{-}FEC} = N_{CBPS} - N_{CBPS,LAST} \quad (28\text{-}76)$$

The last m_{STBC} symbols shall consist of $N_{CBPS.LAST}$ bits from the FEC output followed by $N_{PAD.POST\text{-}FEC}$ post-FEC padding bits. The values of the post-FEC padding bits are not specified and are left up to implementation.

28.3.11.5.4 Encoding process for an HE MU PPDU

For an HE MU PPDU, all the users shall use a common pre-FEC padding factor value and a common N_{SYM} value. The padding process is described as follows.

First compute initial pre-FEC padding factor value ($a_{init,u}$) for each user u using Equation (28-61), and the initial number of OFDM symbols ($N_{SYM,init,u}$) for each user u using Equation (28-65) if user u is BCC encoded, or Equation (28-70) if user u is LDPC encoded. Among all the users, derive the user index with the longest encoded packet duration, as in Equation (28-77).

$$u_{\max} = \arg\max_{u=0}^{N_u - 1} (N_{SYM,init,u} - m_{STBC} + 0.25 m_{STBC} a_{init,u}) \quad (28\text{-}77)$$

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where m_{STBC} is the common STBC setting among all the users, as described in 28.3.11.7 (Segment parser).

Then the common a_{init} and $N_{SYM,init}$ values among all the users are derived by Equation (28-78):

$$\begin{aligned} N_{SYM.init} &= N_{SYM,\,init,\,u_{\max}} \\ a_{init} &= a_{init,\,u_{\max}} \end{aligned} \tag{28-78}$$

Update each user's initial number of coded bits in its last symbol as below:

$$\begin{aligned} N_{DBPS,\,last,\,init,\,u} &= \begin{cases} a_{init} N_{DBPS,\,short,\,u}, \text{ if } a_{init} < 4 \\ N_{DBPS,\,u}, \text{ if } a_{init} = 4 \end{cases} \\ N_{CBPS,\,last,\,init,\,u} &= \begin{cases} a_{init} N_{CBPS,\,short,\,u}, \text{ if } a_{init} < 4 \\ N_{CBPS,\,u}, \text{ if } a_{init} = 4 \end{cases} \end{aligned} \tag{28-79}$$

For each user with LDPC encoding, the number of pre-FEC padding bits is computed as in Equation (28-80):

$$\begin{aligned} N_{PAD,\,\text{Pre-FEC},\,u} = {} & (N_{SYM,\,init} - m_{STBC}) N_{DBPS,\,u} + m_{STBC} N_{DBPS,\,last,\,init,\,u} \\ & - 8 \cdot \text{APEP_LENGTH}_u - N_{service} \end{aligned} \tag{28-80}$$

For each user with LDPC encoding, the parameters $N_{pld,u}$ and $N_{avbits,u}$ are computed using Equation (28-81) and Equation (28-82) respectively:

$$N_{pld,\,u} = (N_{SYM,\,init} - m_{STBC}) N_{DBPS,\,u} + m_{STBC} N_{DBPS,\,last,\,init,\,u} \tag{28-81}$$

$$N_{avbits,\,u} = (N_{SYM,\,init} - m_{STBC}) N_{CBPS,\,u} + m_{STBC} N_{CBPS,\,last,\,init,\,u} \tag{28-82}$$

For each user with LDPC encoding continue LDPC encoding process as in 19.3.11.7.5 (LDPC PPDU encoding process) starting with the parameters $N_{pld,u}$ and $_{avbits,u}$. If there is at least one user with LDPC encoding, where step d) of its LDPC encoding process of 19.3.11.7.5 (LDPC PPDU encoding process), meets the following condition:

$(N_{punc,\,u} > 0.1 \times N_{CW,\,u} \times L_{LDPC,\,u} \times (1 - R_u))$ AND $\left(N_{shrt,\,u} < 1.2 \times N_{punc,\,u} \times \frac{R_u}{1 - R_u}\right)$ is true OR if

$N_{punc,\,u} > 0.3 \times N_{CW,\,u} \times L_{LDPC,\,u} \times (1 - R_u)$ is true,

where $N_{punc,u}$, $N_{CW,u}$, $L_{LDPC,u}$ and $N_{shrt,u}$ are the LDPC encoding parameters for user u, as defined in 19.3.11.7.5 (LDPC PPDU encoding process), and R_u is the coding rate of user u, then the LDPC Extra Symbol Segment field in HE-SIG-A shall be set to 1, and all the users with LDPC encoding shall increment N_{avbits} and recomputed N_{punc}, by the following two equations once:

$$N_{avbits,\,u} = \begin{cases} N_{avbits,\,u} + m_{STBC} \cdot (N_{CBPS} - 3 N_{CBPS,\,short,\,u}), \text{ if } a_{init} = 3 \\ N_{avbits,\,u} + m_{STBC} \cdot N_{CBPS,\,last,\,u}, \text{ otherwise} \end{cases} \tag{28-83}$$

$$N_{punc,\,u} = \max(0, (N_{CW,\,u} \times L_{LDPC,\,u}) - N_{avbits,\,u} - N_{shrt,\,u}) \tag{28-84}$$

Update the common pre-FEC padding factor and N_{SYM} values for all users by the following equation:

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$$\begin{cases} N_{SYM} = N_{SYM,\,init} + m_{STBC} \text{ and } a = 1, \text{ if } a_{init} = 4 \\ N_{SYM} = N_{SYM,\,init} \text{ and } a = a_{init} + 1, \text{ otherwise} \end{cases} \quad (28\text{-}85)$$

If among all the users with LDPC encoding, in step d) of 19.3.11.7.5 (LDPC PPDU encoding process), the above mentioned condition is not met, or if all the users in the HE MU PPDU are BCC encoded, then the LDPC Extra Symbol Segment field in HE-SIG-A shall be set to 0, and:

$$a = a_{init},\ N_{SYM} = N_{SYM,\,init} \quad (28\text{-}86)$$

Note that users with BCC encoding shall also use the common N_{SYM} and pre-FEC padding parameters as in Equation (28-86).

For the users with LDPC encoding, $N_{DBPS.LAST.u} = N_{DBPS.LAST.init.u}$.

For the users with BCC encoding, update the N_{DBPS} of the last symbol as

$$N_{DBPS,\,last,\,u} = \begin{cases} a \cdot N_{DBPS,\,short,\,u}, \text{ if } a < 4 \\ N_{DBPS,\,u}, \text{ if } a = 4 \end{cases}$$

For each user with either LDPC or BCC encoding, update the N_{CBPS} of the last symbol as

$$N_{CBPS,\,last,\,u} = \begin{cases} a \cdot N_{CBPS,\,short,\,u}, \text{ if } a < 4 \\ N_{CBPS,\,u}, \text{ if } a_{init} = 4 \end{cases}$$

For the users with BCC encoding, the number of pre-FEC padding bits is shown in Equation (28-87).

$$\begin{aligned} N_{PAD,\,\text{Pre-FEC},\,u} = {} & (N_{SYM} - m_{STBC}) N_{DBPS,\,u} + m_{STBC} N_{DBPS,\,last,\,u} \\ & - 8 \cdot \text{APEP_LENGTH}_u - N_{Tail} - N_{service} \end{aligned} \quad (28\text{-}87)$$

For each user with either LDPC or BCC encoding, the number of post-FEC padding bits in each of the last m_{STBC} symbol(s) is computed as in Equation (28-88):

$$N_{PAD,\,\text{Post-FEC},\,u} = N_{CBPS,\,u} - N_{CBPS,\,last,\,u} \quad (28\text{-}88)$$

Among the pre-FEC padding bits, the MAC delivers a PSDU that fills the available octets in the Data field of the HE PPDU, toward the desired pre-FEC padding boundary, represented by a_{init}, in the last OFDM symbol(s). The PHY then determines the number of pad bits to add and appends them to the PSDU. The number of pre-FEC pad bits added by PHY will always be 0 to 7. The procedure is defined in Equation (28-89) and Equation (28-90).

$$N_{PAD,\,\text{Pre-FEC},\,MAC} = 8 \cdot \left\lfloor \frac{N_{PAD,\,\text{Pre-FEC}}}{8} \right\rfloor \quad (28\text{-}89)$$

$$N_{PAD,\,\text{Pre-FEC},\,PHY} = N_{PAD,\,\text{Pre-FEC}} \bmod 8 \quad (28\text{-}90)$$

28.3.11.5.5 Encoding process for an HE trigger-based PPDU

The AP indicates the common N_{SYM}, pre-FEC padding factor, STBC indication and LDPC Extra Symbol Segment fields in the Trigger frame.

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For an HE trigger-based PPDU with BCC encoding, follow the HE SU PPDU padding and encoding process as introduced in 28.3.11.2 (Pre-FEC padding process), 28.3.11.5.1 (Binary convolutional coding and puncturing), and 28.3.11.5.3 (Post-FEC padding), with initial parameters setting to $N_{SYM.init} = N_{SYM}$, and $a_{init} = a$, where N_{SYM} and a are the common number of symbols and pre-FEC padding factor indicated in the Trigger frame, respectively.

For an HE trigger-based PPDU with LDPC encoding, follow the HE SU PPDU padding and encoding process as introduced in 28.3.11.2 (Pre-FEC padding process), 28.3.11.5.2 (LDPC coding), and 28.3.11.5.3 (Post-FEC padding), with the following exceptions:

When the LDPC Extra Symbol Segment field in the Trigger frame is 1, set the initial parameters following Equation (28-91):

$$\begin{cases} a_{init} = 4 \text{ and } N_{SYM,\,init} = N_{SYM} - m_{STBC}, & \text{if } a = 1 \\ a_{init} = a - 1 \text{ and } N_{SYM,\,init} = N_{SYM}, & \text{otherwise} \end{cases} \tag{28-91}$$

where N_{SYM} and a are the common number of symbols and pre-FEC padding factor indicated in the Trigger frame respectively, and m_{STBC} is 2 if the Trigger frame indicates STBC and 1 otherwise. Then continue with the LDPC encoding process as in 20.3.11.7.5 (LDPC PPDU encoding process), during which in step d) of 20.3.11.7.5 (LDPC PPDU encoding process), always increment N_{avbits} as in Equation (28-72), and always recompute N_{punc} as in Equation (19-40).

When the LDPC Extra Symbol Segment field in the Trigger frame is 0, set initial parameters to $N_{SYM,init} = N_{SYM}$, and $a_{init} = a$, where N_{SYM} and a are the common number of symbols and pre-FEC padding factor indicated in the Trigger frame respectively. Then continue with the LDPC encoding process as in 20.3.11.7.5 (LDPC PPDU encoding process), during which in step d) of 20.3.11.7.5 (LDPC PPDU encoding process), N_{avbits} and N_{punc} are not changed, and $a = a_{init}$.

28.3.11.6 Stream parser

After coding, scrambling, puncturing and post-FEC padding, the data bit streams at the output of the FEC encoder are processed in groups of N_{CBPS} bits. Each of these groups is re-arranged into N_{SS} blocks of N_{CBPSS} bits ($N_{SS,u}$ blocks of $N_{CBPSS,u}$ bits in the case of an HE MU transmission). This operation is referred to as “stream parsing” and is described in this subclause.

The description is given in terms of an SU transmission. For MU transmissions, the rearrangements are carried out in the same way per user.

The number of bits assigned to a single axis (real or imaginary) in a constellation point in a spatial stream is denoted by Equation (28-92).

$$s = max(1, \frac{N_{BPSCS}}{2}) \tag{28-92}$$

The sum of these over all streams is $S = N_{SS} \cdot s$.

Consecutive blocks of s bits are assigned to different spatial streams in a round robin fashion.

For the N_{CBPS} bits of each OFDM symbol, S bits from the output of the encoder are divided among all spatial streams, s bits per stream.

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Note that for all RU sizes the coded bits of each OFDM symbol are always evenly allocated to N_{SS} spatial streams.

The following equations are an equivalent description to the above procedure. Bit i at the output of the encoder is assigned to input bit k of spatial stream i_{SS} where

$$i = (i_{SS} - 1)s + S \cdot \left\lfloor \frac{k}{s} \right\rfloor + (k \bmod s)$$

$$i_{SS} = 1, 2, \ldots, N_{SS}$$

$$i = 0, 1, \ldots, N_{CBPS} - 1$$

$$k = 0, 1, \ldots, N_{CBPSS} - 1$$

28.3.11.7 Segment parser

The description in this subclause is for an SU transmission. For an MU transmissions, the rearrangements are carried out in the same way but per user.

For a 20 MHz, 40 MHz, 80 MHz, 160 MHz and 80+80 MHz transmission with a 26-, 52-, 106-, 242-, 484- or 996-tone RU, the segment parser is bypassed and the output bits of each stream parser are as specified in Equation (28-93).

$$y_{k,l} = x_k \tag{28-93}$$

where

x_k is bit k of a block of N_{CBPSS} bits, $k = 0$ to $N_{CBPSS} - 1$

l is the frequency subblock index and $l = 0$ for a 26-, 52-, 106-, 242-, 484- and 996-tone RU.

$y_{k,l}$ is bit k of the frequency subblock l

For a 160 MHz and 80+80 MHz transmission with a 2×996-tone RU, the output bits of each stream parser are first divided into blocks of N_{CBPSS} bits ($N_{CBPSS,u}$ bits in the case of an MU transmission). Then, each block is further divided into two frequency subblocks of $N_{CBPSS}/2$ bits as shown in Equation (28-94).

$$y_{k,l} = x_m \tag{28-94}$$

$$m = 2s \cdot \left\lfloor \frac{k}{s} \right\rfloor + l \cdot s + (k \bmod s), \quad k = 0, 1, \ldots, \frac{N_{CBPSS}}{2} - 1 \tag{28-95}$$

and

x_m is bit m of a block of N_{CBPSS} bits and $m = 0, \ldots, N_{CBPSS} - 1$

l is the frequency subblock index and $l = 0, 1$

$y_{k,l}$ is bit k of the frequency subblock l

s is defined in Equation (28-92)

28.3.11.8 BCC interleavers

For ease of explanation, the operation of the interleaver is described only for the SU case. For user u of an MU transmission, the interleaver operates in the same way on the output bits for the user from the stream parser by replacing N_{SS}, N_{CBPSS}, N_{CBPS}, and N_{BPSCS} with $N_{SS,u}$, $N_{CBPSS,u}$, $N_{CBPS,u}$ and $N_{BPSCS,u}$, respectively. That is, the operation of the interleaver is the same as if the transmission were an SU one, consisting of bits from only that user.

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The BCC interleaver operation is specified in 21.3.10.8 (BCC interleaver). When DCM is used with BPSK modulation in a 106-tone RU or a 242-tone RU with $N_{SS} = 1$, after the $2 \times N_{DBPS}$ coded bits in each OFDM symbol, 1 padding bit is added before the bits are interleaved. (The interleaver parameters, N_{COL}, N_{ROW}, and N_{ROT}, for the Data field depend on the RU size and whether or not DCM is used and are defined in the RU size column of Table 28-27 (BCC interleaver parameters).

Table 28-27—BCC interleaver parameters

DCM	Parameter	RU size (tones)				HE-SIG-A/ HE-SIG-B (tones)
		26	52	106	242	56
Not used	N_{COL}	8	16	17	26	13
	N_{ROW}	$3 \times N_{BPSCS}$	$3 \times N_{BPSCS}$	$6 \times N_{BPSCS}$	$9 \times N_{BPSCS}$	$4 \times N_{BPSCS}$
	N_{ROT} $(2 \le N_{SS} \le 4)$	2	11	29	58	-
Used	N_{COL}	4	8	17	13	13
	N_{ROW}	$3 \times N_{BPSCS}$	$3 \times N_{BPSCS}$	$3 \times N_{BPSCS}$	$9 \times N_{BPSCS}$	$2 \times N_{BPSCS}$
	N_{ROT} $(N_{SS} = 2)$	2	2	11	29	-

The interleaver parameters, N_{COL} and N_{ROW}, for the HE-SIG-A and HE-SIG-B fields are defined in the HE-SIG-A/HE-SIG-B column of Table 28-27 (BCC interleaver parameters).

NOTE—DCM is not used on the HE-SIG-A field.

28.3.11.9 Constellation mapping

The mapping between the input bits of the constellation mapper and complex constellation points for BPSK, QPSK, 16-QAM, 64-QAM and 256-QAM is as defined in 21.3.10.9 (Constellation mapping).

1024-QAM is optional for SU and MU for RUs equal to or larger than 242 subcarriers. For 1024-QAM, the mapping of the bits at the output of the interleaver to the complex constellation points is defined in Figure 28-30 (Constellation bit encoding for 1024-QAM (1st quadrant)), Figure 28-31 (Constellation bit

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encoding for 1024-QAM (2nd quadrant)), Figure 28-32 (Constellation bit encoding for 1024-QAM (3rd quadrant)) and Figure 28-33 (Constellation bit encoding for 1024-QAM (4th quadrant)).

Figure 28-30—Constellation bit encoding for 1024-QAM (1st quadrant)

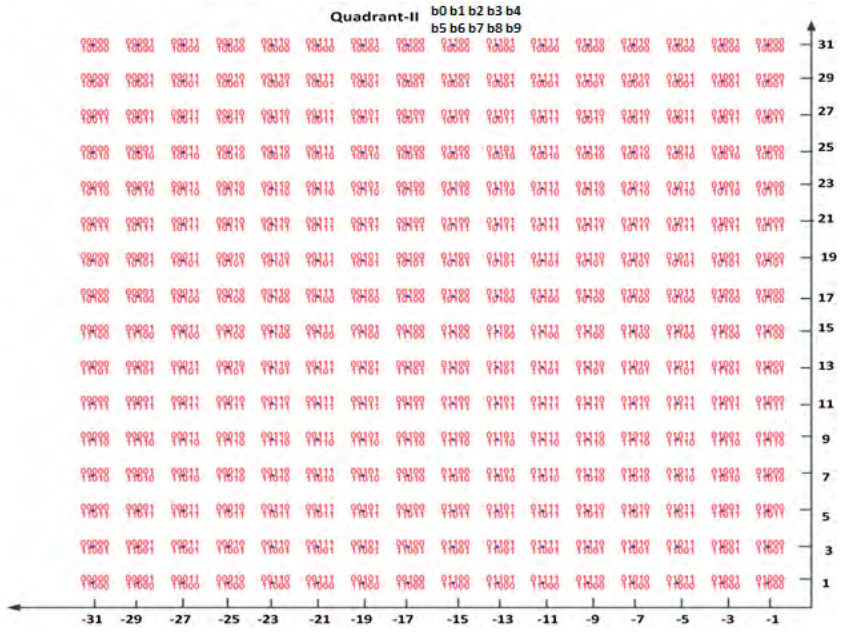

Figure 28-31—Constellation bit encoding for 1024-QAM (2nd quadrant)

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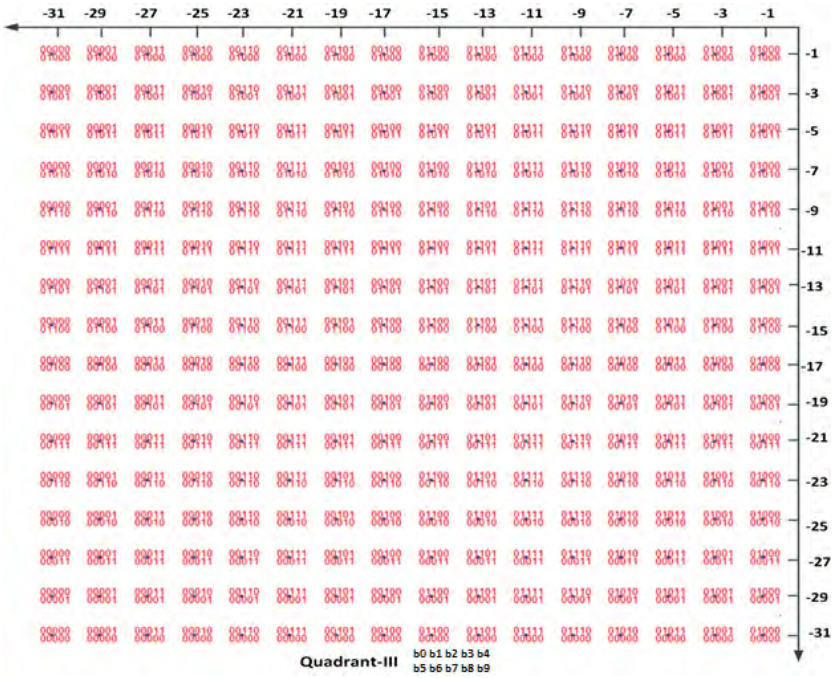

Figure 28-32—Constellation bit encoding for 1024-QAM (3rd quadrant)

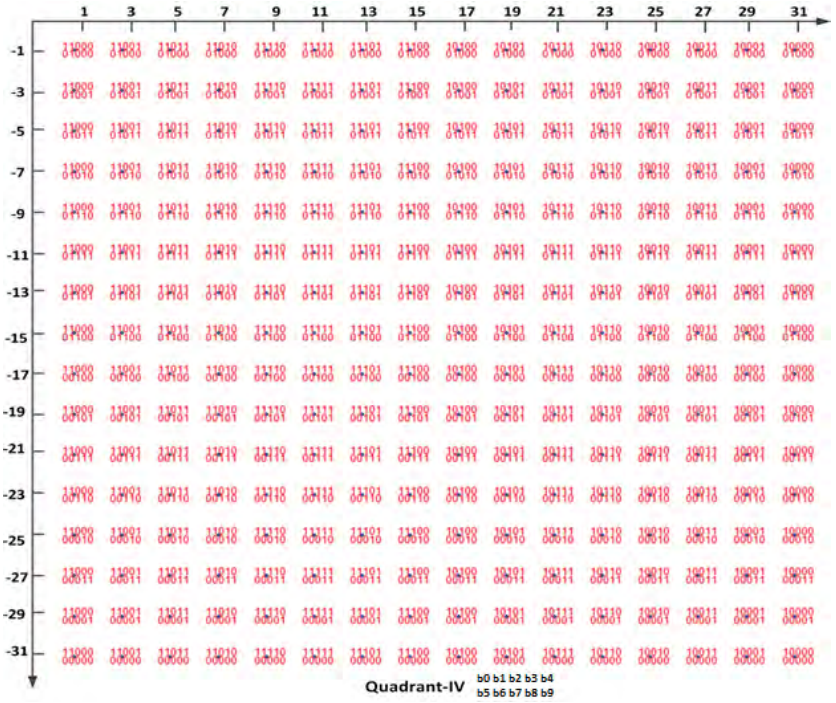

Figure 28-33—Constellation bit encoding for 1024-QAM (4th quadrant)

The normalization factor K_{mod} for 1024 QAM is $1/\sqrt{682}$.

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Dual subcarrier modulation (DCM) is an optional modulation scheme for the HE-SIG-B and Data fields. DCM can be applied to an HE SU PPDU and an HE extended range SU PPDU. In an HE MU PPDU, DCM can be applied only to RUs containing data for 1 user.

DCM is only applied to MCS0, MCS 1, MCS 3 and MCS 4. DCM is applied only with $N_{SS} = 1$ or $N_{SS} = 2$ (in the case of single user RU in an HE MU PPDU, $N_{SS,r,u} = 1$ or $N_{SS,r,u} = 2$). DCM is not applied with MU-MIMO or with STBC.

When DCM is employed, bit sequences are mapped to a pair symbols $(d_k, d_{q(k)})$ where k is in the range of $0 \le k \le N_{SD} - 1$ and $q(k)$ is in the range of $N_{SD} \le q(k) \le 2N_{SD} - 1$ in order to exploit frequency diversity for a and $0 \le k \le N_{SD}/2 - 1$ and $q(k)$ is in the range of $N_{SD}/2 \le q(k) \le N_{SD} - 1$ for a 2×996-tone RU. To maximize the frequency diversity, the indices of a pair of DCM subcarriers $(k, q(k))$ is $q(k) = k + N_{SD}$. The N_{SD} here refers to the N_{SD} with DCM = 1, which is half the value of N_{SD} with DCM = 0.

For BPSK modulation with DCM, the input stream is broken into groups of N_{CBPS} or $N_{CBPS,u}$ bits $(B_0, B_1, \ldots, B_{N_{CBPS,u}-1})$. Each bit B_k is BPSK modulated to a sample d_k. This generates the samples for the lower half of the data subcarriers. For the upper half of the subcarriers, the samples are generated as $d_{k+N_{SD}} = d_k \times e^{j(k+N_{SD})\pi}$, $k = 0, 1, \ldots, N_{SD} - 1$. The N_{SD} here refers to the N_{SD} with DCM = 1, which is half the value of N_{SD} with DCM = 0.

For QPSK modulation with DCM, the input stream is broken into groups of N_{CBPS} or $N_{CBPS,u}$ bits $(B_0, B_1, \ldots, B_{N_{CBPS,u}-1})$. Each pair of bits (B_{2k}, B_{2k+1}) is QPSK modulated to a symbol d_k. This generates the constellation points for the lower half the data subcarriers in the RU. For the upper half of the data sub-carriers in the RU, $d_{k+N_{SD}} = conj(d_k)$.

For 16-QAM modulation with DCM, the input stream is broken into groups of N_{CBPS} or $N_{CBPS,u}$ bits $(B_0, B_1, \ldots, B_{N_{CBPS,u}-1})$. A group of 4 bits ($B_{4k}$, B_{4k+1}, B_{4k+2}, B_{4k+3}) is 16-QAM modulated to a sample d_k as described in 18.3.5.8. This is the sample on subcarrier k in the lower half. In the upper half, the sample $d_{k+N_{SD}}$ on subcarrier $k + N_{SD}$ is obtained by 16-QAM modulating a permutation of the bits (B_{4k}, B_{4k+1}, B_{4k+2}, B_{4k+3}). Specifically, $d_{k+N_{SD}}$ is obtained by applying the 16-QAM modulation procedure in 18.3.5.8 to the bit group (B_{4k+1}, B_{4k}, B_{4k+3}, B_{4k+2}). he N_{SD} here refers to the N_{SD} with DCM = 1, which is half the value of N_{SD} with DCM = 0.

28.3.11.10 Space-time block coding

This subclause defines a set of optional robust transmission techniques that are applicable only when using STBC coding. For an HE PPDU, STBC is allowed only with single spatial stream and two space-time streams, and its application is as indicated by the STBC bit in HE-SIG-A. In an HE MU PPDU, STBC coding is used in all RUs or not used in any of the RUs. If in an RU, DL MU-MIMO is applied, STBC shall not be used in any RU in the HE MU PPDU.

The STBC encoding process is as described in 22.3.10.9.4 (Space-time block coding), with $N_{SS,0} = 1$ and $N_{STS,0} = 2$.

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28.3.11.11 LDPC tone mapper

The LDPC tone mapping shall be performed on all LDPC encoded streams mapped in an RU as described in this subclause. LDPC tone mapping shall not be performed on streams that are encoded using BCC. When DCM is applied to LDPC encoded streams, $D_{\mathrm{TM_DCM}}$ shall be applied on both the lower half data subcarriers in an RU and the upper half data subcarriers of the RU. The LDPC tone-mapping distance parameters D_{TM} and D_{TM_DCM} are constant for each RU size and the values for different RU sizes are given in Table 28-28 (LDPC tone mapping distance for each RU size).

Table 28-28—LDPC tone mapping distance for each RU size

Parameter	RU Size (tones)						
	26	52	106	242	484	996	2×996
D_{TM}	1	3	6	9	12	20	20
D_{TM_DCM}	1	1	3	9	9	14	14

NOTE—The LDPC tone mapping parameters D_{TM} and D_{TM_DCM} are applied for each frequency subblock, $l = 0$ and $l = 1$.

For an HE PPDU without DCM, the LDPC tone mapping for the LDPC encoded stream for user u in the r-th RU is done by permuting the stream of complex numbers generated by the constellation mappers (see 28.3.11.9 (Constellation mapping)) as defined by Equation (28-96).

$$d''_{t(k),\,i,\,n,\,l,\,r,\,u} = d'_{k,\,i,\,n,\,l,\,r,\,u} \tag{28-96}$$

where

$$k = \begin{cases} 0, 1, \ldots, N_{SD} - 1 \text{ for a 26-, 52-, 106-, 242-, 484- and 996-tone RU} \\ 0, 1, \ldots, N_{SD}/2 - 1 \text{ for a 2x996-tone RU} \end{cases}$$

$$i = 1, \ldots, N_{SS,\,r,\,u}$$

$$n = 0, 1, \ldots, N_{SYM} - 1$$

$$l = \begin{cases} 0 \text{ for a 26-, 52-, 106-, 242-, 484- and 996-tone RU} \\ 0, 1 \text{ for a 2x996-tone RU} \end{cases}$$

$$u = 0, \ldots, N_{user,\,r} - 1$$

$$r = 0, \ldots, N_{RU} - 1$$

N_{SD} is the number of data tones in the r-th RU

$$t(k) = \begin{cases} D_{TM}\left(k \bmod \dfrac{N_{SD}}{D_{TM}}\right) + \left\lfloor \dfrac{k \cdot D_{TM}}{N_{SD}} \right\rfloor, \text{ for a 26-, 52-, 106-, 242-, 484- and 996-tone RU} \\ D_{TM}\left(k \bmod \dfrac{N_{SD}/2}{D_{TM}}\right) + \left\lfloor \dfrac{k \cdot D_{TM}}{N_{SD}/2} \right\rfloor, \text{ for a 2x996-tone RU} \end{cases}$$

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For an HE PPDU with DCM, the LDPC tone mapping for the LDPC encoded stream corresponding to user u in the r-th RU is done by permuting the stream of complex numbers generated by the constellation mappers (see 25.3.10.7) as defined by Equation (28-97).

$$d''_{t(k),\,i,\,n,\,l,\,r,\,u} = d'_{k,\,i,\,n,\,l,\,r,\,u} \tag{28-97}$$

where

$$k = \begin{cases} 0, 1, \ldots, 2N_{SD} - 1 \text{ for a 26-, 52-, 106-, 242-, 484- and 996-tone RU} \\ 0, 1, \ldots, N_{SD} - 1 \text{ for a 2x996-tone RU} \end{cases}$$

$$i = 1, \ldots, N_{SS,\,r,\,u}$$

$$n = 0, 1, \ldots, N_{SYM} - 1$$

$$l = \begin{cases} 0 \text{ for a 26-, 52-, 106-, 242-, 484- and 996-tone RU} \\ 0, 1 \text{ for a 2x996-tone RU} \end{cases}$$

$$u = 0, \ldots, N_{user,\,r} - 1$$

$$r = 0, \ldots, N_{RU} - 1$$

N_{SD} is the number of data tones in the r-th RU when DCM is applied

For a 26-, 52-, 106-, 242-, 484- and 996-tone RU,

$$t(k) = \begin{cases} D_{TM_DCM}\left(k \bmod \dfrac{N_{SD}}{D_{TM_DCM}}\right) + \left\lfloor \dfrac{k \cdot D_{TM_DCM}}{N_{SD}} \right\rfloor, & \text{for } k < N_{SD} \\ D_{TM_DCM}\left((k - N_{SD}) \bmod \dfrac{N_{SD}}{D_{TM_DCM}}\right) + \left\lfloor \dfrac{(k - N_{SD}) \cdot D_{TM_DCM}}{N_{SD}} \right\rfloor + N_{SD}, & \text{for } k \geq N_{SD} \end{cases}$$

For a 2x996-tone RU,

$$t(k) = \begin{cases} D_{TM_DCM}\left(k \bmod \dfrac{N_{SD}/2}{D_{TM_DCM}}\right) + \left\lfloor \dfrac{k \cdot D_{TM_DCM}}{N_{SD}/2} \right\rfloor, & \text{for } 0 \leq k < N_{SD}/2 - 1 \\ D_{TM_DCM}\left((k - N_{SD}/2) \bmod \dfrac{N_{SD}/2}{D_{TM_DCM}}\right) + \left\lfloor \dfrac{(k - N_{SD}/2) \cdot D_{TM_DCM}}{N_{SD}/2} \right\rfloor + N_{SD}/2, & \text{for } N_{SD}/2 \leq k \leq N_{SD} - 1 \end{cases}$$

D_{TM_DCM} is the LDPC tone mapping distance for the r-th RU when DCM is applied.

NOTE—LDPC tone mapper for a 26-, 52-, 106-, 242-, 484- and 996-tone RU is defined as one segment. LDPC tone mapping is performed separately for the upper and lower 80 MHz frequency segments of a 2×996-tone RU as indicated by the frequency subblock index l in Error! Reference source not found. and Error! Reference source not found.

Since LDPC tone mapping is not performed on BCC-coded streams, for BCC-coded streams, Equation (28-98) applies.

$$d''_{k,\,i,\,n,\,l,\,r,\,u} = d'_{k,\,i,\,n,\,l,\,r,\,u} \tag{28-98}$$

where

$$k = \begin{cases} 0, 1, \ldots, N_{SD} - 1 \text{ for a 26-, 52-, 106-, 242-, 484- and 996-tone RU} \\ 0, 1, \ldots, N_{SD}/2 - 1 \text{ for a 2x996-tone RU} \end{cases}$$

$$i = 1, \ldots, N_{SS,\,r,\,u}$$

$$n = 0, 1, \ldots, N_{SYM} - 1$$

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$$l = \begin{cases} 0 \text{ for a 26-, 52-, 106-, 242-, 484- and 996-tone RU} \\ 0, 1 \text{ for a 2x996-tone RU} \end{cases}$$

$u = 0, \ldots, N_{user,r} - 1$

$r = 0, \ldots, N_{RU} - 1$

28.3.11.12 Segment deparser

For a 26-, 52-, 106-, 242-, 484- and 996-tone RU, the segment deparsing is not performed and $d^{(i_{Seg})}_{k,i,n,l,r,u}$ is specified in Equation (28-99).

$$d^{(i_{Seg})}_{k,i,n,l,r,u} = d''_{k,i,n,0,r,u}, \quad \text{if } 0 \le k \le N_{SD} - 1, i_{Seg} = 0 \tag{28-99}$$

For a 2×996-tone RU in a 160 MHz HE PPDU, the two frequency subblocks at the output of the LDPC tone mapper are combined into one frequency segment as specified in Equation (28-100).

$$d^{(i_{Seg})}_{k,i,n,l,r,u} = \begin{cases} d''_{k,i,n,0,r,u}, & \text{if } 0 \le k \le \dfrac{N_{SD}}{2} - 1 \\ d''_{k-\frac{N_{SD}}{2},i,n,l,r,u}, & \text{if } \dfrac{N_{SD}}{2} \le k \le N_{SD} - 1 \end{cases}, i_{Seg} = 0 \tag{28-100}$$

For a 2×996-tone RU in an 80+80 MHz HE PPDU, the segment deparsing is not performed and $d^{(i_{Seg})}_{k,i,n,l,r,u}$ is specified in Equation (28-101).

$$d^{(i_{Seg})}_{k,i,n,r,u} = d''_{k,i,n,i_{Seg},r,u}, \quad \text{if } 0 \le k \le N_{SD} - 1, i_{Seg} = 0, 1 \tag{28-101}$$

NOTE—As per Table 21-7 (center frequency for frequency segment iSeg = 0), $f_c^{(0)}$ is always less than $f_c^{(1)}$ in case of 80+80 MHz HE PPDU. Hence, $d''_{k,i,n,0,r,u}$ (frequency subblock 0) is always transmitted in the frequency segment lower in frequency, while $d''_{k,i,n,1,r,u}$ (frequency subblock 1) is always transmitted in the frequency segment higher in frequency.

28.3.11.13 Pilot subcarriers

For a user transmitting on the *i*-th 26-tone RU in a given PPDU BW, two pilot subcarriers shall be inserted in subcarriers $k \in K_{R26_i}$, where K_{R26_i} is given by the *i*-th pilot index set in the row of given PPDU BW of Table 28-29 (Pilot indices for a 26-tone RU).

Table 28-29—Pilot indices for a 26-tone RU

PPDU BW	K_{R26_i}
20 MHz, *i* = 1:9	−116/−102, −90/−76, −62/−48, −36/−22, −10/10, 22/36, 48/62, 76/90, 102/116

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Table 28-29—Pilot indices for a 26-tone RU *(continued)*

40 MHz, i = 1:18	−238/−224, −212/−198, −184/−170, −158/−144, −130/−116, −104/−90, −78/−64, −50/−36, −24/−10, 10/24, 36/50, 64/78, 90/104, 116/130, 144/158, 170/184, 198/212, 224/238
80 MHz, i = 1:37	−494/−480, −468/−454, −440/−426, −414/−400, −386/−372, −360/−346, −334/−320, −306/−292, −280/−266, −252/−238, −226/−212, −198/−184, −172/−158, −144/−130, −118/−104, −92/−78, −64/−50, −38/−24, −10/10, 24/38, 50/64, 78/92, 104/118, 130/144, 158/172, 184/198, 212/226, 238/252, 266/280, 292/306, 320/334, 346/360, 372/386, 400/414, 426/440, 454/468, 480/494
160 MHz, i = 1:74	{pilot subcarrier indices in 80 MHz −512, pilot subcarrier indices in 80 MHz +512}

The pilot mapping P_n^k for the subcarrier k for symbol n shall be as specified in Equation (28-102).

$$P_n^{K_{R26_i}} = \{\Psi_{n \bmod 2}, \Psi_{(n+1) \bmod 2}\}$$
$$P_n^{k \notin K_{R26_i}} = 0 \quad (28\text{-}102)$$

where

Ψ_m is defined in Table 28-30 (The 2 pilot values for a 26-tone RU)

Table 28-30—The 2 pilot values for a 26-tone RU

Ψ_0	Ψ_1
1	−1

For a user transmitting on the i-th 52-tone RU in a given PPDU BW, four pilot subcarriers shall be inserted in subcarriers $k \in K_{R52_i}$, where K_{R52_i} is given by the i-th pilot index set in the row of given PPDU BW of Table 28-31 (Pilot indices for 52-tone RU transmission).

Table 28-31—Pilot indices for 52-tone RU transmission

PPD BW	K_{R52_i}
20 MHz, i = 1:4	−116/−102/−90/−76, −62/−48/−36/−22, 22/36/48/62, 76/90/102/116
40 MHz, i = 1:8	−238/−224/−212/−198, −184/−170/−158/−144, −104/−90/−78/−64, −50/−36/−24/−10, 10/24/36/50, 64/78/90/104, 144/158/170/184, 198/212/224/238
80 MHz, i = 1:16	−494/−480/−468/−454, −440/−426/−414/−400, −360/−346/−334/−320, −306/−292/−280/−266, −252/−238/−226/−212, −198/−184/−172/−158, −118/−104/−92/−78, −64/−50/−38/−24, 24/38/50/64, 78/92/104/118, 158/172/184/198, 212/226/238/252, 266/280/292/306, 320/334/346/360, 400/414/426/440, 454/468/480/494
160 MHz, i = 1:32	{pilot subcarrier indices in 80 MHz −512, pilot subcarrier indices in 80 MHz +512}

The pilot mapping P_n^k for the subcarrier k for symbol n shall be as specified in Equation (28-103).

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$$P_n^{K_{R52_i}} = \{\Psi_{n \bmod 4}, \Psi_{(n+1) \bmod 4}, \Psi_{(n+2) \bmod 4}, \Psi_{(n+3) \bmod 4}\}$$
$$P_n^{k \notin K_{R52_i}} = 0 \quad (28\text{-}103)$$

where

Ψ_m is defined in Table 28-32 (The 4 pilot values in a 52- and 106-tone RU)

Table 28-32—The 4 pilot values in a 52- and 106-tone RU

Ψ_0	Ψ_1	Ψ_2	Ψ_3
1	1	1	−1

For a user transmitting on the *i*-th 106-tone RU in a given PPDU BW, four pilot subcarriers shall be inserted in subcarriers $k \in K_{R106_i}$, where K_{R106_i} is given by the *i*-th pilot index set in the row of given PPDU BW of Table 28-33 (Pilot indices for 106-tone RU transmission).

Table 28-33—Pilot indices for 106-tone RU transmission

PPD BW	K_{R106_i}
20 MHz, *i* = 1:2	−116/−90/−48/−22, 22/48/90/116
40 MHz, *i* = 1:4	−238/−212/−170/−144, −104/−78/−36/−10, 10/36/78/104, 144/170/212/238
80 MHz, *i* = 1:8	−494/−468/−426/−400, −360/−334/−292/−266, −252/−226/−184/−158, −118/−92/−50/−24, 24/50/92/118, 158/184/226/252, 266/292/334/360, 400/426/468/494
160 MHz, *i* = 1:16	{pilot subcarrier indices in 80 MHz −512, pilot subcarrier indices in 80 MHz +512}

The pilot mapping P_n^k for the subcarrier *k* for symbol *n* shall be as specified in Equation (28-104).

$$P_n^{K_{R106_i}} = \{\Psi_{n \bmod 4}, \Psi_{(n+1) \bmod 4}, \Psi_{(n+2) \bmod 4}, \Psi_{(n+3) \bmod 4}\}$$
$$P_n^{k \notin K_{R106_i}} = 0 \quad (28\text{-}104)$$

where

Ψ_m is defined in Table 28-32 (The 4 pilot values in a 52- and 106-tone RU)

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For a user transmitting on the *i*-th 242-tone RU in a given PPDU BW, eight pilot subcarriers shall be inserted in subcarriers $k \in K_{R242_i}$, where K_{R242_i} is given by the *i*-th pilot index set in the row of given PPDU BW of Table 28-34 (Pilot indices for 242-tone RU transmission).

Table 28-34—Pilot indices for 242-tone RU transmission

PPD BW	K_{R242_i}
20 MHz, i = 1	−116/−90/−48/−22/22/48/90/116
40 MHz, i = 1:2	−238/−212/−170/−144/−104/−78/−36/−10, 10/36/78/104/144/170/212/238
80 MHz, i = 1:4	−494/−468/−426/−400/−360/−334/−292/−266,−252/−226/−184/−158/−118/−92/−50/−24, 24/50/92/118/158/184/226/252, 266/292/334/360/400/426/468/494
160 MHz, i = 1:8	{pilot subcarrier indices in 80 MHz −512, pilot subcarrier indices in 80 MHz +512}

The pilot mapping P_n^k for the subcarrier *k* for symbol *n* shall be as specified in Equation (28-105).

$$P_n^{K_{R242_i}} = \{\Psi_{n \bmod 8}, \Psi_{n+1 \bmod 8}, \Psi_{n+2 \bmod 8}, \Psi_{n+3 \bmod 8}, \Psi_{(n+4) \bmod 8}, \Psi_{(n+5) \bmod 8}, \Psi_{(n+6) \bmod 8}, \Psi_{(n+7) \bmod 8}\} \quad (28\text{-}105)$$

$$P_n^{k \notin K_{R242_i}} = 0$$

where

Ψ_m is defined in Table 28-35 (The 8 pilot values in a 242-tone RU)

Table 28-35—The 8 pilot values in a 242-tone RU

Ψ_0	Ψ_1	Ψ_2	Ψ_3	Ψ_4	Ψ_5	Ψ_6	Ψ_7
1	1	1	−1	−1	1	1	1

For a 484-tone RU transmission, the pilot mapping for 8 pilots in 242-tone RU is replicated in the two 242-RUs of the 484-tone RU transmission. Specifically, for a user transmitting on the *i*-th 484-tone RU in a given PPDU BW, sixteen pilot subcarriers shall be inserted in subcarriers $k \in K_{R484_i}$, where K_{R484_i} is given by the *i*-th pilot index set in the row of given PPDU BW of Table 28-36 (Pilot indices for 484-tone RU transmission).

Table 28-36—Pilot indices for 484-tone RU transmission

PPD BW	K_{R484_i}

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Table 28-36—Pilot indices for 484-tone RU transmission *(continued)*

40 MHz, i = 1	−238/−212/−170/−144/−104/−78/−36/−10/10/36/78/104/144/170/212/238
80 MHz, i = 1:2	−494/−468/−426/−400/−360/−334/−292/−266/−252/−226/−184/−158/−118/−92/−50/−24, 24/50/92/118/158/184/226/252/266/292/334/360/400/426/468/494
160 MHz, i = 1:4	{pilot subcarrier indices in 80 MHz −512, pilot subcarrier indices in 80 MHz +512}

The pilot mapping P_n^k for the subcarrier k for symbol n shall be as specified in Equation (28-106).

$$\begin{aligned} P_n^{K_{R484_i}} = \{&\Psi_{n \bmod 8}, \Psi_{n+1 \bmod 8}, \Psi_{n+2 \bmod 8}, \Psi_{n+3 \bmod 8}, \\ &\Psi_{(n+4) \bmod 8}, \Psi_{(n+5) \bmod 8}, \Psi_{(n+6) \bmod 8}, \Psi_{(n+7) \bmod 8}, \\ &\Psi_{(n+8) \bmod 8}, \Psi_{(n+9) \bmod 8}, \Psi_{(n+10) \bmod 8}, \Psi_{(n+11) \bmod 8}, \\ &\Psi_{(n+12) \bmod 8}, \Psi_{(n+13) \bmod 8}, \Psi_{(n+14) \bmod 8}, \Psi_{(n+15) \bmod 8}\} \\ P_n^{k \notin K_{R484_i}} = 0 \end{aligned} \quad (28\text{-}106)$$

where

Ψ_m is defined in Table 28-35 (The 8 pilot values in a 242-tone RU)

For a 996-tone RU transmission, the pilot mapping for its 16 pilots is the same as the mapping for 484-tone RU transmission. Specifically, for a user transmitting on the i-th 996-tone RU in a given PPDU BW, sixteen pilot subcarriers shall be inserted in subcarriers $k \in K_{R996_i}$, where K_{R996_i} is given by the i-th pilot index set in the row of given PPDU BW of Table 28-37 (Pilot indices for 996-tone RU transmission).

Table 28-37—Pilot indices for 996-tone RU transmission

PPD BW	K_{R996_i}
80 MHz, i = 1	−468/−400/−334/−266/−226/−158/−92/−24/24/92/158/226/266/334/400/468
160 MHz, i = 1:2	{for i = 1 pilot subcarrier indices in 80 MHz −512, for i = 2 pilot subcarrier indices in 80 MHz +512}

The pilot mapping P_n^k for the subcarrier k for symbol n shall be as specified in Equation (28-107).

$$\begin{aligned} P_n^{K_{R996_i}} = \{&\Psi_{n \bmod 8}, \Psi_{(n+1) \bmod 8}, \Psi_{(n+2) \bmod 8}, \Psi_{(n+3) \bmod 8}, \\ &\Psi_{(n+4) \bmod 8}, \Psi_{(n+5) \bmod 8}, \Psi_{(n+6) \bmod 8}, \Psi_{(n+7) \bmod 8}, \\ &\Psi_{(n+8) \bmod 8}, \Psi_{(n+9) \bmod 8}, \Psi_{(n+10) \bmod 8}, \Psi_{(n+11) \bmod 8}, \\ &\Psi_{(n+12) \bmod 8}, \Psi_{(n+13) \bmod 8}, \Psi_{(n+14) \bmod 8}, \Psi_{(n+15) \bmod 8}\} \\ P_n^{k \notin K_{R996_i}} = 0 \end{aligned} \quad (28\text{-}107)$$

where

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Ψ_m is defined in Table 28-35 (The 8 pilot values in a 242-tone RU)

For a 160 MHz transmission (equivalently two 996-tone RU transmissions), the 80 MHz (equivalently 996-tone RU) pilot mapping is replicated in the two 80 MHz subchannels of the 160 MHz transmission. Specifically, 32 pilot subcarriers shall be inserted in subcarriers $k \in K_{\text{R2x996}_i}$, where K_{R2x996_i} is given by {–980, –912, –846, –778, –738, –670, –604, –536, –488, –420, –354, –286, –246, –178, –112, –44, 44, 112, 178, 246, 286, 354, 420, 488, 536, 604, 670, 738, 778, 846, 912, 980}. The pilot mapping P_n^k for the subcarrier *k* for symbol *n* shall be as specified in Equation (28-108).

$$
\begin{aligned}
P_n^{K_{R2x996_i}} = \{ & \Psi_{n \bmod 8}, \Psi_{(n+1) \bmod 8}, \Psi_{(n+2) \bmod 8}, \Psi_{(n+3) \bmod 8}, \\
& \Psi_{(n+4) \bmod 8}, \Psi_{(n+5) \bmod 8}, \Psi_{(n+6) \bmod 8}, \Psi_{(n+7) \bmod 8}, \\
& \Psi_{(n+8) \bmod 8}, \Psi_{(n+9) \bmod 8}, \Psi_{(n+10) \bmod 8}, \Psi_{(n+11) \bmod 8}, \\
& \Psi_{(n+12) \bmod 8}, \Psi_{(n+13) \bmod 8}, \Psi_{(n+14) \bmod 8}, \Psi_{(n+15) \bmod 8}, \\
& \Psi_{n \bmod 8}, \Psi_{(n+1) \bmod 8}, \Psi_{(n+2) \bmod 8}, \Psi_{(n+3) \bmod 8}, \\
& \Psi_{(n+4) \bmod 8}, \Psi_{(n+5) \bmod 8}, \Psi_{(n+6) \bmod 8}, \Psi_{(n+7) \bmod 8}, \\
& \Psi_{(n+8) \bmod 8}, \Psi_{(n+9) \bmod 8}, \Psi_{(n+10) \bmod 8}, \Psi_{(n+11) \bmod 8}, \\
& \Psi_{(n+12) \bmod 8}, \Psi_{(n+13) \bmod 8}, \Psi_{(n+14) \bmod 8}, \Psi_{(n+15) \bmod 8} \} \\
P_n^{k \notin K_{R2x996_i}} = & \ 0
\end{aligned}
\tag{28-108}
$$

where

Ψ_m is defined in Table 28-35 (The 8 pilot values in a 242-tone RU)

For a noncontiguous 80+80 MHz transmission, each frequency segment shall follow the 80 MHz pilot subcarrier allocation and values defined for 996-tone RU in 80 MHz transmission as specified in Equation (28-107).

The above pilot mapping shall be copied to all space-time streams before the space-time stream cyclic shifts are applied.

28.3.11.14 OFDM modulation

The time domain waveform of the Data field of an HE PPDU that is not an HE trigger-based PPDU, from transmit chain i_{TX}, $1 \le i_{TX} \le N_{TX}$ and frequency segment i_{Seg}, shall be as defined in Equation (28-109).

$$
\begin{aligned}
r_{\text{HE-Data}}^{(i_{Seg} i_{TX})}(t) = & \frac{1}{\sqrt{\sum_{r=1}^{N_{RU}} \alpha_r^2 |K_r|}} \sum_{n=0}^{N_{SYM}-1} w_{T_{\text{HE-Data}}}(t - nT_{SYM}) \sum_{r=0}^{N_{RU}-1} \frac{\alpha_r}{\sqrt{N_{STS,\,r,\,total}}} \\
& \sum_{k \in K_r} \sum_{u=0}^{N_{user,\,r}-1} \sum_{m=1}^{N_{STS,\,r,\,u}} \left(\begin{array}{l} \left[Q_k^{(i_{Seg})} \right]_{i_{TX},\,(M_{r,\,u}+m)} (\tilde{D}_{k,\,m,\,n,\,r}^{(i_{Seg},\,u)} + p_{n+2+N_{\text{HE-SIG-A}}+N_{\text{HE-SIG-B}}} P_n^k) \\ \cdot \exp(j2\pi k \Delta_{F,\,\text{HE}}(t - nT_{SYM} - T_{GI,\,Data} - T_{CS,\,\text{HE}}(M_{r,\,u}+m))) \end{array} \right)
\end{aligned}
\tag{28-109}
$$

where

p_n is defined in 17.3.5.10 (OFDM modulation)

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P_n^k is defined in 28.3.11.13 (Pilot subcarriers)

$T_{CS,\,\mathrm{HE}}(M_{r,\,u}+m)$ represents the cyclic shift for space time stream $M_{r,u}+m$ as defined in 28.3.10.2.2 (Cyclic shift for HE modulated fields)

$T_{GI,\,Data}$ is the guard interval duration as defined in Table 28-9 (Timing-related constants)

$\tilde{D}_{k,\,m,\,n,\,r}^{(i_{Seg},\,u)}$ is the transmitted constellation for user u in the r-th RU at subcarrier k, space-time stream m, and Data field OFDM symbol n and is defined by Equation (28-110).

$$\tilde{D}_{k,\,m,\,n,\,r}^{(i_{Seg},\,u)} = \begin{cases} 0, & k \in K_{\mathrm{Pilot}} \\ \tilde{d}_{M_r(k),\,m,\,n,\,r,\,u}^{(i_{Seg})}, & \text{otherwise} \end{cases} \tag{28-110}$$

where

K_{Pilot} is the set of subcarrier indices of pilot subcarriers, as defined in 28.3.3.4 (Pilot subcarriers)

$M_r(k)$ is defined in Equation (28-111)

$$M_r(k) = k - K_{r,\,\min} - \left|\{k' : K_{r,\,\min} \le k' < k\} \cap K_{\mathrm{Pilot}}\right| \tag{28-111}$$

where

$K_{r,min}$ is the minimum value of the set K_r

$|\Phi|$ is the cardinality of a set Φ

NOTE – $M_r(k)$ translates a subcarrier index k ($-N_{SR} \le k \le N_{SR}$) into the index of data symbols in a transmission over an RU ($0 \le M_r(k) \le N_{SD,r}$). The subcarrier index k for the data tone is first offset by the minimum value of subcarrier index $K_{r,min}$ (for the lower edge tone) in this RU, and then subtracted by the number of pilot subcarriers falling in between the data tone and the edge tone.

In a noncontiguous 80+80 MHz transmission, each frequency segment shall follow the 80 MHz HE subcarrier mapping as specified in 28.3.9 (Mathematical description of signals).

The time domain waveform of the Data field of an HE trigger-based PPDU for user u in the r-th RU from transmit chain i_{TX}, $1 \le i_{TX} \le N_{TX}$ shall be as defined in Equation (28-112).

$$r_{\text{HE-Data}}^{(i_{Seg} i_{TX})}(t) = \frac{1}{\sqrt{|K_r|}} \sum_{n=0}^{N_{SYM}-1} w_{T_{\text{HE-Data}}}(t - nT_{SYM}) \frac{1}{\sqrt{N_{STS,\,r,\,total}}} \sum_{k \in K_r} \sum_{m=1}^{N_{STS,\,r,\,u}} \left(\left[Q_k^{(i_{Seg})} \right]_{i_{TX},\,(M_{r,\,u}+m)} (\tilde{D}_{k,\,m,\,n,\,r}^{(i_{Seg},\,u)} + p_{n+4} P_n^k) \cdot \exp(j2\pi k \Delta_{F,\,\mathrm{HE}}(t - nT_{SYM} - T_{GI,\,Data} - T_{CS,\,HE}(M_{r,\,u}+m))) \right) \tag{28-112}$$

where

$Q_k^{(i_{Seg})}$ is a spatial mapping/steering matrix with N_{TX} rows and $N_{STS,r,total}$ columns for subcarrier k in frequency segment i_{Seg}. $Q_k^{(i_{Seg})}$ may be frequency dependent, and the dimension may be variant in each RU. Refer to the descriptions in 22.3.10.11.1 (Transmission in VHT format) for examples of $Q_k^{(i_{Seg})}$.

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28.3.11.15 Dual carrier modulation

Dual carrier modulation (DCM) modulates the same information on a pair of sub-carriers. DCM is an optional modulation scheme for the HE-SIG-B and Data fields. DCM is only applied to BPSK, QPSK and 16-QAM modulations.

The constellation mapper for DCM is defined in 28.3.11.9 (Constellation mapping). The LDPC tone mapper for DCM is defined in 28.3.11.11 (LDPC tone mapper). The BCC interleaver for DCM is defined in 28.3.11.8 (BCC interleavers).

28.3.12 Packet extension

An HE PPDU may have a Packet Extension (PE) field appended at the end of the PPDU, with possible durations being 0 μs, 4 μs, 8 μs, 12 μs, or 16 μs. The PE field, when present, shall be transmitted with the same average power as the Data field, and its content is arbitrary.

The PE field is applied for the recipient of the PPDU to obtain longer processing time at the end of an HE PPDU, and its duration is determined by both the pre-FEC padding factor value in the last OFDM symbol(s) of the Data field, and the maximum PE duration requested by the recipient for the signal bandwidth (or RU size), the number of spatial streams, and the constellation size of the current PPDU, which is based on the PPE Thresholds field in HE Capabilities element (see 9.4.2.218 (HE Capabilities element)).

For an HE PPDU, the maximum PE durations as defined by the PPE Thresholds field in the HE Capabilities element (see 9.4.2.218 (HE Capabilities element)) are 0 μs, 8 μs and 16 μs.

— A 0 μs maximum PE duration means no PE is present.

— A 8 μs maximum PE duration means that a PE field of 0 μs, 0 μs, 4 μs, and 8 μs are appended at the end of the PPDU, corresponding to a pre-FEC padding factor of 1, 2, 3 and 4, respectively, as shown in Figure 28-34 (PE field when maximum PE duration is 8 μs (non STBC)).

— A 16 μs maximum PE duration means that a PE field of 4 μs, 8 μs, 12 μs, and 16 μs are appended at the end of the PPDU, corresponding to a pre-FEC padding factor of 1, 2, 3 and 4, respectively, as shown in Figure 28-35 (PE field when maximum PE duration is 16 μs (non STBC)).

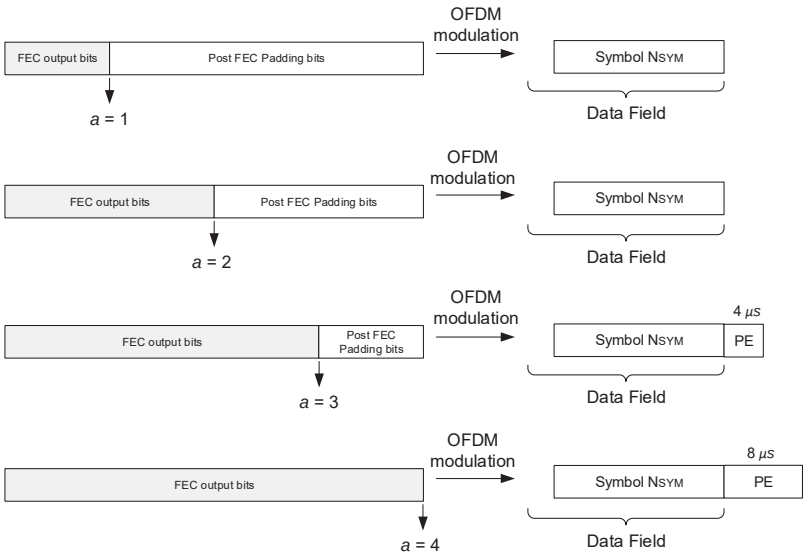

Figure 28-34—PE field when maximum PE duration is 8 μs (non STBC)

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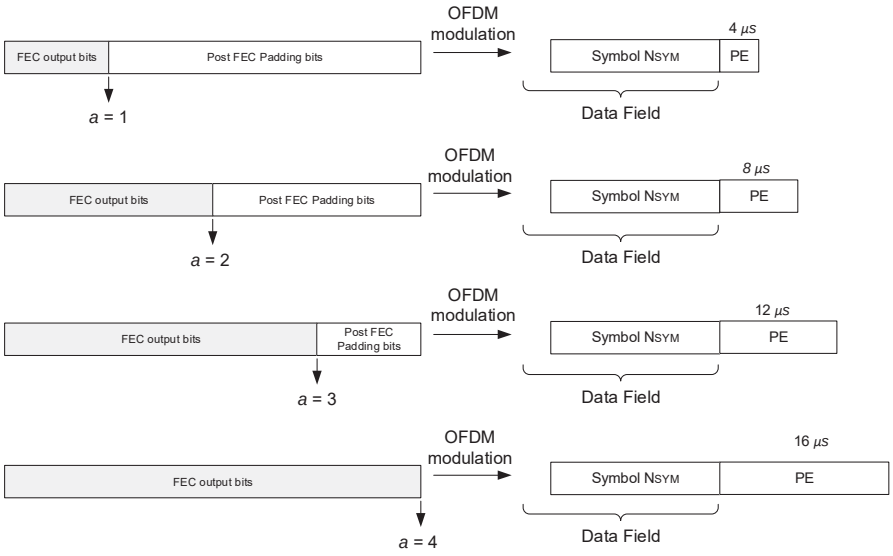

Figure 28-35—PE field when maximum PE duration is 16 μs (non STBC)

For an HE MU PPDU, the AP computes the PE duration, $T_{PE,u}$, for each user u, according to the common pre-FEC padding factor value among all users as described in 28.3.11.5.4 (Encoding process for an HE MU PPDU), the Maximum PE Duration capabilities, the RU size, the number of spatial streams and constellation size for user u. The AP shall choose the largest PE duration among all the users as the common PE duration of the current HE MU PPDU as:

$$T_{PE} = \max_u(T_{PE,u}) \tag{28-113}$$

and then append the PE field at the end of the current HE MU PPDU, with duration T_{PE}.

For an HE trigger-based PPDU, the AP indicates the packet extension duration information for all users in the Packet Extension subfield in the Common Info field of the Trigger frame. The first two bits in the Packet Extension subfield indicate the pre-FEC padding factor and the third bit indicates the PE-Disambiguity. Each user, when responding to the Trigger frame with an HE trigger-based PPDU, shall append PE field at the end of the current HE trigger-based PPDU, with a duration T_{PE}. The value of T_{PE} can be calculated using Equation (28-114).

$$T_{PE} = \left\lfloor \frac{\left(\frac{\text{LENGTH} + m + 3}{3} \times 4 - T_{\text{RL-SIG}} - T_{\text{HE-SIG-A}} - T_{\text{HE-PREAMBLE}}\right) - N_{SYM} T_{SYM}}{4} \right\rfloor \times 4 \tag{28-114}$$

where

$$N_{SYM} = \left\lfloor \left(\frac{\text{LENGTH} + m + 3}{3} \times 4 - T_{\text{RL-SIG}} - T_{\text{HE-SIG-A}} - T_{\text{HE-PREAMBLE}}\right) / T_{SYM} \right\rfloor - b_{\text{PE-Disambiguity}}$$

LENGTH is the value indicated by Length subfield of the Common Info field in the Trigger frame

$b_{\text{PE-Disambiguity}}$ is B2 of the Packet Extension subfield of the Common Info field in the Trigger frame

$T_{\text{HE-PREAMBLE}} = T_{\text{HE-STF-T}} + N_{\text{HE-LTF}} T_{\text{HE-LTF},SYM}$

$T_{\text{HE-STF-T}}$, $T_{\text{HE-LTF},SYM}$, $T_{\text{RL-SIG}}$ and $T_{\text{HE-SIG-A}}$ are defined in Table 28-9 (Timing-related constants)

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Editor's Note: The HE-SIG-A bits definition below should be moved into 28.3.10.7 (HE-SIG-A)

The 3-bit Packet Extension field in HE-SIG-A are defined as in Table 28-38 (Packet Extension field in HE-SIG-A).

Table 28-38—Packet Extension field in HE-SIG-A

Name	bits	Definition
Pre-FEC Padding Factor	B0-B1	Indicates the pre-FEC padding factor value of the current PPDU
PE Disambiguity	B2	Indicates PE disambiguity

The Pre-FEC Padding Factor subfield of the Packet Extension field is encoded as shown in Table 28-39 (Pre-FEC Padding Factor subfield encoding).

Table 28-39—Pre-FEC Padding Factor subfield encoding

Pre-FEC padding factor value	Pre-FEC Padding Factor subfield encoding
1	b01
2	b10
3	b11
4	b00

The PE Disambiguity subfield of the Packet Extension field shall be set to 1 if the condition in Equation (28-115) is met, otherwise it shall be set to 0.

$$T_{PE} + 4 \times \left(\left\lceil \frac{\text{TXTIME} - SignalExtension - 20}{4} \right\rceil - \left(\frac{\text{TXTIME} - SignalExtension - 20}{4} \right) \right) \geq T_{SYM} \quad (28\text{-}115)$$

where

T_{PE} is the PE field duration

T_{SYM} is the symbol duration of the Data field as defined in 28.3.8 (Timing-related parameters)

TXTIME (in μs) is defined in 28.4.2 (TXTIME and PSDU_LENGTH calculation)

SignalExtension is 0 μs when TXVECTOR parameter NO_SIG_EXTN is true and is aSignalExtension as defined in Table 19-25 (HT PHY characteristics) when TXVECTOR parameter NO_SIG_EXTN is false

The receiver computes N_{SYM} and T_{PE} using Equation (28-116) and Equation (28-117), respectively.

$$N_{SYM} = \left\lfloor \left(\frac{\text{L_LENGTH} + m + 3}{3} \times 4 - T_{\text{HE-PREAMBLE}} \right) / T_{SYM} \right\rfloor - b_{\text{PE-Disambiguity}} \quad (28\text{-}116)$$

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$$T_{PE} = \left\lfloor \frac{\left(\frac{\text{L_LENGTH} + m + 3}{3} \times 4 - T_{\text{HE-PREAMBLE}}\right) - N_{SYM} T_{SYM}}{4} \right\rfloor \times 4 \quad (28\text{-}117)$$

where

$$T_{\text{HE-PREAMBLE}} = \begin{cases} T_{\text{RL-SIG}} + T_{\text{HE-SIG-A}} + T_{\text{HE-STF-T}} + N_{\text{HE-LTF}} T_{\text{HE-LTF, }SYM}, \text{ for an HE trigger-based PPDU} \\ T_{\text{RL-SIG}} + T_{\text{HE-SIG-A}} + T_{\text{HE-STF-NT}} + N_{\text{HE-LTF}} T_{\text{HE-LTF, }SYM}, \text{ for an HE SU PPDU} \\ T_{\text{RL-SIG}} + T_{\text{HE-SIG-A}} + N_{\text{HE-SIG-B}} T_{\text{HE-SIG-B}} + T_{\text{HE-STF-NT}} + N_{\text{HE-LTF}} T_{\text{HE-LTF, }SYM}, \text{ for an HE MU PPDU} \\ T_{\text{RL-SIG}} + T_{\text{HE-SIG-A}} + T_{\text{HE-SIG-A-R}} + T_{\text{HE-STF-NT}} + N_{\text{HE-LTF}} T_{\text{HE-LTF, }SYM}, \text{ for an HE extended range SU PPDU} \end{cases}$$

$T_{\text{RL-SIG}}$, $T_{\text{HE-STF-T}}$, $T_{\text{HE-STF-NT}}$, $T_{\text{HE-LTF,SYM}}$, $T_{\text{HE-SIG-A}}$, $T_{\text{HE-SIG-A-R}}$, $T_{\text{HE-SIG-B}}$ are defined in Table 28-9 (Timing-related constants)

$N_{\text{HE-SIG-B}}$, $N_{\text{HE-LTF}}$ are defined in Table 28-12 (Frequently used parameters)

$b_{\text{PE-Disambiguity}}$ is PE Disambiguity subfield in the Packet Extension subfield of the HE-SIG-A field

28.3.13 Non-HT duplicate transmission

When the TXVECTOR parameter FORMAT is NON_HT and the TXVECTOR parameter NON_HT_MODULATION is NON_HT_DUP_OFDM, the transmitted PPDU is a non-HT duplicate. Non-HT duplicate transmission is used to transmit to non-HT OFDM STAs, HT STAs, VHT STAs and HE STAs that may be present in a part of a 40 MHz, 80 MHz, or 160 MHz channel (see Table 21-2 (Interpretation of FORMAT, NON_HT Modulation and CH_BANDWIDTH parameters)). The RL-SIG, HE-SIG-A, HE-SIG-B, HE-STF, and HE-LTF fields are not transmitted. The L-STF, L-LTF, and L-SIG fields shall be transmitted in the same way as in the HE transmission when the TXVECTOR parameter BEAM_CHANGE is 0, with the exceptions for the Rate and Length fields which shall follow 17.3.4 (SIGNAL field).

In a 40 MHz non-HT duplicate transmission, the Data field shall be as defined by Equation (28-60).

For 80 MHz and 160 MHz non-HT duplicate transmissions, the Data field shall be as defined by Equation (21-101).

In a noncontiguous 80+80 MHz non-HT duplicate transmission, data transmission in each frequency segment shall be as defined for an 80 MHz non-HT duplicate transmission in Equation (21-101).

28.3.14 Transmit requirements for an HE trigger-based PPDU

28.3.14.1 Introduction

HE trigger-based PPDU transmissions are preceded by a Trigger frame from the AP. Since multiple transmitters take part in an HE trigger-based PPDU transmission, it requires transmission time, frequency, sampling symbol clock, and power pre-correction by the participating STAs to mitigate the synchronization related issues at the AP. Frequency and sampling clock pre-corrections are needed to prevent inter-carrier interference. Power pre-correction is required to control interference among participating STAs HE trigger-based PPDU transmission. An AP can schedule in the same HE trigger-based PPDU transmission both Class A and Class B devices. A STA participating in HE trigger-based PPDU transmissions shall support power pre-correction described in 28.3.14.2 (Power pre-correction) and shall meet pre-correction accuracy requirements described in 28.3.14.3 (Pre-correction accuracy requirements).

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28.3.14.2 Power pre-correction

An AP indicates in the AP Tx Power subfield of the Common Info field in Trigger frame the combined transmit power of all the transmit antennas used to transmit the Trigger frame normalized to 20 MHz bandwidth. An AP indicates in the Target RSSI subfield of the User Info field in Trigger frame the target receive signal power averaged over the AP's antennas for the HE trigger-based PPDU.

Each STA that is scheduled in the Trigger frame calculates UL transmit power, Tx_{pwr}^{STA}, of the HE trigger-based PPDU for the assigned MCS using Equation (28-118).

$$Tx_{pwr}^{STA} = PL_{DL} + \mathrm{Target}_{RSSI} \quad (28\text{-}118)$$

where PL_{DL} represents DL pathloss and $Target_{RSSI}$ represents target receive signal power averaged over the AP's antennas for the HE trigger-based PPDU. $Target_{RSSI}$ is dBm value of Target RSSI subfield of User Info field in Trigger frame, the encoding of which is specified in Table 9-25g (Target RSSI subfield encoding). Note that an encoded value of 127 in Target RSSI subfield indicates to the STA to transmit an HE trigger-based PPDU at its maximum transmit power for the assigned MCS.

Each STA computes PL_{DL} using Equation (28-119).

$$PL_{DL} = Tx_{pwr}^{AP} - DL_{RSSI} \quad (28\text{-}119)$$

where Tx_{pwr}^{AP} represents AP's combined transmit power of all the transmit antennas used to transmit the Trigger frame normalized to 20 MHz bandwidth and DL_{RSSI} represents measured received power from the legacy preamble portion of the Trigger frame at the STA, also normalized to 20 MHz bandwidth. Tx_{pwr}^{AP} is dBm value of AP Tx Power subfield of the Common Info field in Trigger frame, the encoding of which is specified in Table 9-25e (AP Tx Power subfield encoding). DL_{RSSI} is an average of the received power over the antennas on which the average PL_{DL} is being computed.

A STA that applies beamforming (BF) in the UL should take the BF gain into account when calculating the transmit power needed to meet the target RSSI.

The UL transmit power of HE trigger-based PPDU is further subject to a STA's minimum and maximum transmit power limit due to hardware capability, regulatory requirements and local maximum transmit power levels (see 11.8.5 (Specification of regulatory and local maximum transmit power levels)) as well as non-802.11 in-device coexistence requirements.

Each STA that is scheduled in the Trigger frame transmits UL Power headroom HR_{STA} in the HE trigger-based PPDU to assist in the AP's MCS selection. The UL power headroom for the assigned MCS is defined in Equation (28-120).

$$HR_{STA} = Tx_{pwr}^{Max} - Tx_{pwr}^{STA} \quad (28\text{-}120)$$

where Tx_{pwr}^{Max} and Tx_{pwr}^{STA} represent maximum UL transmit power of HE trigger-based PPDU for the assigned MCS and current UL transmit power of HE trigger-based PPDU for the assigned MCS, respectively. HR_{STA} is dB value of UL Headroom in HE trigger-based PPDU, the encoding of which is specified in 9.2.4.6.4.6 (UL power headroom). Note that the MSB bit of the UL Headroom subfield being set

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to 1 indicates that the STA is transmitting the HE trigger-based PPDU at its minimum Tx_{pwr}^{STA} for the assigned MCS.

28.3.14.3 Pre-correction accuracy requirements

A STA that transmits an HE trigger-based PPDU shall support per chain max(*P*–32, –10 dBm) as the minimum transmit power, with P the maximum power the STA can transmit at the antenna connector of that chain using MCS 0 while meeting the TX EVM and spectral mask requirements. A STA transmitting at and above the minimum power shall support the EVM requirements for MCS 7.

A STA that transmits an HE trigger-based PPDU shall support the absolute transmit power requirements and the RSSI measurement accuracy requirements defined in Table 28-40 (Transmit power and RSSI measurement accuracy). The absolute transmit power accuracy is applicable for the entire range of transmit

Table 28-40—Transmit power and RSSI measurement accuracy

Parameter	Minimum Requirement		Comments
	Class A	Class B	
Absolute transmit power accuracy	±3 dB	±9 dB	Accuracy of achieving a specified transmit power
RSSI measurement accuracy	±3 dB	±5 dB	The difference between the RSSI and the received power Requirements are valid from minimum Rx to maximum Rx input power
Relative transmit power accuracy	-	±3 dB	Accuracy of achieving a change in transmit power for consecutive HE trigger-based PPDU The relative transmit power accuracy is applicable only to Class B devices.

power that the STA is capable of. The RSSI accuracy requirements shall be applied to receive signal level range from −82 dBm to −20 dBm in 2.4 GHz and −82 dBm to −30 dBm in 5 GHz. The requirements are for nominal (room) temperature conditions. The RSSI shall be measured during the reception of the PHY legacy preamble

A STA that transmits an HE trigger-based PPDU shall pre-compensate for carrier frequency offset (CFO) error and symbol clock error. After compensation, the absolute value of residual CFO error with respect to the PPDU carrying the associated Trigger frame shall not exceed 350 Hz for data subcarriers when measured as the 10% point of CCDF of CFO errors in AWGN at a received power of −60 dBm in the primary 20 MHz. The residual CFO error measurement shall be made on the HE trigger-based PPDU following the HE-SIG-A field. The symbol clock error shall be pre-compensated by the same ppm amount as CFO error.

A STA that transmits an HE trigger-based PPDU shall have timing accuracy of ±0.4 μs relative to the actual ending time of the PPDU carrying the Trigger frame. This requirement does not include round trip delay.

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28.3.15 SU-MIMO and DL MU-MIMO beamforming

28.3.15.1 General

For SU-MIMO and DL MU-MIMO beamforming in RU *r*, the receive signal vector in subcarrier *k* (where subcarrier *k* is one of the subcarriers in RU *r*, $k \in K_r$) at beamformee *u*, $\boldsymbol{y}_{k,u} = [y_{k,0}, y_{k,1}, \ldots, y_{k,N_{RX_u}-1}]^T$, is shown in Equation (28-121), where $\boldsymbol{x}_k = [\boldsymbol{x}_{k,0}^T, \boldsymbol{x}_{k,1}^T, \ldots, \boldsymbol{x}_{k,N_{user,r}-1}^T]^T$ denotes the transmit signal vector in subcarrier *k* for all N_{user} beamformees, with $\boldsymbol{x}_{k,u} = [x_{k,0}, x_{k,1}, \ldots, x_{k,N_{STS,r,u}-1}]^T$ being the transmit signal for beamformee *u*.

$$\boldsymbol{y}_{k,u} = \boldsymbol{H}_{k,u} \times [Q_{k,0}, Q_{k,1}, \ldots, Q_{k,N_{user}-1}] \times \boldsymbol{x}_k + \boldsymbol{n} \quad (28\text{-}121)$$

where

$\boldsymbol{H}_{k,u}$ is the channel matrix from the beamformer to beamformee *u* in subcarrier *k* with dimensions $N_{RX_u} \times N_{TX}$

N_{RX_u} is the number of receive antennas at beamformee *u*

$Q_{k,u}$ is a steering matrix for beamformee *u* in subcarrier *k* with dimensions $N_{TX} \times N_{STS,r,u}$

$N_{user,r}$ is the number of HE MU PPDU recipients (see Table 28-12 (Frequently used parameters)) in RU *r*

$\boldsymbol{n}$ is a vector of additive noise and may include interference

The DL MU-MIMO steering matrix $Q_k = [Q_{k,0}, Q_{k,1}, \ldots, Q_{k,N_{user,r}-1}]$ can be determined by the beamformer using the beamforming feedback for subcarrier *k* from beamformee *u*, where $u = 0, 1, \ldots, N_{user,r} - 1$. The feedback report format is described in 9.4.1.63 (HE Compressed Beamforming Report field) and 9.4.1.64 (HE MU Exclusive Beamforming Report field). The steering matrix that is computed (or updated) using new beamforming feedback from some or all of participating beamformees might replace the existing steering matrix Q_k for the next DL MU-MIMO data transmission.

For SU-MIMO beamforming, the steering matrix Q_k can be determined from the beamforming feedback matrix V_k that is sent back to the beamformer by the beamformee using the compressed beamforming feedback matrix format as defined in 19.3.12.3.6 (Compressed beamforming feedback matrix). The feedback report format is described in 9.4.1.63 (HE Compressed Beamforming Report field).

28.3.15.2 Beamforming feedback matrix *V*

Upon receipt of an HE NDP PPDU, the beamformee computes a set of matrices for feedback to the beamformer as described in 21.3.11.2 (Beamforming Feedback Matrix V). The eligible beamformees shall remove the space-time stream CSD in Table 21-11 (Cyclic shift values for the VHT modulated fields of a PPDU) from the measured channel before computing a set of matrices for feedback to the beamformer.

The beamforming feedback matrix, $V_{k,u}$, found by the beamformee *u* for subcarrier *k* in RU *r* shall be compressed in the form of angles using the method described in 19.3.12.3.6 (Compressed beamforming feedback matrix). The angles, $\phi(k,v)$ and $\psi(k,u)$, are quantized according to Table 9-68 (Quantization of angles). The number of bits for quantization is set by the beamformer, i.e., HE AP. The number of bits for quantization, tone grouping factor, and the number of columns in the HE Compressed beamforming feedback are set by the beamformee, i.e., non-AP STA, only if the NDP Announcement frame contains only

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one STA Info field. The compressed beamforming feedback matrix as defined in 19.3.12.3.6 (Compressed beamforming feedback matrix) is the only Clause 28 beamforming feedback matrix defined.

The beamformee shall generate the beamforming feedback matrices with the number of rows (Nr) equal to the N_{STS} of the NDP.

After receiving the angle information, $\phi(k,v)$ and $\psi(k,u)$, the beamformer reconstructs $V_{k,u}$ using Equation (19-79). For SU-MIMO beamforming, the beamformer uses $V_{k,0}$, matrix to determine the steering matrix Q_k. For MU-MIMO beamforming, the beamformer may calculate a steering matrix $Q_k = [Q_{k,0}, Q_{k,1}, \ldots, Q_{k,N_{user,r}-1}]$ using $V_{k,u}$ and $SNR_{k,u}$ ($0 \le u \le N_{user,r}-1$) in order to suppress crosstalk between participating beamformees. The method used by the beamformer to calculate the steering matrix Q_k is implementation specific.

28.3.15.3 CQI-only feedback

Whenever the HE NDP Announcement frame is requesting a CQI-only feedback, upon receipt of the HE NDP, the beamformee computes HE CQI-only feedback as described in 9.4.1.64. The CQI-only feedback $CQI_{s,r,u}$, in RU r for space time stream s shall be estimated using the method described in 9.4.1.65 (HE CQI-only Report field). The CQI values to be fed back are derived from quantized SNRs according to Table 9-76h (Average SNR of RU index k for space-time stream i subfield). The beamformee shall transmit the HE CQI-only feedback for space-time stream 1, …, Nc for each of the RU indices for which the CQI-only report is being requested by the beamformer. After receiving the CQI information, the beamformer may use it to identify the best range of RUs for compressed beamforming feedback or for RU assignment during subsequent MU transmissions. The actual use is implementation specific.

28.3.16 HE preamble format for sounding PPDUs

NDP is the only HE sounding format.

The format of an HE NDP PPDU is shown in Figure 28-36 (HE NDP PPDU format).

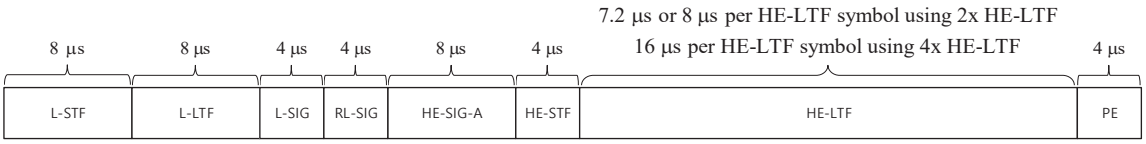

Figure 28-36—HE NDP PPDU format

NOTE—The number of HE-LTF symbols in the HE NDP is determined by the Nsts field in HE SIG-A.

The HE NDP PPDU has the following properties:

— Uses the HE SU PPDU format but without the Data field

— Has a Packet Extension field that is 4 us in duration

28.3.17 Receiver specification

28.3.17.1 General

For tests in this subclause, the input levels are measured at the antenna connectors and are referenced as the average power per receive antenna. The number of spatial streams under test shall be equal to the number of utilized transmitting STA antenna (output) ports and also equal to the number of utilized Device Under Test

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input ports. Each output port of the transmitting STA shall be connected through a cable to one input port of the Device Under Test.

28.3.17.2 Receiver minimum input sensitivity

The packet error rate (PER) shall be less than 10% for a PSDU with the rate-dependent input levels listed in Table 28-41 (Receiver minimum input level sensitivity). The PSDU length shall be 2048 octets for BPSK modulation with DCM or 4096 octets for all other modulations. The test in this subclause and the minimum sensitivity levels specified in Table 28-41 (Receiver minimum input level sensitivity) apply only to non-STBC modes, 800 ns GI, BCC for 20 MHz bandwidth and LDPC for bandwidth greater than 20 MHz, and HE SU PPDUs.

Table 28-41—Receiver minimum input level sensitivity

Modulation		Rate (R)	Minimum sensitivity (20 MHz PPDU) (dBm)	Minimum sensitivity (40 MHz PPDU) (dBm)	Minimum sensitivity (80 MHz PPDU) (dBm)	Minimum sensitivity (160 MHz or 80+80 MHz PPDU) (dBm)
Without DCM	With DCM					
N/A	BPSK	1/2	–82	–79	–76	–73
BPSK	QPSK	1/2	–82	–79	–76	–73
QPSK	16-QAM	1/2	–79	–76	–73	–70
QPSK	16-QAM	3/4	–77	–74	–71	–68
16-QAM	N/A	1/2	–74	–71	–68	–65
16-QAM	N/A	3/4	–70	–67	–64	–61
64-QAM	N/A	2/3	–66	–63	–60	–57
64-QAM	N/A	3/4	–65	–62	–59	–56
64-QAM	N/A	5/6	–64	–61	–58	–55
256-QAM	N/A	3/4	–59	–56	–53	–50
256-QAM	N/A	5/6	–57	–54	–51	–48
1024-QAM	N/A	3/4	–54	–51	–48	–45
1024-QAM	N/A	5/6	–52	–49	–46	–43

28.3.17.3 Adjacent channel rejection

Adjacent channel rejection for *W* MHz (where *W* is 20, 40, 80, or 160) shall be measured by setting the desired signal's strength 3 dB above the rate-dependent sensitivity specified in Table 28-41 (Receiver minimum input level sensitivity) and raising the power of the interfering signal of W MHz bandwidth until 10% PER is caused for a PSDU length of 2048 octets for BPSK modulation with DCM or 4096 octets for all other modulations. The difference in power between the signals in the interfering channel and the desired channel is the corresponding adjacent channel rejection. The center frequency of the adjacent channel shall be placed *W* MHz away from the center frequency of the desired signal.

Adjacent channel rejection for 80+80 MHz channels shall be measured by setting the desired signal's strength 3 dB above the rate-dependent sensitivity specified in Table xx-a (Receiver minimum input level

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sensitivity). Then, an interfering signal of 80 MHz bandwidth is introduced, where the center frequency of the interfering signal is placed 80 MHz away from the center frequency of the frequency segment lower in the frequency of the desired signal. The power of interfering signal is raised until 10% PER is caused for a PSDU length of 2048 octets for BPSK modulation with DCM or 4096 octets for all other modulations. Let ΔP_1 be the difference between the interfering and desired signal. Next, the interfering signal of 80 MHz bandwidth is moved to the frequency where the center frequency of the interfering signal is 80 MHz away from the center frequency of the frequency segment higher in frequency of the desired signal. The power of the interfering is raised until 10% PER is caused for a PSDU length of 2048 octets for BPSK modulation with DCM or 4096 octets for all other modulations. Let ΔP_2 be the power difference between the interfering and desired signal. The smaller value between ΔP_1 and ΔP_2 is the corresponding adjacent channel rejection.

The interfering signal in the adjacent channel shall be a signal compliant with the HE PHY, unsynchronized with the signal in the channel under test, and shall have a minimum duty cycle of 50%. The corresponding rejection shall be no less than specified in Table 28-42 (Minimum required adjacent and nonadjacent channel rejection levels).

The test in this subclause and the adjacent sensitivity levels specified in Table 28-42 (Minimum required adjacent and nonadjacent channel rejection levels) apply only to non-STBC modes, 800 ns GI, BCC for 20 MHz bandwidth and LDPC for greater than 20 MHz bandwidth, and HE SU PPDUs.

Table 28-42—Minimum required adjacent and nonadjacent channel rejection levels

Modulation		Rate (R)	Adjacent channel rejection (dB)		Nonadjacent channel rejection (dB)	
Without DCM	With DCM		20/40/80/ 160 MHz Channel	80+80 MHz Channel	20/40/80/ 160 MHz Channel	80+80 MHz Channel
N/A	BPSK	1/2	16	13	32	29
BPSK	QPSK	1/2	16	13	32	29
QPSK	16-QAM	1/2	13	10	29	26
QPSK	16-QAM	3/4	11	8	27	24
16-QAM	N/A	1/2	8	5	24	21
16-QAM	N/A	3/4	4	1	20	17
64-QAM	N/A	2/3	0	–3	16	13
64-QAM	N/A	3/4	–1	–4	15	12
64-QAM	N/A	5/6	–2	–5	14	11
256-QAM	N/A	3/4	–7	–10	9	6
256-QAM	N/A	5/6	–9	–12	7	4
1024-QAM	N/A	3/4	–12	–15	4	1
1024-QAM	N/A	5/6	–14	–17	2	–1

The measurement of adjacent channel rejection for 160 MHz operation in regulatory domain is required only if such a frequency band plan is permitted in the regulatory domain.

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28.3.17.4 Nonadjacent channel rejection

Nonadjacent channel rejection for *W* MHz channels (where *W* is 20, 40, 80, or 160) shall be measured by setting the desired signal's strength 3 dB above the rate-dependent sensitivity specified in Table 28-41 (Receiver minimum input level sensitivity), and raising the power of the interfering signal of *W* MHz bandwidth until a 10% PER occurs for a PSDU length of 2048 octets for BPSK modulation with DCM or 4096 octets for all other modulations. The difference in power between the signals in the interfering channel and the desired channel is the corresponding nonadjacent channel rejection. The nonadjacent channel rejection shall be met with any nonadjacent channels located at least 2×W MHz away from the center frequency of the desired signal.

Nonadjacent channel rejection for 80+80 MHz channels shall be measured by setting the desired signal's strength 3 dB above the rate-dependent sensitivity specified in Table 28-41 (Receiver minimum input level sensitivity). Then, an interfering signal of 80 MHz bandwidth is introduced, where the center frequency of the interfering signal is placed at least 160 MHz away from the center frequency of the frequency segment lower in the frequency of the desired signal. The center frequency of the interfering signal shall also be at least 160 MHz away from the center frequency of the frequency segment higher in frequency of the desired signal. The power of interfering signal is raised until 10% PER is caused for a PSDU length of 2048 octets for BPSK modulation with DCM or 4096 octets for all other modulations. Let ΔP_1 be the difference between the interfering and desired signal. Next, the interfering signal of 80 MHz bandwidth is moved to the frequency where the center frequency of the interfering signal is at least 160 MHz away from the center frequency of the frequency segment higher in frequency of the desired signal. The center frequency of the interfering signal shall also be at least 160 MHz away from the center frequency of the frequency segment lower in frequency of the desired signal. The power of the interfering is raised until 10% PER is caused for a PSDU length of 2048 octets for BPSK modulation with DCM or 4096 octets for all other modulations. Let ΔP_2 be the power difference between the interfering and desired signal. The smaller value between ΔP_1 and ΔP_2 is the corresponding nonadjacent channel rejection.

The interfering signal in the nonadjacent channel shall be a signal compliant with the HE PHY, unsynchronized with the signal in the channel under test, and shall have a minimum duty cycle of 50%. The corresponding rejection shall be no less than specified in Table 28-42 (Minimum required adjacent and nonadjacent channel rejection levels).

The test in this subclause and the nonadjacent sensitivity levels specified in Table 28-42 (Minimum required adjacent and nonadjacent channel rejection levels) apply only to non-STBC modes, 800 ns GI, BCC for 20 MHz bandwidth and LDPC for greater than 20 MHz bandwidth, and HE SU PPDUs.

The measurement of nonadjacent channel rejection for 160 MHz operation in regulatory domain is required only if such a frequency band plan is permitted in the regulatory domain.

28.3.17.5 Receiver maximum input level

The receiver shall provide a maximum PER of 10% at a PSDU length of 2048 octets for BPSK modulation with DCM or 4096 octets for all other modulations, for a maximum input level of –30 dBm in 5 GHz band and –20 dBm in 2.4 GHz band, measured at each antenna for any baseband HE modulation.

28.3.17.6 CCA sensitivity

28.3.17.6.1 General

The thresholds in this subclause are compared with the signal level at each receiving antenna.

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28.3.17.6.2 CCA sensitivity for operating classes requiring CCA-ED

For the operating classes requiring CCA-Energy Detect (CCA-ED), the PHY shall also indicate a medium busy condition when CCA-ED detects a channel busy condition. For improved spectrum sharing, CCA-ED is required in some bands. The behavior class indicating CCA-ED is given in Table D-2 (Behavior limits). The operating classes requiring the corresponding CCA-ED behavior class are given in E.1 (Country information and operating classes). The PHY of a STA that is operating within an operating class that requires CCA-ED shall operate with CCA-ED. CCA-ED shall detect a channel busy condition when the received signal strength exceeds the CCA-ED threshold as given by dot11OFDMEDThreshold for the primary 20 MHz channel, dot11OFDMEDThreshold for the secondary 20 MHz channel (if present), dot11OFDMEDThreshold +3 dB for the secondary 40 MHz channel (if present), and dot11OFDMEDThreshold + 6 dB for the secondary 80 MHz channel (if present). The CCA-ED thresholds for the operating classes requiring CCA-ED are subject to the criteria in D.2.5 (CCA-ED threshold).

NOTE—The requirement to detect a channel busy condition as stated in 21.3.18.5.3 (CCA sensitivity for signals occupying the primary 20 MHz channel) and 21.3.18.5.4 (CCA sensitivity for signals not occupying the primary 20 MHz channel) is a mandatory energy detect requirement on all Clause 21 (Very High Throughput (VHT) PHY specification) receivers. Support for CCA-ED is an additional requirement that relates specifically to the sensitivities described in D.2.5 (CCA-ED threshold).

28.3.17.6.3 CCA sensitivity for signals occupying the primary 20 MHz channel

The PHY shall issue a PHY-CCA.indication(BUSY, {primary}) primitive if one of the conditions listed in Table 28-43 (Conditions for CCA BUSY on the primary 20 MHz) is met in an otherwise idle 20 MHz, 40 MHz, 80 MHz, 160 MHz, or 80+80 MHz operating channel width. With >90% probability, the PHY shall detect the start of a PPDU that occupies at least the primary 20 MHz channel under the conditions listed in Table 28-43 (Conditions for CCA BUSY on the primary 20 MHz) within a period of aCCATime (see 21.4.4 (VHT PHY)) and hold the CCA signal busy (PHY-CCA.indication(BUSY, channel-list) primitive) for the duration of the PPDU, unless it receives a CCARESET.request primitive before the end of the PPDU for instance during spatial reuse operation as described in 27.9 (Spatial reuse operation).

Table 28-43—Conditions for CCA BUSY on the primary 20 MHz

Operating Channel Width	Conditions
20 MHz, 40 MHz, 80 MHz, 160 MHz, or 80+80 MHz	The start of a 20 MHz NON_HT PPDU in the primary 20 MHz channel as defined in 17.3.10.6 (CCA requirements). The start of an HT PPDU under the conditions defined in 19.3.19.5 (CCA sensitivity). The start of a 20 MHz VHT PPDU in the primary 20 MHz channel at or above –82 dBm. The start of a 20 MHz HE PPDU in the primary 20 MHz channel at or above –82 dBm.
40 MHz, 80 MHz, 160 MHz, or 80+80 MHz	The start of a 40 MHz non-HT duplicate, VHT PPDU or HE PPDU in the primary 40 MHz channel at or above –79 dBm. The start of an HT PPDU under the conditions defined in 19.3.19.5 (CCA sensitivity).
80 MHz, 160 MHz, or 80+80 MHz	The start of an 80 MHz non-HT duplicate, VHT PPDU or HE PPDU in the primary 80 MHz channel at or above –76 dBm.
160 MHz or 80+80 MHz	The start of a 160 MHz or 80+80 MHz non-HT duplicate, VHT PPDU or HE PPDU at or above –73 dBm.

The receiver shall issue a PHY-CCA.indication(BUSY, {primary}) primitive for any signal that exceeds a threshold equal to 20 dB above the minimum modulation and coding rate sensitivity (–82 + 20 = –62 dBm)

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in the primary 20 MHz channel within a period of aCCATime after the signal arrives at the receiver's antenna(s); then the receiver shall not issue a PHY-CCA.indication(BUSY,{secondary}), PHYCCA.indication(BUSY,{secondary40}), PHY-CCA.indication(BUSY,{secondary80}), or PHYCCA.indication(IDLE) primitive while the threshold continues to be exceeded.

28.3.17.6.4 CCA sensitivity for signals not occupying the primary 20 MHz channel

The PHY shall issue a PHY-CCA.indication(BUSY, {secondary}) primitive if the conditions for issuing PHY-CCA.indication(BUSY, {primary}) primitive are not present and one of the following conditions are present in an otherwise idle 40 MHz, 80 MHz, 160 MHz, or 80+80 MHz operating channel width:

— Any signal within the secondary 20 MHz channel at or above a threshold of –62 dBm within a period of aCCATime after the signal arrives at the receiver's antenna(s); then the PHY shall not issue a PHY-CCA.indication(BUSY,{secondary40}), PHY-CCA.indication(BUSY,{secondary80}), or PHY-CCA.indication(IDLE) primitive while the threshold continues to be exceeded.

— A 20 MHz NON_HT, HT_MF, HT_GF, VHT PPDU or HE PPDU detected in the secondary 20 MHz channel at or above max(–72 dBm, OBSS_PD) with >90% probability within a period aCCAMidTime (see 28.4.3 (HE PHY)).

The PHY shall issue a PHY-CCA.indication(BUSY, {secondary40}) primitive if the conditions for issuing a PHY-CCA.indication(BUSY, {primary}) and PHY-CCA.indication(BUSY, {secondary}) primitive are not present and one of the following conditions are present in an otherwise idle 80 MHz, 160 MHz, or 80+80 MHz operating channel width:

— Any signal within the secondary 40 MHz channel at or above a threshold of –59 dBm within a period of aCCATime after the signal arrives at the receiver's antenna(s); then the PHY shall not issue a PHY-CCA.indication(BUSY, {secondary80}) primitive or PHY-CCA.indication(IDLE) primitive while the threshold continues to be exceeded.

— A 40 MHz non-HT duplicate, HT_MF, HT_GF, VHT PPDU or HE PPDU detected in the secondary 40 MHz channel at or above max(–72 dBm, OBSS_PD) with >90% probability within a period aCCAMidTime (see 28.4.3 (HE PHY)).

— A 20 MHz non-HT, HT_MF, HT_GF, VHT PPDU or HE PPDU detected in any 20 MHz sub-channel of the secondary 40 MHz channel at or above max(–72 dBm, OBSS_PD) with >90% probability within a period aCCAMidTime.

The PHY shall issue a PHY-CCA.indication(BUSY, {secondary80}) primitive if the conditions for PHYCCA.indication(BUSY, {primary}), PHY-CCA.indication(BUSY, {secondary}), and PHYCCA.indication(BUSY, {secondary40}) primitive are not present and one of the following conditions are present in an otherwise idle 160 MHz or 80+80 MHz operating channel width:

— Any signal within the secondary 80 MHz channel at or above –56 dBm.

— An 80 MHz non-HT duplicate, VHT PPDU or HE PPDU detected in the secondary 80 MHz channel at or above max(–69 dBm, OBSS_PD) with >90% probability within a period aCCAMidTime (see 28.4.3 (HE PHY)).

— A 40 MHz non-HT duplicate, HT_MF, HT_GF, VHT or HE PPDU detected in any 40 MHz sub-channel of the secondary 80 MHz channel at or above max(–72 dBm, OBSS_PD) with >90% probability within a period aCCAMidTime.

— A 20 MHz NON_HT, HT_MF, HT_GF, VHT or HE PPDU detected in any 20 MHz sub-channel of the secondary 80 MHz channel at or above max(–72 dBm, OBSS_PD) with >90% probability within a period aCCAMidTime.

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28.3.18 Transmit specification

28.3.18.1 Transmit spectral mask

The bandwidth of the spectral mask applied to an HE PPDU shall be determined by the bandwidth indicated in the Bandwidth subfield of the HE-SIG-A field. All HE PPDU formats shall be compliant with the transmit spectral mask described in this section.

NOTE 1—In the presence of additional regulatory restrictions, the device has to meet both the regulatory requirements and the mask defined in this subclause.

NOTE 2—Transmit spectral mask figures in this subclause are not drawn to scale.

NOTE 3—For rules regarding TX center frequency leakage levels, see 28.3.18.4.2 (Transmit center frequency leakage). The spectral mask requirements in this subclause do not apply to the RF LO.

For a 20 MHz mask PPDU of HE format, the interim transmit spectral mask shall have a 0 dBr (dB relative to the maximum spectral density of the signal) bandwidth of 19.5 MHz, −20 dBr at 10.25 MHz frequency offset, −28 dBr at 20 MHz frequency offset, and −40 dBr at 30 MHz frequency offset and above. The interim transmit spectral mask for frequency offsets in between 9.75 and 10.25 MHz, 10.25 and 20 MHz, and 20 and 30 MHz shall be linearly interpolated in dB domain from the requirements for 9.75 MHz, 10.25 MHz, 20 MHz, and 30 MHz frequency offsets. The transmit spectrum shall not exceed the maximum of the interim transmit spectral mask and −53 dBm/MHz at any frequency offset. Figure 28-37 (Example transmit spectral mask for a 20 MHz mask PPDU) shows an example of the resulting overall spectral mask when the −40 dBr spectrum level is above −53 dBm/MHz.

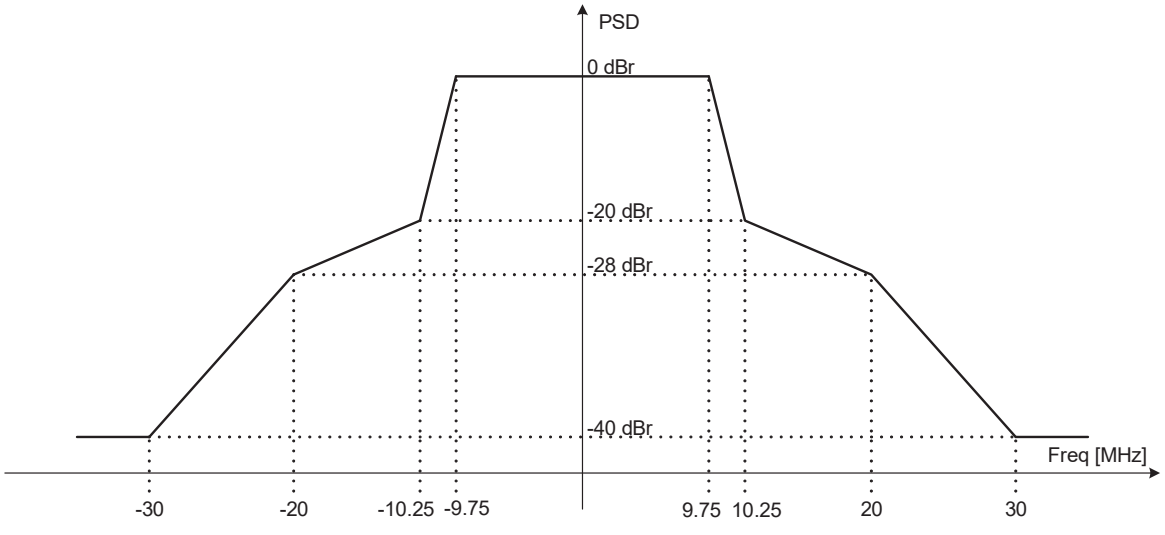

Figure 28-37—Example transmit spectral mask for a 20 MHz mask PPDU

For a 40 MHz mask PPDU of HE format, the interim transmit spectral mask shall have a 0 dBr (dB relative to the maximum spectral density of the signal) bandwidth of 39 MHz, −20 dBr at 20.5 MHz frequency offset, −28 dBr at 40 MHz frequency offset, and −40 dBr at 60 MHz frequency offset and above. The interim transmit spectral mask for frequency offsets in between 19.5 and 20.5 MHz, 20.5 and 40 MHz, and 40 and 60 MHz shall be linearly interpolated in dB domain from the requirements for 19.5 MHz, 20.5 MHz, 40 MHz, and 60 MHz frequency offsets. The transmit spectrum shall not exceed the maximum of the interim transmit spectral mask and −56 dBm/MHz at any frequency offset greater than 19.5 MHz. Figure 28-38

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(Example transmit spectral mask for a 40 MHz mask PPDU) shows an example of the resulting overall spectral mask when the –40 dBr spectrum level is above –56 dBm/MHz.

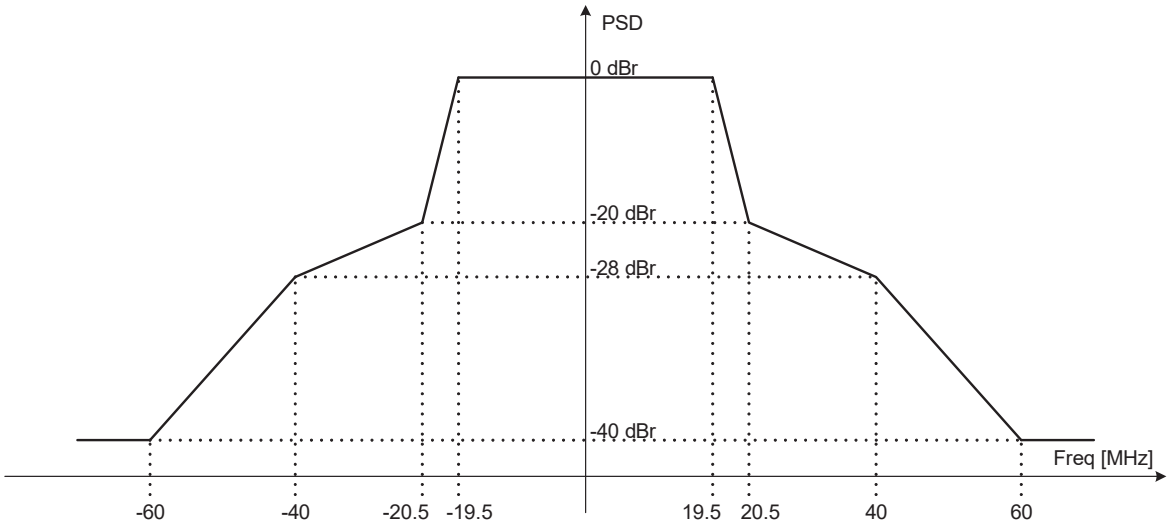

Figure 28-38—Example transmit spectral mask for a 40 MHz mask PPDU

For an 80 MHz mask PPDU of HE format, the interim transmit spectral mask shall have a 0 dBr (dB relative to the maximum spectral density of the signal) bandwidth of 79 MHz, –20 dBr at 40.5 MHz frequency offset, –28 dBr at 80 MHz frequency offset, and –40 dBr at 120 MHz frequency offset and above. The interim transmit spectral mask for frequency offsets in between 39.5 and 40.5 MHz, 40.5 and 80 MHz, and 80 and 120 MHz shall be linearly interpolated in dB domain from the requirements for 39.5 MHz, 40.5 MHz, 80 MHz, and 120 MHz frequency offsets. The transmit spectrum shall not exceed the maximum of the interim transmit spectrum mask and –59 dBm/MHz at any frequency offset. Figure 28-39 (Example transmit spectral mask for a 80 MHz mask PPDU) shows an example of the resulting overall spectral mask when the –40 dBr spectrum level is above –59 dBm/MHz.

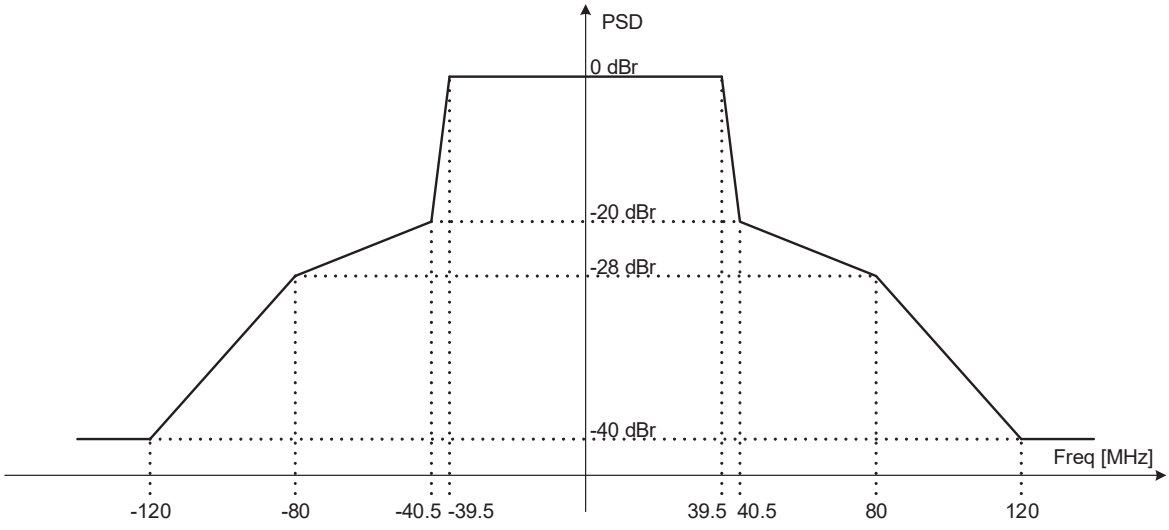

Figure 28-39—Example transmit spectral mask for a 80 MHz mask PPDU

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For a 160 MHz mask PPDU of HE format, the interim transmit spectral mask shall have a 0 dBr (dB relative to the maximum spectral density of the signal) bandwidth of 159 MHz, −20 dBr at 80.5 MHz frequency offset, −28 dBr at 160 MHz frequency offset, and −40 dBr at 240 MHz frequency offset and above. The interim transmit spectral mask for frequency offsets in between 79.5 and 80.5 MHz, 80.5 and 160 MHz, and 160 and 240 MHz shall be linearly interpolated in dB domain from the requirements for 79.5 MHz, 80.5 MHz, 160 MHz, and 240 MHz frequency offsets. The transmit spectrum shall not exceed the maximum of the interim transmit spectrum mask and −59 dBm/MHz at any frequency offset. Figure 28-40 (Example transmit spectral mask for a 160 MHz mask PPDU) shows an example of the resulting overall spectral mask when the −40 dBr spectrum level is above −59 dBm/MHz.

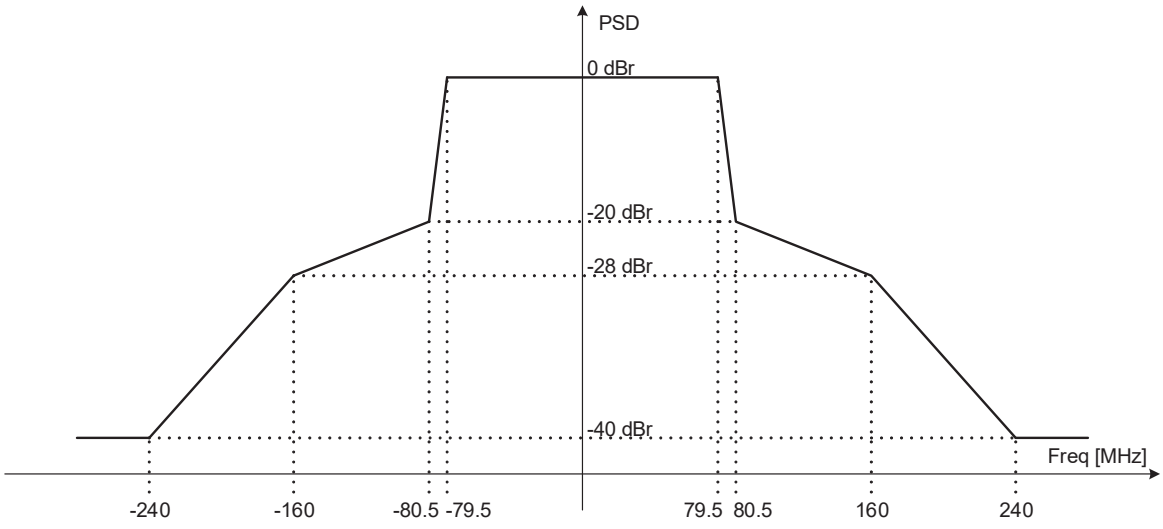

Figure 28-40—Example transmit spectral mask for a 160 MHz mask PPDU

For an 80+80 MHz mask PPDU of HE format, the overall transmit spectral mask is constructed in the following manner. First, the 80 MHz interim spectral mask is placed on each of the two 80 MHz segments. Then, for each frequency at which both of the 80 MHz interim spectral masks have values greater than −40 dBr and less than −20 dBr, the sum of the two interim mask values (summed in linear domain) shall be taken as the overall spectral mask value. Next, for each frequency at which neither of the two 80 MHz interim masks have values greater than or equal to −20 dBr and less than or equal to 0 dBr, the higher value of the two interim masks shall be taken as the overall interim spectral value. Finally, for any frequency region where the mask value has not been defined yet, linear interpolation (in dB domain) between the nearest two frequency points with the interim spectral mask value defined shall be used to define the interim spectral mask value. The transmit spectrum shall not exceed the maximum of the interim transmit spectrum mask and −59 dBm/MHz at any frequency offset. Figure 28-41 (Example transmit spectral mask for a 80+80 MHz mask PPDU) shows an example of a transmit spectral mask for a noncontiguous transmission using

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two 80 MHz channels where the center frequency of the two 80 MHz channels are separated by 160 MHz and the −40 dBr spectrum level is above −59 dBm/MHz.

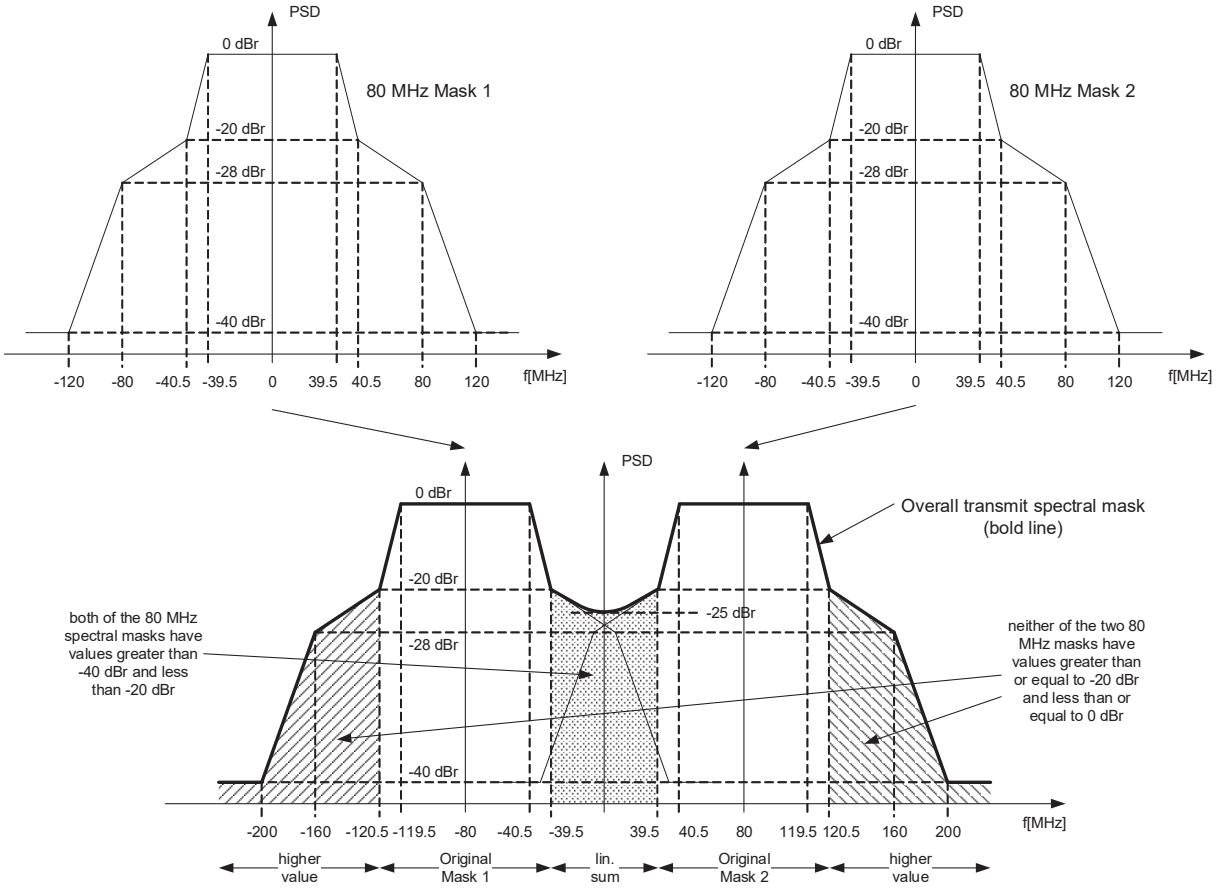

Figure 28-41—Example transmit spectral mask for a 80+80 MHz mask PPDU

Different center frequency separation between the two 80 MHz frequency segments of the spectral mask as well as different peak levels of each 80 MHz frequency segment of the spectral mask are possible, in which case a similar procedure in determining the spectral mask as in Figure 28-41 (Example transmit spectral mask for a 80+80 MHz mask PPDU) is followed.

The transmit spectral mask for noncontiguous transmissions using two nonadjacent 80 MHz channels is applicable only in regulatory domains that allow for such transmissions.

Measurements shall be made using a 25 kHz resolution bandwidth and a 7.5 kHz video bandwidth.

When channel puncturing happens in an HE MU PPDU, the HE MU PPDU is still treated as an 80 MHz or 160 MHz (80+80 MHz) PPDU, therefore the spectral mask is the same as those defined for the total channel width.

28.3.18.2 Spectral flatness

Spectral flatness measurements shall be conducted using BPSK modulated HE PPDUs. Demodulate the HE PPDUs according to the following (or equivalent) procedure:

a) Start of PPDU shall be detected.

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b) Transition from L-STF to L-LTF shall be detected and fine timing shall be established.

c) Coarse and fine frequency offsets shall be estimated.

d) Symbols in a PPDU shall be manipulated to account for both frequency error and sampling offset drift.

e) For each HE-LTF symbol, transform the symbol into subcarrier received values, estimate the phase from the pilot subcarriers, and compensate the subcarrier values according to the estimated phase.

f) For each of the data OFDM symbols: transform the symbol into subcarrier received values.

The spectral flatness test shall be performed over at least 20 HE PPDUs. The PPDUs under test shall be at least 16 data OFDM symbols long.

Evaluate spectral flatness using the subcarrier received values or the magnitude of the channel estimation of the occupied subcarriers of the transmission HE PPDUs. Non-occupied subcarriers of the transmitted HE PPDUs shall be ignored during averaging and testing. Resource unit power boosting and beamforming should not be used when measuring spectral flatness.

Let $E_{i,avg}$ denote the magnitude of the channel estimation on subcarrier i or the average constellation energy of a BPSK modulated subcarrier i in an HE data symbol. In a contiguous HE transmission having a bandwidth listed in Table 28-44 (Maximum transmit spectral flatness deviations), $E_{i,avg}$ of each of the subcarriers with indices listed as tested subcarrier indices shall not deviate by more than the specified maximum deviation in Table 28-44 (Maximum transmit spectral flatness deviations) from the average of $E_{i,avg}$ over subcarrier indices listed as averaging subcarrier indices. Averaging of $E_{i,avg}$ is done in the linear domain.

Table 28-44—Maximum transmit spectral flatness deviations

Bandwidth of transmission (MHz)	Averaging subcarrier indices (inclusive)	Tested subcarrier indices (inclusive)	Maximum deviation (dB)
20	–84 to –2 and +2 to +84	–84 to –2 and +2 to +84	±4
		–122 to –85 and +85 to +122	+4/–6
40	–168 to –3 and +3 to +168	–168 to –3 and +3 to +168	±4
		–244 to –169 and +169 to +244	+4/–6
80	–344 to –3 and +3 to +3441	–344 to –3 and +3 to +344	±4
		–500 to –345 and +345 to +500	+4/–6
160	–696 to –515, –509 to –166, +166 to +509, and +515 to +696	–696 to –515, –509 to –166, +166 to +509, and +515 to +696	±4
		–1012 to –697, –165 to –12, +12 to +165, and +697 to +1012	+4/–6

In an 80+80 MHz transmission, each segment shall meet the spectral flatness requirement for an 80 MHz transmission.

For the spectral flatness test, the transmitting STA shall be configured to use a spatial mapping matrix Q_k (see 28.3.11.14 (OFDM modulation)) with flat frequency response. Each output port under test of the transmitting STA shall be connected through a cable to one input port of the testing instrumentation. The

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requirements apply to 20 MHz, 40 MHz, 80 MHz, and 160 MHz contiguous transmissions as well as 80+80 MHz transmissions.

28.3.18.3 Transmit center frequency and symbol clock frequency tolerance

Transmit center frequency and the symbol clock frequency for all transmit antennas and frequency segments shall be derived from the same reference oscillator. The symbol clock frequency and transmit center frequency maximum tolerance shall be ±20 ppm. HE trigger-based PPDU format is subject to additional requirements as defined in 28.3.14 (Transmit requirements for an HE trigger-based PPDU).

28.3.18.4 Modulation accuracy

28.3.18.4.1 Introduction to modulation accuracy tests

Transmit modulation accuracy specifications are described in 28.3.18.4.2 (Transmit center frequency leakage) and 28.3.18.4.3 (Transmitter constellation error). The test method is described in 28.3.18.4.4 (Transmitter modulation accuracy (EVM) test).

28.3.18.4.2 Transmit center frequency leakage

The TX LO leakage requirement for all transmission modes shall be the following. The power measured at the location of the RF LO using resolution BW 78.125 kHz shall not exceed the maximum of –32 dB relative to the total transmit power and –20 dBm, or equivalently max(P–32, –20), where P is the transmit power per antenna in dBm. The transmit center frequency leakage is specified per antenna.

For an 80+80 MHz transmission where the RF LO falls outside both frequency segments, the RF LO shall additionally met the spectral mask requirements as defined in 28.3.18.1 (Transmit spectral mask).

28.3.18.4.3 Transmitter constellation error

The relative constellation RMS error, calculated by first averaging over subcarriers, frequency segments, HE PPDUs, and spatial streams (see Equation (28-122)) shall not exceed a data-rate dependent value according to Table 28-45 (Allowed relative constellation error versus constellation size and coding rate). The number of spatial streams under test shall be equal to the number of utilized transmitting STA antenna (output) ports and also equal to the number of utilized testing instrumentation input ports. In the test, $N_{SS} = N_{STS}$ (no STBC) shall be used. Each output port of the transmitting STA shall be connected through a cable to one input port of the testing instrumentation. The requirements apply to 20 MHz, 40 MHz, 80 MHz, and 160 MHz contiguous transmissions as well as 80+80 MHz noncontiguous transmissions.

28.3.18.4.4 Transmitter modulation accuracy (EVM) test

The transmit modulation accuracy test shall be performed by instrumentation capable of converting the transmitted signals into a stream of complex samples at sampling rate greater than or equal to the bandwidth of the signal being transmitted except that for a noncontiguous transmissions each frequency segment may be tested independently.

In this case, transmit modulation accuracy of each segment shall meet the required value in Table 28-45 (Allowed relative constellation error versus constellation size and coding rate) using only the occupied data subcarriers within the corresponding segment.

LO leakage that can potentially show up in center frequency of the HE PPDU tone plan and its ±3 tone neighbors shall be excluded from the computation of the transmitter modulation accuracy test. The potential LO leakage tones for 20 MHz operating devices are the center of primary 20 MHz of the HE PPDU tone plan and ±3 tones. The potential LO leakage tones for 40MHz operating devices are the center of the

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Table 28-45—Allowed relative constellation error versus constellation size and coding rate

Modulation		Coding rate	Relative constellation error in an HE SU PPDU, HE extended rate SU PPDU and HE MU PPDU (dB)	Relative constellation error in an HE trigger-based PPDU (dB)	Relative constellation error in HE trigger-based PPDU when transmit power is less than or equal to the maximum power of MCS7 (dB)
Without DCM	With DCM				
N/A	BPSK	1/2	–5	–13	–27
BPSK	QPSK	1/2	–5	–13	–27
QPSK	16-QAM	1/2	–10	–13	–27
QPSK	16-QAM	3/4	–13	–13	–27
16-QAM	N/A	1/2	–16	–16	–27
16-QAM	N/A	3/4	–19	–19	–27
64-QAM	N/A	2/3	–22	–22	–27
64-QAM	N/A	3/4	–25	–25	–27
64-QAM	N/A	5/6	–27	–27	–27
256-QAM	N/A	3/4	–30	–30	–30
256-QAM	N/A	5/6	–32	–32	–32
1024-QAM	N/A	3/4	–35	–35	–35
1024-QAM	N/A	5/6	–35	–35	–35

NOTE—The maximum power of MCS7 can be measured by setting the Target RSSI subfield as defined in Table 9-25g (Target RSSI subfield encoding) in the Trigger frame to 127 for the same data-carrying subcarriers which EVM test is conducted.

primary 40 MHz of the PPDU tone plan and ±3 tones. For 80 MHz capable devices that transmits 20 MHz or 40 MHz PPDU, the potential LO leakage tone exist outside the PPDU bandwidth and should not affect the transmitter modulation accuracy test.

The instrument shall have sufficient accuracy in terms of I/Q branch amplitude and phase balance, DC offsets, phase noise, and analog to digital quantization noise. A possible embodiment of such a setup is converting the signals to a low IF frequency with a microwave synthesizer, sampling the signal with a digital oscilloscope and decomposing it digitally into quadrature components. The sampled signal shall be processed in a manner similar to an actual receiver, according to the following steps, or equivalent procedure:

a) Start of PPDU shall be detected.

b) Transition from L-STF to L-LTF shall be detected and fine timing shall be established.

c) Coarse and fine frequency offsets shall be estimated.

d) Symbols in a PPDU shall be derotated according to estimated frequency offset. Sampling offset drift shall be also compensated. Note that amplitude drift shall not be compensated by the testing instrument.

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e) For each HE-LTF symbol, transform the symbol into subcarrier received values, estimate the phase from the pilot subcarriers, and derotate the subcarrier values according to the estimated phase.

f) Estimate the complex channel response coefficient for each of the subcarriers and each of the transmit streams.

g) For each of the data OFDM symbols: transform the symbol into subcarrier received values, estimate the phase from the pilot subcarriers, and compensate the subcarrier values according to the estimated phase, group the results from all of the receiver chains in each subcarrier to a vector, and multiply the vector by a zero-forcing equalization matrix generated from the estimated channel.

h) For each data-carrying subcarrier in each spatial stream of RU under test, find the closest constellation point and compute the Euclidean distance from it.

i) Compute the average across PPDUs of the RMS of all errors per PPDU as given by Equation (28-122).

$$Error_{RMS} = \frac{1}{N_f}\sum_{i_f=1}^{N_f}\sqrt{\frac{\sum_{i_s=1}^{N_{SYM}}\sum_{i_{ss}=1}^{N_{SS}}\sum_{i_{sc}=1}^{N_{ST}}\left(I_e(i_f, i_s, i_{ss}, i_{sc}) - I_0(i_f, i_s, i_{ss}, i_{sc})\right)^2 + \left(Q_e(i_f, i_s, i_{ss}, i_{sc}) - Q_0(i_f, i_s, i_{ss}, i_{sc})\right)^2}{N_{SYM}N_{SS}N_{ST}P_0}} \quad (28\text{-}122)$$

where

$I_0(i_f, i_s, i_{ss}, i_{sc})$ $Q_0(i_f, i_s, i_{ss}, i_{sc})$ denotes the ideal symbol point in the complex plane in i_{sc}-th data tone of the RU under test, spatial stream i_{ss}, and the OFDM symbol of frame i_f.

$I_e(i_f, i_s, i_{ss}, i_{sc})$ $Q_e(i_f, i_s, i_{ss}, i_{sc})$ denotes the equalized observed symbol point in the complex plane of the i_{sc}-th data tone of the RU under test, spatial stream i_{ss}, and the OFDM symbol of frame i_f.

P_0 is the average power of constellation

N_f is the number of tested frames

N_{ST} is the number of data tones of the occupied RU

N_{SS} is the number of spatial streams of the data

N_{SYM} is the number of data OFDM symbols

NOTE 1—In the case the transmit modulation accuracy test is performed simultaneously for the two frequency segments of the 80+80 MHz transmissions with 2×996-subcarrier RU.

The test shall be performed over at least 20 PPDUs (N_f as defined in Equation (28-122)). When the occupied RU has 26 tones, the PPDUs under test shall be at least 32 data OFDM symbols long. For occupied RUs that have more than 26 tones, the PPDUs under test shall be at least 16 data OFDM symbols long. Random data shall be used for the symbols.

For an HE trigger-based PPDU, additional transmit modulation accuracy test for the unoccupied subcarriers of the PPDU shall be performed. The transmit modulation accuracy of unoccupied subcarriers of the PPDU test shall be performed by instrumentation capable of converting the transmitted signals into a stream of complex samples at sampling rate greater than or equal to the bandwidth of the signal being transmitted except that for noncontiguous transmissions, only the frequency segment with occupied subcarriers is tested. The transmit modulation accuracy of unoccupied subcarriers of the PPDU shall meet the relative constellation error staircase mask for each modulation and code rate using the unoccupied subcarriers within the corresponding segment.

The instrument shall have sufficient accuracy in terms of I/Q branch amplitude and phase balance, DC offsets, phase noise, and analog to digital quantization noise. A possible embodiment of such a setup is

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converting the signals to a low IF frequency with a microwave synthesizer, sampling the signal with a digital oscilloscope and decomposing it digitally into quadrature components. The sampled signal shall be processed in a manner similar to an actual receiver, according to the following steps, or equivalent procedure:

a) Start of PPDU shall be detected.

b) Transition from L-STF to L-LTF shall be detected and fine timing shall be established.

c) Coarse and fine frequency offsets shall be estimated.

d) Symbols in a PPDU shall be derotated according to estimated frequency offset. Sampling offset drift shall be also compensated. Note that amplitude drift shall not be compensated by the testing instrument.

e) For each of the data OFDM symbols, transform the symbol into subcarrier received values and estimate the power of each subcarrier.

f) Compute the average unoccupied subcarrier error vector magnitude for each unoccupied 26-tone RU and average across PPDUs of the RMS of all errors per PPDU as given by Equation (28-123).

$$UnusedToneError_{RMS}(k) = \frac{1}{N_f}\sum_{i_f=1}^{N_f}\sqrt{\frac{\sum_{i_s}\sum_{i_{RU}\in\Omega_k}(I_u(i_f, i_s, i_{RU}))^2 + (Q_u(i_f, i_s, i_{RU}))^2}{N_{SYM}\cdot 26\cdot P_S}} \quad (28\text{-}123)$$

where

$I_u(i_f, i_s, i_{RU})$ $Q_u(i_f, i_s, i_{RU})$ denotes unequalized observed symbol point in the complex plane in unoccupied 26-tone RU i_{RU} and OFDM symbol is of frame i_f.

Ω_k is a set of subcarriers for k-th 26-tone RU as defined in Table 28-3 (Subcarrier indices for RUs in a 20 MHz HE PPDU), Table 28-4 (Subcarrier indices for RUs in a 40 MHz HE PPDU) and Table 28-5 (Subcarrier indices for RUs in an 80 MHz HE PPDU)

P_S is the average data subcarrier power of the occupied RU under test and is given by Equation (28-124)

$$P_S = \frac{1}{N_{SYM}N_{ST}}\sum_{i_s=1}^{N_{SYM}}\sum_{i_{sc}=1}^{N_{ST}}(I_u(i_f, i_s, i_{SC}))^2 + (Q_u(i_f, i_s, i_{SC}))^2 \quad (28\text{-}124)$$

N_f is the number of tested frames

N_{SYM} is the number of data OFDM symbols

N_{ST} is the number of data tones of the occupied RU

g) For all MCS, for an occupied RU bandwidth of r in units of a 26-tone RU as defined by Equation (28-125)

$$r = \begin{cases} 1, \text{ if 26-tone RU} \\ 2, \text{ if 52-tone RU} \\ 4, \text{ if 106-tone RU} \\ 9, \text{ if 242-tone RU} \\ 18, \text{ if 484-tone RU} \\ 37, \text{ if 996-tone RU} \end{cases} \quad (28\text{-}125)$$

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the average unoccupied subcarrier error vector magnitude for each unoccupied 26-tone RU as calculated in step e) shall meet the staircase mask requirement in Equation (28-126).

$$UnusedToneError_{RMS}(m) \leq \begin{cases} \max(UsedToneError_{RMS} - 2, -35 \text{ dB}), & 1 \leq m \leq r \\ \max(UsedToneError_{RMS} - 12, -35 \text{ dB}), & r+1 \leq m \leq 2r \\ \max(UsedToneError_{RMS} - 22, -35 \text{ dB}), & 2r \leq m \leq 3r \\ -35 \text{ dB, otherwise} \end{cases} \quad (28\text{-}126)$$

where

m defines the gap in the units of 26-tone RU to the occupied RU from either side and is a positive integer with $m = 1$ being the adjacent 26-tone RU.

$UsedToneError_{RMS}$ is the relative constellation error for the HE trigger based PPDU defined in Table 28-45 (Allowed relative constellation error versus constellation size and coding rate)

h) Compute the maximum average unoccupied subcarrier error vector magnitude as given by Equation (28-127).

$$UnusedToneError_{\text{MAX-RMS}} = \max_{\forall k}(UnusedToneError_{RMS}(k)) \quad (28\text{-}127)$$

The test shall be performed over at least 20 PPDUs (N_f as defined in Equation (28-122)). The PPDUs under test shall be at least 16 data OFDM symbols long. The unequalized observed symbol of potential LO leakage subcarrier locations shall be treated as zero during unoccupied subcarriers transmit modulation accuracy test. Random data shall be used for the symbols.

28.3.18.5 Time of Departure accuracy

The Time of Departure accuracy test evaluates TIME_OF_DEPARTURE against aTxPHYTxStartRMS and aTxPHYTxStartRMS against TIME_OF_DEPARTURE_ACCURACY_TEST_THRESH as defined in Annex P with the following test parameters:

— MULTICHANNEL_SAMPLING_RATE is:

$20 \times 10^6\left(1 + \left\lceil \frac{f_H - f_L}{20 \text{ MHz}} \right\rceil\right)$ sample/s, for a CH_BANDWIDTH parameter equal to CBW20

$40 \times 10^6\left(1 + \left\lceil \frac{f_H - f_L}{40 \text{ MHz}} \right\rceil\right)$ sample/s, for a CH_BANDWIDTH parameter equal to CBW40

$80 \times 10^6\left(1 + \left\lceil \frac{f_H - f_L}{80 \text{ MHz}} \right\rceil\right)$ sample/s, for a CH_BANDWIDTH parameter equal to CBW80

$160 \times 10^6\left(1 + \left\lceil \frac{f_H - f_L}{160 \text{ MHz}} \right\rceil\right)$ sample/s, for a CH_BANDWIDTH parameter equal to CBW160 or CBW80+80

where

f_H is the nominal center frequency in Hz of the highest channel in the channel set

f_L is the nominal center frequency in Hz of the lowest channel in the channel set, the channel set is the set of channels upon which frames providing measurements are transmitted, the channel set comprises channels uniformly spaced across.

— FIRST_TRANSITION_FIELD is L-STF.

— SECOND_TRANSITION_FIELD is L-LTF.

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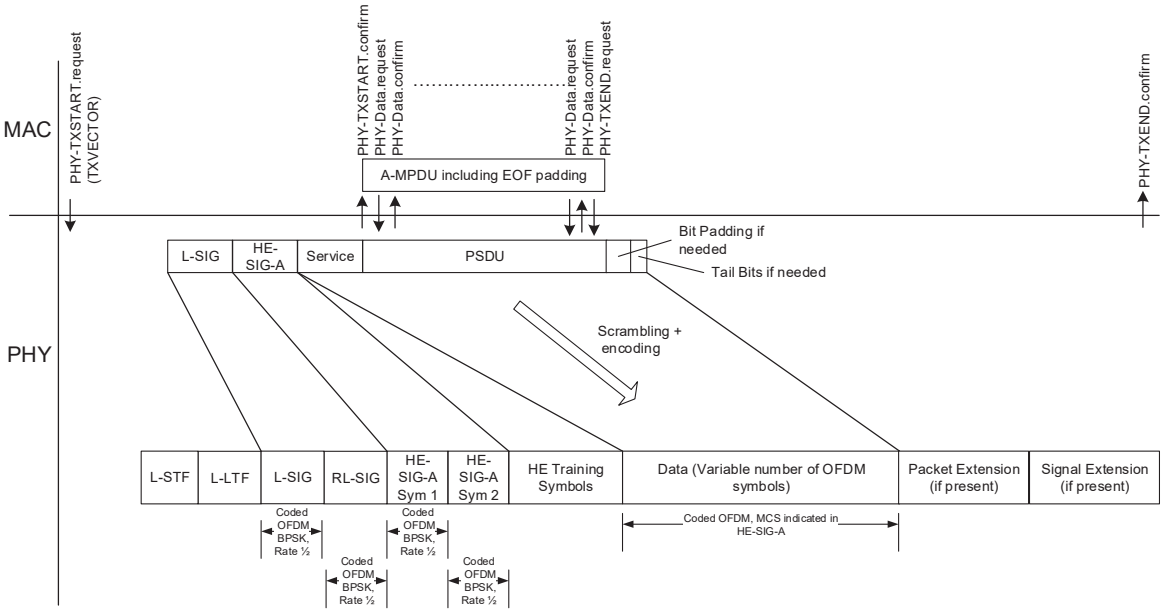
— TRAINING_FIELD is L-LTF windowed in a manner which should approximate the windowing described in 17.3.2.5 (Mathematical conventions in the signal descriptions) with TTR = 100 ns.

— TIME_OF_DEPARTURE_ACCURACY_TEST_THRESH is 80 ns.

NOTE—The indicated windowing applies to the time of departure accuracy test equipment, and not the transmitter or receiver.

28.3.19 HE transmit procedure

There are five options for the transmit PHY procedure. The first four options, for which typical transmit procedures are shown in Figure 28-42 (PHY transmit procedure for an HE SU PPDU), Figure 28-44 (PHY transmit procedure for an HE MU PPDU), Figure 28-43 (PHY transmit procedure for an HE extended range SU PPDU) and Figure 28-45 (PHY transmit procedure for an HE trigger-based PPDU), are selected if the FORMAT field of the PHY-TXSTART.request(TXVECTOR) primitive is equal to HE_SU, HE_MU, HE_EXT_SU, or HT_TRIG, respectively. These transmit procedures do not describe the operation of optional features, such as DCM.



NOTE—This procedure does not describe the operation of optional features, such as DCM.

Figure 28-42—PHY transmit procedure for an HE SU PPDU

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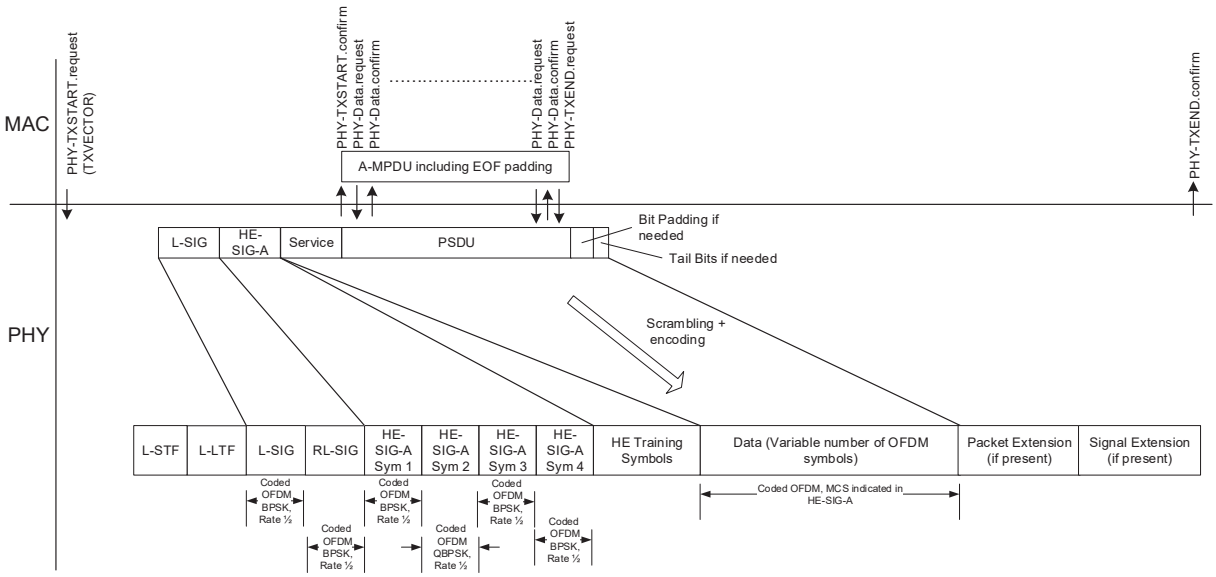
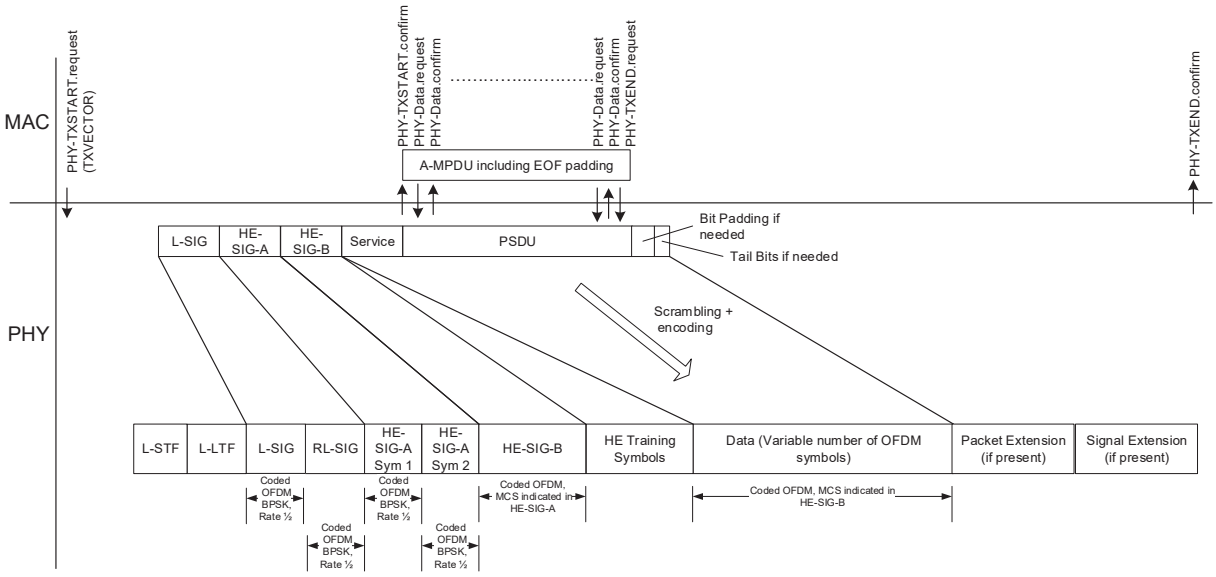


NOTE—This procedure does not describe the operation of optional features, such as DCM.

Figure 28-43—PHY transmit procedure for an HE extended range SU PPDU



NOTE—This procedure does not describe the operation of optional features, such as DCM.

Figure 28-44—PHY transmit procedure for an HE MU PPDU

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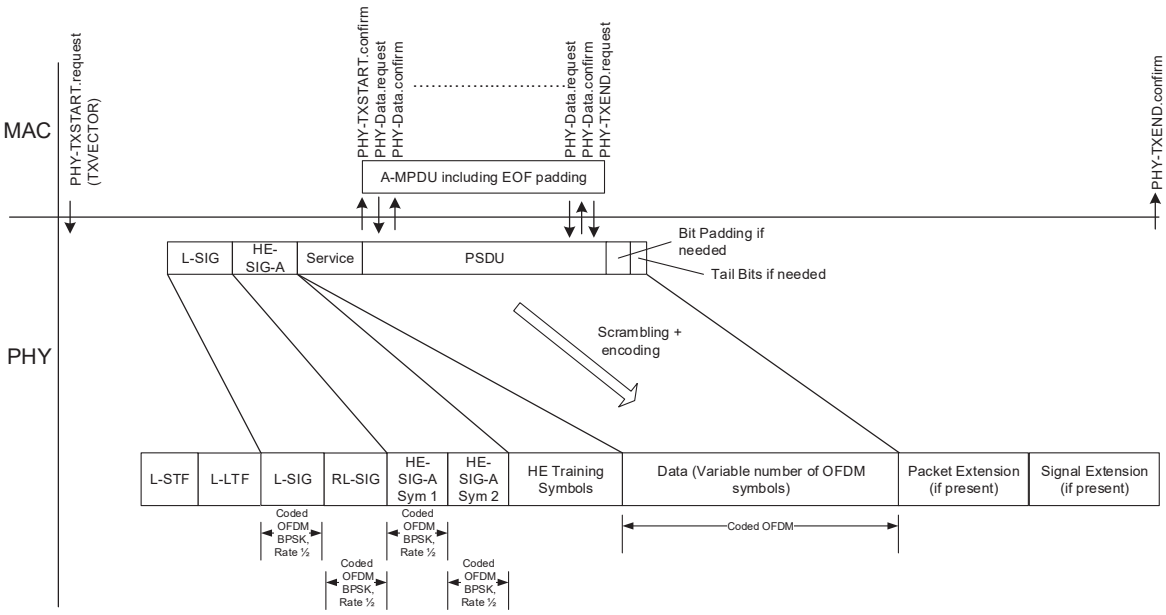

NOTE—This procedure does not describe the operation of optional features, such as DCM.

Figure 28-45—PHY transmit procedure for an HE trigger-based PPDU

The fifth option is to follow the transmit procedure in Clause 17 (Orthogonal frequency division multiplexing (OFDM) PHY specification) if the FORMAT parameter of the PHYTXSTART.request(TXVECTOR) primitive is NON_HT and the NON_HT_MODULATION parameter is set to NON_HT_DUP_OFDM except that the signal referred to in Clause 17 (Orthogonal frequency division multiplexing (OFDM) PHY specification) is instead generated simultaneously on each of the 20 MHz channels that are indicated by the CH_BANDWIDTH parameter as defined in 28.3.10 (HE preamble) and 28.3.13 (Non-HT duplicate transmission).

NOTE 1—For an HE MU PPDU the A-MPDU is per user in the MAC sublayer and the HE Training Symbols, and Data are per user in the PHY in Figure 28-44 (PHY transmit procedure for an HE MU PPDU), with the number HE Training Symbols depending on the maximum total number of space-time streams across all RUs.

NOTE 2—The transmit procedure for NON_HT, HT_MF, HT_GF, and VHT format are specified in 26.2.x (Support for NON-HT, HT, and VHT formats).

In all options, in order to transmit data, the MAC generates a PHY-TXSTART.request primitive, which causes the PHY entity to enter the transmit state. Further, the PHY is set to operate at the appropriate frequency through station management via the PLME, as specified in 28.4 (HE PLME). Other transmit parameters, such as HE-MCS Coding types and transmit power, are set via the PHY-SAP using the PHYTXSTART.request(TXVECTOR) primitive, as described in 28.2.2 (TXVECTOR and RXVECTOR parameters). The remainder of the clause applies to the first four options.

The PHY indicates the state of the primary channel and other channels (if any) via the PHY-CCA.indication primitive (see 22.3.18.5 (CCA sensitivity) and 7.3.5.12 (PHY-CCA.indication)). Transmission of the PPDU shall be initiated by the PHY after receiving the PHY-TXSTART.request(TXVECTOR) primitive. The TXVECTOR elements for the PHY-TXSTART.request primitive are specified in Table 28-1 (TXVECTOR and RXVECTOR parameters).

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Transmission of the PHY preamble may start if TIME_OF_DEPARTURE_REQUESTED is false, and shall start immediately if TIME_OF_DEPARTURE_REQUESTED is true, based on the parameters passed in the PHY-TXSTART.request primitive.

If all of the following conditions are met:

— if dot11TODImplemented and dot11TODActivated are true or if dot11TimingMsmtActivated is true,

— the TXVECTOR parameter TIME_OF_DEPARTURE_REQUESTED is true,

then the PHY shall issue a PHY-TXSTART.confirm(TXSTATUS) primitive to the MAC, forwarding the TIME_OF_DEPARTURE corresponding to the time when the first frame energy is sent by the transmitting port and TIME_OF_DEPARTURE_ClockRate parameter within the TXSTATUS vector. If dot11TimingMsmtActivated is true, then the PHY shall forward the value of TX_START_OF_FRAME_OFFSET in TXSTATUS vector.

After the PHY preamble transmission is started, the PHY entity immediately initiates data scrambling and data encoding. The encoding method for the Data field is based on the FEC_CODING, CH_BANDWIDTH, NUM_STS, STBC, MCS, and NUM_USERS parameter of the TXVECTOR, as described in 28.3.4 (HE PPDU formats).

The SERVICE field and PSDU are encoded as described in 28.3.5 (Transmitter block diagram). The data shall be exchanged between the MAC and the PHY through a series of PHY-DATA.request(DATA) primitives issued by the MAC, and PHY-DATA.confirm primitives issued by the PHY. PHY padding bits are appended to the PSDU to make the number of bits in the coded PSDU an integral multiple of the number of coded bits per OFDM symbol.

Transmission can be prematurely terminated by the MAC through the PHY-TXEND.request primitive. PSDU transmission is terminated by receiving a PHY-TXEND.request primitive. Each PHYTXEND.request primitive is acknowledged with a PHY-TXEND.confirm primitive from the PHY.

A packet extension and/or a signal extension may be present in the PPDU. When no packet extension and signal extension are present, the PHY-TXEND.confirm primitive is generated at the end of last symbol of the PPDU. When a packet extension and/or a signal extension present, the PHY-TXEND.confirm primitive is generated at the end of the packet extension or signal extension.

In the PHY, the GI with GI duration indicated in GI_TYPE parameter of the TXVECTOR is inserted in every data OFDM symbol as a countermeasure against delay spread.

When the PPDU transmission is completed the PHY entity enters the receive state.

A typical state machine implementation of the transmit PHY for an HE PPDU transmission is provided in Figure 28-46 (PHY transmit state machine for an HE PPDU). Request (.request) and confirmation(.confirm)

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primitives are issued once per state as shown. This state machine does not describe the operation of optional features, such as DCM.

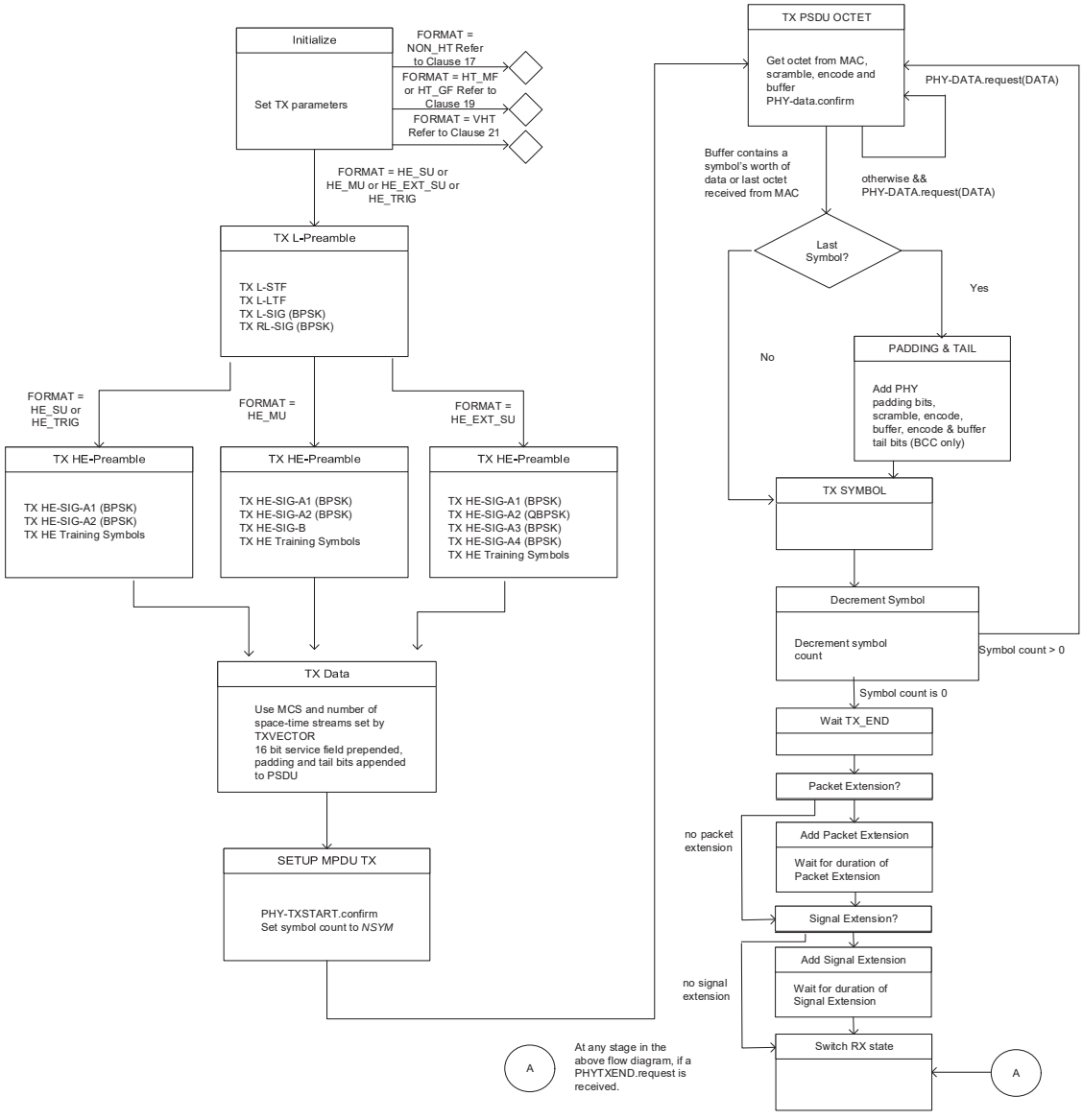

Figure 28-46—PHY transmit state machine for an HE PPDU

28.3.20 HE receive procedure

Typical PHY receive procedures are shown in Figure 28-47 (PHY receive procedure for an HE SU PPDU), Figure 28-48 (PHY receive procedure for an HE extended range SU PPDU), Figure 28-49 (PHY receive procedure for an HE MU PPDU), and Figure 28-50 (PHY receive procedure for an HE trigger-based PPDU) respectively. A typical state machine implementation of the receive PHY is given in Figure 28-51 (PHY receive state machine). This receive procedure and state machine do not describe the operation of optional features, such as DCM. If the detected format indicates a Non-HT PPDU, refer to the receive procedure and state machine in Clause 17 (Orthogonal frequency division multiplexing (OFDM) PHY specification). If the detected format indicates an HT PPDU format, refer to the receive procedure and state machine in Clause 19

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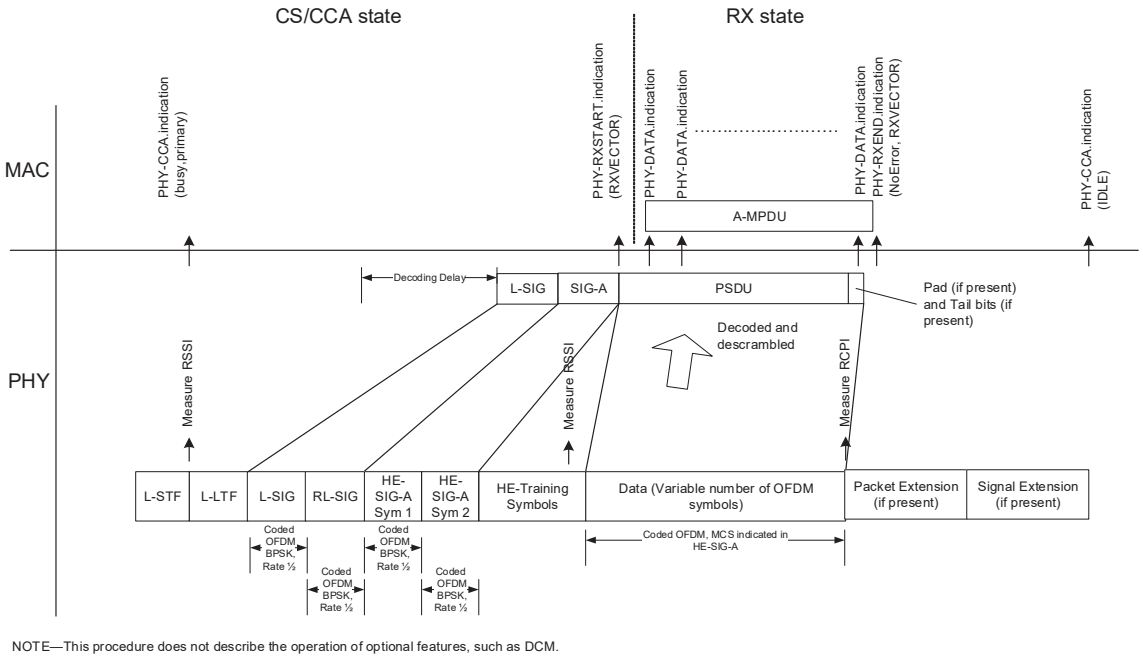
(High Throughput (HT) PHY specification). If the detected format indicates a VHT PPDU format, refer to the receive procedure and state machine in Clause 21 (Very High Throughput (VHT) PHY specification).Through station management (via the PLME) the PHY is set to the appropriate frequency, as specified in 28.4 (HE PLME). The PHY has also been configured with cell identification information and STA identification information (i.e., BSS Color value and STA ID in the cell) so that it can receive data intended for the STA in the specific cell. Other receive parameters, such as RSSI and indicated DATARATE, may be accessed via the PHY-SAP.



NOTE—This procedure does not describe the operation of optional features, such as DCM.

Figure 28-47—PHY receive procedure for an HE SU PPDU

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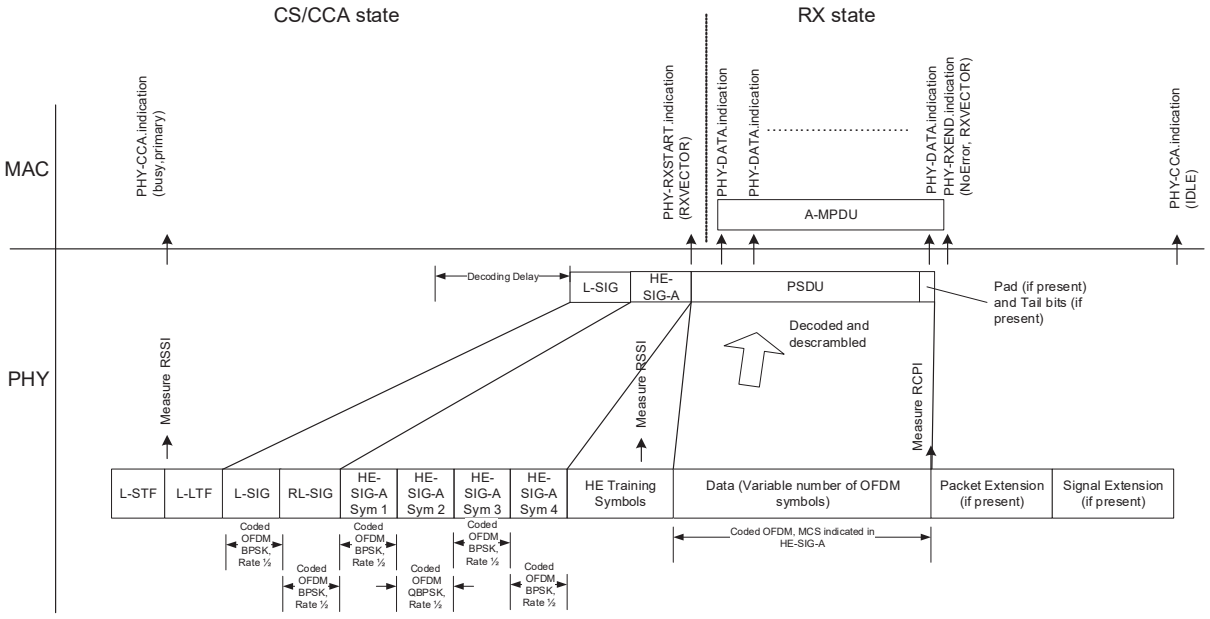
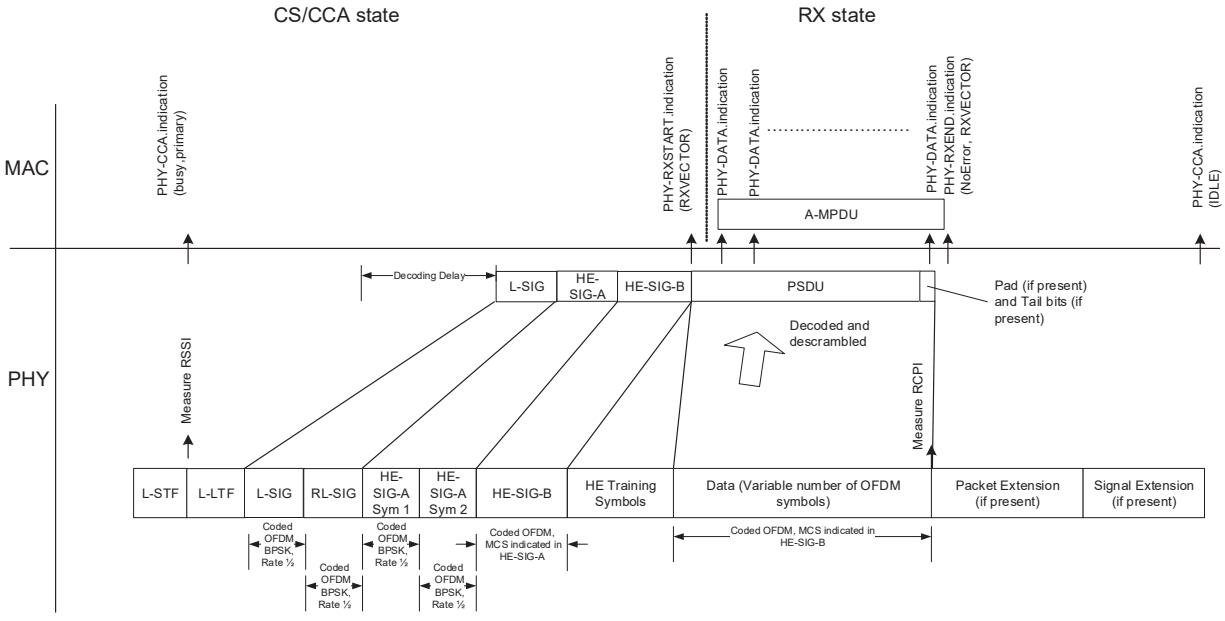


NOTE—This procedure does not describe the operation of optional features, such as DCM.

Figure 28-48—PHY receive procedure for an HE extended range SU PPDU



NOTE—This procedure does not describe the operation of optional features, such as DCM.

Figure 28-49—PHY receive procedure for an HE MU PPDU

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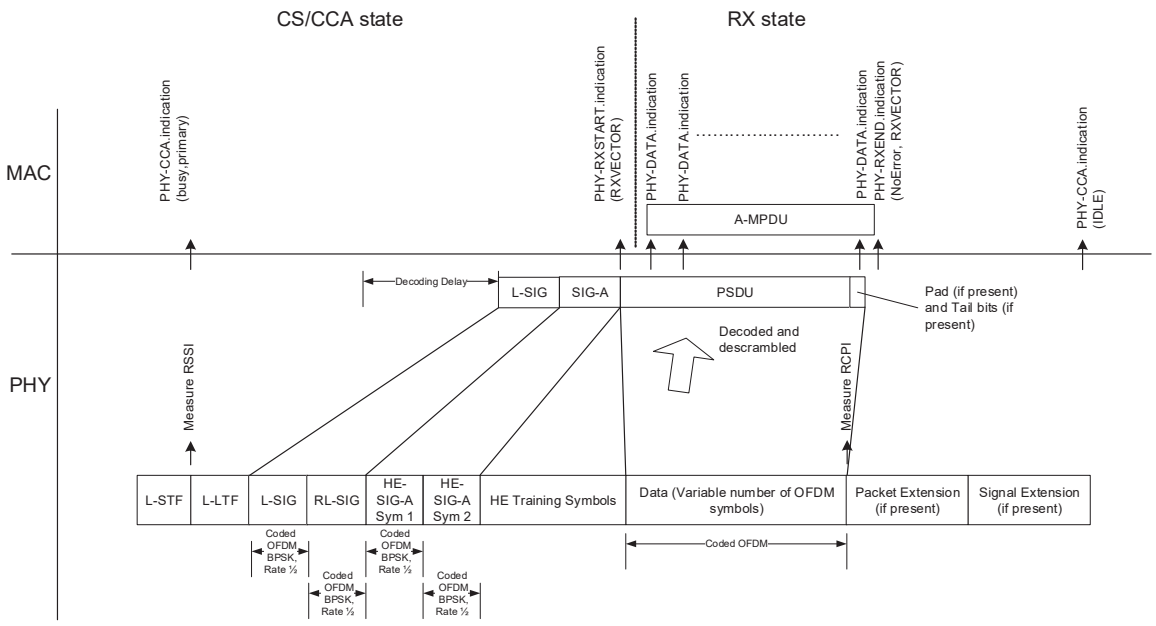

NOTE—This procedure does not describe the operation of optional features, such as DCM.

Figure 28-50—PHY receive procedure for an HE trigger-based PPDU

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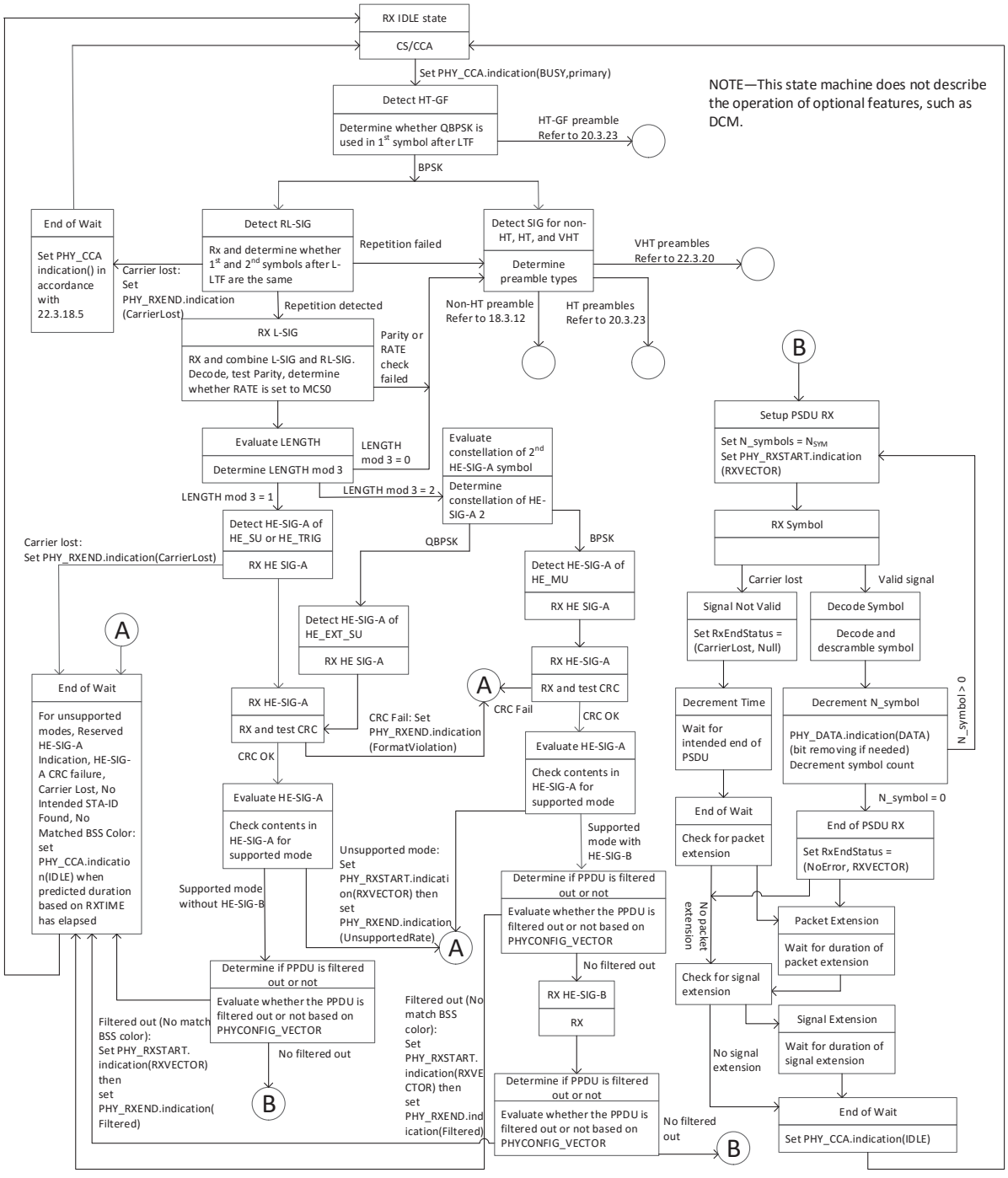

Figure 28-51—PHY receive state machine

Upon receiving the transmitted PHY preamble overlapping the primary 20 MHz channel in a greater than or equal to 20 MHz BSS, the PHY measures a receive signal strength. This activity is indicated by the PHY to the MAC via a PHY-CCA.indication primitive. A PHY-CCA.indication(BUSY, channel-list) primitive is also issued as an initial indication of reception of a signal as specified in 22.3.18.5 (CCA sensitivity). The channel-list parameter of the PHYCCA.indication primitive is absent when the operating channel width is

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20 MHz. The channel-list parameter is present and includes the element primary when the operating channel width is 40 MHz, 80 MHz, 160 MHz, or 80+80 MHz.

The PHY shall not issue a PHY-RXSTART.indication primitive in response to a PPDU that does not overlap the primary channel, except when the PHY at an AP receives the HE-trigger based PPDU. In such case, the PHY shall issue a PHY-RXSTART.indication primitive in response to a PPDU transmission either at the primary or at the secondary channel.

The PHY includes the most recently measured RSSI value in the PHY-RXSTART.indication(RXVECTOR) primitive issued to the MAC.

After the PHY-CCA.indication(BUSY, channel-list) primitive is issued, the PHY entity shall begin receiving the training symbols and searching for the preambles for NON-HT, HT, VHT, and HE PPDUs, respectively. If the constellation used in the first symbol after the first long training field is QBPSK, the PHY entity shall continue to detect the received signal using the receive procedure for HT-GF depicted in Clause 19. Otherwise, for detecting the HE preamble, the PHY entity shall search for L-SIG and RL-SIG in order to set the maximum duration of the data stream. If RL-SIG is detected, the PHY entity should check the parity bit and RATE fields in L-SIG and RL-SIG. If either the check of the parity bit is invalid or the RATE field is not set to MCS0 in NON-HT, a PHY-RXSTART.indication primitive is not issued. If the check of the parity bit is valid and the RATE field is set to MCS0 but the LENGTH field value in L-SIG is a multiple of 3, a PHY-RXSTART.indication primitive is not issued. In both cases, the PHY should continue to detect the received signal using non-HT, HT, and VHT receive procedure in Clauses 17, 19, and 21, respectively.

If a valid parity bit and the RATE with MCS0 are indicated in L-SIG and RL-SIG and the LENGTH field value in L-SIG and RL-SIG meet the condition that the remainder is 1 after LENGTH divided by 3, the PHY entity should begin receiving the sequence of HE-SIG-A, HE-STF, and HE-LTF for HE SU PPDU and HE trigger-based PPDU as shown in Figure 28-47 (PHY receive procedure for an HE SU PPDU) and Figure 28-50 (PHY receive procedure for an HE trigger-based PPDU), respectively. After RL-SIG, the PHY entity shall receive two symbols of HE-SIG-A immediately followed by HE-STF. The PHY entity shall check CRC of HE-SIG-A. If the CRC check is valid, the PHY entity shall report TXOP, BSS Color and check Format field, and continue to receive HE-STF. The PHY entity shall report to the MAC entity the predicted duration of the TXOP in HE-SIG-A. The PHY entity shall check the BSS color in HE-SIG-A. If the BSS color doesn't contain an intended value, the PHY entity shall set PHY_RXSTART.indication(RXVECTOR) then set PHY_RXEND.indication(Filtered). The PHY entity shall check Format field in HE-SIG-A. If the Format field indicates an HE SU PPDU, the PHY entity shall receive HE-STF for 4 μs after HE-SIG-A. If the Format field indicates an HE trigger-based PPDU, the PHY entity shall receive HE-STF for 8 μs after HE-SIG-A. The PHY entity shall maintain PHY-CCA.indication(BUSY, channellist) primitive for the predicted duration of the transmitted PPDU, as defined by RXTIME in Equation (28-128), for all supported modes, unsupported modes, Reserved HE-SIG-A Indication, and invalid HE-SIG-A CRC. Reserved HE-SIG-A Indication is defined as an HE-SIG-A with Reserved bits equal to 0. If the HE-SIG-A indicates an unsupported mode, the PHY shall issue a PHY-RXEND.indication(UnsupportedRate)primitive. If the HE-SIG-A indicates an invalid CRC or Reserved HE-SIG-A Indication, the PHY shall issue the error condition PHY-RXEND.indication(FormatViolation)primitive.

If a valid parity bit of L-SIG and RL-SIG is indicated and the LENGTH field value in L-SIG and RL-SIG meet the condition that the remainder is 2 after LENGTH divided by 3, the PHY entity should detect the signal constellations in the second symbol after RL-SIG. If the constellation is QBPSK, the PHY entity shall continue receiving the sequence of HE-SIG-A, HE-STF, and HE-LTF for an HE extended range SU PPDU shown in Figure 28-48 (PHY receive procedure for an HE extended range SU PPDU). After RL-SIG, the PHY entity shall receive four symbols of HE-SIG-A immediately followed by HE-STF. The PHY entity shall check CRC of HE-SIG-A. If the CRC check is valid, the PHY entity shall report TXOP, BSS Color, and continue to receive HE-STF. The PHY entity shall report to the MAC entity the predicted duration of the TXOP in HE-SIG-A. The PHY entity shall check the BSS color in HE-SIG-A. If the BSS color doesn't

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contain an intended value, the PHY entity shall set PHY_RXSTART.indication(RXVECTOR) then set PHY_RXEND.indication(Filtered). The PHY entity shall receive HE-STF for 4 μs after HE-SIG-A. The PHY entity shall maintain PHY-CCA.indication(BUSY, channellist) primitive for the predicted duration of the transmitted PPDU, as defined by RXTIME in Equation (28-128), for all supported modes, unsupported modes, Reserved HE-SIG-A Indication, and invalid HE-SIG-A CRC. Reserved HE-SIG-A Indication is defined as an HE-SIG-A with Reserved bits equal to 0. If the HE-SIG-A indicates an unsupported mode, the PHY shall issue a PHY-RXEND.indication(UnsupportedRate)primitive. If the HE-SIG-A indicates an invalid CRC or Reserved HE-SIG-A Indication, the PHY shall issue the error condition PHY-RXEND.indication(FormatViolation) primitive.

If a valid parity bit of L-SIG and RL-SIG is indicated and the LENGTH field value in L-SIG and RL-SIG meet the condition that the remainder is 2 after LENGTH divided by 3, the PHY entity should detect the signal constellations in the second symbol after RL-SIG. If the constellation is BPSK, the PHY entity shall continue receiving the sequence of HE-SIG-A, HE-SIG-B, HE-STF, and HE-LTF for an HE MU PPDU shown in Figure 28-49 (PHY receive procedure for an HE MU PPDU). After RL-SIG, the PHY entity shall receive two symbols of HE-SIG-A immediately followed by HE-SIG-B. The PHY entity shall check CRC of HE-SIG-A. If the CRC check is valid, the PHY entity shall report TXOP, BSS Color, and continue to receive HE-SIG-B. The PHY entity shall report to the MAC entity the predicted duration of the TXOP in HE-SIG-A. The PHY entity shall check the BSS color in HE-SIG-A. If the BSS color doesn't contain an intended value, the PHY entity shall set PHY_RXSTART.indication(RXVECTOR) then set PHY_RXEND.indication(Filtered). After HE-SIG-A, the PHY entity shall receive HE-SIG-B for the number of symbols predicted from HE-SIG-A. If the common field presents in HE-SIG-B, the PHY entity shall check the CRC of the common field. If the CRC in the common field is valid or the common field is not present, the PHY entity shall search for intended STA-ID in each user-specific subfield with a valid CRC. If no CRC is valid or no intended STA-ID is detected, the PHY entity shall set PHY_RXSTART.indication(RXVECTOR) then set PHY_RXEND.indication(Filtered). If a complete allocation of an intended STA-ID is detected in block with valid CRC, the PHY entity shall continue receiving HE-STF for 4 μs after HE-SIG-B for the detected and intended STA. The PHY entity shall maintain PHY-CCA.indication(BUSY, channellist) primitive for the predicted duration of the transmitted PPDU, as defined by RXTIME in Equation (28-128), for all supported modes, unsupported modes, Reserved HE-SIG-A Indication, and invalid HE-SIG-A CRC. Reserved HE-SIG-A Indication is defined as an HE-SIG-A with Reserved bits equal to 0. If the HE-SIG-A indicates an unsupported mode, the PHY shall issue a PHY-RXEND.indication(UnsupportedRate)primitive. If the HE-SIG-A indicates an invalid CRC or Reserved HE-SIG-A Indication, the PHY shall issue the error condition PHY-RXEND.indication(FormatViolation)primitive.

If signal loss occurs during reception prior to completion of the PSDU reception, the error condition PHYRXEND. indication(CarrierLost) shall be reported to the MAC. After waiting for the end of the PPDU as determined by Equation (28-128) the PHY shall set the PHY-CCA.indication (IDLE) primitive and return to the RX IDLE state.

$$\text{RXTIME}(\mu\text{s}) = 20 + T_{\text{HE_PREAMBLE}} + N_{SYM}T_{SYM} + T_{PE} + SignalExtension \quad (28\text{-}128)$$

where

$T_{\text{HE_PREAMBLE}}$, N_{SYM} and T_{PE} are defined in Equation (28-116) and Equation (28-117)

SignalExtension is 0 μs when TXVECTOR parameter NO_SIG_EXTN is true and is aSignalExtension as defined in Table 19-25 (HT PHY characteristics) when TXVECTOR parameter NO_SIG_EXTN is false.

Except in an HE NDP PPDU, a Data field follows the HE-STF and HE-LTF fields. The number of symbols in the Data field and the packet extension duration are computed from Equation (28-116) and Equation (28-117), respectively.

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The received PSDU bits are assembled into octets, decoded, and present to the MAC using a series of PHY-DATA.indication(DATA) primitive exchanges. Any final bits that cannot be assembled into a complete octet are considered pad bits and discarded. After the reception of the final bit of the last PSDU octet, and possible padding and tail bits, the PHY entity shall check whether packet extension and/or signal extension is applied. If packet extension and/or signal extension is applied, the PHY entity shall wait until the packet extension and/or signal extension expires before returning to the RX IDLE state, as shown in Figure 28-51 (PHY receive state machine).

The receiving procedures are subject to further changes depending on the decisions of spatial reuse and 20 MHz only devices.

28.4 HE PLME

28.4.1 PLME_SAP sublayer management primitives

Table 25-1 (HE PHY MIB attributes (11ax)) lists the MIB attributes that may be accessed by the PHY entities and the intralayer of higher level LMEs. These attributes are accessed via the PLME-GET, PLME-SET, PLME-RESET, and PLME-CHARACTERISTICS primitives defined in 6.5 (PLME SAP interface).

28.4.2 TXTIME and PSDU_LENGTH calculation

The value of the TXTIME parameter returned by the PLME-TXTIME.confirm primitive shall be calculated for an HE PPDU using Equation (28-129).

$$\text{TXTIME} = 20 + T_{\text{HE_PREAMBLE}} + N_{SYM}T_{SYM} + T_{PE} + SignalExtension \quad (28\text{-}129)$$

where

$T_{\text{HE_PREAMBLE}}$ is defined as in Equation (28-116) and Equation (28-117), and *SignalExtension* is 0 μs when TXVECTOR parameter NO_SIG_EXTN is true and is aSignalExtension as defined in Table 19-25 (HT PHY characteristics) when TXVECTOR parameter NO_SIG_EXTN is false

For an HE NDP PPDU, there is no Data field and $N_{SYM} = 0$.

For an HE SU PPDU and HE extended range SU PPDU using BCC encoding, the total number of OFDM symbols in the Data field is given by Equation (28-66).

For an HE SU PPDU and HE extended range SU PPDU using LDPC encoding, the total number of OFDM symbols in the Data field, N_{SYM}, is given in 28.3.11.5.2 (LDPC coding).

For an HE MU PPDU (including both MU-MIMO and OFDMA), the total number of OFDM symbols in the Data field, N_{SYM}, is given in 28.3.11.5.4 (Encoding process for an HE MU PPDU).

For an HE trigger-based PPDU, the total number of OFDM symbols in the Data field, N_{SYM}, is given in 28.3.11.5.5 (Encoding process for an HE trigger-based PPDU).

T_{PE} is given by Equation (28-113).

The value of the PSDU_LENGTH parameter returned in the PLME-TXTIME.confirm primitive for an HE SU PPDU and HE extended range SU PPDU is calculated using Equation (28-130).

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$$\text{PSDU_LENGTH} = \left\lfloor \frac{(N_{SYM,init} - m_{STBC})N_{DBPS} + m_{STBC}N_{DBPS,last,init} - N_{service} - N_{tail}}{8} \right\rfloor \quad (28\text{-}130)$$

where

$N_{SYM,init}$ is given by Equation (28-65) for BCC encoding and by Equation (28-70) for LDPC encoding

m_{STBC} is 2 when STBC is used, and 1 otherwise

N_{DBPS} is given in 28.5 (Parameters for HE-MCSs)

$N_{DBPS,last,init}$ is given by Equation (28-62)

The value of the PSDU_LENGTH parameter for user *u* returned in the PLME-TXTIME.confirm primitive and in the RXVECTOR for an HE MU PPDU is calculated using Equation (28-131).

$$\text{PSDU_LENGTH}_u = \left\lfloor \frac{(N_{SYM,init} - m_{STBC})N_{DBPS,u} + m_{STBC}N_{DBPS,last,init,u} - N_{service} - N_{tail}}{8} \right\rfloor \quad (28\text{-}131)$$

$N_{SYM,init}$ is given by Equation (28-78)

$N_{DBPS,last,init,u}$ is given by Equation (28-79)

The value of the PSDU_LENGTH parameter returned in the PLME-TXTIME.confirm primitive for an HE NDP PPDU is 0.

28.4.3 HE PHY

The static HE PHY characteristics, provided through the PLME-CHARACTERISTICS service primitive, shall be as shown in Table 20-25 (HT PHY characteristics) unless otherwise listed in Table 28-46 (HE PHY characteristics). The definitions for these characteristics are given in 6.5 (PLME SAP interface).

Table 28-46—HE PHY characteristics

Characteristic	Value
aTxPHYDelay	Implementation dependent
aRxPHYDelay	Implementation dependent
aCCAMidTIme	25 μs
aPPDUMaxTime	5.484 ms
aPSDUMaxLength	6 500 631 octets

28.5 Parameters for HE-MCSs

The rate-dependent parameters for 26-tone RU, 52-tone RU, 106-tone RU, 242-tone RU and non-OFDMA 20 MHz, 484-tone RU and non-OFDMA 40 MHz, 996-tone RU and non-OFDMA 80 MHz, non-OFDMA 160 MHz and 80+80 MHz N_{SS} = 1, …, 8 are given in Table 28-47 (HE-MCSs for mandatory 26-tone RU, NSS = 1) through Table 28-102 (HE-MCSs for optional non-OFDMA 160 MHz and 80+80 MHz, NSS = 8). Support for HE-MCS 8, 9, 10, and 11 (when valid) is optional in all cases. HE-MCS 10 and 11 (1024-QAM) are applicable only to RU sizes equal to or larger than 242 tones.

Dual sub-carrier modulation (DCM) is an optional modulation scheme for any OFDMA and non OFDMA transmissions. DCM is only applied to MCS 0, MCS 1, MCS 3 and MCS 4. DCM is applied only with

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N_{SS} = 1 or N_{SS} = 2 (in the case of single user RU in an HE MU PPDU, $N_{SS,r,u}$ = 1 or $N_{SS,r,u}$ = 2). An HE STA shall support single spatial stream HE-MCSs within the range HE-MCS 0 to HE-MCS 7 for all channel widths for which it has indicated support regardless of the Tx or Rx Highest Supported Long GI Data Rate subfield values in the Supported HE-MCS and NSS Set field. When more than one spatial stream is supported, the Tx or Rx Highest Supported Long GI Data Rate subfield values in the Supported HE-MCS and NSS Set field may result in a reduced HE-MCS range (cut-off) for N_{SS} = 2, …, 8. Support for OFDMA 26-tone RU, 52-tone RU, 106-tone RU, 242-tone RU and 996-tone RU with N_{SS} = 1 is mandatory. Support for non-OFDMA 20 MHz, 40 MHz, and 80 MHz with N_{SS} = 1 is mandatory. Support for more than one spatial stream is optional in all cases. Support for OFDMA and non-OFDMA 160 MHz and 80+80 MHz with N_{SS} = 1, …, 8 is optional.

Table 28-47 (HE-MCSs for mandatory 26-tone RU, NSS = 1) to Table 28-102 (HE-MCSs for optional non-OFDMA 160 MHz and 80+80 MHz, NSS = 8) define HE-MCSs not only for SU transmission but also for user *u* at *r*-th RU of an MU transmission. In the case of HE-MCSs for MU transmissions, the parameters, N_{SS}, R, N_{BPSCS}, N_{CBPS}, and N_{DBPS} are replaced with $N_{SS,u}$, R_u, $N_{BPSCS,u}$, $N_{CBPS,u}$, and $N_{DBPS,u}$, respectively.

Table 28-47—HE-MCSs for mandatory 26-tone RU, N_{SS} = 1

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 µs GI	1.6 µs GI	3.2 µs GI
0	1	BPSK	1/2	1	12	12	6	0.4	0.4	0.4
	0		1/2		24	24	12	0.9	0.8	0.8
1	1	QPSK	1/2	2	12	24	12	0.9	0.8	0.8
	0		1/2		24	48	24	1.8	1.7	1.5
2	N/A		3/4		24	48	36	2.6	2.5	2.3
3	1	16-QAM	1/2	4	12	48	24	1.8	1.7	1.5
	0		1/2		24	96	48	3.5	3.3	3.0
4	1		3/4		12	48	36	2.6	2.5	2.3
	0		3/4		24	96	72	5.3	5.0	4.5
5	N/A	64-QAM	2/3	6	24	144	96	7.1	6.7	6.0
6			3/4				108	7.9	7.5	6.8
7			5/6				120	8.8	8.3	7.5
8		256-QAM	3/4	8		192	144	10.6	10.0	9.0
9			5/6				160	11.8	11.1	10.0

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Table 28-48—HE-MCSs for mandatory 26-tone RU, N_{SS} = 2

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 μs GI	1.6 μs GI	3.2 μs GI
0	1	BPSK	1/2	1	12	24	12	0.9	0.8	0.8
	0		1/2		24	48	24	1.8	1.7	1.5
1	1	QPSK	1/2	2	12	48	24	1.8	1.7	1.5
	0		1/2		24	96	48	3.5	3.3	3.0
2	N/A		3/4		24	96	72	5.3	5.0	4.5
3	1	16-QAM	1/2	4	12	96	48	3.5	3.3	3.0
	0		1/2		24	192	96	7.1	6.7	6.0
4	1		3/4		12	96	72	5.3	5.0	4.5
	0		3/4		24	192	144	10.6	10.0	9.0
5	N/A	64-QAM	2/3	6	24	288	192	14.1	13.3	12.0
6			3/4				216	15.9	15.0	13.5
7			5/6				240	17.6	16.7	15.0
8		256-QAM	3/4	8		384	288	21.2	20.0	18.0
9			5/6				320	23.5	22.2	20.0

Table 28-49—HE-MCSs for mandatory 26-tone RU, N_{SS} = 3

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 μs GI	1.6 μs GI	3.2 μs GI
0	N/A	BPSK	1/2	1	24	72	36	2.6	2.5	2.3
1		QPSK	1/2	2		144	72	5.3	5.0	4.5
2			3/4				108	7.9	7.5	6.8
3		16-QAM	1/2	4		288	144	10.6	10.0	9.0
4			3/4				216	15.9	15.0	13.5
5		64-QAM	2/3	6		432	288	21.2	20.0	18.0
6			3/4				324	23.8	22.5	20.3
7			5/6				360	26.5	25.0	22.5
8		256-QAM	3/4	8		576	432	31.8	30.0	27.0
9			5/6				480	35.3	33.3	30.0

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Table 28-50—HE-MCSs for mandatory 26-tone RU, N_{SS} = 4

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 μs GI	1.6 μs GI	3.2 μs GI
0	N/A	BPSK	1/2	1	24	96	24	3.5	3.3	3.0
1		QPSK	1/2	2		192	96	7.1	6.7	6.0
2			3/4				144	10.6	10.0	9.0
3		16-QAM	1/2	4		384	192	14.1	13.3	12.0
4			3/4				288	21.2	20.0	18.0
5		64-QAM	2/3	6		576	384	28.2	26.7	24.0
6			3/4				432	31.8	30.0	27.0
7			5/6				480	35.3	33.3	30.0
8		256-QAM	3/4	8		768	576	42.4	40.0	36.0
9			5/6				640	47.1	44.4	40.0

Table 28-51—HE-MCSs for mandatory 26-tone RU, N_{SS} = 5

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 μs GI	1.6 μs GI	3.2 μs GI
0	N/A	BPSK	1/2	1	24	120	60	4.4	4.2	3.8
1		QPSK	1/2	2		240	120	8.8	8.3	7.5
2			3/4				180	13.2	12.5	11.3
3		16-QAM	1/2	4		480	240	17.6	16.7	15.0
4			3/4				360	26.5	25.0	22.5
5		64-QAM	2/3	6		720	480	35.3	33.3	30.0
6			3/4				540	39.7	37.5	33.8
7			5/6				600	44.1	41.7	37.5
8		256-QAM	3/4	8		960	720	52.9	50.0	45.0
9			5/6				800	58.8	55.6	50.0

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Table 28-52—HE-MCSs for mandatory 26-tone RU, N_{SS} = 6

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 µs GI	1.6 µs GI	3.2 µs GI
0	N/A	BPSK	1/2	1	24	144	72	5.3	5.0	4.5
1		QPSK	1/2	2		288	144	10.6	10.0	9.0
2			3/4				216	15.9	15.0	13.5
3		16-QAM	1/2	4		576	288	21.2	20.0	18.0
4			3/4				432	31.8	30.0	27.0
5		64-QAM	2/3	6		864	576	42.4	40.0	36.0
6			3/4				648	47.6	45.0	40.5
7			5/6				720	52.9	50.0	45.0
8		256-QAM	3/4	8		1 152	864	63.5	60.0	54.0
9			5/6				960	70.6	66.7	60.0

Table 28-53—HE-MCSs for mandatory 26-tone RU, N_{SS} = 7

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 µs GI	1.6 µs GI	3.2 µs GI
0	N/A	BPSK	1/2	1	24	168	84	6.2	5.8	5.3
1		QPSK	1/2	2		336	168	12.4	11.7	10.5
2			3/4				252	18.5	17.5	15.8
3		16-QAM	1/2	4		672	336	24.7	23.3	21.0
4			3/4				504	37.1	35.0	31.5
5		64-QAM	2/3	6		1 008	672	49.4	46.7	42.0
6			3/4				756	55.6	52.5	47.3
7			5/6				840	61.8	58.3	52.5
8		256-QAM	3/4	8		1 344	1 008	74.1	70.0	63.0
9			5/6				1 120	82.4	77.8	70.0

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Table 28-54—HE-MCSs for mandatory 26-tone RU, N_{SS} = 8

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 µs GI	1.6 µs GI	3.2 µs GI
0	N/A	BPSK	1/2	1	24	192	96	7.1	6.7	6.0
1		QPSK	1/2	2		384	192	14.1	13.3	12.0
2			3/4				288	21.2	20.0	18.0
3		16-QAM	1/2	4		768	384	28.2	26.7	24.0
4			3/4				576	42.4	40.0	36.0
5		64-QAM	2/3	6		1 152	768	56.5	53.3	48.0
6			3/4				864	63.5	60.0	54.0
7			5/6				960	70.6	66.7	60.0
8		256-QAM	3/4	8		1 536	1 152	84.7	80.0	72.0
9			5/6				1 280	94.1	88.9	80.0

Table 28-55—HE-MCSs for mandatory 52-tone RU, N_{SS} = 1

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 µs GI	1.6 µs GI	3.2 µs GI
0	1	BPSK	1/2	1	24	24	12	0.9	0.8	0.8
	0		1/2		48	48	24	1.8	1.7	1.5
1	1	QPSK	1/2	2	24	48	24	1.8	1.7	1.5
	0		1/2		48	96	48	3.5	3.3	3.0
2	N/A		3/4		48	96	72	5.3	5.0	4.5
3	1	16-QAM	1/2	4	24	96	48	3.5	3.3	3.0
	0		1/2		48	192	96	7.1	6.7	6.0
4	1		3/4		24	96	72	5.3	5.0	4.5
	0		3/4		48	192	144	10.6	10.0	9.0
5	N/A	64-QAM	2/3	6	48	288	192	14.1	13.3	12.0
6			3/4				216	15.9	15.0	13.5
7			5/6				240	17.6	16.7	15.0
8		256-QAM	3/4	8		384	288	21.2	20.0	18.0
9			5/6				320	23.5	22.2	20.0

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Table 28-56—HE-MCSs for mandatory 52-tone RU, N_{SS} = 2

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 μs GI	1.6 μs GI	3.2 μs GI
0	1	BPSK	1/2	1	24	48	24	1.8	1.7	1.5
	0		1/2		48	96	48	3.5	3.3	3.0
1	1	QPSK	1/2	2	24	96	48	3.5	3.3	3.0
	0		1/2		48	192	96	7.1	6.7	6.0
2	N/A		3/4		48	192	144	10.6	10.0	9.0
3	1	16-QAM	1/2	4	24	192	96	7.1	6.7	6.0
	0		1/2		48	384	192	14.1	13.3	12.0
4	1		3/4		24	192	144	10.6	10.0	9.0
	0		3/4		48	384	288	21.2	20.0	18.0
5	N/A	64-QAM	2/3	6	48	576	384	28.2	26.7	24.0
6			3/4				432	31.8	30.0	27.0
7			5/6				480	35.3	33.3	30.0
8		256-QAM	3/4	8		768	576	42.4	40.0	36.0
9			5/6				640	47.1	44.4	40.0

Table 28-57—HE-MCSs for mandatory 52-tone RU, N_{SS} = 3

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 μs GI	1.6 μs GI	3.2 μs GI
0	N/A	BPSK	1/2	1	48	144	72	5.3	5.0	4.5
1		QPSK	1/2	2		288	144	10.6	10.0	9.0
2			3/4				216	15.9	15.0	13.5
3		16-QAM	1/2	4		576	288	21.2	20.0	18.0
4			3/4				432	31.8	30.0	27.0
5		64-QAM	2/3	6		864	576	42.4	40.0	36.0
6			3/4				648	47.6	45.0	40.5
7			5/6				720	52.9	50.0	45.0
8		256-QAM	3/4	8		1 152	864	63.5	60.0	54.0
9			5/6				960	70.6	66.7	60.0

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Table 28-58—HE-MCSs for mandatory 52-tone RU, N_{SS} = 4

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 µs GI	1.6 µs GI	3.2 µs GI
0	N/A	BPSK	1/2	1	48	192	96	7.1	6.7	6.0
1		QPSK	1/2	2		384	192	14.1	13.3	12.0
2			3/4				288	21.2	20.0	18.0
3		16-QAM	1/2	4		768	384	28.2	26.7	24.0
4			3/4				576	42.4	40.0	36.0
5		64-QAM	2/3	6		1 152	768	56.5	53.3	48.0
6			3/4				864	63.5	60.0	54.0
7			5/6				960	70.6	66.7	60.0
8		256-QAM	3/4	8		1 536	1 152	84.7	80.0	72.0
9			5/6				1 280	94.1	88.9	80.0

Table 28-59—HE-MCSs for mandatory 52-tone RU, N_{SS} = 5

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 µs GI	1.6 µs GI	3.2 µs GI
0	N/A	BPSK	1/2	1	48	240	120	8.8	8.3	7.5
1		QPSK	1/2	2		480	240	17.6	16.7	15.0
2			3/4				360	26.5	25.0	22.5
3		16-QAM	1/2	4		960	480	35.3	33.3	30.0
4			3/4				720	52.9	50.0	45.0
5		64-QAM	2/3	6		1 440	960	70.6	66.7	60.0
6			3/4				1080	79.4	75.0	67.5
7			5/6				1 200	88.2	83.3	75.0
8		256-QAM	3/4	8		1 920	1 440	105.9	100.0	90.0
9			5/6				1 600	117.6	111.1	100.0

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Table 28-60—HE-MCSs for mandatory 52-tone RU, N_{SS} = 6

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 μs GI	1.6 μs GI	3.2 μs GI
0	N/A	BPSK	1/2	1	48	288	144	10.6	10.0	9.0
1		QPSK	1/2	2		576	288	21.2	20.0	18.0
2			3/4				432	31.8	30.0	27.0
3		16-QAM	1/2	4		1 152	576	42.4	40.0	36.0
4			3/4				864	63.5	60.0	54.0
5		64-QAM	2/3	6		1 728	1 152	84.7	80.0	72.0
6			3/4				1 296	95.3	90.0	81.0
7			5/6				1 440	105.9	100.0	90.0
8		256-QAM	3/4	8		2 304	1 728	127.1	120.0	108.0
9			5/6				1 920	141.2	133.3	120.0

Table 28-61—HE-MCSs for mandatory 52-tone RU, N_{SS} = 7

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 μs GI	1.6 μs GI	3.2 μs GI
0	N/A	BPSK	1/2	1	48	336	168	12.4	11.7	10.5
1		QPSK	1/2	2		672	336	24.7	23.3	21.0
2			3/4				504	37.1	35.0	31.5
3		16-QAM	1/2	4		1 344	672	49.4	46.7	42.0
4			3/4				1 008	74.1	70.0	63.0
5		64-QAM	2/3	6		2 016	1 344	98.8	93.3	84.0
6			3/4				1 512	111.2	105.0	94.5
7			5/6				1 680	123.5	116.7	105.0
8		256-QAM	3/4	8		2 688	2 016	148.2	140.0	126.0
9			5/6				2 240	164.7	155.6	140.0

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Table 28-62—HE-MCSs for mandatory 52-tone RU, N_{SS} = 8

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 µs GI	1.6 µs GI	3.2 µs GI
0	N/A	BPSK	1/2	1	48	384	192	14.1	13.3	12.0
1		QPSK	1/2	2		768	384	28.2	26.7	24.0
2			3/4				576	42.4	40.0	36.0
3		16-QAM	1/2	4		1 536	768	56.5	53.3	48.0
4			3/4				1 152	84.7	80.0	72.0
5		64-QAM	2/3	6		2 304	1 536	112.9	106.7	96.0
6			3/4				1 728	127.1	120.0	108.0
7			5/6				1 920	141.2	133.3	120.0
8		256-QAM	3/4	8		3 072	2 304	169.4	160.0	144.0
9			5/6				2 560	188.2	177.8	160.0

Table 28-63—HE-MCSs for mandatory 106-tone RU, N_{SS} = 1

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 µs GI	1.6 µs GI	3.2 µs GI
0	1	BPSK	1/2	1	51	51	25	1.8	1.7	1.6
	0		1/2		102	102	51	3.8	3.5	3.2
1	1	QPSK	1/2	2	51	102	51	3.8	3.5	3.2
	0		1/2		102	204	102	7.5	7.1	6.4
2	N/A		3/4		102	204	153	11.3	10.6	9.6
3	1	16-QAM	1/2	4	51	204	102	7.5	7.1	6.4
	0		1/2		102	408	204	15.0	14.2	12.8
4	1		3/4		51	204	153	11.3	10.6	9.6
	0		3/4		102	408	306	22.5	21.3	19.1
5	N/A	64-QAM	2/3	6	102	612	408	30.0	28.3	25.5
6			3/4		102		459	33.8	31.9	28.7
7			5/6		102		510	37.5	35.4	31.9
8		256-QAM	3/4	8	102	816	612	45.0	42.5	38.3
9			5/6		102		680	50.0	47.2	42.5

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Table 28-64—HE-MCSs for mandatory 106-tone RU, N_{SS} = 2

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 μs GI	1.6 μs GI	3.2 μs GI
0	1	BPSK	1/2	1	51	102	51	3.8	3.5	3.2
	0		1/2		102	204	102	7.5	7.1	6.4
1	1	QPSK	1/2	2	51	204	102	7.5	7.1	6.4
	0		1/2		102	408	204	15.0	14.2	12.8
2	N/A		3/4		102	408	306	22.5	21.3	19.1
3	1	16-QAM	1/2	4	51	408	204	15.0	14.2	12.8
	0		1/2		102	816	408	30.0	28.3	25.5
4	1		3/4		51	408	306	22.5	21.3	19.1
	0		3/4		102	816	612	45.0	42.5	38.3
5	N/A	64-QAM	2/3	6	102	1 224	816	60.0	56.7	51.0
6			3/4		102		918	67.5	63.8	57.4
7			5/6		102		1 020	75.0	70.8	63.8
8		256-QAM	3/4	8	102	1 632	1 224	90.0	85.0	76.5
9			5/6		102		1 360	100.0	94.4	85.0

Table 28-65—HE-MCSs for mandatory 106-tone RU, N_{SS} = 3

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 μs GI	1.6 μs GI	3.2 μs GI
0	N/A	BPSK	1/2	1	102	306	153	11.3	10.6	9.6
1		QPSK	1/2	2		612	306	22.5	21.3	19.1
2			3/4				459	33.8	31.9	28.7
3		16-QAM	1/2	4		1 224	612	45.0	42.5	38.3
4			3/4				918	67.5	63.8	57.4
5		64-QAM	2/3	6		1 836	1 224	90.0	85.0	76.5
6			3/4				1 337	101.3	95.6	86.1
7			5/6				1 530	112.5	106.3	95.6
8		256-QAM	3/4	8		2 448	1 836	135.0	127.5	114.8
9			5/6				2 048	150.0	141.7	127.5

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Table 28-66—HE-MCSs for mandatory 106-tone RU, N_{SS} = 4

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 µs GI	1.6 µs GI	3.2 µs GI
0	N/A	BPSK	1/2	1	102	408	204	15.0	14.2	12.8
1		QPSK	1/2	2		816	408	30.0	28.3	25.5
2			3/4				612	45.0	42.5	38.3
3		16-QAM	1/2	4		1 632	816	60.0	56.7	51.0
4			3/4				1 224	90.0	85.0	76.5
5		64-QAM	2/3	6		2 448	1 632	120.0	113.3	102.0
6			3/4				1 836	135.0	127.5	114.8
7			5/6				2 040	150.0	141.7	127.5
8		256-QAM	3/4	8		3 264	2 448	180.0	170.0	153.0
9			5/6				2 720	200.0	188.9	170.0

Table 28-67—HE-MCSs for mandatory 106-tone RU, N_{SS} = 5

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 µs GI	1.6 µs GI	3.2 µs GI
0	N/A	BPSK	1/2	1	102	510	255	18.8	17.7	15.9
1		QPSK	1/2	2		1 020	510	37.5	35.4	31.9
2			3/4				765	56.3	53.1	47.8
3		16-QAM	1/2	4		2 040	1 020	75.0	70.8	63.8
4			3/8				1 530	112.5	106.3	95.6
5		64-QAM	2/3	6		3 060	2 040	150.0	141.7	127.5
6			3/4				2 295	168.8	159.4	143.4
7			5/6				2 550	187.5	177.1	159.4
8		256-QAM	3/4	8		4 080	3 060	225.0	212.5	191.3
9			5/6				3 400	250.0	236.1	212.5

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Table 28-68—HE-MCSs for mandatory 106-tone RU, N_{SS} = 6

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 μs GI	1.6 μs GI	3.2 μs GI
0	N/A	BPSK	1/2	1	102	612	306	22.5	21.3	19.1
1		QPSK	1/2	2		1 224	612	45.0	42.5	38.3
2			3/4				918	67.5	63.8	57.4
3		16-QAM	1/2	4		2 448	1 224	90.0	85.0	76.5
4			3/4				1 836	135.0	127.5	114.8
5		64-QAM	2/3	6		3 672	2 448	180.0	170.0	153.0
6			3/4				2 754	202.5	191.3	172.1
7			5/6				3 060	225.0	212.5	191.3
8		256-QAM	3/4	8		4 896	3 672	270.0	255.0	229.5
9			5/6				4 080	300.0	283.3	255.0

Table 28-69—HE-MCSs for mandatory 106-tone RU, N_{SS} = 7

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 μs GI	1.6 μs GI	3.2 μs GI
0	N/A	BPSK	1/2	1	102	714	357	26.3	24.8	22.3
1		QPSK	1/2	2		1 428	714	52.5	49.6	44.6
2			3/4				1 071	78.8	74.4	66.9
3		16-QAM	1/2	4		2 856	1 428	105.0	99.2	89.3
4			3/4				2 142	157.5	148.8	133.9
5		64-QAM	2/3	6		4 284	2 856	210.0	198.3	178.5
6			3/4				3 213	236.3	223.1	200.8
7			5/6				3 570	262.5	247.9	223.1
8		256-QAM	3/4	8		5 712	4 284	315.0	297.5	267.8
9			5/6				4 760	350.0	330.6	297.5

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Table 28-70—HE-MCSs for mandatory 106-tone RU, N_{SS} = 8

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 μs GI	1.6 μs GI	3.2 μs GI
0	N/A	BPSK	1/2	1	102	816	408	30.0	28.3	25.5
1		QPSK	1/2	2		1632	816	60.0	56.7	51.0
2			3/4				1 224	90.0	85.0	76.5
3		16-QAM	1/2	4		3264	1 632	120.0	113.3	102.0
4			3/4				2 448	180.0	170.0	153.0
5		64-QAM	2/3	6		4896	3 264	240.0	226.7	204.0
6			3/4				3 672	270.0	225.0	229.5
7			5/6				4 080	300.0	283.3	255.0
8		256-QAM	3/4	8		6528	4 896	360.0	340.0	306.0
9			5/6				5 440	400.0	377.8	340.0

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Table 28-71—HE-MCSs for mandatory 242-tone RU and mandatory non-OFDMA 20 MHz, N_{SS} = 1

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 μs GI	1.6 μs GI	3.2 μs GI
0	1	BPSK	1/2	1	117	117	58	4.3	4.0	3.6
	0		1/2		234	234	117	8.6	8.1	7.3
1	1	QPSK	1/2	2	117	234	117	8.6	8.1	7.3
	0		1/2		234	468	234	17.2	16.3	14.6
2	N/A		3/4		234	468	351	25.8	24.4	21.9
3	1	16-QAM	1/2	4	117	468	234	17.2	16.3	14.6
	0		1/2		234	936	468	34.4	32.5	29.3
4	1		3/4		117	468	351	25.8	24.4	21.9
	0		3/4		234	936	702	51.6	48.8	43.9
5	N/A	64-QAM	2/3	6	234	1 404	936	68.8	65.0	58.5
6			3/4				1 053	77.4	73.1	65.8
7			5/6				1 170	86.0	81.3	73.1
8		256-QAM	3/4	8		1 872	1 404	103.2	97.5	87.8
9			5/6				1 560	114.7	108.3	97.5
10		1024-QAM	3/4	10		2 340	1 755	129.0	121.9	109.7
11			5/6				1 950	143.4	135.4	121.9

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Table 28-72—HE-MCSs for mandatory 242-tone RU and mandatory non-OFDMA 20 MHz, N_{SS} = 2

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 μs GI	1.6 μs GI	3.2 μs GI
0	1	BPSK	1/2	1	117	234	117	8.6	8.1	7.3
	0		1/2		234	468	234	17.2	16.3	14.6
1	1	QPSK	1/2	2	117	468	234	17.2	16.3	14.6
	0		1/2		234	936	468	34.4	32.5	29.3
2	N/A		3/4		234	936	702	51.6	48.8	43.9
3	1	16-QAM	1/2	4	117	936	468	34.4	32.5	29.3
	0		1/2		234	1 872	936	68.8	65.0	58.5
4	1		3/4		117	936	702	51.6	48.8	43.9
	0		3/4		234	1 872	1 404	103.2	97.5	87.8
5	N/A	64-QAM	2/3	6	234	2 808	1 872	137.6	130.0	117.0
6			3/4				2 106	154.9	146.3	131.6
7			5/6				2 340	172.1	162.5	146.3
8		256-QAM	3/4	8		3 744	2 808	206.5	195.0	175.5
9			5/6				3 120	229.4	216.7	195.0
10		1024-QAM	3/4	10		4 680	3 510	258.1	243.8	219.4
11			5/6				3 900	286.8	270.8	243.8

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Table 28-73—HE-MCSs for mandatory 242-tone RU and mandatory non-OFDMA 20 MHz, N_{SS} = 3

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 μs GI	1.6 μs GI	3.2 μs GI
0	N/A	BPSK	1/2	1	234	702	351	25.8	24.4	21.9
1		QPSK	1/2	2		1 404	702	51.6	48.8	43.9
2			3/4				1 053	77.4	73.1	65.8
3		16-QAM	1/2	4		2 808	1 404	103.2	97.5	87.8
4			3/4				2 106	154.9	146.3	131.6
5		64-QAM	2/3	6		4 212	2 808	206.5	195.0	175.5
6			3/4				3 159	232.3	219.4	197.4
7			5/6				3 510	258.1	243.8	219.4
8		256-QAM	3/4	8		5 616	4 212	309.7	292.5	263.3
9			5/6				4 680	344.1	325.0	292.5
10		1024-QAM	3/4	10		7 020	5 265	387.1	365.6	329.1
11			5/6				5 850	430.1	406.3	365.6

Table 28-74—HE-MCSs for mandatory 242-tone RU and mandatory non-OFDMA 20 MHz, N_{SS} = 4

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 μs GI	1.6 μs GI	3.2 μs GI
0	N/A	BPSK	1/2	1	234	936	468	34.4	32.5	29.3
1		QPSK	1/2	2		1 872	936	68.8	65.0	58.5
2			3/4				1 404	103.2	97.5	87.8
3		16-QAM	1/2	4		3 744	1 872	137.6	130.0	117.0
4			3/4				2 808	206.5	195.0	175.5
5		64-QAM	2/3	6		5 616	3 744	275.3	260.0	234.0
6			3/4				4 212	309.7	292.5	263.3
7			5/6				4 680	344.1	325.0	292.5
8		256-QAM	3/4	8		7 488	5 616	412.9	390.0	351.0
9			5/6				6 240	458.8	433.3	390.0
10		1024-QAM	3/4	10		9 360	7 020	516.2	487.5	438.8
11			5/6				7 800	573.5	541.7	487.5

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Table 28-75—HE-MCSs for mandatory 242-tone RU and mandatory non-OFDMA 20 MHz, N_{SS} = 5

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 μs GI	1.6 μs GI	3.2 μs GI
0	N/A	BPSK	1/2	1	234	1 170	585	43.0	40.6	36.6
1		QPSK	1/2	2		2 340	1 170	86.0	81.3	73.1
2			3/4				1 755	129.0	121.9	109.7
3		16-QAM	1/2	4		4 680	2 340	172.1	162.5	146.3
4			3/4				3 510	258.1	243.8	219.4
5		64-QAM	2/3	6		7 020	4 680	344.1	325.0	292.5
6			3/4				5 265	387.1	365.6	329.1
7			5/6				5 850	430.1	406.3	365.6
8		256-QAM	3/4	8		9 360	7 020	516.2	487.5	438.8
9			5/6				7 800	573.5	541.7	487.5
10		1024-QAM	3/4	10		11 700	8 775	645.2	609.4	548.4
11			5/6				9 750	716.9	677.1	609.4

Table 28-76—HE-MCSs for mandatory 242-tone RU and mandatory non-OFDMA 20 MHz, N_{SS} = 6

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 μs GI	1.6 μs GI	3.2 μs GI
0	N/A	BPSK	1/2	1	234	1 404	702	51.6	48.8	43.9
1		QPSK	1/2	2		2 808	1 404	103.2	97.5	87.8
2			3/4				2 106	154.9	146.3	131.6
3		16-QAM	1/2	4		5 616	2 808	206.5	195.0	175.5
4			3/4				4 212	309.7	292.5	263.3
5		64-QAM	2/3	6		8 424	5 616	412.9	390.0	351.0
6			3/4				6 318	464.6	438.8	394.9
7			5/6				7 020	516.2	487.5	438.8
8		256-QAM	3/4	8		11 232	8 424	619.4	585.0	526.5
9			5/6				9 360	688.2	650.0	585.0
10		1024-QAM	3/4	10		14 040	10 530	774.3	731.3	658.1
11			5/6				11 700	860.3	812.5	731.3

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Table 28-77—HE-MCSs for mandatory 242-tone RU and mandatory non-OFDMA 20 MHz, N_{SS} = 7

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 μs GI	1.6 μs GI	3.2 μs GI
0	N/A	BPSK	1/2	1	234	1 638	819	60.2	56.9	51.2
1		QPSK	1/2	2		3 276	1 638	120.4	113.8	102.4
2			3/4				2 457	180.7	170.6	153.6
3		16-QAM	1/2	4		6 552	3 276	240.9	227.5	204.8
4			3/4				4 914	361.3	341.3	307.1
5		64-QAM	2/3	6		9 828	6 552	481.8	455.0	409.5
6			3/4				7 371	542.0	511.9	460.7
7			5/6				8 190	602.2	568.8	511.9
8		256-QAM	3/4	8		13 104	9 828	722.6	682.5	614.3
9			5/6				10 920	802.9	758.3	682.5
10		1024-QAM	3/4	10		16 380	12 285	903.3	853.1	767.8
11			5/6				13 650	1 003.7	947.9	853.1

Table 28-78—HE-MCSs for mandatory 242-tone RU and mandatory non-OFDMA 20 MHz, N_{SS} = 8

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 μs GI	1.6 μs GI	3.2 μs GI
0	N/A	BPSK	1/2	1	234	1 872	936	68.8	65.0	58.5
1		QPSK	1/2	2		3 744	1 872	137.6	130.0	117.0
2			3/4				2 808	206.5	195.0	175.5
3		16-QAM	1/2	4		7 488	3 744	275.3	260.0	234.0
4			3/4				5 616	412.9	390.0	351.0
5		64-QAM	2/3	6		11 232	7 488	550.6	520.0	468.0
6			3/4				8 424	619.4	585.0	526.5
7			5/6				9 360	688.2	650.0	585.0
8		256-QAM	3/4	8		14 976	11 232	825.9	780.0	702.0
9			5/6				12 480	917.6	866.7	780.0
10		1024-QAM	3/4	10		18 720	14 040	1 032.4	975.0	877.5
11			5/6				15 600	1 147.1	1 083.3	975.0

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Table 28-79—HE-MCSs for mandatory 484-tone RU and mandatory non-OFDMA 40 MHz, N_{SS} = 1

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 μs GI	1.6 μs GI	3.2 μs GI
0	1	BPSK	1/2	1	234	234	117	8.6	8.1	7.3
	0		1/2		468	468	234	17.2	16.3	14.6
1	1	QPSK	1/2	2	234	468	234	17.2	16.3	14.6
	0		1/2		468	936	468	34.4	32.5	29.3
2	N/A		3/4		468	936	702	51.6	48.8	43.9
3	1	16-QAM	1/2	4	234	936	468	34.4	32.5	29.3
	0		1/2		468	1 872	936	68.8	65.0	58.5
4	1		3/4		234	936	702	51.6	48.8	43.9
	0		3/4		468	1 872	1 404	103.2	97.5	87.8
5	N/A	64-QAM	2/3	6	468	2 808	1 872	137.6	130.0	117.0
6			3/4				2 106	154.9	146.3	131.6
7			5/6				2 340	172.1	162.5	146.3
8		256-QAM	3/4	8		3 744	2 808	206.5	195.0	175.5
9			5/6				3 120	229.4	216.7	195.0
10		1024-QAM	3/4	10		4 680	3 510	258.1	243.8	219.4
11			5/6				3 900	286.8	270.8	243.8

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Table 28-80—HE-MCSs for mandatory 484-tone RU and mandatory non-OFDMA 40 MHz, N_{SS} = 2

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 μs GI	1.6 μs GI	3.2 μs GI
0	1	BPSK	1/2	1	234	468	234	17.2	16.3	14.6
	0		1/2		468	936	468	34.4	32.5	29.3
1	1	QPSK	1/2	2	234	936	468	34.4	32.5	29.3
	0		1/2		468	1 872	936	68.8	65.0	58.5
2	N/A		3/4		468	1 872	1 404	103.2	97.5	87.8
3	1	16-QAM	1/2	4	234	1 872	936	68.8	65.0	58.5
	0		1/2		468	3 744	1 872	137.6	130.0	117.0
4	1		3/4		234	1 872	1 404	103.2	97.5	87.8
	0		3/4		468	3 744	2 808	206.5	195.0	175.5
5	N/A	64-QAM	2/3	6	468	5 616	3 744	275.3	260.0	234.0
6			3/4				4 212	309.7	292.5	263.3
7			5/6				4 680	344.1	325.0	292.5
8		256-QAM	3/4	8		7 488	5 616	412.9	390.0	351.0
9			5/6				6 240	458.8	433.3	390.0
10		1024-QAM	3/4	10		9 360	7 020	516.2	487.5	438.8
11			5/6				7 800	573.5	541.7	487.5

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Table 28-81—HE-MCSs for mandatory 484-tone RU and mandatory non-OFDMA 40 MHz, N_{SS} = 3

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 μs GI	1.6 μs GI	3.2 μs GI
0	N/A	BPSK	1/2	1	468	1 404	702	51.6	48.8	43.9
1		QPSK	1/2	2		2 808	1 404	103.2	97.5	87.8
2			3/4				2 106	154.9	146.3	131.6
3		16-QAM	1/2	4		5 616	2 808	206.5	195.0	175.5
4			3/4				4 212	309.7	292.5	263.3
5		64-QAM	2/3	6		8 424	5 616	412.9	390.0	351.0
6			3/4				6 318	464.6	438.8	394.9
7			5/6				7 020	516.2	487.5	438.8
8		256-QAM	3/4	8		11 232	8 424	619.4	585.0	526.5
9			5/6				9 360	688.2	650.0	585.0
10		1024-QAM	3/4	10		14 040	10 530	774.3	731.3	658.1
11			5/6				11 700	860.3	812.5	731.3

Table 28-82—HE-MCSs for mandatory 484-tone RU and mandatory non-OFDMA 40 MHz, N_{SS} = 4

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 μs GI	1.6 μs GI	3.2 μs GI
0	N/A	BPSK	1/2	1	468	1 872	936	68.8	65.0	58.5
1		QPSK	1/2	2		3 744	1 872	137.6	130.0	117.0
2			3/4				2 808	206.5	195.0	175.5
3		16-QAM	1/2	4		7 488	3 744	275.3	260.0	234.0
4			3/4				5 616	412.9	390.0	351.0
5		64-QAM	2/3	6		11 232	7 488	550.6	520.0	468.0
6			3/4				8 424	619.4	585.0	526.5
7			5/6				9 360	688.2	650.0	585.0
8		256-QAM	3/4	8		14 976	11 232	825.9	780.0	702.0
9			5/6				12 480	917.6	866.7	780.0
10		1024-QAM	3/4	10		18 720	14 040	1 032.4	975.0	877.5
11			5/6				15 600	1 147.1	1 083.3	975.0

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Table 28-83—HE-MCSs for mandatory 484-tone RU and mandatory non-OFDMA 40 MHz, N_{SS} = 5

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 μs GI	1.6 μs GI	3.2 μs GI
0	N/A	BPSK	1/2	1	468	2 340	1 170	86.0	81.3	73.1
1		QPSK	1/2	2		4 680	2 340	172.1	162.5	146.3
2			3/4				3 510	258.1	243.8	219.4
3		16-QAM	1/2	4		9 360	4 680	344.1	325.0	292.5
4			3/8				7 020	516.2	487.5	438.8
5		64-QAM	2/3	6		14 040	9 360	688.2	650.0	585.0
6			3/4				10 530	774.3	731.3	658.1
7			5/6				11 700	860.3	812.5	731.3
8		256-QAM	3/4	8		18 720	14 040	1 032.4	975.0	877.5
9			5/6				15 600	1 147.1	1 083.3	975.0
10		1024-QAM	3/4	10		23 400	17 550	1 290.4	1 218.8	1 096.9
11			5/6				19 500	1 433.8	1 354.2	1 218.8

Table 28-84—HE-MCSs for mandatory 484-tone RU and mandatory non-OFDMA 40 MHz, N_{SS} = 6

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 μs GI	1.6 μs GI	3.2 μs GI
0	N/A	BPSK	1/2	1	468	2 808	1404	103.2	97.5	87.8
1		QPSK	1/2	2		5 616	2808	206.5	195.0	175.5
2			3/4				4212	309.7	292.5	263.3
3		16-QAM	1/2	4		11 232	5616	412.9	390.0	351.0
4			3/4				8424	619.4	585.0	526.5
5		64-QAM	2/3	6		16 848	11 232	825.9	780.0	702.0
6			3/4				12 636	929.1	877.5	789.8
7			5/6				14 040	1 032.4	975.0	877.5
8		256-QAM	3/4	8		22 464	16 848	1 238.8	1 170.0	1 053.0
9			5/6				18 720	1 376.5	1 300.0	1 170.0
10		1024-QAM	3/4	10		28 080	21 060	1 548.5	1 462.5	1 316.3
11			5/6				23 400	1 720.6	1 625.0	1 462.5

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Table 28-85—HE-MCSs for mandatory 484-tone RU and mandatory non-OFDMA 40 MHz, N_{SS} = 7

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 μs GI	1.6 μs GI	3.2 μs GI
0	N/A	BPSK	1/2	1	468	3 276	1 638	120.4	113.8	102.4
1		QPSK	1/2	2		6 552	3 276	240.9	227.5	204.8
2			3/4				4 914	361.3	341.3	307.1
3		16-QAM	1/2	4		13 104	6 552	481.8	455.0	409.5
4			3/4				9 828	722.6	682.5	614.3
5		64-QAM	2/3	6		19 656	13 104	963.5	910.0	819.0
6			3/4				14 742	1 084.0	1 023.8	921.4
7			5/6				16 380	1 204.4	1 137.5	1 023.8
8		256-QAM	3/4	8		26 208	19 656	1 445.3	1 365.0	1 228.5
9			5/6				21 840	1 605.9	1 516.7	1 365.0
10		1024-QAM	3/4	10		32 760	24 570	1 806.6	1 706.3	1 535.6
11			5/6				27 300	2 007.4	1 895.8	1 706.3

Table 28-86—HE-MCSs for mandatory 484-tone RU and mandatory non-OFDMA 40 MHz, N_{SS} = 8

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 μs GI	1.6 μs GI	3.2 μs GI
0	N/A	BPSK	1/2	1	468	3 744	1 872	137.6	130.0	117.0
1		QPSK	1/2	2		7 488	3 744	275.3	260.0	234.0
2			3/4				5 616	412.9	390.0	351.0
3		16-QAM	1/2	4		14 976	7 488	550.6	520.0	468.0
4			3/4				11 232	825.9	780.0	702.0
5		64-QAM	2/3	6		22 464	14 976	1 101.2	1 040.0	936.0
6			3/4				16 848	1 238.8	1 170.0	1 053.0
7			5/6				18 720	1 376.5	1 300.0	1 170.0
8		256-QAM	3/4	8		29 952	22 464	1 651.8	1 560.0	1 404.0
9			5/6				24 960	1 835.3	1 733.3	1 560.0
10		1024-QAM	3/4	10		37 440	28 080	2 064.7	1 950.0	1 755.0
11			5/6				31 200	2 294.1	2 166.7	1 950.0

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Table 28-87—HE-MCSs for mandatory 969-tone RU and mandatory non-OFDMA 80 MHz, N_{SS} = 1

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 μs GI	1.6 μs GI	3.2 μs GI
0	1	BPSK	1/2	1	490	490	245	18.0	17.0	15.3
	0		1/2		980	980	490	36.0	34.0	30.6
1	1	QPSK	1/2	2	490	980	490	36.0	34.0	30.6
	0		1/2		980	1960	980	72.1	68.1	61.3
2	N/A		3/4		980	1960	1 470	108.1	102.1	91.9
3	1	16-QAM	1/2	4	490	1960	980	72.1	68.1	61.3
	0		1/2		980	3920	1 960	144.1	136.1	122.5
4	1		3/4		490	1960	1 470	108.1	102.1	91.9
	0		3/4		980	3920	2 940	216.2	204.2	183.8
5	N/A	64-QAM	2/3	6	980	5 880	3 920	288.2	272.2	245.0
6			3/4				4 410	324.3	306.3	275.6
7			5/6				4 900	360.3	340.3	306.3
8		256-QAM	3/4	8		7 840	5 880	432.4	408.3	367.5
9			5/6				6 533	480.4	453.7	408.3
10		1024-QAM	3/4	10		9 800	7 350	540.4	510.4	459.4
11			5/6				8 166	600.4	567.1	510.4

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Table 28-88—HE-MCSs for mandatory 969-tone RU and mandatory non-OFDMA 80 MHz, N_{SS} = 2

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 μs GI	1.6 μs GI	3.2 μs GI
0	1	BPSK	1/2	1	490	980	490	36.0	34.0	30.6
	0		1/2		980	1 960	980	72.1	68.1	61.3
1	1	QPSK	1/2	2	490	1 960	980	72.1	68.1	61.3
	0		1/2		980	3 920	1 960	144.1	136.1	122.5
2	N/A		3/4		980	3 920	2 940	216.2	204.2	183.8
3	1	16-QAM	1/2	4	490	3 920	1 960	144.1	136.1	122.5
	0		1/2		980	7 840	3 920	288.2	272.2	245.0
4	1		3/4		490	3 920	2 940	216.2	204.2	183.8
	0		3/4		980	7 840	5 880	432.4	408.3	367.5
5	N/A	64-QAM	2/3	6	980	11 760	7 840	576.5	544.4	490.0
6			3/4				8 820	648.5	612.5	551.3
7			5/6				9 800	720.6	680.6	612.5
8		256-QAM	3/4	8		15 680	11 760	864.7	816.7	735.0
9			5/6				13 066	960.7	907.4	816.6
10		1024-QAM	3/4	10		19 600	14 700	1 080.9	1 020.8	918.8
11			5/6				16 333	1 201.0	1 134.3	1 020.8

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Table 28-89—HE-MCSs for mandatory 969-tone RU and mandatory non-OFDMA 80 MHz, N_{SS} = 3

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 μs GI	1.6 μs GI	3.2 μs GI
0	N/A	BPSK	1/2	1	980	2 940	1 470	108.1	102.1	91.9
1		QPSK	1/2	2		5 880	2 940	216.2	204.2	183.8
2			3/4				4 410	324.3	306.3	275.6
3		16-QAM	1/2	4		11 760	5 880	432.4	408.3	367.5
4			3/4				8 820	648.5	612.5	551.3
5		64-QAM	2/3	6		17 640	11 760	864.7	816.7	735.0
6			3/4				13 230	972.8	918.8	826.9
7			5/6				14 700	1 080.9	1 020.8	918.8
8		256-QAM	3/4	8		23 520	17 640	1 297.1	1 225.0	1 102.5
9			5/6				19 600	1 441.2	1 361.1	1 225.0
10		1024-QAM	3/4	10		29 400	22 050	1 621.3	1 531.3	1 378.1
11			5/6				24 500	1 801.5	1 701.4	1 531.3

Table 28-90—HE-MCSs for mandatory 969-tone RU and mandatory non-OFDMA 80 MHz, N_{SS} = 4

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 μs GI	1.6 μs GI	3.2 μs GI
0	N/A	BPSK	1/2	1	980	3 920	1 960	144.1	136.1	122.5
1		QPSK	1/2	2		7 840	3 920	288.2	272.2	245.0
2			3/4				5 880	432.4	408.3	367.5
3		16-QAM	1/2	4		15 680	7 840	576.5	544.4	490.0
4			3/4				11 760	864.7	816.7	735.0
5		64-QAM	2/3	6		23 520	15 680	1 152.9	1 088.9	980.0
6			3/4				17 640	1 297.1	1 225.0	1 102.5
7			5/6				19 600	1 441.2	1 361.1	1 225.0
8		256-QAM	3/4	8		31 360	23 520	1 729.4	1 633.3	1 470.0
9			5/6				26 133	1 921.5	1 814.8	1 633.3
10		1024-QAM	3/4	10		39 200	29 400	2 161.8	2 041.7	1 837.5
11			5/6				32 666	2 401.9	2 268.5	2 041.6

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Table 28-91—HE-MCSs for mandatory 969-tone RU and mandatory non-OFDMA 80 MHz, N_{SS} = 5

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 μs GI	1.6 μs GI	3.2 μs GI
0	N/A	BPSK	1/2	1	980	4 900	2 450	180.1	170.1	153.1
1		QPSK	1/2	2		9 800	4 900	360.3	340.3	306.3
2			3/4				7 350	540.4	510.4	459.4
3		16-QAM	1/2	4		19 600	9 800	720.6	680.6	612.5
4			3/8				14 700	1 080.9	1 020.8	918.8
5		64-QAM	2/3	6		29 400	19 600	1 441.2	1 361.1	1 225.0
6			3/4				22 050	1 621.3	1 531.3	1 378.1
7			5/6				24 500	1 801.5	1 701.4	1 531.3
8		256-QAM	3/4	8		39 200	29 400	2 161.8	2 041.7	1 837.5
9			5/6				32 666	2 401.9	2 268.5	2 041.6
10		1024-QAM	3/4	10		49 000	36 750	2 702.2	2 552.1	2 296.9
11			5/6				40 833	3 002.4	2 835.6	2 552.1

Table 28-92—HE-MCSs for mandatory 969-tone RU and mandatory non-OFDMA 80 MHz, N_{SS} = 6

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 μs GI	1.6 μs GI	3.2 μs GI
0	N/A	BPSK	1/2	1	980	5 880	2 940	216.2	204.2	183.8
1		QPSK	1/2	2		11 760	5 880	432.4	408.3	367.5
2			3/4				8 820	648.5	612.5	551.3
3		16-QAM	1/2	4		23 520	11 760	864.7	816.7	735.0
4			3/4				17 640	1 297.1	1 225.0	1 102.5
5		64-QAM	2/3	6		35 280	23 520	1 729.4	1 633.3	1 470.0
6			3/4				26 460	1 945.6	1 837.5	1 653.8
7			5/6				29 400	2 161.8	2 041.7	1 837.5
8		256-QAM	3/4	8		47 040	35 280	2 594.1	2 450.0	2 205.0
9			5/6				39 200	2 882.4	2 722.2	2 450.0
10		1024-QAM	3/4	10		58 800	44 100	3 242.6	3 062.5	2 756.3
11			5/6				49 000	3 602.9	3 402.8	3 062.5

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Table 28-93—HE-MCSs for mandatory 969-tone RU and mandatory non-OFDMA 80 MHz, N_{SS} = 7

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 μs GI	1.6 μs GI	3.2 μs GI
0	N/A	BPSK	1/2	1	980	6 860	3 430	252.2	238.2	214.4
1		QPSK	1/2	2		13 720	6 860	504.4	476.4	428.8
2			3/4				10 290	756.6	714.6	643.1
3		16-QAM	1/2	4		27 440	13 720	1 008.8	952.8	857.5
4			3/4				20 580	1 513.2	1 429.2	1 286.3
5		64-QAM	2/3	6		41 160	27 440	2 017.6	1 905.6	1 715.0
6			3/4				30 870	2 269.9	2 143.8	1 929.4
7			5/6				34 300	2 522.1	2 381.9	2 143.8
8		256-QAM	3/4	8		54 880	41 160	3 026.5	2 858.3	2 572.5
9			5/6				45 733	3 362.7	3 175.9	2 858.3
10		1024-QAM	3/4	10		68 600	51 450	3 783.1	3 572.9	3 215.6
11			5/6				57 166	4 203.4	3 969.9	3 572.9

Table 28-94—HE-MCSs for mandatory 969-tone RU and mandatory non-OFDMA 80 MHz, N_{SS} = 8

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 μs GI	1.6 μs GI	3.2 μs GI
0	N/A	BPSK	1/2	1	980	7 840	3 920	288.2	272.2	245.0
1		QPSK	1/2	2		15 680	7 840	576.5	544.4	490.0
2			3/4				11 760	864.7	816.7	735.0
3		16-QAM	1/2	4		31 360	15 680	1 152.9	1 088.9	980.0
4			3/4				23 520	1 729.4	1 633.3	1 470.0
5		64-QAM	2/3	6		47 040	31 360	2 305.9	2 177.8	1 960.0
6			3/4				35 280	2 594.1	2 450.0	2 205.0
7			5/6				39 200	2 882.4	2 722.2	2 450.0
8		256-QAM	3/4	8		62 720	47 040	3 458.8	3 266.7	2 940.0
9			5/6				52 266	3 843.1	3 629.6	3 266.6
10		1024-QAM	3/4	10		78 400	58 800	4 323.5	4 083.3	3 675.0
11			5/6				65 333	4 803.9	4 537.0	4 083.3

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Table 28-95—HE-MCSs for optional non-OFDMA 160 MHz and 80+80 MHz, N_{SS} = 1

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 μs GI	1.6 μs GI	3.2 μs GI
0	1	BPSK	1/2	1	980	980	490	36.0	34.0	30.6
	0		1/2		1 960	1 960	980	72.1	68.1	61.3
1	1	QPSK	1/2	2	980	1 960	980	72.1	68.1	61.3
	0		1/2		1 960	3 920	1 960	144.1	136.1	122.5
2	N/A		3/4		1 960	3 920	2 940	216.2	204.2	183.8
3	1	16-QAM	1/2	4	980	3 920	1 960	144.1	136.1	122.5
	0		1/2		1 960	7 840	3 920	288.2	272.2	245.0
4	1		3/4		980	3 920	2 940	216.2	204.2	183.8
	0		3/4		1 960	7 840	5 880	432.4	408.3	367.5
5	N/A	64-QAM	2/3	6	1 960	11 760	7 840	576.5	544.4	490.0
6			3/4				8 820	648.5	612.5	551.3
7			5/6				9 800	720.6	680.6	612.5
8		256-QAM	3/4	8		15 680	11 760	864.7	816.7	735.0
9			5/6				13 066	960.7	907.4	816.6
10		1024-QAM	3/4	10		19 600	14 700	1 080.9	1 020.8	918.8
11			5/6				16 333	1 201.0	1 134.2	1 020.8

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Table 28-96—HE-MCSs for optional non-OFDMA 160 MHz and 80+80 MHz, N_{SS} = 2

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 μs GI	1.6 μs GI	3.2 μs GI
0	1	BPSK	1/2	1	980	1 960	980	72.1	68.1	61.3
	0		1/2		1 960	3 920	1 960	144.1	136.1	122.5
1	1	QPSK	1/2	2	980	3 920	1 960	144.1	136.1	122.5
	0		1/2		1 960	7 840	3 920	288.2	272.2	245.0
2	N/A		3/4		1 960	7 840	5 880	432.4	408.3	367.5
3	1	16-QAM	1/2	4	980	7 840	3 920	288.2	272.2	245.0
	0		1/2		1 960	15 680	7 840	576.5	544.4	490.0
4	1		3/4		980	7 840	5 880	432.4	408.3	367.5
	0		3/4		1 960	15 680	11 760	864.7	816.7	735.0
5	N/A	64-QAM	2/3	6	1 960	23 520	15 680	1 152.9	1 088.9	980.0
6			3/4				17 640	1 297.1	1 225.0	1 102.5
7			5/6				19 600	1 441.2	1 361.1	1 225.0
8		256-QAM	3/4	8		31 360	23 520	1 729.4	1 633.3	1 470.0
9			5/6				26 133	1 921.5	1 814.8	1 633.3
10		1024-QAM	3/4	10		39 200	29 400	2 161.8	2 041.7	1 837.5
11			5/6				32 666	2 401.9	2 268.5	2 041.6

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Table 28-97—HE-MCSs for optional non-OFDMA 160 MHz and 80+80 MHz, N_{SS} = 3

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 μs GI	1.6 μs GI	3.2 μs GI
0	N/A	BPSK	1/2	1	1 960	5 880	2 940	216.2	204.2	183.8
1		QPSK	1/2	2		11 760	5 880	432.4	408.3	367.5
2			3/4				8 820	648.5	612.5	551.3
3		16-QAM	1/2	4		23 520	11 760	864.7	816.7	735.0
4			3/4				17 640	1 297.1	1 225.0	1 102.5
5		64-QAM	2/3	6		35 280	23 520	1 729.4	1 633.3	1 470.0
6			3/4				26 460	1 945.6	1 837.5	1 653.8
7			5/6				29 400	2 161.8	2 041.7	1 837.5
8		256-QAM	3/4	8		47 040	35 280	2 594.1	2 450.0	2 205.0
9			5/6				39 200	2 882.4	2 722.2	2 450.0
10		1024-QAM	3/4	10		58 800	44 100	3 242.6	3 062.5	2 756.3
11			5/6				49 000	3 602.9	3 402.8	3 062.5

Table 28-98—HE-MCSs for optional non-OFDMA 160 MHz and 80+80 MHz, N_{SS} = 4

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 μs GI	1.6 μs GI	3.2 μs GI
0	N/A	BPSK	1/2	1	1 960	7 840	3 920	288.2	272.2	245.0
1		QPSK	1/2	2		15 680	7 840	576.5	544.4	490.0
2			3/4				11 760	864.7	816.7	735.0
3		16-QAM	1/2	4		31 360	15 680	1 152.9	1 088.9	980.0
4			3/4				23 520	1 729.4	1 633.3	1 470.0
5		64-QAM	2/3	6		47 040	31 360	2 305.9	2 177.8	1 960.0
6			3/4				35 280	2 594.1	2 450.0	2 205.0
7			5/6				39 200	2 882.4	2 722.2	2 450.0
8		256-QAM	3/4	8		62 720	47 040	3 458.8	3 266.7	2 940.0
9			5/6				52 266	3 843.1	3 629.6	3 266.6
10		1024-QAM	3/4	10		78 400	58 800	4 323.5	4 083.3	3 675.0
11			5/6				65 333	4 803.9	4 537.0	4 083.3

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Table 28-99—HE-MCSs for optional non-OFDMA 160 MHz and 80+80 MHz, N_{SS} = 5

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 μs GI	1.6 μs GI	3.2 μs GI
0	N/A	BPSK	1/2	1	1 960	9 800	4 900	360.3	340.3	306.3
1		QPSK	1/2	2		19 600	9 800	720.6	680.6	612.5
2			3/4				14 700	1 080.9	1 020.8	918.8
3		16-QAM	1/2	4		39 200	19 600	1 441.2	1 361.1	1 225.0
4			3/4				29 400	2 161.8	2 041.7	1 837.5
5		64-QAM	2/3	6		58 800	39 200	2 882.4	2 722.2	2 450.0
6			3/4				44 100	3 242.6	3 062.5	2 756.3
7			5/6				49 000	3 602.9	3 402.8	3 062.5
8		256-QAM	3/4	8		78 400	58 800	4 323.5	4 083.3	3 675.0
9			5/6				65 333	4 803.9	4 537.0	4 083.3
10		1024-QAM	3/4	10		98 000	73 500	5 404.4	5 104.2	4 593.8
11			5/6				81 666	6 004.9	5 671.3	5 104.1

Table 28-100—HE-MCSs for optional non-OFDMA 160 MHz and 80+80 MHz, N_{SS} = 6

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 μs GI	1.6 μs GI	3.2 μs GI
0	N/A	BPSK	1/2	1	1 960	11 760	5 880	432.4	408.3	367.5
1		QPSK	1/2	2		23 520	11 760	864.7	816.7	735.0
2			3/4				17 640	1 297.1	1 225.0	1 102.5
3		16-QAM	1/2	4		47 040	23 520	1 729.4	1 633.3	1 470.0
4			3/4				35 280	2 594.1	2 450.0	2 205.0
5		64-QAM	2/3	6		70 560	47 040	3 458.8	3 266.7	2 940.0
6			3/4				52 920	3 891.2	3 675.0	3 307.5
7			5/6				58 800	4 323.5	4 083.3	3 675.0
8		256-QAM	3/4	8		94 080	70 560	5 188.2	4 900.0	4 410.0
9			5/6				78 400	5 764.7	5 444.4	4 900.0
10		1024-QAM	3/4	10		11 7600	88 200	6 485.3	6 125.0	5 512.5
11			5/6				98 000	7 205.9	6 805.6	6 125.0

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Table 28-101—HE-MCSs for optional non-OFDMA 160 MHz and 80+80 MHz, N_{SS} = 7

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 μs GI	1.6 μs GI	3.2 μs GI
0	N/A	BPSK	1/2	1	1 960	13 720	6 860	504.4	476.4	428.8
1		QPSK	1/2	2		27 440	13 720	1 008.8	952.8	857.5
2			3/4				20 580	1 513.2	1 429.2	1 286.3
3		16-QAM	1/2	4		54 880	27 440	2 017.6	1 905.6	1 715.0
4			3/4				41 160	3 026.5	2 858.3	2 572.5
5		64-QAM	2/3	6		82 320	54 880	4 035.3	3 811.1	3 430.0
6			3/4				61 740	4 539.7	4 287.5	3 858.8
7			5/6				68 600	5 044.1	4 763.9	4 287.5
8		256-QAM	3/4	8		109 760	82 320	6 052.9	5 716.7	5 145.0
9			5/6				91 466	6 725.4	6 351.8	5 716.6
10		1024-QAM	3/4	10		137 200	102 900	7 566.2	7 145.8	6 431.3
11			5/6				114 333	8 406.8	7 939.8	7 145.8

Table 28-102—HE-MCSs for optional non-OFDMA 160 MHz and 80+80 MHz, N_{SS} = 8

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
								0.8 μs GI	1.6 μs GI	3.2 μs GI
0	N/A	BPSK	1/2	1	1 960	15 680	7 840	576.5	544.4	490.0
1		QPSK	1/2	2		31 360	15 680	1 152.9	1 088.9	980.0
2			3/4				23 520	1 729.4	1 633.3	1 470.0
3		16-QAM	1/2	4		62 720	31 360	2 305.9	2 177.8	1 960.0
4			3/4				47 040	3 458.8	3 266.7	2 940.0
5		64-QAM	2/3	6		94 080	62 720	4 611.8	4 355.6	3 920.0
6			3/4				70 560	5 188.2	4 900.0	4 410.0
7			5/6				78 400	5 764.7	5 444.4	4 900.0
8		256-QAM	3/4	8		125 440	94 080	6 917.6	6 533.3	5 880.0
9			5/6				104 533	7 686.3	7 259.2	6 533.3
10		1024-QAM	3/4	10		156 800	117 600	8 647.1	8 166.7	7 350.0
11			5/6				130 666	9 607.8	9 074.0	8 166.6

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Annex B

(normative)

Protocol Implementation Conformance Statement (PICS) proforma

B.4 PICS proforma—IEEE Std 802.11-<year>

Change B.4.3 as follows:

B.4.3 IUT configuration

Item	IUT configuration	References	Status	Support
	What is the configuration of the IUT?			
* CFOFDM	Orthogonal frequency division multiplexing (OFDM) PHY	—	O.2 CFHT5G:M CFTVHT:M CFHEW:M	Yes ☐ No ☐
...				
*CFHT	High throughput (HT) PHY	9.4.2.56 (HT Capabilities element)	O.2 CFVHT:M CFHEW:M	Yes ☐ No ☐
...				
*CFESM	Extended spectrum management	10.21.3 (Operation with operating classes)	O CFVHT OR CFTVHT:M	Yes ☐ No ☐
*CFHE	High Efficiency WLAN (HEW) operation	9.4.2.218 (HE Capabilities element)	O CFHEW20:M CFHEW80:M	Yes ☐ No ☐
CFHEW2G4	HEW operation in 2.4 GHz band	Clause 28 (High Efficiency (HE) PHY specification)	CFHEW:O.6	Yes ☐ No ☐
CFHEW5G	HEW Operation in 5 GHz band	Clause 28 (High Efficiency (HE) PHY specification)	CFHEW:O.6	Yes ☐ No ☐
CFHEW20	HEW operation with 20 MHz only	Clause 28 (High Efficiency (HE) PHY specification)	CFIndSTA and CFHEW:M	Yes ☐ No ☐

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B.4.3 IUT configuration *(continued)*

Item	IUT configuration	References	Status	Support
CFHEW80	HEW Operation with capability of 80 MHz or higher channel width	Clause 28 (High Efficiency (HE) PHY specification)	CFAP and CFHEW and CFVHT:M CFIndSTA and CFHEW and CFVHT:M	Yes ☐ No ☐

B.4.4 MAC protocol

Change B.4.4.1 as follows:

B.4.4.1 MAC protocol capabilities

Item	Protocol capability	References	Status	Support
	Are the following MAC protocol capabilities supported?			
PC6	Fragmentation	10.3 (DCF), 10.5 (Fragmentation)	~~M~~	~~Yes ☐ No ☐~~
PC6.1	Static fragmentation	10.3 (DCF), 10.5 (Fragmentation)	M	Yes ☐ No ☐
PC6.1	Dynamic fragmentation	10.3 (DCF), 10.5 (Fragmentation)		
PC6.2.1	Dynamic fragmentation level 0		CFHEW:M	Yes ☐ No ☐
PC6.2.2	Dynamic fragmentation level 1	27.3.3.2 (Level 1 dynamic fragmentation)	CFHEW:O	Yes ☐ No ☐
PC6.2.3	Dynamic fragmentation level 2	27.3.3.3 (Level 2 dynamic fragmentation)	CFHEW:O	Yes ☐ No ☐
PC6.2.4	Dynamic fragmentation level 3	27.3.3.4 (Level 3 dynamic fragmentation)	CFHEW:O	Yes ☐ No ☐
PC7	Defragmentation	10.3 (DCF), 10.6 (Defragmentation)	M	Yes ☐ No ☐

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Change B.4.4.2 as follows:

B.4.4.2 MAC frames

Item	MAC frame	References	Status	Support
	Is transmission of the following MAC frames supported?	9 (Frame formats)		
FT42	Transmission of Operating Mode Notification frame and Operating Mode Notification element	9.6.23.4 (Operating Mode Notification frame format), 9.4.2.166 (Operating Mode Notification element), 11.42 (Notification of operating mode changes)	O	Yes ☐ No ☐ N/A ☐
FT43	Trigger frame		CFHEW:M	Yes ☐ No ☐ N/A ☐
	Is reception of the following MAC frames supported?	9 (Frame formats)		
FR41	VHT NDP Announcement	9 (Frame formats)	VHTM4.2:M TVHTM4.2:M	Yes ☐ No ☐ N/A ☐
FR42	Beamforming Report Poll	9 (Frame formats)	VHTM4.2:O VHTM4.4:M TVHTM4.2:O TVHTM4.4:M	Yes ☐ No ☐ N/A ☐
FR43	Reception of Operating Mode Notification frame and Operating Mode Notification element	9.6.23.4 (Operating Mode Notification frame format), 9.4.2.166 (Operating Mode Notification element), 11.42 (Notification of operating mode changes)	CFVHT:M CFTVHT:M	Yes ☐ No ☐ N/A ☐
FR44	Trigger frame	9 (Frame formats)	CFHEW:M	Yes ☐ No ☐ N/A ☐

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Change B.4.4.10 as follows:

B.4.10 QoS base functionality

Item	Protocol capability	References	Status	Support
...				
QB4	Block acknowledgments (block ack)			
...				
QB4.4	Multi-TID Block Ack	9.3.1.9.4 (Multi-TID BlockAck variant)	CFQoS:O CFHT OR CFTVHT:M	Yes ☐ No ☐ N/A ☐
QB4.5	Multi-STA BlockAck	9.3.1.9.7 (Multi-STA BlockAck variant)		
QB4.5.1	Transmission of Multi-STA BlockAck	9.3.1.9.7 (Multi-STA BlockAck variant)	CFAP and CFHEW: M	Yes ☐ No ☐ N/A ☐
QB4,5,2	Reception of Multi-STA BlockAck	9.3.1.9.7 (Multi-STA BlockAck variant)	CFIndSTA and CFHEW: M	Yes ☐ No ☐ N/A ☐
...				

Insert a new subclause B.4.27 as follows:

B.4.27 High Efficiency WLAN (HEW) features

B.4.27.1 HEW MAC features

Item	Protocol capability	References	Status	Support
	Are the following MAC protocol features supported?			
HEWM1	HEW capabilities signaling			
HEWM1.1	HE Capabilities element	9.4.2.218 (HE Capabilities element)	CFHEW:M	Yes ☐ No ☐ N/A ☐
HEWM1.2	Signaling of STA capabilities in Probe Request, (Re)Association Request frames	9.3.3.6 (Association Request frame format), 9.3.3.8 (Reassociation Request frame format), 9.3.3.10 (Probe Request frame format), 9.4.2.218 (HE Capabilities element)	(CFHEW AND CFIndepSTA): M	Yes ☐ No ☐ N/A ☐

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B.4.27.1 HEW MAC features *(continued)*

Item	Protocol capability	References	Status	Support
HEWM1.3	Signaling of STA and BSS capabilities in Beacon, Probe Response, (Re)Association Response frames	9.3.3.3 (Beacon frame format), 9.3.3.7 (Association Response frame format), 9.3.3.9 (Reassociation Response frame format), 9.3.3.11 (Probe Response frame format), 9.4.2.218 (HE Capabilities element)	(CFVHT AND CFAP):M	Yes ☐ No ☐ N/A ☐
HEWM2	Signaling of HE operation	9.4.2.219 (HE Operation element)	(CFHEW AND CFAP):M	Yes ☐ No ☐ N/A ☐
HEWM3	A-MPDU with multiple TIDs	27.10.4 (A-MPDU with multiple TIDs)	CFHEW:O	Yes ☐ No ☐ N/A ☐
HEWM4	HE variant HT Control			
HEWM4.1	UL MU Response Scheduling	9.2.4.6.4.2 (UL MU response scheduling)	CFHEW:O	Yes ☐ No ☐ N/A ☐
HEWM4.2	Operating Mode	9.2.4.6.4.3 (Operating Mode)	CFHEW:O	Yes ☐ No ☐ N/A ☐
HEWM4.3	HE Link Adaptation	9.2.4.6.4.4 (HE link adaptation)	CFHEW:O	Yes ☐ No ☐ N/A ☐
HEWM4.4	Buffer Status Report	9.2.4.6.4.5 (Buffer Status Report (BSR))	CFHEW:O	Yes ☐ No ☐ N/A ☐
HEWM4.5	UL Power Headroom	9.2.4.6.4.6 (UL power headroom)	CFHEW:M	Yes ☐ No ☐ N/A ☐
HEWM5	Trigger			
HEWM5.1	Basic Trigger	9.3.1.23.1 (Basic Trigger variant)	CFHEW:M	Yes ☐ No ☐ N/A ☐
HEWM5.2	Beamforming Report Poll	9.3.1.23.2 (Beamforming Report Poll variant)	CFHEW:M	Yes ☐ No ☐ N/A ☐
HEWM5.3	MU-BAR	9.3.1.23.3 (MU-BAR variant)	CFHEW:O	Yes ☐ No ☐ N/A ☐
HEWM5.4	MU-RTS transmission	9.3.1.23.4 (MU-RTS variant)	CFHEW:O	Yes ☐ No ☐ N/A ☐

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B.4.27.1 HEW MAC features *(continued)*

Item	Protocol capability	References	Status	Support
HEWM5.5	MU-RTS reception	9.3.1.23.4 (MU-RTS variant)	CFHEW:M	Yes ☐ No ☐ N/A ☐
HEWM5.6	BSRP	9.3.1.23.5 (BSRP variant)	CFHEW:O	Yes ☐ No ☐ N/A ☐
HEWM6	Transmit beamforming			
HEWM6.1	SU beamformer capable	9.4.2.218 (HE Capabilities element)	CFHEW:O	Yes ☐ No ☐ N/A ☐
HEWM6.2	SU beamformee capable	9.4.2.218 (HE Capabilities element)	CFHEW:O	Yes ☐ No ☐ N/A ☐
HEWM6.3	MU beamformer capable	9.4.2.218 (HE Capabilities element)	CFAP AND CFHEWM6.1: O	Yes ☐ No ☐ N/A ☐
HEWM6.4	MU beamformee capable	9.4.2.218 (HE Capabilities element)	CFIndepSTA and VHTM7.2: O	Yes ☐ No ☐ N/A ☐
HEWM6.5	Transmission of HE NDP	27.6 (HE sounding protocol)	HEWM6.1:M	Yes ☐ No ☐ N/A ☐
HEWM6.6	Reception of HE NDP	27.6 (HE sounding protocol)	HEWM6.2:M	Yes ☐ No ☐ N/A ☐
HEWM6.7	Transmission of Trigger frame	27.6 (HE sounding protocol)	HEWM6.1:O	Yes ☐ No ☐ N/A ☐
HEWM6.8	Reception of Trigger frame	27.6 (HE sounding protocol)	HEWM6.7:M	Yes ☐ No ☐ N/A ☐
HEWM7	Sounding protocol			
HEWM7.1	HE Sounding Protocol as SU beamformer	27.6 (HE sounding protocol)	HEWM6.1:M	Yes ☐ No ☐ N/A ☐
HEWM7.2	HE Sounding Protocol as SU beamformee	27.6 (HE sounding protocol)	HEWM6.2:M	Yes ☐ No ☐ N/A ☐
HEWM7.3	HE Sounding Protocol as MU beamformer	27.6 (HE sounding protocol)	HEWM6.4:M	Yes ☐ No ☐ N/A ☐
HEWM7.4	HE Sounding Protocol as MU beamformee	27.6 (HE sounding protocol)	HEWM6.5:M	Yes ☐ No ☐ N/A ☐
HEWM8	NAV update	27.2.2 (Updating two NAVs)		
HEWM8.1	Update basic NAV	27.2.2 (Updating two NAVs)	CFHEW:M	Yes ☐ No ☐ N/A ☐

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B.4.27.1 HEW MAC features *(continued)*

Item	Protocol capability	References	Status	Support
HEWM8.2	Update IntraBSS NAV	27.2.2 (Updating two NAVs)	CFAP AND CFHEW: O CFIndSTA AND CFHEW: M	Yes ☐ No ☐ N/A ☐
HEWM9	OFDMA-based random access	27.5.2.6 (UL OFDMA-based random access)	CFHEW: O	Yes ☐ No ☐ N/A ☐
HEWM10	TWT operation	27.7 (TWT operation)	CFHEW: O	Yes ☐ No ☐ N/A ☐

B.4.27.2 HEW PHY features

Item	Protocol capability	References	Status	Support
	Are the following PHY protocol features supported?			
HEWP1	PHY operating modes			
HEWP1.1	Operation according to Clause 17 (Orthogonal frequency division multiplexing (OFDM) PHY specification) (Orthogonal frequency division multiplexing (OFDM) PHY specification), Clause 19 (High Throughput (HT) PHY specification) (High Throughput) and/or Clause 21 (Very High Throughput (VHT) PHY specification)	28.1.1 (Introduction to the HE PHY)	CFHEW5G and (CFAP or CFHEW80):M	Yes ☐ No ☐ N/A ☐
HEWP1.2	Operation according Clause 19 (High Throughput (HT) PHY specification) (High Throughput) in 5GHz	28.1.1 (Introduction to the HE PHY)	CFHEW5G and CFHEW20: M	Yes ☐ No ☐ N/A ☐
HEWP1.3	Operation according Clause 19 (High Throughput (HT) PHY specification) (High Throughput) in 2.4 GHz	28.1.1 (Introduction to the HE PHY)	CFHEW2G4: M	Yes ☐ No ☐ N/A ☐
HEWP2	HE PPDU format	28.1.4 (PPDU formats)		
HEWP2.1	HE SU PPDU	28.1.4 (PPDU formats)		Yes ☐ No ☐ N/A ☐
HEWP2.2	HE extended range SU PPDU	28.1.4 (PPDU formats)		Yes ☐ No ☐ N/A ☐
HEWP2.3	HE MU PPDU	28.1.4 (PPDU formats)		Yes ☐ No ☐ N/A ☐
HEWP2.4	HE trigger-based PPDU	28.1.4 (PPDU formats)		Yes ☐ No ☐ N/A ☐
HEWP3	BSS bandwidth			

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B.4.27.2 HEW PHY features *(continued)*

Item	Protocol capability	References	Status	Support
HEWP3.1	20 MHz operation	27.16 (HE BSS operation)	CFHEW: M	Yes ☐ No ☐ N/A ☐
HEWP3.2	40 MHz operation	27.16 (HE BSS operation)	CFHEW80 and CFHEW5G:M CFHEW2G4:O	Yes ☐ No ☐ N/A ☐
HEWP3.3	80 MHz operation	27.16 (HE BSS operation)	CFHEW80 and CFHEW5G:M	Yes ☐ No ☐ N/A ☐
HEWP3.4	160 MHz operation	27.16 (HE BSS operation)	CFHEW80 and CFHEW5G:O HEWP3.5:M	Yes ☐ No ☐ N/A ☐
HEWP3.5	80+80 MHz operation	27.16 (HE BSS operation)	CFHEW80 and CFHEW5G:O	Yes ☐ No ☐ N/A ☐
HEWP4	PHY timing information			
HEWP4.1	Values in 20 MHz channel	28.3.8 (Timing-related parameters)	HEWP4.1:M	Yes ☐ No ☐ N/A ☐
HEWP4.2	Values in 40 MHz channel	28.3.8 (Timing-related parameters)	HEWP4.2:M	Yes ☐ No ☐ N/A ☐
HEWP4.3	Values in 80 MHz channel	28.3.8 (Timing-related parameters)	HEWP4.3:M	Yes ☐ No ☐ N/A ☐
HEWP4.4	Values in 160 MHz channel	28.3.8 (Timing-related parameters)	HEWP4.4:M	Yes ☐ No ☐ N/A ☐
HEWP4.5	Values in 80+80 MHz channel	28.3.8 (Timing-related parameters)	HEWP4.5:M	Yes ☐ No ☐ N/A ☐
HEWP5	STBC	28.3.11.10 (Space-time block coding)	CFHEW:O	Yes ☐ No ☐ N/A ☐
HEWP6	Tone allocation			
HEWP6.1	26-tone RU mapping		CFHEW:M	Yes ☐ No ☐ N/A ☐
HEWP6.2	52-tone RU mapping		CFHEW:M	Yes ☐ No ☐ N/A ☐
HEWP6.3	106-tone RU mapping		CFHEW:M	Yes ☐ No ☐ N/A ☐
HEWP6.4	242-tone RU mapping		CFHEW80:M CFHEW20:O	Yes ☐ No ☐ N/A ☐
HEWP6.5	484-tone RU mapping		CFHEW80 and HEWP3.2:M	Yes ☐ No ☐ N/A ☐
HEWP6.6	996-tone RU mapping		CFHEW80 and HEWP3.3:M CFHEW80 and HEWP3.4:M	Yes ☐ No ☐ N/A ☐
HEWP6.7	2x996-tone RU mapping		CFHEW80 and HEWP3.4:M	Yes ☐ No ☐ N/A ☐
HEWP7	Coding			

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B.4.27.2 HEW PHY features *(continued)*

Item	Protocol capability	References	Status	Support
HEWP10.1	BCC with less than 4 spatial streams		(HEWP6.1 or HEWP6.2 or HEWP6.3 or HEWP6.4):M (HEWP3.1 and HEWP2.1):M	Yes ☐ No ☐ N/A ☐
HEWP10.2	LDPC with more than 4 spatial streams		CFHEW80:M CFHEW20:O	Yes ☐ No ☐ N/A ☐
HEWP10.3	LDPC with less or equal to 4 spatial streams		(HEWP6.5 or HEWP6.6 or HEWP6.7):M ((HEWP3.2 or HEWP3.3 or HEWP3.4 or HEWP3.5) and HEWP2.1):M (HEWP6.1 or HEWP6.2 or HEWP6.3 or HEWP6.4):O (HEWP3.1 and HEWP2.1):O CFHEW20: O	Yes ☐ No ☐ N/A ☐
HEWP11	STBC		CFHEW: O	Yes ☐ No ☐ N/A ☐
HEWP12	Coding and modulation schemes			
HEWP12.1	For 26-, 52-, 106-, 242-, 484- and 996-tone mapping			
HEWP12.1.1	HE-MCS with Index 0-7 and N_{SS} = 1	28.5 (Parameters for HE-MCSs)	CFHEW: M	Yes ☐ No ☐ N/A ☐
HEWP12.1.2	HE-MCS with Index 0-8 and N_{SS} = 1	28.5 (Parameters for HE-MCSs)	HEWP12.1.1:O	Yes ☐ No ☐ N/A ☐
HEWP12.1.3	HE-MCS with Index 0-9 and N_{SS} = 1	28.5 (Parameters for HE-MCSs)	HEWP12.1.2:O	Yes ☐ No ☐ N/A ☐
HEWP12.1.4	HE-MCS with Index 0-7 and N_{SS} = 2	28.5 (Parameters for HE-MCSs)	CFHEW:O	Yes ☐ No ☐ N/A ☐
HEWP12.1.5	HE-MCS with Index 0-8 and N_{SS} = 2	28.5 (Parameters for HE-MCSs)	HEWP12.1.4:O	Yes ☐ No ☐ N/A ☐
HEWP12.1.6	HE-MCS with Index 0-9 and N_{SS} = 2	28.5 (Parameters for HE-MCSs)	HEWP12.1.5:O	Yes ☐ No ☐ N/A ☐
HEWP12.1.7	HE-MCS with Index 0-7 and N_{SS} = 3	28.5 (Parameters for HE-MCSs)	CFHEW:O	Yes ☐ No ☐ N/A ☐

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B.4.27.2 HEW PHY features *(continued)*

Item	Protocol capability	References	Status	Support
HEWP12.1.8	HE-MCS with Index 0-8 and N_{SS} = 3	28.5 (Parameters for HE-MCSs)	HEWP12.1.7:O	Yes ☐ No ☐ N/A ☐
HEWP12.1.9	HE-MCS with Index 0-9 and N_{SS} = 3	28.5 (Parameters for HE-MCSs)	HEWP12.1.8:O	Yes ☐ No ☐ N/A ☐
HEWP12.1.10	HE-MCS with Index 0-7 and N_{SS} = 4	28.5 (Parameters for HE-MCSs)	CFHEW:O	Yes ☐ No ☐ N/A ☐
HEWP12.1.11	HE-MCS with Index 0-8 and N_{SS} = 4	28.5 (Parameters for HE-MCSs)	HEWP12.1.10: O	Yes ☐ No ☐ N/A ☐
HEWP12.1.12	HE-MCS with Index 0-9 and N_{SS} = 4	28.5 (Parameters for HE-MCSs)	HEWP12.1.11: O	Yes ☐ No ☐ N/A ☐
HEWP12.1.13	HE-MCS with Index 0-7 and N_{SS} = 5	28.5 (Parameters for HE-MCSs)	CFHEW:O	Yes ☐ No ☐ N/A ☐
HEWP12.1.14	HE-MCS with Index 0-8 and N_{SS} = 5	28.5 (Parameters for HE-MCSs)	HEWP12.1.13: O	Yes ☐ No ☐ N/A ☐
HEWP12.1.15	HE-MCS with Index 0-9 and N_{SS} = 5	28.5 (Parameters for HE-MCSs)	HEWP12.1.14: O	Yes ☐ No ☐ N/A ☐
HEWP12.1.16	HE-MCS with Index 0-7 and N_{SS} = 6	28.5 (Parameters for HE-MCSs)	CFHEW:O	Yes ☐ No ☐ N/A ☐
HEWP12.1.17	HE-MCS with Index 0-8 and N_{SS} = 6	28.5 (Parameters for HE-MCSs)	HEWP12.1.16: O	Yes ☐ No ☐ N/A ☐
HEWP12.1.18	HE-MCS with Index 0-9 and N_{SS} = 6	28.5 (Parameters for HE-MCSs)	HEWP12.1.17: O	Yes ☐ No ☐ N/A ☐
HEWP12.1.19	HE-MCS with Index 0-7 and N_{SS} = 7	28.5 (Parameters for HE-MCSs)	CFHEW:O	Yes ☐ No ☐ N/A ☐
HEWP12.1.20	HE-MCS with Index 0-8 and N_{SS} = 7	28.5 (Parameters for HE-MCSs)	HEWP12.1.19: O	Yes ☐ No ☐ N/A ☐
HEWP12.1.21	HE-MCS with Index 0-9 and N_{SS} = 7	28.5 (Parameters for HE-MCSs)	HEWP12.1.20: O	Yes ☐ No ☐ N/A ☐
HEWP12.1.22	HE-MCS with Index 0-7 and N_{SS} = 8	28.5 (Parameters for HE-MCSs)	CFHEW:O	Yes ☐ No ☐ N/A ☐
HEWP12.1.23	HE-MCS with Index 0-8 and N_{SS} = 8	28.5 (Parameters for HE-MCSs)	HEWP12.1.22: O	Yes ☐ No ☐ N/A ☐
HEWP12.1.24	HE-MCS with Index 0-9 and N_{SS} = 8	28.5 (Parameters for HE-MCSs)	HEWP12.1.23: O	Yes ☐ No ☐ N/A ☐

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B.4.27.2 HEW PHY features *(continued)*

Item	Protocol capability	References	Status	Support
HEWP12.2	For 242-, 484- and 996-tone plan			
HEWP12.2.1	HE-MCS with Index 0-10 and $N_{SS} = 1$	28.5 (Parameters for HE-MCSs)	CFHEW80: O	Yes ☐ No ☐ N/A ☐
HEWP12.2.2	HE-MCS with Index 0-11 and $N_{SS} = 1$	28.5 (Parameters for HE-MCSs)	HEWP12.2.1:O	Yes ☐ No ☐ N/A ☐
HEWP12.2.3	HE-MCS with Index 0-10 and $N_{SS} = 2$	28.5 (Parameters for HE-MCSs)	CFHEW80: O	Yes ☐ No ☐ N/A ☐
HEWP12.2.4	HE-MCS with Index 0-11 and $N_{SS} = 2$	28.5 (Parameters for HE-MCSs)	HEWP12.2.3:O	Yes ☐ No ☐ N/A ☐
HEWP12.2.5	HE-MCS with Index 0-10 and $N_{SS} = 3$	28.5 (Parameters for HE-MCSs)	CFHEW80: O	Yes ☐ No ☐ N/A ☐
HEWP12.2.6	HE-MCS with Index 0-11 and $N_{SS} = 3$	28.5 (Parameters for HE-MCSs)	HEWP12.2.5:O	Yes ☐ No ☐ N/A ☐
HEWP12.2.7	HE-MCS with Index 0-10 and $N_{SS} = 4$	28.5 (Parameters for HE-MCSs)	CFHEW80: O	Yes ☐ No ☐ N/A ☐
HEWP12.2.8	HE-MCS with Index 0-11 and $N_{SS} = 4$	28.5 (Parameters for HE-MCSs)	HEWP12.2.7:O	Yes ☐ No ☐ N/A ☐
HEWP12.2.9	HE-MCS with Index 0-10 and $N_{SS} = 5$	28.5 (Parameters for HE-MCSs)	CFHEW80: O	Yes ☐ No ☐ N/A ☐
HEWP12.2.10	HE-MCS with Index 0-11 and $N_{SS} = 5$	28.5 (Parameters for HE-MCSs)	HEWP12.2.9:O	Yes ☐ No ☐ N/A ☐
HEWP12.2.11	HE-MCS with Index 0-10 and $N_{SS} = 6$	28.5 (Parameters for HE-MCSs)	CFHEW80: O	Yes ☐ No ☐ N/A ☐
HEWP12.2.12	HE-MCS with Index 0-11 and $N_{SS} = 6$	28.5 (Parameters for HE-MCSs)	HEWP12.2.11: O	Yes ☐ No ☐ N/A ☐
HEWP12.2.13	HE-MCS with Index 0-10 and $N_{SS} = 7$	28.5 (Parameters for HE-MCSs)	CFHEW80: O	Yes ☐ No ☐ N/A ☐
HEWP12.2.14	HE-MCS with Index 0-11 and $N_{SS} = 7$	28.5 (Parameters for HE-MCSs)	HEWP12.2.13: O	Yes ☐ No ☐ N/A ☐
HEWP12.2.15	HE-MCS with Index 0-10 and $N_{SS} = 8$	28.5 (Parameters for HE-MCSs)	CFHEW80: O	Yes ☐ No ☐ N/A ☐
HEWP12.2.16	HE-MCS with Index 0-11 and $N_{SS} = 8$	28.5 (Parameters for HE-MCSs)	HEWP12.2.15: O	Yes ☐ No ☐ N/A ☐

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Annex C

(normative)

ASN.1 encoding of the MAC and PHY MIB

C.3 MIB Detail

Change the dot11smt object as follows:

```
dot11smt OBJECT IDENTIFIER ::= { ieee802dot11 1 }
…
-- dot11STACivicLocationConfigTable::= { dot11smt 37 }
-- dot11HEStationConfigTable::= { dot11smt <ANA> }
-- dot11PPEThresholdsMappingsTable::= { dot11smt <ANA> }
…
```

Change Dot11StationConfigEntry as follows:

```
Dot11StationConfigEntry ::= SEQUENCE
    {
        …,
        dot11FutureChannelGuidanceActivated                    TruthValue,
        dot11HEOptionImplemented                               TruthValue,
    }
…
```

Insert the following after the dot11FutureChannelGuidanceActivated OBJECT-TYPE element in the Dot11StationConfig TABLE:

```
dot11HEOptionImplemented OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
    "This is a capability variable.
    Its value is determined by device capabilities.

    This attribute indicates whether the entity is HE Capable."
::= { dot11StationConfigEntry <ANA>}
```

Insert the following after the dot11S1GStationConfig TABLE:

```
-- ********************************************************************
-- * dot11HEStationConfig TABLE
-- ********************************************************************

dot11HEStationConfigTable OBJECT-TYPE
    SYNTAX SEQUENCE OF Dot11HEStationConfigEntry
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION
        "Station Configuration attributes. In tabular form to allow for multiple
        instances on an agent."
    ::= { dot11smt <ANA> }

dot11HEStationConfigEntry OBJECT-TYPE
    SYNTAX Dot11HEStationConfigEntry
    MAX-ACCESS not-accessible
```

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```
    STATUS current
    DESCRIPTION
        "An entry (conceptual row) in the dot11HEStationConfig Table.

        ifIndex - Each IEEE 802.11 interface is represented by an ifEntry. Inter-
        face tables in this MIB module are indexed by ifIndex."
    INDEX { ifIndex }
    ::= { dot11HEStationConfigTable 1 }

Dot11HEStationConfigEntry ::=
    SEQUENCE {
        dot11HEULMUResponseSchedulingOptionImplemented        TruthValue,
        dot11ULMUMIMOOptionImplemented                        TruthValue,
        dot11OFDMARandomAccessOptionImlemented                TruthValue,
        dot11HEControlFieldOptionImplemented                  TruthValue,
        dot11OMIOptionImplemented                             TruthValue,
        dot11HEMCSFeedbackOptionImplemented                   TruthValue,
        dot11HEDynamicFragmentationImplemented                TruthValue,
        dot11AMPDUwithMultipleTIDOptionImplemented            TruthValue,
        dot11MPDUAskedforAckInMultiTIDAMPDU                   TruthValue,
        dot11DurationRTSThreshold                             Unsigned32,
        dot11PPEThresholdsRequired                            TruthValue,
        dot11IntraPPDUPowerSaveOptionActivated                TruthValue,
        dot11AMSDUFragmentationOptionImplemented              TruthValue
        }

dot11HEULMUResponseSchedulingOptionImplemented OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.

        This attribute, when true, indicates that the station implementation is
        capable of receiving frames with an UL MU response scheduling A-Control
        field. The capability is disabled, otherwise."
    DEFVAL { false }
    ::= { dot11HEStationConfigEntry 1}

dot11ULMUMIMOOptionImplemented OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.

        This attribute, when true, indicates that the station implementation is
        capable of a full bandwidth UL MU-MIMO transmission. The capability is
        disabled, otherwise."
    DEFVAL { false }
    ::= { dot11HEStationConfigEntry 2}

dot11OFDMARandomAccessOptionImlemented OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.

        This attribute, when true, indicates that the station implementation is
        capable of an OFDMA random access operation. The capability is disabled,
```


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```
        otherwise."
    DEFVAL { false }
    ::= { dot11HEStationConfigEntry 3}

dot11HEControlFieldOptionImplemented OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.

        This attribute, when true, indicates that the station implementation is
        capable of receiving the HE variant HT Control field. The capability is
        disabled, otherwise."
    DEFVAL { false }
    ::= { dot11HEStationConfigEntry 4}

dot11OMIOptionImplemented OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.

        This attribute, when true, indicates that the station implementation is
        capable of generating frames with an OMI A-Control field. The capability
        is disabled, otherwise."
    DEFVAL { false }
    ::= { dot11HEStationConfigEntry 5}

dot11HEMCSFeedbackOptionImplemented OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.

        This attribute indicates the MCS feed back capability supported by the
        station implementation."
    DEFVAL { false }
    ::= { dot11HEStationConfigEntry 6}

dot11HEDynamicFragmentationImplemented OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.

        This attribute, when true, indicates that the STA implementation is
        capable of receiving dynamic fragments. The capability is disabled,
        otherwise"
    DEFVAL { false }
    ::= { dot11HEStationConfigEntry 7}

dot11AMPDUwithMultipleTIDOptionImplemented OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
```

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```
        "This is a capability variable.
        Its value is determined by device capabilities.

        This attribute, when true, indicates that the station implementation is
        capable of generating an A-MPDU that contains QoS Data frames with two or
        more different TID values. The capability is disabled, otherwise."
    DEFVAL { false }
    ::= { dot11HEStationConfigEntry 8}

dot11MPDUAskedforAckInMultiTIDAMPDU OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.

        This attribute, when true, indicates that the station implementation is
        capable of receiving a multi-TID A-MPDU that can solicit either Ack or
        BlockAck, or both. The capability is disabled, otherwise."
    DEFVAL { false }
    ::= { dot11HEStationConfigEntry 9}

dot11DurationRTSThreshold OBJECT-TYPE
    SYNTAX Unsigned32 (0..1023)
    UNITS "32 microseconds"
    MAX-ACCESS read-write
    STATUS current
    DESCRIPTION
        "This is a control variable.
        It is written by an external management entity or by the MAC upon receiv-
        ing duration-based RTS threshold notification frame.
        Changes take effect as soon as practical in the implementation.

        This attribute indicates the duration of the transmission or TXOP above
        which an RTS/CTS handshake is performed. Value zero means the RTS should
        be always used for TxOP transmission. Value 1023 means this feature is
        disabled"
    DEFVAL { 1023 }
    ::= { dot11HEStationConfigEntry 10}

dot11PPEThresholdsRequired OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.
        This attribute, when true, indicates that Post-FEC Padding and Packet
        Extension Thresholds exist and are provided in dot11PPEThreshold-
        sTable(#1313)."
    DEFVAL { false }
    ::= { dot11HEStationConfigEntry 11}

dot11IntraPPDUPowerSaveOptionActivated OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
        Its value is determined by device capabilities.

        This attribute, when true, indicates that the station implementation is
        capable of Intra PPDU Power Save operation. The capability is disabled,
```


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```
        otherwise."
    DEFVAL { false }
    ::= { dot11HEStationConfigEntry 12}

dot11AMSDUFragmentationOptionImplemented OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable. Its value is determined by device
         capabilities.

         This attribute, when true, indicates that the STA implementation is
         capable of receiving dynamic fragments of A-MSDUs. The capability is
         disabled, otherwise"
    DEFVAL { false }
::= { dot11HEStationConfigEntry 13}

-- ********************************************************************
-- * End of dot11HEStationConfigTable TABLE
-- ********************************************************************

-- ********************************************************************
-- * dot11PPEThresholdsMappings TABLE
-- ********************************************************************
dot11PPEThresholdsMappingsTable OBJECT-TYPE
    SYNTAX SEQUENCE OF Dot11PPEThresholdsMappingsEntry
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION
        "Conceptual table for PPE Thresholds Mappings. The MIB supports the
         ability to share separate PPE Thresholds for each NSS/RU pair. The
         Thresholds Mappings Table contains one entry for each NSS/RU pair
         and contains two fields for each entry: PPET8 and PPET16. The PPE
         Thresholds mappings are logically WRITE-ONLY. Attempts to read the
         entries in this table return unsuccessful status and values of null or 0.
         The default value for all PPET8 fields is NONE."
    REFERENCE "IEEE Std 802.11-<year>, 27.12 (HE PPDU post FEC padding and packet
        extension)"
::= { dot11smt <ANA>}

dot11PPEThresholdsMappingsEntry OBJECT-TYPE
    SYNTAX Dot11PPEThresholdsMappingsEntry
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION
        "An Entry (conceptual row) in the PPE Thresholds Mappings Table.
         ifIndex - Each IEEE Std 802.11 interface is represented by an ifEntry.
         Interface tables in this MIB module are indexed by ifIndex."
    INDEX { ifIndex, dot11PPEThresholdsMappingIndex }
::= { dot11PPEThresholdsMappingsTable 1 }

Dot11PPEThresholdsMappingsEntry ::= SEQUENCE {
    dot11PPEThresholdsMappingIndex                  Unsigned32,
    dot11PPEThresholdsMappingNSS                    Integer,
    dot11PPEThresholdsMappingRUIndex                Integer,
    dot11PPEThresholdsMappingPPET8                  Integer,
    dot11PPEThresholdsMappingPPET16                 Integer,
    dot11PPEThresholdsMappingStatus                 RowStatus}

dot11PPEThresholdsMappingIndex OBJECT-TYPE
    SYNTAX Unsigned32
    MAX-ACCESS not-accessible
    STATUS current
```

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```
    DESCRIPTION
    "The auxiliary variable used to identify instances of the columnar objects
     in the PPE Thresholds Mappings Table."
::= { dot11PPEThresholdsMappingsEntry 1 }

dot11PPEThresholdsMappingNSS OBJECT-TYPE
    SYNTAX Integer
    MAX-ACCESS read-create
    STATUS current
    DESCRIPTION
        "The NSS value portion of the NSS/RU pair for which the values from this
         Thresholds mapping entry are to be used."
::= { dot11PPEThresholdsMappingsEntry 2 }

dot11PPEThresholdsMappingRUIndex OBJECT-TYPE
    SYNTAX Integer
    MAX-ACCESS read-create
    STATUS current
    DESCRIPTION
        "The index of the RU value portion of the NSS/RU pair for which the values
         from this Thresholds mapping entry are to be used. The index values
         map to an RU as follows: RU Index of 0 is 996 tones, 1 is 448 tones,
         2 is 996 tones, 3 is 2x996 tones."
::= { dot11PPEThresholdsMappingsEntry 3 }

dot11PPEThresholdsMappingPPET8 OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-create
    STATUS current
    DESCRIPTION
        "An index that determines a constellation value at or above which a
         Post FEC Padding and Packet Extension value of at least 8 us is
         required for the given NSS/RU pair corresponding to the row of the
         entry. The index values are mapped as follows: 0 is BPSK, 1 is QPSK,
         2 is 16-QAM, 3 is 64-QAM, 4 is 256-QAM, 5 is 1024-QAM,
         6 is reserved, 7 is the special value of NONE."
::= { dot11PPEThresholdsMappingsEntry 4 }

dot11PPEThresholdsMappingPPET16 OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-create
    STATUS current
    DESCRIPTION
        "An index that determines a constellation value at or above which a
         Post FEC Padding and Packet Extension value of 16 us is required for
         the given NSS/RU pair corresponding to the row of the entry. The index
         values are mapped as follows: 0 is BPSK, 1 is QPSK, 2 is 16-QAM,
         3 is 64-QAM, 4 is 256-QAM, 5 is 1024-QAM, 6 is reserved,
         7 is the special value of NONE."
::= { dot11PPEThresholdsMappingsEntry 5 }

dot11PPEThresholdsMappingStatus OBJECT-TYPE
    SYNTAX RowStatus
    MAX-ACCESS read-create
    STATUS current
    DESCRIPTION
        "The status column used for creating, modifying, and deleting instances
         of the columnar objects in the PPE Thresholds mapping Table."
    DEFVAL { active }
::= { dot11PPEThresholdsMappingsEntry 6 }

-- ************************************************************************
-- * End of dot11PPEThresholdsMappings TABLE
-- ************************************************************************
```


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Insert the following compliance objects after the dot11S1GComplianceGroup object:

```
dot11HEComplianceGroup OBJECT-GROUP
    OBJECTS {
        dot11HEULMUResponseSchedulingOptionImplemented,
        dot11ULMUMIMOOptionImplemented,
        dot11OFDMARandomAccessOptionImlemented,
        dot11HEControlFieldOptionImplemented,
        dot11OMIOptionImplemented,
        dot11HEMCSFeedbackOptionImplemented,
        dot11HEDynamicFragmentationImplemented,
        dot11AMPDUwithMultipleTIDOptionImplemented,
        dot11MPDUAskedforAckInMultiTIDAMPDU,
        dot11DurationRTSThreshold,
        dot11PPEThresholdsRequired,
        dot11IntraPPDUPowerSaveOptionActivated,}
    STATUS current
    DESCRIPTION
        "Attributes that configure the HE Group for IEEE 802.11."
::= { dot11Groups <ANA> }
```

Insert the following after dot11S1GCompliance:

```
-- ****************************************************************
-- * Compliance Statements - HE
-- ****************************************************************
dot11HECompliance MODULE-COMPLIANCE
    STATUS current
    DESCRIPTION
        "This object class provides the objects from the IEEE 802.11
        MIB used to operate at high efficiency."
    MODULE -- this module
    MANDATORY-GROUPS { dot11HEComplianceGroup }
--  OPTIONAL-GROUPS { }
    ::= { dot11Compliances <ANA> }
```

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Annex G

(normative)

Frame exchange sequences

Insert a new subclause as follows:

G.5 HE sequences

ht-txop-sequence = L-sig-protected-sequence |
ht-nav-protected-sequence |
dual-cts-protected-sequence |
1{initiator-sequence};

Only Trigger frame sequence is defined here. It can be used for all Trigger frame variants.

(* Trigger frame is sent by the AP to initiate non-AP UL transmission. A PPDU containing a trigger is either a non-A MPDU trigger frame, or an A MPDU containing carrying trigger frame *)

He-mu-sequence = MU-RTS-CTS-protected-sequence | HE-mu-sequence-no-protection

MU-RTS-CTS-protected-sequence = {**MU-RTS** + **CTS**} + *HE-mu-sequence-no-protection*

HE-mu-sequence-no-protection = *dl-mu-sequence* | *ul-mu-sequence* | *cascading-mu-sequence*

(**Trigger**) | (**Trigger** +*a-mpdu* + *mu-user-respond* + *a-mpdu-end*)
1{**Data**[+*HTC*]+*QoS*+(*no-ack* | *block-ack*)+*a-mpdu*}
+ *a-mpdu-end*;
[+*mu-user-respond* other-users];

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Appendix H

IEEE P802.11ax™/D0.1, March 2016
(amendment to IEEE P802.11REVmc™/D5.0
as amended by IEEE P802.11ai™/D6.0,
IEEE P802.11ah™/D5.0,
IEEE P802.11aq™/D3.0,
IEEE P802.11ak™/D1.0,
and IEEE P802.11aj™/D1.0)

IEEE P802.11ax™/D0.1

Draft Standard for Information technology— Telecommunications and information exchange between systems Local and metropolitan area networks— Specific requirements

Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications

Amendment 6: Enhancements for high efficiency in frequency bands between 1 GHz and 6 GHz

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LAN/MAN Standards Committee
of the
IEEE Computer Society

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Abstract: This amendment defines modifications to both the IEEE 802.11 physical layer (PHY) and the medium access control (MAC) sublayer for high efficiency operation in frequency bands between 1 GHz and 6 GHz.

Keywords: high efficiency, PHY, physical layer, MAC, medium access control, OFDMA, orthogonal frequency division multiple access, wireless local area network, WLAN

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Introduction

This introduction is not part of IEEE P802.11ax /D0.1, March 2016, IEEE Standard for Information technology—Telecommunications and information exchange between systems—Local and metropolitan area network—Specific requirements—Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications—Amendment 6: Enhancements for high efficiency in frequency bands between 1 GHz and 6 GHz.

This amendment defines modifications to both the IEEE 802.11 physical layer (PHY) and the medium access control (MAC) sublayer for high efficiency operation in frequency bands between 1 GHz and 6 GHz.

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Table 26-81—HE-MCSs for TBD mandatory/optional 996-tone RU and mandatory non-OFDMA 80 MHz, NSS = 5 193
Table 26-82—HE-MCSs for TBD mandatory/optional 996-tone RU and mandatory non-OFDMA 80 MHz, NSS = 6 194
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IEEE P802.11ax™/D0.1

Draft STANDARD for Information Technology— Telecommunications and information exchange between systems— Local and metropolitan area networks— Specific requirements

Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications

Amendment 6: Enhancements for high efficiency in frequency bands between 1 GHz and 6 GHz

[This amendment is based on IEEE P802.11REVmc D5.0 amended by IEEE P802.11ai/D4.0, IEEE P802.11ah/D5.0, IEEE P802.11aq/D3.0, IEEE P802.11ak/D1.0 and IEEE P802.11aj/D1.0]

NOTE—The editing instructions contained in this amendment define how to merge the material contained therein into the existing base standard and its amendments to form the comprehensive standard.

The editing instructions are shown in ***bold italic***. Four editing instructions are used: change, delete, insert, and replace. ***Change*** is used to make corrections in existing text or tables. The editing instruction specifies the location of the change and describes what is being changed by using ~~strikethrough~~ (to remove old material) and underscore (to add new material). ***Delete*** removes existing material. ***Insert*** adds new material without disturbing the existing material. Insertions may require renumbering. If so, renumbering instructions are given in the editing instruction. ***Replace*** is used to make changes in figures or equations by removing the existing figure or equation and replacing it with a new one. Editorial instructions, change markings and this NOTE will not be carried over into future editions because the changes will be incorporated into the base standard.

Editorial Notes

Editor's Note: Editorial Notes in the body of the standard appear like this. They will be removed before publication. They may highlight some issue that the editor has had to address during the implementation of a change. Where there may be any technical impact from an editing issue, the editor will raise a technical letter ballot comment. There is no need for voters to comment on such issues unless they have a specific resolution they wish to present.

Editor's Note: Headings with empty content or Headings preceding editing instructions that modify the contents of the referenced subclause are there to provide context to the reader of this document, they have no other significance.

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Editor's Note: The default IEEE-SA style for tables is to "float". This means that they be repositioned later, usually at the head of the next page, to avoid splitting the table and reduce the amount of blank space. The table can appear to move out of the subclause it is referenced first from, and can even split a paragraph. This is the intended IEEE-SA behavior, please do not report it as a defect in the draft. In many cases, additional line feeds have been inserted to force tables to follow text, rather than float beyond sequential text. The additional line feeds will be removed before publication, please do not report them as a defect in the text.

Editor's Note: Line numbering is only approximate. This is a limitation of the FrameMaker tool. Whitespace between paragraphs is part of the IEEE-SA style, as defined in their templates. The combination of these two facts leads to the appearance of blank lines in the draft between every paragraph. Please do not report this as an editorial defect as it is the unavoidable behavior.

Tags:

Tags are placed in this draft near changes to identify the source of the change. Changes resulting from incorporation of an approved proposal are shown like this: (#<number>), where <number> identifies the submission/revision that introduced that change.

These tags will be hidden in versions of the draft sent out to letter ballot - i.e., they are present only to assist the editorial review panel in checking that changes have been properly applied.

Tags are shown close to the point of change. When a whole subclause is new, the heading is tagged.

Otherwise, when a whole paragraph is new, the paragraph is tagged. Otherwise tags are placed after a section of changes within a paragraph or at the end of the paragraph if the changes are substantial.

New tables are tagged in the table caption (if there is one), or in the introductory paragraph. Otherwise, new rows in existing tables are tagged only in the first column, to avoid distraction. Otherwise, a modified cell is tagged.

Finally, any other changes made by the editor (e.g., for grammar, language, style & consistency with other comment resolutions, baseline, etc.) are tagged (#Ed).

Editor's Note: A cumulative status of the versions of this draft is shown below.

Table 1—Draft Status

Draft	Date	Status
D0.1	2016-03-03	Converted to FrameMaker from 16/0024r1 Proposed draft specification

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3. Definitions, acronyms, and abbreviations

3.2 Definitions specific to IEEE 802.11

Change the following definition:

Insert the following definitions:

3.4 Abbreviations and acronyms

Insert the following acronym definitions (maintaining alphabetical order):

DL	Dowlink
DL MU	Downlink multi-user
HE	High efficiency
OFDMA	Orthogonal frequency-division multiple access
MU-RTS	Multi-user request to send
UL	Uplink

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4. General description

4.3 Components of the IEEE Std 802.11 architecture

Insert a new subclause after subclause 4.3.12 as follows:

4.3.12a High efficiency (HE) STA

The IEEE 802.11 HE STA operates in frequency bands between 1 GHz and 6 GHz.

An HE STA is VHT STA that, in addition to the features supported as a VHT STA, supports the MAC features defined in Clause 25 and the PHY features defined in Clause 26.

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6. Layer management

6.1 Overview of management model

6.2 Generic management primitives

6.3 MLME SAP interface

6.3.7 Associate

6.3.7.2 MLME-ASSOCIATE.request

6.3.7.2.2 Semantics of the service primitive

Change the primitive parameters as follows (note that not all existing parameters in the baseline are shown):

The primitive parameters are as follows:

MLME-ASSOCIATE.request(

...

HE Capabilities,

VendorSpecificInfo

)

Insert the following entry to the unnumbered table in this subclause:

Name	Type	Valid range	Description
HE Capabilities	As defined in frame format HE Capabilities element.	As defined in 9.4.2.213 (HE Capabilities element)	Specifies the parameters within the HE Capabilities element that are supported by the MAC entity. The parameter is optionally present if dot11HighEfficiencyOptionImplemented is true; otherwise, this parameter is not present.

6.3.7.3 MLME-ASSOCIATE.confirm

6.3.7.3.2 Semantics of the service primitive

Change the primitive parameters as follows (note that not all existing parameters in the baseline are shown):

The primitive parameters are as follows:

MLME-ASSOCIATE.confirm(

...,

HE Capabilities,

VendorSpecificInfo

)

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Insert the following entry to the unnumbered table in this subclause:

Name	Type	Valid range	Description
HE Capabilities	As defined in frame format HE Capabilities element.	As defined in 9.4.2.213 (HE Capabilities element)	Specifies the parameters within the HE Capabilities element that are supported by the MAC entity. The parameter is optionally present if dot11HighEfficiencyOptionImplemented is true; otherwise, this parameter is not present.

6.3.8 Reassociate

6.3.8.2 MLME-REASSOCIATE.request

6.3.8.2.2 Semantics of the service primitive

Change the primitive parameters as follows (note that not all existing parameters in the baseline are shown):

The primitive parameters are as follows:

MLME-REASSOCIATE.request(

...
HE Capabilities,
VendorSpecificInfo
)

Insert the following entry to the unnumbered table in this subclause:

Name	Type	Valid range	Description
HE Capabilities	As defined in frame format HE Capabilities element.	As defined in 9.4.2.213 (HE Capabilities element)	Specifies the parameters within the HE Capabilities element that are supported by the MAC entity. The parameter is optionally present if dot11HighEfficiencyOptionImplemented is true; otherwise, this parameter is not present.

6.3.8.3 MLME-REASSOCIATE.confirm

6.3.8.3.2 Semantics of the service primitive

Change the primitive parameters as follows (note that not all existing parameters in the baseline are shown):

The primitive parameters are as follows:

MLME-REASSOCIATE.confirm(

...
HE Capabilities,

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VendorSpecificInfo
)

Insert the following entry to the unnumbered table in this subclause:

Name	Type	Valid range	Description
HE Capabilities	As defined in frame format HE Capabilities element.	As defined in 9.4.2.213 (HE Capabilities element)	Specifies the parameters within the HE Capabilities element that are supported by the MAC entity. The parameter is optionally present if dot11HighEfficiencyOptionImplemented is true; otherwise, this parameter is not present.

6.3.11 Start

6.3.11.2 MLME-START.request

6.3.11.2.2 Semantics of the service primitive

Change the primitive parameters as follows (note that not all existing parameters in the baseline are shown):

MLME-START.request(

...,
HE Capabilities,
HE Operation,
VendorSpecificInfo
)

Insert the following entry to the unnumbered table in this subclause:

Name	Type	Valid range	Description
HE Capabilities	As defined in frame format HE Capabilities element.	As defined in 9.4.2.213 (HE Capabilities element)	Specifies the parameters within the HE Capabilities element that are supported by the MAC entity. The parameter is optionally present if dot11HighEfficiencyOptionImplemented is true; otherwise, this parameter is not present.
HE Operation	As defined in frame format HE Operation element.	As defined in 9.4.2.214 (HE Operation element)	The additional HE capabilities to be advertised for the BSS. The parameter is present if BSSType = INFRASTRUCTURE and dot11HighEfficiencyOptionImplemented is true; otherwise, this parameter is not present.

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9. Frame formats

9.2 MAC frame formats

9.2.4 Frame fields

9.2.4.1 Frame Control field

9.2.4.1.3 Type and Subtype fields

Change the row below and insert a new row immediately after it in Table 9-1 (Valid type and subtype combinations) as follows:

Table 9-1—Valid type and subtype combinations

Type value B3 B2	Type description	Subtype value B7 B6 B5 B4	Subtype description
01	Control	0000–~~0011~~<ANA>	Reserved
01	Control	<ANA>	Trigger

9.2.4.1.10 Order field

Change this subclause as follows:

The Order field is 1 bit in length. The setting of the Order field is as follows:

— It is set to 1 in a non-QoS Data frame transmitted by a non-QoS STA to indicate that the frame contains an MSDU, or fragment thereof, that is being transferred using the StrictlyOrdered service class.

— It is set to 1 in a QoS Data or Management frame transmitted with a value of HT_GF, HT_MF, VHT, HE or S1G for the FORMAT parameter of the TXVECTOR to indicate that the frame contains an HT Control field.

— It is set to 1 in an S1G RTS frame to indicate that the intended recipient of the frame has permission to extend the TXOP as described in 10.51.5.4 (Relay-shared TXOP protection mechanisms).

Otherwise, the Order field is set to 0.

NOTE—The Order field is always set to 0 for frames transmitted by a DMG STA.

9.2.4.6 HT Control field

9.2.4.6.1 General

Remove Figure 9-7 (HT Control field).

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Insert Table 9-1 as follows:

Table 9-9a—HT Control field

Variant	Bit 0 (value)	Bit 1 (value)	Bit 2-29	Bit 30	Bit 31
HT variant	VHT (0)	HT Control Middle		AC Constraint	RDG/More PPDU
VHT variant	VHT (1)	HE (0)	VHT Middle	AC Constraint	RDG/More PPDU
HE variant	VHT (1)	HE (1)	Aggregated Control		

Change the paragraphs below of 9.2.4.6.1 as follows:

The HT Control field has ~~two~~ different forms, the HT variant, and the VHT variant, and the HE variant. These forms differ in the values of the VHT and/or HE subfields and in their formats, which are shown in Table 9-9a (HT Control field). ~~The two forms differ in the format of the HT Control Middle subfield, described in 9.2.4.6.2 (HT variant) for the HT variant and in 9.2.4.6.3 (VHT variant) for the VHT variant and in the value of the VHT subfield.~~

The VHT subfield is set to 0 to indicate a HT variant HT Control field. The VHT subfield is set to 1 and the HE subfield is set to 0 to indicate a VHT variant HT Control field. The VHT subfield is set to 1 and the HE subfield is set to 1 to indicate a HE variant HE Control field.

The HT Control Middle subfield is defined in 8.2.4.6.2 (HT variant) and the VHT Control Middle subfield is defined in 8.2.4.6.3 (VHT variant).

The Aggregated Control subfield is defined in 8.2.4.6.4 (HE variant).

~~The VHT subfield of the HT Control field indicates whether the HT Control Middle subfield is the VHT Variant or the HT Variant. The VHT subfield is set to 1 to indicate that the HT Control Middle subfield is the VHT Variant and is set to 0 to indicate that the HT Control Middle subfield is the HT Variant.~~

9.2.4.6.3 VHT variant

Change the paragraph below as follows:

The format of the VHT Control Middle subfield of the VHT variant HT Control field is shown in Figure 9-12 (VHT Control Middle subfield of the VHT variant HT Control field).Insert the following after Figure 14 (MFB subfield in the VHT variant HT control field):

Change Figure 9-12 as follows (remove Reserved field and change title):

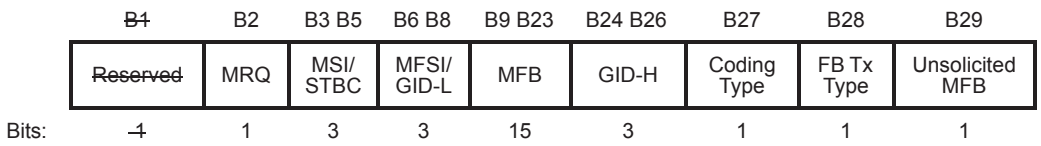

Figure 9-12—VHT Control Middle subfield of the VHT variant HT Control field

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Insert a new subclause 9.2.4.6.4 following 9.2.4.6.3:

9.2.4.6.4 HE variant

9.2.4.6.4.1 General

The format of the Aggregated Control (A-Control) subfield of the HE variant HT Control is shown in Figure 9-14a (A-Control subfield of the HE variant HT Control field).

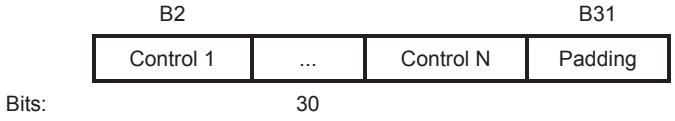

Figure 9-14a—A-Control subfield of the HE variant HT Control field

The A-Control subfield contains a sequence of one or more Control subfields. The format of each Control subfield is defined in Figure 9-14b (Control subfield format). The Control subfield with Control ID subfield equal to 0, if present, is the first subfield of the sequence.

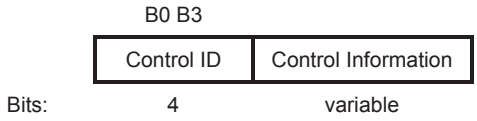

Figure 9-14b—Control subfield format

The Control ID subfield indicates the type of information carried in the Control Information subfield, and the length of the Control Information subfield, which is fixed and that corresponds to each value of the Control ID subfield. The values of the Control ID subfield and the associated length of the Control Information subfield are defined in Table 9-18a (Control ID subfield values).

Table 9-18a—Control ID subfield values

Control ID value	Meaning	Length of the Control Information subfield (bits)	Content of the Control Information subfield
0	UL MU response scheduling	TBD	
1	Receive operation mode indication	TBD	
2	HE link adaptation	TBD	
TBD	...		
8-15	Reserved		

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The Control Information subfield carries control information that depends on the Control ID value, as defined in Table 9-18a (Control ID subfield values).

The Padding subfield follows the last Control subfield and is set to a sequence of zeros so that the length of the A-Control subfield is 30 bits.

9.2.4.6.4.2 UL MU response scheduling

The Control Information subfield, when the Control ID subfield is 0, contains scheduling information for an HE trigger-based PPDU that carries an immediate acknowledgment, which is sent as a response to the soliciting A-MPDU (see 25.5.2 (UL MU operation)).

The format of the Control Information subfield is defined in Figure 9-14c (Control Information subfield format when Control ID subfield is 0).

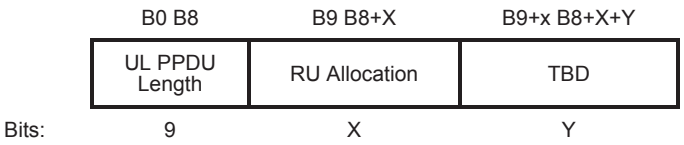

Figure 9-14c—Control Information subfield format when Control ID subfield is 0

The UL PPDU Length subfield indicates the length of the HE trigger-based PPDU response and is set to a nonzero value that is TBD.

The RU Allocation subfield indicates the resource unit (RU) assigned for transmitting the HE trigger-based PPDU response and is set to TBD.

9.2.4.6.4.3 Receive operation mode indication

The Control Information subfield, when the Control ID subfield is 1, contains information related to the receive operation mode of the STA transmitting the frame containing this information (see 25.8 (Receive operating mode)).

The format of the Control Information subfield is defined in Figure 9-14d (Control Information subfield format when Control ID subfield is 1).

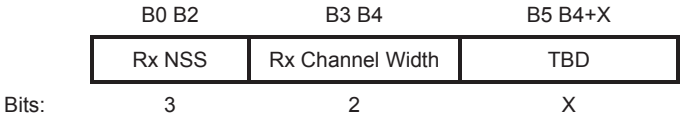

Figure 9-14d—Control Information subfield format when Control ID subfield is 1

The RX NSS subfield indicates the maximum number of spatial streams, N_{SS}, supported by the STA in reception, and is set to $N_{SS} - 1$.

The RX Channel Width subfield indicates the operating channel width supported by the STA in reception, and is set to 0 for 20 MHz, 1 for 40 MHz, 2 for 80 MHz, and 3 for 160 MHz.

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9.2.4.6.4.4 HE link adaptation

The Control Information subfield, when the Control ID subfield is 2, contains information related to the HE link adaptation procedure (see 9.31.4 (Link adaptation using the HE variant HT Control field)).

The format of the Control Information subfield is defined in Figure 9-14e (Control Information subfield format when Control ID subfield is 2).

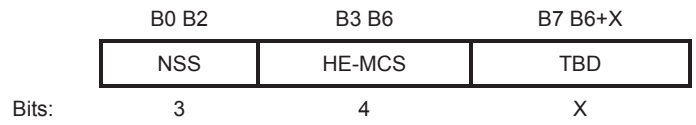

Figure 9-14e—Control Information subfield format when Control ID subfield is 2

The NSS subfield indicates the recommended number of spatial streams, N_{SS}, and is set to $N_{SS} - 1$.

The HE-MCS subfield indicates the recommended HE-MCS, and is set to the HE-MCS Index value (defined in 26.5 (Parameters for HE-MCSs)).

9.2.5 Duration/ID field (QoS STA)

9.2.5.1 Setting for single and multiple protection under enhanced distributed channel access (EDCA)

Change item a) of the 2nd paragraph in this subclause as follows:

The Duration/ID field is determined as follows:

a) Single protection settings.

1) For an RTS frame that is not part of a dual clear-to-send (CTS) exchange and is not part of a BDT exchange(11ah), the Duration/ID field is set to the estimated time, in microseconds, required to transmit the pending frame, plus one CTS frame, plus one Ack or BlockAck frame if required, plus any NDPs required, plus explicit feedback if required, plus applicable IFSs.

1a) In an MU-RTS frame, the Duration/ID field is set to the estimated time, in microseconds, required for the pending transmission.

Insert the two sentences as below under $T_{pending}$ of item 4) of item b):

b) Multiple protection settings. The Duration/ID field is set to a value D as follows:

4) Else $T_{END-NAV} - T_{PPDU} \le D \le T_{TXOP-REMAINING} - T_{PPDU}$

where

$T_{SINGLE\text{-}MSDU}$ is the estimated time required for the transmission of the allowed frame exchange sequence defined in 10.22.2.8 (TXOP limits) (for a TXOP limit of 0), including applicable IFS durations

$T_{PENDING}$ is the estimated time required for the transmission of

—Pending MPDUs of the same AC

—Any associated immediate response frames

—Any HT NDP, VHT NDP, or Beamforming Report Poll frame transmissions and explicit feedback response frames

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—Applicable IFSs

—Any RDG

—Any pending QoS Null frame exchanges by paged STAs(11ah)

—Any pending PS-Poll or NDP PS-Poll frame exchanges by paged STAs(11ah)

—Any DL MU PPDUs

—Any HE trigger-based PPDUs

—Any Trigger frames to solicit HE trigger-based PPDUs

T_{TXOP} is the duration given by dot11EDCATableTXOPLimit (dot11QAPEDCATableTXOPLimit for the AP) for that AC

$T_{TXOP\text{-}REMAINING}$ is T_{TXOP} less the time already used time within the TXOP

$T_{END\text{-}NAV}$ is the remaining duration of any NAV set by the TXOP holder, or 0 if no NAV has been established

T_{PPDU} is the time required for transmission of the current PPDU

9.2.5.7 Setting for control response frames

Insert a new paragraph after the 2nd paragraph of this subclause:

In a CTS frame that is transmitted in response to an MU-RTS frame, the Duration/ID field is set to the value obtained from the Duration/ID field of the MU-RTS frame that elicited the CTS frame minus the time, in microseconds, between the end of the PPDU carrying the MU-RTS frame and the end of the PPDU carrying the CTS frame.

9.3 Format of individual frame types

9.3.1 Control frames

9.3.1.3 CTS frame format

Change the 2nd paragraph of this subclause as follows:

When the CTS frame is a response to an RTS frame, the value of the RA field of the CTS frame is set to the address from the TA field of the RTS frame with the Individual/Group bit forced to the value 0. When the CTS frame is a response to an MU-RTS frame, the value of the RA field of the CTS frame is set to the address from the TA field of the MU-RTS frame with the Individual/Group bit forced to the value 0.

9.3.1.9 BlockAck frame format

Change Figure 9-32 as follows:

	B0	B1	B2	B3	B4	~~B4~~B5 B11	B12 B15
	BA Ack Policy	Multi-TID	Compressed Bitmap	GCR	Multi STA	Reserved	TID_INFO
Bits:	1	1	1	1	1	~~8~~7	4

Figure 9-32—BA Control field

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Change the 6th paragraph of this subclause as follows:

For BlockAck frames sent under Delayed and HT-delayed agreements, the BA Ack Policy subfield of the BA Control field has the meaning shown in Table 9-23 (BA Ack Policy subfield). For BlockAck frames sent under other types of agreement, the BA Ack Policy subfield is reserved. A BlockAck frame with the Multi-STA subfield equal to 1 is not sent under Delayed and HT-delayed agreements.

Change Table 9-24 as follows:

Table 9-24—BlockAck frame variant encoding

Multi-TID subfield value	Compressed Bitmap subfield value	GCR subfield value	Multi-STA subfield value	BlockAck frame variant
0	0	0	0	Basic BlockAck
0	1	0	0	Compressed BlockAck
1	0	0	0	Extended Compressed BlockAck
1	1	0	0	Multi-TID BlockAck
0	0	1	0	Reserved
0	1	1	0	GCR BlockAck
1	0	1	0	Reserved
1	1	1	0	Reserved
0	0	0	1	Reserved
1	0	0	1	Reserved
1	1	0	1	Multi-STA BlockAck
0	0	1	1	Reserved
0	1	1	1	Reserved
1	0	1	1	Reserved
1	1	1	1	Reserved

Change the 7th paragraph of this subclause as follows:

The values of the Multi-TID, Compressed Bitmap, ~~and~~ GCR and Multi-STA subfields of the BA Control field determine which of the BlockAck frame variants is represented, as indicated in the Table 9-24 (BlockAck frame variant encoding).

9.3.1.9.3 Compressed BlockAck variant

Change subclause 9.3.1.9.3 as follows:

The TID_INFO subfield of the BA Control field of the Compressed BlockAck frame contains the TID for which this BlockAck frame is sent.

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The BA Information field of the Compressed BlockAck frame comprises the Block Ack Starting Sequence Control subfield and the Block Ack Bitmap subfield, as shown in Figure 9-34 (BA Information field (Compressed BlockAck)). The Starting Sequence Number subfield of the Block Ack Starting Sequence Control subfield contains the sequence number of the first MSDU or A-MSDU for which this BlockAck frame is sent. The value of this subfield is defined in 10.24.7.5 (Generation and transmission of BlockAck frames by an HT STA or DMG STA). ~~The Fragment Number subfield of the Block Ack Starting Sequence Control subfield is set to 0.~~

When the Fragment Number subfield is 0, the ~~The~~ Block Ack Bitmap subfield of the BA Information field of the Compressed BlockAck frame is 8 octets in length and is used to indicate the received status of up to 64 MSDUs and A-MSDUs. Each bit that is equal to 1 in the compressed Block Ack Bitmap field acknowledges the successful reception of a single MSDU or A-MSDU in the order of sequence number, with the first bit of the Block Ack Bitmap field corresponding to the MSDU or A-MSDU with the sequence number that matches the value of the Starting Sequence Number subfield of the Block Ack Starting Sequence Control subfield.

When the Fragment Number subfield is 1, the Block Ack Bitmap subfield of the BA Information field of the Compressed BlockAck frame is used to indicate the receive status of up to 16 MSDUs and A-MSDUs. Bit position n of the Block Ack Bitmap field, if equal to 1, acknowledges receipt of an MPDU with sequence number value, SN and fragment number value, FN with n equal to 4 × (SN – SSN) + FN, where SSN is the value of the Starting Sequence Number subfield of the Block Ack Starting Sequence Control subfield and the operations on the sequence numbers are performed modulo 4096. When bit position n of the Block Ack Bitmap field is equal to 0 it indicates that the MPDU has not been received.

NOTE—When the Fragment Number subfield is equal to 1 then the BlockAck Bitmap field is split into 16 subbitmaps, each of which indicates receive status for 4 fragments of each of the 16 MSDUs.

Insert a new subclause after 9.3.1.9.6:

9.3.1.9.7 Multi-STA BlockAck variant

The TID_INFO subfield of the BA Control field of the Multi-STA BlockAck frame is reserved.

The BA Information field of the Multi-STA BlockAck frame comprises one or more instances of the Per STA Info subfields. The Per STA Info subfield is shown in Figure 9-37a (Per STA Info subfield format).

	Per AID TID Info	Block Ack Starting Sequence Control	Block Ack Bitmap
Octets	2	0 or 2	0 or 8

Figure 9-37a—Per STA Info subfield format

The Per AID TID Info subfield is shown in Figure 9-37b (Per AID TID Info subfield format).

	B0 B10	B11	B12 B15
	AID	ACK Type	TID
Bits:	11	1	4

Figure 9-37b—Per AID TID Info subfield format

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The AID field carries the AID of the STA for which the Per STA Info field is intended.

The TID field contains the TID for which the acknowledgement or block acknowledgement applies.

If the ACK Type field is 0, then the Block Ack Starting Sequence Control and Block Ack Bitmap are not present and the Per STA Info field indicates the acknowledgement of successful reception of either a single MPDU or of all the MPDUs carried in the eliciting (A-) MPDU. If the ACK Type subfield is 1, then the Block Ack Starting Sequence Control and Block Ack Bitmap fields are present.

When the Fragment Number subfield is 1, the Block Ack Starting Sequence Control subfield is as shown in Figure 9-27. The Block Ack Bitmap subfield of the BA Information field of the Multi-STA BlockAck frame contains an 8-octet block ack bitmap. Each bit that is equal to 1 in the Block Ack Bitmap subfield acknowledges the successful reception of a single MSDU or A-MSDU in the order of sequence number with the first bit of the Block Ack Bitmap subfield corresponding to the MSDU or A-MSDU with the sequence number that matches the value of the Starting Sequence Number subfield of the Block Ack Starting Sequence Control subfield.

When the Fragment Number subfield is 1, the Block Ack Bitmap subfield of the BA Information field of the Multi-STA Block Ack frame is used to indicate the receive status of up to 16 MSDUs and A-MSDUs. Bit position n of the Block Ack Bitmap field, if equal to 1, acknowledges receipt of an MPDU with sequence number value, *SN* and fragment number value, *FN* with *n* equal to $4 \times (SN - SSN) + FN$, where SSN is the value of the Starting Sequence Number subfield of the Block Ack Starting Sequence Control subfield and the operations on the sequence numbers are performed modulo 4096. When bit position n of the Block Ack Bitmap field is equal to 0 it indicates that the MPDU has not been received.

NOTE—When the Fragment Number subfield is equal to 1 then the BlockAck Bitmap field is split into 16 subbitmaps, each of which indicates receive status for 4 fragments of each of the 16 MSDUs.

Insert a new subclause after 9.3.1.22:

9.3.1.23 Trigger frame format

The Trigger frame is used to allocate resource for UL MU transmission and to solicit an UL MU transmission at [TBD IFS] after the PPDU that carries the Trigger frame. The Trigger frame also carries other information required by the responding STA to send UL MU.

The frame format for the Trigger frame is as defined in Figure 9-51a (Trigger frame).

	Frame Control	Duration	(RA)	TA	Common Info	Per User Info	...	Per User Info	Padding	FCS
Octets:	2	2	6	6	TBD	TBD		TBD		4

Figure 9-51a—Trigger frame

The Duration/ID field is set as defined in 9.2.5 (Duration/ID field (QoS STA)).

The RA field of the Trigger frame is the address of the recipient STA. Whether RA is not part of Trigger frame is TBD.

The TA field value is the address of the STA transmitting the Trigger frame.

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The Common Info field is defined in Figure 9-51b (Common Info field).

	Length	Cascade Indication	CS Required	HE-SIG-A Info	CP and LTF Type	Trigger Type	Trigger Dependent Common Info
Bits:	12	1	1	TBD	TBD	TBD	variable

Figure 9-51b—Common Info field

The Length subfield of the Common Info field indicates the value of the L-SIG Length field of the HE trigger-based PPDU that is the response to the Trigger frame.

If the Cascade Indication subfield is 1, then a subsequent Trigger frame follows the current Trigger frame. Otherwise the Cascade Indication subfield is 0.

The CS Required subfield is set to 1 to indicate that the STAs identified in the Per User Info fields are required to use ED to sense the medium and to consider the medium state and the NAV in determining whether or not to repond. The CS Requred subfield is set to 0 to indicate that the STAs identified in the Per User Info fields are not required consider the medium state or the NAV in determining whether or not to respond.

The HE-SIG-A Info subfield of the Common Info field indicates the content of the HE-SIG-A field of the HE trigger-based PPDU response. The TBD bits in HE-SIG-A of the HE trigger-based PPDU that may be implicitly known by all responding STAs can be excluded.

The CP and LTF Type subfield of the Common Info field indicates the CP and HE-LTF type of the HE trigger-based PPDU response. The CP and LTF field encoding is defined in Table 9-ax1 (CP and LTF field encoding).

Table 9-ax1—CP and LTF field encoding

CP and LTF field value	Description
0	2x LTF + 0.8 μs CP
1	2x LTF + 1.6 μs CP
2	4x LTF + 3.2μs CP
3-TBD	Reserved

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The Trigger Type subfield indicates the type of the Trigger frame. The Trigger frame can include an optional type-specific Common Info and optional type-specific Per User Info. Table 9-ax2 (Trigger Type field encoding) defines the valid Trigger Type.

Table 9-ax2—Trigger Type field encoding

Trigger Type field value	Description
0	Basic Trigger
1	Beamforming Report Poll Trigger
2	MU-BAR
3	MU-RTS
4-TBD	Reserved

The Per User Info field is defined in Figure 9-51c (Per User Info field).

	User Identifier	RU Allocation	Coding Type	MCS	DCM	SS Allocation	Trigger Dependent Per User Info
Bits:	12	TBD	TBD	TBD	TBD	TBD	variable

Figure 9-51c—Per User Info field

The User Identifier subfield of the Per User Info field indicates the AID of the STA allocated the RU to transmit the MPDU(s) in the HE trigger-based PPDU.

The RU Allocation subfield of the Per User Info field indicates the RU used by the HE trigger-based PPDU of the STA identified by User Identifier subfield. The length and coding of RU Allocation subfield are TBD.

The Coding Type subfield of the Per User Info field indicates the code type of the HE trigger-based PPDU response of the STA identified by User Identifier subfield. Set to 0 for BCC and set to 1 for LDPC.

The MCS subfield of the Per User Info field indicates the MCS of the HE trigger-based PPDU response of the STA identified by User Identifier field. The encoding of the MCS field is as defined in Section XXX.

The DCM subfield of the Per User Info field indicates dual carrier modulation of the HE trigger-based PPDU response of the STA identified by User Identifier subfield. A value of 1 indicates that the HE trigger-based PPDU response shall use DCM as defined in section XXX. Set to 0 to indicate that DCM shall not be used.

The SS Allocation subfield of the Per User Info field indicates the spatial streams of the HE trigger-based PPDU response of the STA identified by User Identifier field.

The Padding field extends the frame length to give the recipient STAs more time to prepare a response. The length and the content of Padding field are TBD.

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9.3.1.23.1 MU-BAR variant

If the Trigger frame is an MU-BAR variant, then the Trigger Dependent Common Info field is define in Figure 9-51d (Trigger Dependent Common Info field for MU-BAR variant).

	User Identifier	RU Allocation	Coding Type	MCS	DCM	SS Allocation	Trigger Dependent Per User Info
Bits:	12	TBD	TBD	TBD	TBD	TBD	variable

Figure 9-51d—Trigger Dependent Common Info field for MU-BAR variant

If the Trigger frame is an MU-BAR variant, then the Trigger-dependent Per User Info field is define in Figure 9-14e (Control Information subfield format when Control ID subfield is 2).

	BAR Control	BAR Information
Bits:		

Figure 9-51e—Trigger Dependent Common Info field for MU-BAR variant

The BAR Control subfield is defined in 9.3.1.8 (BlockAckReq frame format).

The BAR Information subfield is defined in 9.3.1.8 (BlockAckReq frame format).

9.3.1.23.2 MU-RTS variant

The MU-RTS frame format is a variant of Trigger frame format as shown in Figure 9-51a (Trigger frame).

If an MU-RTS frame requests a STA to respond with a CTS frame carried in a non-HT or non-HT duplicate PPDU, the RU Allocation subfield in the Per-User Info field addressed to the STA indicates whether the CTS frame is transmitted on the primary 20 MHz channel, primary 40 MHz channel, primary 80 MHz channel, 160 MHz channel, or 80+80 MHz channel.

The Duration/ID field is defined in 9.2.5.2 Duration/ID field (QoS STA).

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9.3.2 Data frames

9.3.3 Management frames

9.3.3.1 Beacon frame format

Insert the following new rows (header row shown for convenience) into Table 9-27 (Beacon frame body):

Table 9-27—Beacon frame body

Order	Information	Notes
TBD	HE Capabilities	The HE Capabilities element is present when the dot11HEOptionImplemented is true; otherwise it is not present.
TBD	HE Operation	The HE Operation element is present when the dot11HEOptionImplemented is true; otherwise it is not present.
TBD	TWT	The TWT element is optionally present when the dot11TWTOptionActivated is true; otherwise it is not present.

9.3.3.5 Association Request frame format

Insert the following new rows (header row shown for convenience) into Table 9-29 (Association Request frame body):

Table 9-29—Association Request frame body

Order	Information	Notes
TBD	HE Capabilities	The HE Capabilities element is present when the dot11HEOptionImplemented is true; otherwise it is not present.
TBD	HE Operation	The HE Operation element is present when the dot11HEOptionImplemented is true; otherwise it is not present.

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9.3.3.6 Association Response frame format

Insert the following new rows (header row shown for convenience) into Table 9-30 (Association Response frame body):

Table 9-30—Association Response frame body

Order	Information	Notes
TBD	HE Capabilities	The HE Capabilities element is present when the dot11HEOptionImplemented is true; otherwise it is not present.
TBD	HE Operation	The HE Operation element is present when the dot11HEOptionImplemented is true; otherwise it is not present.

9.3.3.7 Reassociation Request frame format

Insert the following new rows (header row shown for convenience) into Table 9-31 (Reassociation Request frame body):

Table 9-31—Reassociation Request frame body

Order	Information	Notes
TBD	HE Capabilities	The HE Capabilities element is present when the dot11HEOptionImplemented is true; otherwise it is not present.
TBD	HE Operation	The HE Operation element is present when the dot11HEOptionImplemented is true; otherwise it is not present.

9.3.3.8 Reassociation Response frame format

Insert the following new rows (header row shown for convenience) into Table 9-32 (Reassociation Response frame body):

Table 9-32—Reassociation Response frame body

Order	Information	Notes
TBD	HE Capabilities	The HE Capabilities element is present when the dot11HEOptionImplemented is true; otherwise it is not present.
TBD	HE Operation	The HE Operation element is present when the dot11HEOptionImplemented is true; otherwise it is not present.

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9.3.3.9 Probe Request frame format

Insert the following new rows (header row shown for convenience) into Table 9-33 (Probe Request frame body):

Table 9-33—Probe Request frame body

Order	Information	Notes
TBD	HE Capabilities	The HE Capabilities element is present when the dot11HEOptionImplemented is true; otherwise it is not present.
TBD	HE Operation	The HE Operation element is present when the dot11HEOptionImplemented is true; otherwise it is not present.

9.3.3.10 Probe Response frame format

Insert the following new rows (header row shown for convenience) into Table 9-34 (Probe Response frame body):

Table 9-34—Probe Response frame body

Order	Information	Notes
TBD	HE Capabilities	The HE Capabilities element is present when the dot11HEOptionImplemented is true; otherwise it is not present.
TBD	HE Operation	The HE Operation element is present when the dot11HEOptionImplemented is true; otherwise it is not present.

9.4 Management and Extension frame body components

9.4.1 Fields that are not elements

Insert the following two subclauses:

9.4.1.62 HE Compressed Beamforming Report field

The format of the HE Compressed Beamforming Report field is based on the VHT Compressed Beamforming Report field in 9.4.1.48 (VHT Compressed Beamforming Report field) except for the following modifications.

The supported values for the tone grouping factor *Ng* shall be $Ng = 4$ and $Ng = 16$ for SU-MIMO, MU-MIMO and OFDMA. Here, the tone grouping factor *Ng* is defined with respect to data tones of the HE PPDU.

Other modification are TBD.

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9.4.1.63 HE MU Exclusive Beamforming Report field

The HE MU Exclusive Beamforming Report Field is based on the VHT Exclusive Beamforming Report Field in 9.4.1.50, except for the following modifications.

The MU Exclusive Beamforming Report information consists of Delta SNR subfields for each space-time stream (1 to *Nc*) of a subset of the subcarriers spaced *Ng* apart (where *Ng* is the tone grouping factor). Specifically, the locations of the feedback tones for delta SNR subfields shall be identical to the tone locations of the compressed V matrices fed back.

Other modification are TBD.

9.4.2 Elements

9.4.2.1 General

Insert the following new rows into Table 9-75 Element IDs (header row shown for convenience)::

Table 9-74—Element IDs

Element	Element ID	Element ID Extension	Extensible
HE Capabilities (see 9.4.2.213 (HE Capabilities element))	<ANA>	N/A	Yes
HE Operation (see 9.4.2.214 (HE Operation element))	<ANA>	N/A	Yes

9.4.2.196 TWT element

Change as Figure 9-577ax (Control field format) follows.

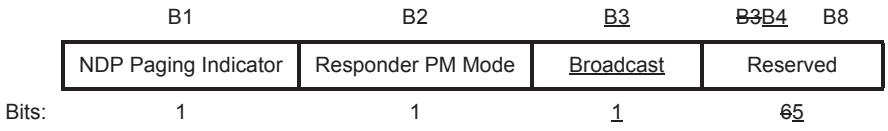

Figure 9-577ax—Control field format

Insert the following paragraph after Table 9-248l (TWT Setup Command field values):

The Broadcast field indicates if the TWT SP indicated by the TWT element is a broadcast TWT as defined in 9.44.3 (Broadcast TWT Operation). The Broadcast field is set to 1 to indicate that the TWT(s) defined by the TWT element are broadcast TWT(s); otherwise, it is set to 0.

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Change Figure 9-577ay (Request Type field format) as follows (B4 from "Reserved" to "Trigger").

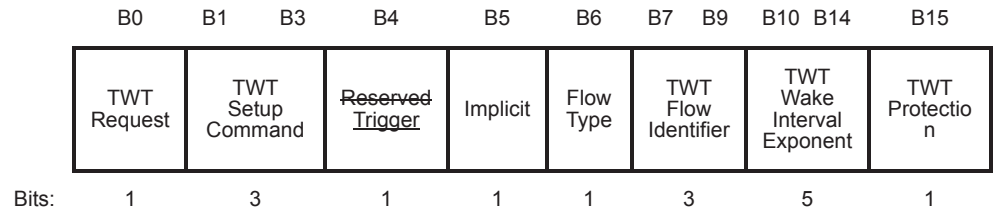

Figure 9-577ay—Request Type field format

Insert the following paragraph after Table 9-248l (TWT Setup Command field values):

The Trigger field indicates if the TWT SP indicated by the TWT element includes Trigger frames as defined in 10.44 (Target wake time (TWT)). The Trigger field is set to 1 to indicate that at least one Trigger frame is transmitted during the TWT SP. The Trigger field is set to 0 otherwise.

Change the text as shown in subclause 9.4.2.196 TWT element:

For a TWT SP that is not a broadcast TWT SP, the ~~The~~ TWT Flow Identifier subfield contains a 3-bit value which identifies the specific information for this TWT request uniquely from other requests made between the same TWT requesting STA and TWT responding STA pair. For a TWT SP that is a broadcast TWT SP, the TWT Flow Identifier subfield contains a value that indicates recommendations on the types of frames that are transmitted during the broadcast TWT SP, encoded according to Table 9-248l1 (TWT Flow Identifier field for a broadcast TWT element).

Insert a new table as follows:

Table 9-248l1—TWT Flow Identifier field for a broadcast TWT element

TWT Flow Identifier field value	Description when transmitted in a broadcast TWT element
0	No constraints on the frames transmitted during a broadcast TWT SP.
1	Frames transmitted during a broadcast TWT SP are recommended to be limited to: PS-Poll, CQI, QoS Null with buffer status, Sounding Feedback, Management Action Trigger frames transmitted by the AP during the broadcast TWT SP do not contain RUs for random access.
2	Frames transmitted during a broadcast TWT SP are recommended to be limited to: PS-Poll, CQI, QoS Null with buffer status, Sounding Feedback, Management Action, (Re)Association Request Trigger frames transmitted by the AP during the broadcast TWT SP contain at least one RU for random access.
3-7	Reserved

Change the paragraph below as follows:

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In a TWT element transmitted by a TWT requesting STA, the TWT wake interval is equal to the average time that the TWT requesting STA expects to elapse between successive TWT SPs. In a TWT element transmitted by a TWT responding STA, the TWT wake interval is equal to the average time that the TWT-responding STA expects to elapse between successive TWT SPs. In a TWT element contained in a TWT request/response that is sent to negotiate the wake intervals for beacon frames containing broadcast TWT, the TWT wake interval indicates the value of the listen interval (see 10.44.3.4 (Negotiation of TBTT and listen interval).

The TWT Wake Interval Exponent subfield is set to the value of the exponent of the TWT wake interval value in microseconds, base 2. The TWT wake interval of the requesting STA is equal to (TWT Wake Interval Mantissa) × 2^(TWT Wake Interval Exponent).

Change the paragraph below as follows:

When transmitted by a TWT requesting STA or a TWT scheduled STA, the Target Wake Time field contains a positive integer which corresponds to a TSF time at which the STA requests to wake, or a value of zero when the TWT Setup Command subfield contains the value corresponding to the command "Request TWT". When a TWT responding STA or a TWT scheduling STA with dot11TWTGroupingSupport equal to 0 transmits a TWT element to the TWT requesting STA, the TWT element contains a value in the Target Wake Time field which corresponds to a TSF time at which the TWT responding STA requests the TWT requesting STA or TWT scheduled STA to wake and it does not contain the TWT Group Assignment field.

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Change Table 9-248l - TWT Setup Command field values by adding two new columns as shown:

Table 9-248l—TWT Setup Command field values

TWT Setup Command field value	Command name	Description when transmitted by a TWT requesting STA	Description when transmitted by a TWT responding STA	Description when transmitted by a TWT scheduled STA	Description when transmitted by a TWT scheduling STA
0	Request TWT	The Target Wake Time field of the TWT element contains 0s as the TWT responding STA specifies the target wake time value for this case, other TWT parameters* are suggested by the TWT requesting STA in the TWT request.	N/A	The Target Wake Time field of the TWT element contains 0s as the TWT scheduling STA specifies the target wake time value for this case, other TWT parameters* are suggested by the TWT scheduled STA in the TWT request.	N/A
1	Suggest TWT	TWT requesting STA includes a set of TWT parameters such that if the requested target wake time value and/or other TWT parameters cannot be accommodated, then the TWT setup might still be accepted.	N/A		N/A
2	Demand TWT	TWT requesting STA includes a set of TWT parameters such that if the requested target wake time value and/or other TWT parameters cannot be accommodated, then the TWT setup will be rejected.	N/A		N/A
3	TWT Grouping	N/A	TWT responding STA suggests TWT group parameters that are different from the suggested or demanded TWT parameters of the TWT requesting STA	N/A	N/A

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Table 9-248l—TWT Setup Command field values *(continued)*

4	Accept TWT	N/A	TWT responding STA accepts the TWT request with the TWT parameters (See NOTE) indicated in the TWT element transmitted by the responding STA	N/A	TWT scheduling STA accepts the TWT request with the TWT parameters* indicated in the TWT element transmtted by the TWT scheduled STA.
5	Alternate TWT	N/A	TWT responding STA suggests TWT parameters that are different from TWT requesting STA suggested or demanded TWT parameters	N/A	N/A
6	Dictate TWT	N/A	TWT responding STA demands TWT parameters that are different from TWT requesting STA TWT suggested or demanded parameters	N/A	
7	Reject TWT	N/A	TWT responding STA rejects TWT setup	N/A	TWT scheduling STA rejects TWT setup

NOTE—TWT Parameters are: TWT, Nominal Minimum Wake Duration, TWT Wake Interval and TWT Channel sub-field values indicated in the element.

Insert the following new subclauses after the last subclause in 9.4.2:

9.4.2.213 HE Capabilities element

An HE STA declares that it is an HE STA by transmitting the HE Capabilities element.

The HE Capabilities element contains a number of fields that are used to advertise the HE capabilities of an HE STA. The HE Capabilities element is defined in Figure 9-ax1 (HE Capabilities element format)..

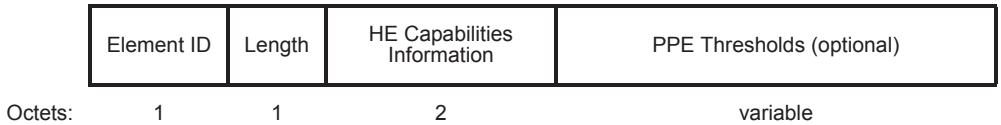

Figure 9-ax1—HE Capabilities element format

The Element ID and Length fields are defined in 9.4.2.1 (General).

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The format of the HE Capabilities Information field is defined in Figure 9-554ab (HE Capabilities field format).

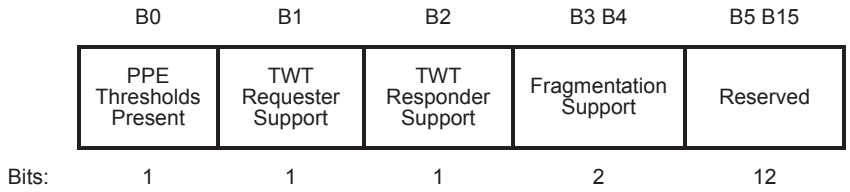

Figure 9-ax2—HE Capabilities Information field format

The PPE Thresholds Present field indicates if the HE PPE Thresholds field is present or not. A value of 1 in this field means that the PPE Thresholds field is present. A value of 0 in this field means that the HE PPE Thresholds field is not present because no packet extension is ever required for the STA transmitting this field.

The TWT Requester Support field indicates support by an HE STA for the role of TWT requesting STA as described in 10.44 (Target wake time (TWT)). The field is set to 1 if dot11TWTOptionActivated is true, the STA is an HE STA and the STA supports TWT requester STA functionality (see 10.44 (Target wake time (TWT))). Set to 0 otherwise.

The TWT Responder Support field indicates support by an HE STA for the role of TWT responder STA as described in 10.44 (Target wake time (TWT)). The field is set to 1 if dot11TWTOptionActivated is true, the STA is an HE STA and the STA supports TWT responder STA functionality (see 10.44 (Target wake time (TWT))). Set to 0 otherwise.

The Fragmentation Support field indicates the level of HE fragmentation that is supported by a STA. The encoding of this field is described in Table 9-ax13 (Fragmentation Support field encoding).

Table 9-ax13—Fragmentation Support field encoding

Fragmentation Support field value	Meaning
0	No support for HE Fragmentation
1	Support for fragments that are contained within a VHT single MPDU, no support for fragments within an A-MPDU
2	Support for up to one fragment per MSDU within a single A-MPDU
3	Support for multiple fragments per MSDU within an A-MPDU

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The format of the PPE Thresholds field is defined in Table 9-ax3 (PPE Thresholds field format).

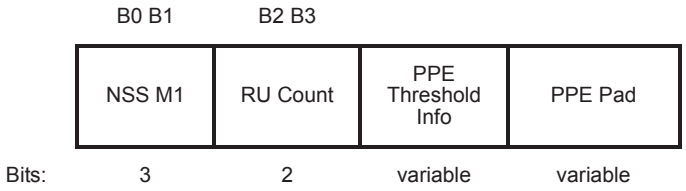

Figure 9-ax3—PPE Thresholds field format

The NSS M1 subfield contains an unsigned integer that is equal to the number of NSS values minus one for which PPE threshold information is included in the PPE Thresholds field. For example, if the number of NSS values represented is 4, then the NSS M1 subfield contains the value 3.

The RU Count subfield contains an unsigned integer that is equal to the number of RU allocation values for which HE PPE threshold information is included in the PPE Thresholds field. The value of zero for this field is reserved. The value of three for this field is reserved.

The PPE Threshold Info field is (NSS M1 + 1) x RU Count x 6 bits in length. The format of the PPE Threshold Info field is defined in Table 9-ax4 (PPE Thresholds Info field format).

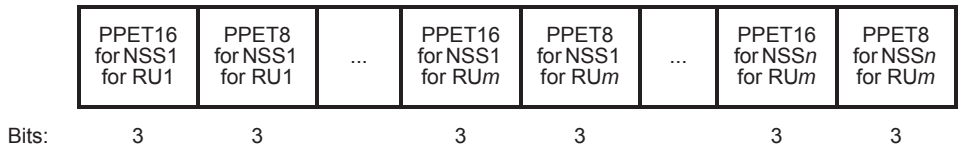

Figure 9-ax4—PPE Thresholds Info field format

Each PPET8 for NSS*n* for RU*m* subfield contains a Constellation Index value.

Each PPET16 for NSS*n* for RU*m* subfield contains a Constellation Index value.

All the PPET8 for NSS*n* for RU*m* subfield and PPET16 for NSS*n* for RU*m* subfield values are combined to encode the minimum duration of the post-FEC padding and packet extension for HE PPDUs that are transmitted to the STA sending this field, for each value of NSS and RU specified by the field and implicitly, for

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values of NSS and RU not explicitly indicated in the field. The encoding is described in Table 9-ax14 (PPET8 and PPET16 encoding).

Table 9-ax14—PPET8 and PPET16 encoding

Result of comparison of the constellation index x of an HE PPDU with NSS value n and RU value m to the value in the PPET8 for NSS*n* for RU*m* subfield	Result of comparison of the constellation index of an HE PPDU with NSS value n and RU value m to the value in the PPET16 for NSS*n* for RU*m* subfield	Combined minimum total duration of the post-FEC padding and packet extension requirement for an HE PPDU transmitted to this STA using the constellation index = x, NSS = *n* and RU = *m*
X < PPET8 or PPET8 == NONE	X < PPET16 or PPET16 == NONE	0 μs
X > PPET8	X < PPET16 or PPET16 == NONE	8 μs
X > PPET8 or PPET8 == NONE	X > PPET16	16 μs
PPET8 == NONE	PPET16 == NONE	0
PPET8 not present	PPET16 not present	0

The RU Allocation Index encoding is indicated in Table 9-ax15 (RU Allocation Index encoding).

Table 9-ax15—RU Allocation Index encoding

RU Allocation Index value	RU allocation value
0	2x996
1	996
2	484
3	242

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The Constellation Index encoding is indicated in Table 9-554ah (Constellation Index encoding).

Table 9-ax16—Constellation Index encoding

Constellation Index value	Corresponding Transmission Constellation
0	BPSK
1	QPSK
2	16-QAM
3	64-QAM
4	256-QAM
5	1024-QAM
6	Reserved
7	None

The PPE Pad field contains all zeros. The number of bits in the PPE Pad field is the number of bits required to round the length of the PPE Thresholds field up to the next integer quantity of octets.

STA that declare support for HE trigger-based PPDU shall also declare whether they belong to class A or class B. Class A STAs that are high capability devices and Class B STAs are low capability devices.

9.4.2.214 HE Operation element

The operation of HE STAs in an HE BSS is controlled by the HT Operation element, the VHT Operation element and the HE Operation element. The format of the HE Operation element is defined in Figure 9-ax5 (HE Operation element format).

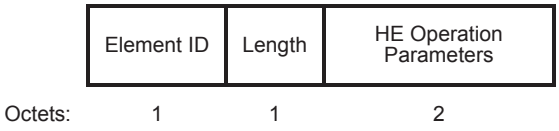

Figure 9-ax5—HE Operation element format

The Element ID and Length fields are defined in 9.4.2.1 (General).

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The format of the HE Operation Parameters field is defined in Figure 9-ax6 (HE Operation Parameter field format).

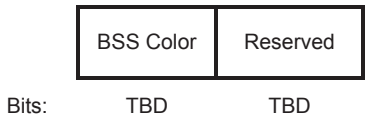

Figure 9-ax6—HE Operation Parameter field format

The BSS Color field is an unsigned integer whose value is the BSS Color of the BSS corresponding to the AP which transmitted this element, except that a value of 0 in this field indicates that there is no BSS Color for this BSS.

9.7 Aggregate MPDU (A-MPDU)

9.7.3 A-MPDU contents

Change the 1st paragraph of this subclause as follows:

In a non-DMG PPDU, an A-MPDU is a sequence of A-MPDU subframes carried in a single PPDU with one of the following combinations of RXVECTOR or TXVECTOR parameter values:

- The FORMAT parameter set to VHT
- The FORMAT parameter set to HT_MF or HT_GF and the AGGREGATION parameter set to 1
- The FORMAT parameter set to S1G, S1G_DUP_1M, or S1G_DUP_2M and the AGGREGATION parameter set to 1(11ah)
- The FORMAT parameter set to HE_SU, HE_MU, HE_TRIG or HE_EXT

Insert the following paragraph:

An A-MPDU carried in a HE MU PPDU may include MPDUs with different values of the TID field. Additional rules are TBD.

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Insert the following three rows in 9-409 (A-MPDU Contexts):

Table 9-409—A-MPDU Contexts

Name of Context	Definition of Context	Table defining permitted contents
Data Enabled Immediate Response with Multiple TID Support	The multiple TID A-MPDU is transmitted outside a PSMP sequence by a TXOP holder in DL/UL MU frame exchange or a STA in UL MU frame exchange sequence including potential immediate responses.	Table 9-426a (Multiple TID A-MPDU contents in the data enabled immediate response context)
Data Enabled No Immediate Response with Multiple TID Support	The multiple TID A-MPDU is transmitted outside a PSMP sequence by a TXOP holder in DL/UL MU frame exchange or a STA in UL MU frame exchange sequence that does not solicit immediate responses.	Table 9-426b (Multiple TID A-MPDU contents in the data enabled no immediate response context)
UL MU Context	An A-MPDU intended for a STA that is UL MU capable	Table 9-426c (A-MPDU content in the UL MU context)

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Insert the following three tables at the end of the subclause:

Table 9-426a—Multiple TID A-MPDU contents in the data enabled immediate response context

MPDU Description	Conditions	
Trigger frame	If the AP schedule resource for following UL MU transmission and HE A-Control field in data/management frames don't include trigger information.	
Ack frame	If the preceding PPDU contains an MPDU that requires an Ack frame response.	At most one of the MPDUs is present
BlockAck frame	If the preceding PPDU contains an implicit or explicit block ack request for a TID for which an HT-immediate block ack agreement exists, at most one BlockAck frame for this TID.	
Multi-STA BlockAck frame	If the preceding PPDU contains implicit or explicit block ack request for multiple TIDs for which an HT-immediate block ack agreement exists, at most one Multi-TID BA frame.	
Action No Ack	Action No Ack frames	
Data frames sent under an HT immediate block ack agreement	QoS Data frames with the multiple TIDs, with TID being corresponding to an HT-immediate block ack agreement	
QoS Null MPDUs with Ack Policy set to No Acknowledgment	In an HE BSS, QoS Null MPDUs with Ack Policy set to No Acknowledgment	
Action frame	At most one Action frame	
Data frame with TID that has no block ack agreement and with Ack Policy set to Normal Ack	At most one data frame of the TID	
Immediate BlockAckReq frames	At most one data frame for one TID that there is no data frames sent under	

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Table 9-426b—Multiple TID A-MPDU contents in the data enabled no immediate response context

MPDU Description	Conditions	
Trigger frame	If the AP schedule resource for following UL MU transmission and HE A-Control field in data/management frames don't include trigger information.	
Ack frame	If the preceding PPDU contains an MPDU that requires an Ack frame response.	At most one of the MPDUs is present
BlockAck frame	If the preceding PPDU contains an implicit or explicit block ack request for a TID for which an HT-immediate block ack agreement exists, at most one BlockAck frame for this TID.	
Multi-STA BlockAck frame	If the preceding PPDU contains implicit or explicit block ack request for multiple TIDs for which an HT-immediate block ack agreement exists, at most one Multi-TID BA frame.	
Action No Ack	Action No Ack frames	
Data frames without immediate block ack agreement and with Ack Policy set to No Ack	QoS Data frames with TIDs that does not correspond to a block ack agreement. These have the Ack Policy field equal to No Ack.	
QoS Null MPDUs with Ack Policy set to No Acknowledgment	In an HE BSS, QoS Null MPDUs with Ack Policy set to No Acknowledgment.	

Table 9-426c—A-MPDU content in the UL MU context

MPDU Description	Conditions
A control frame of subtype Trigger	One or more Trigger frames can be included
MPDU with trigger information in the MAC header	One or more MPDUs with trigger information in the MAC header may be included

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10. MAC sublayer functional description

10.3 DCF

10.3.1 General

Change as follows:

The virtual CS mechanism is achieved by distributing reservation information announcing the impending use of the medium. The exchange of RTS and CTS frames prior to the actual Data frame is one means of distribution of this medium reservation information. The RTS and CTS frames contain a Duration field that defines the period of time that the medium is to be reserved to transmit the actual Data frame and the returning Ack frame. A STA receiving either the RTS frame (sent by the originating STA) or the CTS frame (sent by the destination STA) shall process the medium reservation. Thus, a STA might be unable to receive from the originating STA and yet still know about the impending use of the medium to transmit a Data frame. The exchange of MU-RTS and simultaneous CTS responses by HE STAs prior to the actual Data frames as defined in 10.3.2.8a is one means of distribution of this medium reservation information.

10.3.2 Procedures common to the DCF and EDCAF

10.3.2.1 CS mechanism

Change the 3rd paragraph of the subclause as follows:

A first(11ah) virtual CS mechanism shall be provided by all MAC entities, and an additional second virtual CS mechanism shall be provided by an S1G MAC entity(11ah). The first mechanism is referred to as the NAV. The NAV maintains a prediction of future traffic on the medium based on duration information that is announced in RTS/CTS frames by non-DMG STAs, MU-RTS/CTS by HE STAs as defined in 10.3.2.8a, and RTS/DMG CTS frames by DMG STAs prior to the actual exchange of data. The duration information is also available in the MAC headers of all frames sent during the CP other than PV1 MAC frames and PS-Poll frames and during the BTI, the A-BFT, the ATI, the CBAP, and the SP.

10.3.2.4 Setting and resetting the NAV

Insert the following at the end of 10.3.2.4:

An HE AP may use a TBD mechanism to configure the use of RTS/CTS initiated by non-AP STA.

Insert a new subclause following 10.3.2.8:

10.3.2.8a MU RTS/CTS procedure

10.3.2.8a.1 General

The MU-RTS/CTS procedure allows an AP to protect MU transmission for HE STAs. An HE AP may transmit an MU-RTS frame to solicit simultaneous CTS responses from one or more HE STAs.

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Figure 10-ax1 (Example of MU-RTS/CTS/DL MU PPDU/Acknowledgement Response and NAV setting) shows an example of the exchange of MU-RTS and simultaneous CTS responses to protect DL MU PPDU and acknowledgement responses..

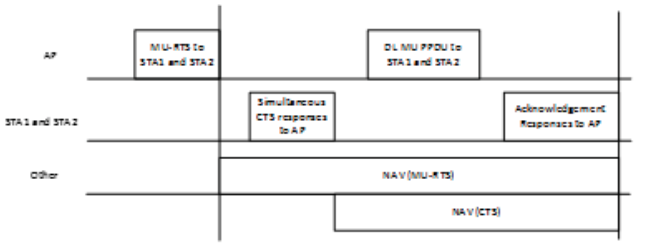

Figure 1 – Example of MU-RTS/CTS/DL MU PPDU/Acknowledgement Response and NAV setting

Figure 10-ax1—Example of MU-RTS/CTS/DL MU PPDU/Acknowledgement Response and NAV setting

Figure 10-ax2 (Example of MU-RTS/CTS/Trigger/HE trigger-based PPDU/Multi-STA BlockAck and NAV setting) shows an example of the exchange of MU-RTS and simultaneous CTS responses to protect the scheduled HE trigger-based PPDU and Multi-STA BlockAck frame.

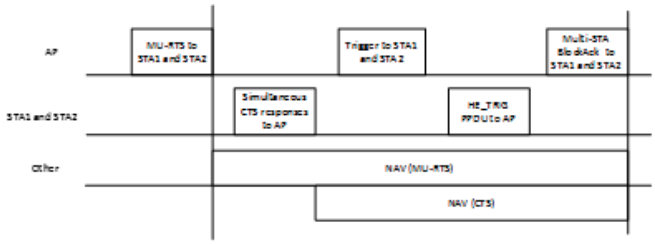

Figure 2 – Example of MU-RTS/CTS/Trigger/HE_TRIG PPDU/Multi-STA BlockAck and NAV setting

Figure 10-ax2—Example of MU-RTS/CTS/Trigger/HE trigger-based PPDU/Multi-STA Block-Ack and NAV setting

10.3.2.8a.2 MU-RTS procedure

An MU-RTS frame shall not request a STA to send CTS responses in any 20 MHz channel that is not occupied by the immediately preceding DL PPDU that contains an MU-RTS frame. In each 20 MHz channel occupied by the immediately preceding DL PPDU that contains an MU-RTS frame, there is at least one STA that is requested to send CTS responses on the 20 MHz channel.

If an MU-RTS frame requests a STA to send CTS responses in a non-HT or non-HT duplicate PPDU, the RU Allocation subfield in the Per-User Info field addressed to the STA shall be set to a value indicating either primary 20 MHz channel, primary 40 MHz channel, primary 80 MHz channel, 160 MHz channel, or 80+80 MHz channel. Other indications are TBD.

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10.3.2.8a.3 CTS Repsonse to MU-RTS

If a HE STA receives an MU-RTS frame, the HE STA shall commence the transmission of a CTS response at the SIFS time boundary after the end of a received PPDU when all the following conditions are met:

— The MU-RTS frame has one of the Per-User Info fields addressed to the STA.

— The UL MU CS condition described in 25.5.2.4 (UL MU CS mechanism) indicates the medium is idle

— Other transmission conditions TBD are met.

HE STAs may transmit CTS responses to an MU-RTS frame in a non-HT or non-HT duplicate PPDU with frame format as defined in 9.3.1.3 based on the request in MU-RTS frame. The method of request is TBD.

The Scrambler Initialization in the SERVICE field of the CTS sent in response to an MU-RTS frame shall be copied from the Scrambler Initialization in the SERVICE field of the MU-RTS frame. The rate of the CTS response is defined in 10.7.6.

The CTS sent in response to an MU-RTS frame shall be transmitted on one or more 20 MHz channels.

If the CTS sent in response to an MU-RTS frame is transmitted in a non-HT or non-HT duplicate PPDU, then the CTS response shall be transmitted on the indicated 20 MHz channels identified in the RU Allocation subfield of the Per-User Info field.

Figure 10-ax3 (Example of MU-RTS and CTS responses on the primary 40 MHz channel) shows an example of the exchange of MU-RTS and simultaneous CTS responses on primary 40 MHz channel. In this example, MU-RTS is transmitted in a 40 MHz non-HT duplicate PPDU on primary 40 MHz channel. Further, MU-RTS requests STA1 to transmit CTS response in a non-HT PPDU on primary 20 MHz channel and STA2 to transmit CTS response in a 40 MHz non-HT duplicate PPDU on primary 40 MHz channel.

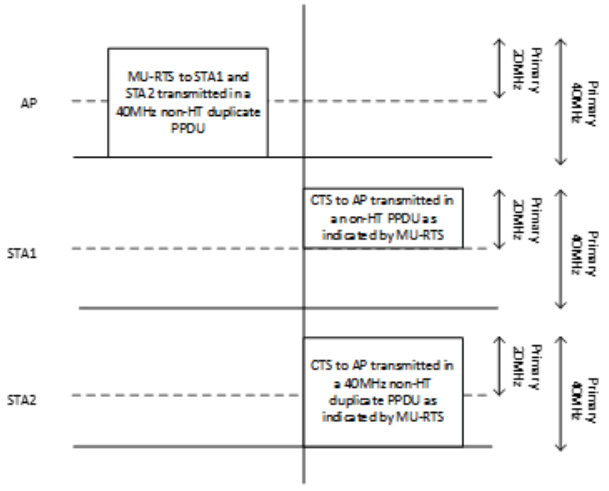

Figure 3 - Example of MU-RTS and CTS Responses on Primary 40MHz Channel

Figure 10-ax3—Example of MU-RTS and CTS responses on the primary 40 MHz channel

10.3.2.11 MU acknowledgment procedure

Insert a new subclause heading before the first paragraph of 10.2.3.11:

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10.3.2.11.1 General

Insert a new subclauses at the end of 10.2.3.11:

10.3.2.11.2 MU acknowledgement procedure for DL MU PPDU in SU format

The acknowledgment procedure performed by a STA that receives MPDUs that were transmitted within a VHT MU PPDU or an HE MU PPDU is the same as the acknowledgment procedure for MPDUs that were not transmitted within a VHT MU PPDU or an HE MU PPDU.

NOTE−All MPDUs transmitted within a VHT MU PPDU or an HE MU PPDU are contained within A-MPDUs, and the rules specified in 9.7.3 (A-MPDU contents) prevent an immediate response to more than one of the A-MPDUs.

Responses to A-MPDUs within a VHT MU PPDU or an HE MU PPDU that are not immediate responses to the VHT MU PPDU or the HE MU PPDU are transmitted in response to explicit BlockAckReq frames by the AP. Examples of VHT MU PPDU frame exchange sequences are shown in Figure 10-11 (An example of a TXOP containing a VHT MU PPDU transmission with an immediate acknowledgment to the VHT MU PPDU) and Figure 10-12 (An example of a TXOP containing a VHT MU PPDU transmission with no immediate acknowledgment to the VHT MU PPDU).

Recovery within the TXOP that contains a VHT MU PPDU or an HE MU PPDU can be performed according to the rules of 10.22.2.7 (Multiple frame transmission in an EDCA TXOP). BlockAckRequest frames related to A-MPDUs within a VHT MU PPDU or an HE MU PPDU can be transmitted in a TXOP separate from the one that contained the VHT MU PPDU or the HE MU PPDU.

NOTE−A BlockAck frame or an Ack frame is sent in immediate response to the BlockAckReq frame for HT-immediate or HT-delayed Block Ack, respectively. An Ack frame might be sent in immediate response to a VHT single MPDU in the VHT MU PPDU or the HE MU PPDU.

10.3.2.11.3 MU acknowledgement procedure for HE MU PPDU in MU format

A non-AP STA that is the recipient, within a HE MU PPDU, of an MPDU that solicits an immediate response with Ack Policy '01' in QoS Control field, shall send the immediate response according to the scheduling information defined by the UL trigger information that is carried either in the Trigger frame(s) or in MAC header. If no valid Trigger frame(s) or MAC header containing UL trigger information is received, then the STA shall not respond. An example of UL OFDMA acknowledgement to an HE MU PPDU is shown in Figure 10-ax4 (An example of a TXOP containing an HE MU PPDU transmission with an immediate UL OFDMA acknowledgement).

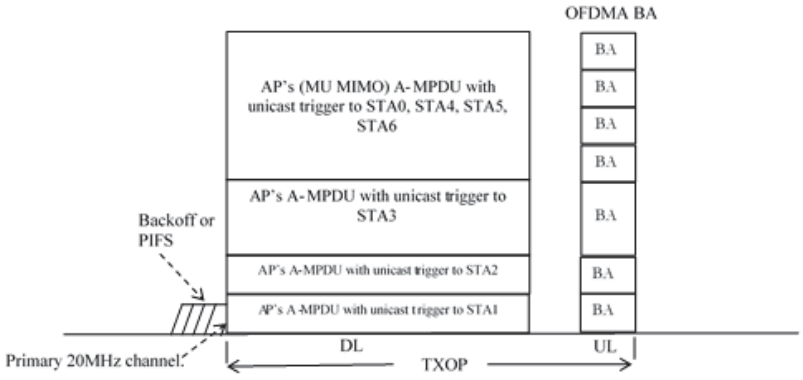

Figure 10-ax4—An example of a TXOP containing an HE MU PPDU transmission with an immediate UL OFDMA acknowledgement

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An AP shall not set Ack Policy to "01" in QoS Control field in MPDUs of HE MU PPDU if both UL MU OFDMA Capable subfield and UL MU MIMO Capable subfield of the HE Capabilities element of the receiver of the MPDUs are set to 0.

10.3.2.11.4 MU acknowledgement procedure for an UL MU transmission

When receiving multiple frames from more than one STA that are part of an UL MU transmission (Clause 9.42.2) and that require an immediate acknowledgement, an AP may send multiple BlockAck frames (or ACK frames) in an OFDMA HE MU PPDU or a Multi-STA BlockAck (M-BA) frame. Additional conditions to transmit multiple BlockAck frames (or ACK frames) in an OFDMA HE MU PPDU or Multi-STA BlockAck are TBD. After a successful reception of an UL frame requiring acknowledgment, transmission of the DL acknowledgement shall commence after a SIFS, without regard to the busy/idle state of the medium.

The example of DL OFDMA BA shown in Figure 10-ax5 (An example of a TXOP containing an UL MU transmission with an immediate DL MU transmission containing unicast BlockAck frames acknowledging the frames received from the respective STAs), and examples for Multi-STA BlockAck frame acknowledgement to a UL MU PPDU is given in Figure 10-ax6 (An example of a TXOP containing UL MU transmissions with an immediate Multi-STA BlockAck (M-BA) frame acknowledging the MPDUs that were correctly received from each STA. The UL MU transmission may be OFDMA or MU-MIMO), Figure 10-ax7 (An example of a TXOP containing UL MU transmissions with an immediate DL non-HT duplicate PPDU containing the M-BA frame. The UL MU transmissions may be OFDMA or MU-MIMO) and Figure 10-ax8 (An example of a TXOP containing UL MU transmissions with an immediate OFDMA HE MU PPDU containing Multi-STA BlockAck frames. The UL MU transmissions may be OFDMA or MU-MIMO).

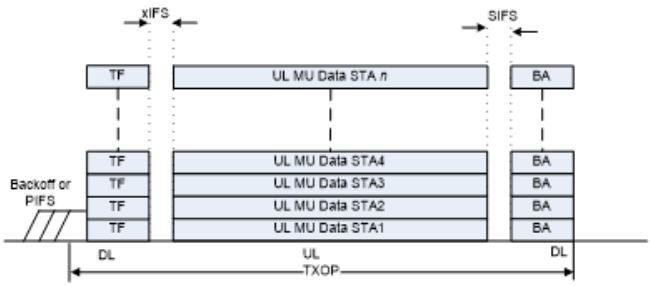

Figure 10-ax5—An example of a TXOP containing an UL MU transmission with an immediate DL MU transmission containing unicast BlockAck frames acknowledging the frames received from the respective STAs

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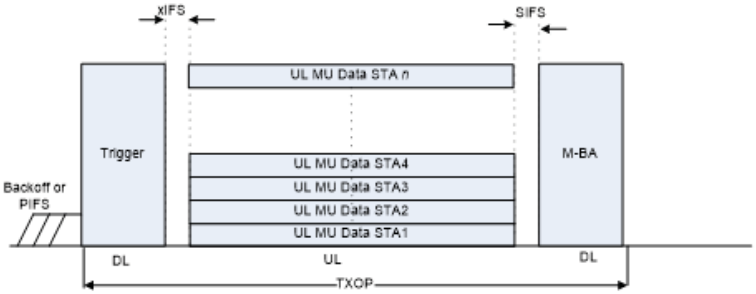

Figure 10-ax6—An example of a TXOP containing UL MU transmissions with an immediate Multi-STA BlockAck (M-BA) frame acknowledging the MPDUs that were correctly received from each STA. The UL MU transmission may be OFDMA or MU-MIMO

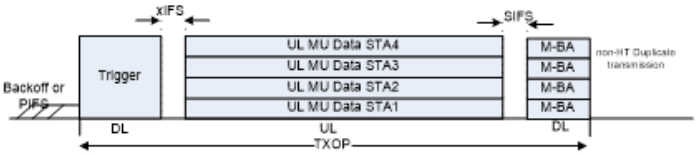

Figure 10-ax7—An example of a TXOP containing UL MU transmissions with an immediate DL non-HT duplicate PPDU containing the M-BA frame. The UL MU transmissions may be OFDMA or MU-MIMO

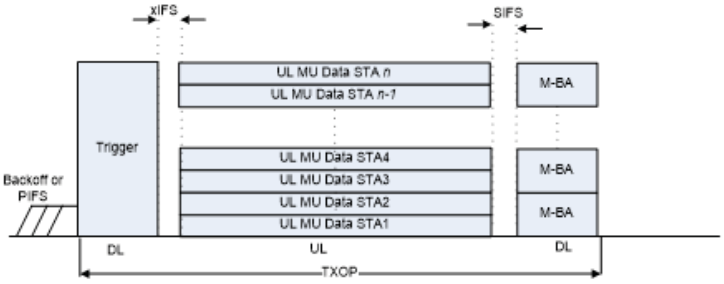

Figure 10-ax8—An example of a TXOP containing UL MU transmissions with an immediate OFDMA HE MU PPDU containing Multi-STA BlockAck frames. The UL MU transmissions may be OFDMA or MU-MIMO

10.7 Multirate support

10.7.6 Rate selection for Control frames

10.7.6.5 Rate selection for control response frames

10.7.6.5.2 Selection of a rate or MCS

Insert the following at the end of the subclause:

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Within a MU RTS/CTS exchange, the simultaneous CTS shall be transmitted with the primary rate based on the rate or MCS of the MU-RTS frame that triggers the simultaneous CTS. The primary rate is defined to be the highest rate in the BSSBasicRateSet parameter that is less than or equal to the rate (or non-HT reference rate; see 10.7.10 (Non-HT basic rate calculation)) of the previous MU-RTS frame. If no rate in the BSSBasicRateSet parameter meets these conditions, the primary rate is defined to be the highest mandatory rate of the attached PHY that is less than or equal to the rate (or non-HT reference rate; see 10.7.10 (Non-HT basic rate calculation)) of the previous frame.

If a Multi-STA BlockAck frame or DL OFDMA ackowlegement frame is sent as an immediate response to an UL HE PPDU, the AP may ignore the <HE-MCS, NSS> tuples that are used for MPDUs in UL HE PPDU from non-AP STAs that elicits the DL acknowledgement.

A Multi-STA BlockAck frame is carried in a non-HT PPDU shall be transmitted by the AP using a rate supported by all the recipients.

A Multi-STA BlockAck frame is carried in an HT or VHT PPDU shall be transmitted by the AP using an HT-MCS or <VHT-MCS, NSS> tuple supported by all the recipients.

A Multi-STA BlockAck frame is carried in an HE PPDU shall be transmitted by the AP using an <HE-MCS, NSS> tuple supported by all the recipients.

10.9 HT Control field operation

If the value of dot11HTControlFieldSupported is true, a STA shall set the +HTC Support subfield of the HT Extended Capabilities field of the HT Capabilities element to 1 in HT Capabilities elements that it transmits. If the value of dot11VHTControlFieldOptionImplemented is true, a STA shall set the +HTC-VHT Support subfield of the VHT Capabilities Information field of the VHT Capabilities element to 1 in VHT Capabilities elements that it transmits. If the value of the dot11HEControlFieldOptionImplemented is true, a STA shall set the +HTC-HE Support subfield of the HE Capabilies Information field of the HE Capabilities element to 1 in HE Capabilities elements that it transmits.

A STA that has a value of true for at least one of dot11RDResponderOptionImplemented, dot11MCSFeedbackOptionImplemented, and dot11AlternateEDCAActivated shall set dot11HTControlFieldSupported or dot11VHTControlFieldOptionImplemented or both to true. A STA that has a value of true for at least one of dot11ULMUOFDMAOptionImplemented, dot11MCSFeedbackOptionImplemented, and dot11ROMIOptionImplemented shall set the dot11HEControlFieldOptionImplemented to true.

An HT variant HT Control field shall not be present in a frame addressed to a STA unless that STA declares support for +HTC-HT in the HT Extended Capabilities field of its HT Capabilities element (see 9.2.4.6 (HT Control field)).

A VHT variant HT Control field shall not be present in a frame addressed to a STA unless that STA declares support for +HTC-VHT in the VHT Capabilities Information field of its VHT Capabilities element.

NOTE–An HT STA that does not support +HTC (HT or VHT variant) that receives a +HTC frame addressed to another STA still performs the CRC on the actual length of the MPDU and uses the Duration/ID field to update the NAV, as described in <reference>.

An HE variant HT Control field shall not be present in a frame addressed to a STA unless that STA declares support for +HTC-HE in the HE Capabilities Information field of its HE Capabilities element. The HE variant HT Control field carried in the frame may contain aControl subfield supported by the intended receiver that has:

— A value of 0 in the Control ID subfield when the transmitting STA expects an UL MU PPDU that carries an immediate acknowledgement, as described in 9.42.2 (UL MU operation).

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- A value of 1 in the Control ID subfield when the transmitting STA changes the receive operation mode, as described in 10.45.2 (Receive operating mode indication).
- A value of 2 in the Control ID subfield when the transmitting STA follows the HE link adaptation procedure, as described in 10.31.4 (Link adaptation using the HE variant HT Control field).
- ...

If the HT Control field is present in an MPDU aggregated in an A MPDU, then all MPDUs of the same frame type (i.e., having the same value for the Type subfield of the Frame Control field) aggregated in the same A MPDU shall contain an HT Control field. The HT Control field of all MPDUs containing the HT Control field aggregated in the same A MPDU shall be set to the same value.

10.22 HCF

10.22.2 HCF contention based channel access (EDCA)

10.22.2.9 Truncation of TXOP

Insert the following at the end of subclause 10.22.2.9:

An HE STA that receives a CF-End frame should not reset its NAV if:

- The CF-End did not originate from the STA's associated BSS or any BSS of a multi-BSSID set that the STA's associated BSS belongs to and the most recent NAV update was due to a PPDU originating from the STA's associated BSS or any BSS of a multi-BSSID set that the STA's associated BSS belongs to.
- The CF-End originated from the STA's associated BSS or any BSS of a multi-BSSID set that the STA's associated BSS belongs to and the most recent NAV update was not due to a PPDU originating from the STA's associated BSS or any BSS of a multi-BSSID set that the STA's associated BSS belongs to.

10.24 Block acknowledgement (block ack)

10.24.10 GCR block ack

Insert the following sentences at the end of 2nd paragraph of section 10.24.10.3:

The originator may send a MU-BAR frame (MU-BAR Trigger variant of UL-Trigger Frame) to one or more of the HE STAs that have a GCR block ack agreement for this group address. Upon reception of the Block-Ack frame, an originator may send a MU-BAR frame to other one or more HE STAs that have a block ack agreement for this group address, and this process may be repeated multiple times.

Insert the following sentences at the end of 4th paragraph of section 10.24.10.3:

When HE STA receives a MU-BAR frame with User identifier field set to the AID of the HE STA, the HE STA shall transmit BlockAck frame in the indicated resource unit SIFS after the Trigger frame. The Block-Ack frames acknowledge the HE STA's reception status of the block of group addressed frames requested by the MU-BAR frame.

Insert the following sentences and a picture at the end of 5th paragraph of section 10.24.10.3:

Figure 10-ax9 (Example of a frame exchange with GCR block ack retransmission policy) shows another example of a frame exchange when the GCR block ack retransmission policy is used. The HE AP sends several A-MSDUs using the GCR block ack retransmission policy. The HE AP then sends a MU-BAR to group

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member 1 and 2 of the GCR group, waits for the BlockAck frames, and then sends a MU-BAR to group member 3. After receiving the BlockAck frame from GCR group member 3, the HE AP determines whether any A-MSDUs need to be retransmitted and sends additional A-MSDUs (some of which might be retransmissions of previous A-MSDUs) using the GCR block ack retransmission policy.

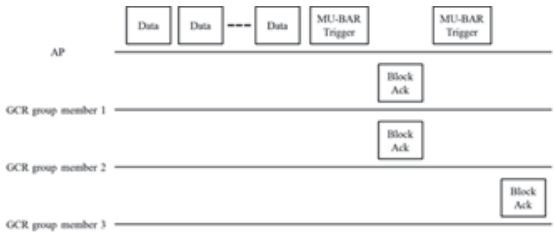

Figure 10-ax9—Example of a frame exchange with GCR block ack retransmission policy

Change the following sentences in 6th paragraph of section 10.24.10.3:

After completing the BlockAckReq and BlockAck frame exchanges or the MU-BAR and BlockAck frame exchanges, the originator determines from the information provided in the BlockAck bitmap and from the missing BlockAck frames which, if any, A-MSDUs need to be retransmitted.

Change the following sentences in 7th paragraph of section 10.24.10.3

An originator adopting the GCR block ack retransmission policy for a GCR group address chooses a lifetime limit for the group address. The originator may vary the lifetime limit for the group address at any time and may use different lifetime limits for different GCR group addresses. The originator transmits and retries each A-MSDU until the appropriate lifetime limit is reached or until each one has been received by all group members to which a BlockAckReq frame or an MU-BAR frame has been sent, whichever occurs first.

Insert the following sentences at the end of 8th paragraph of section 10.24.10.3

An originator may also regularly send an MU-BAR frame with User identifier field set to AIDs of HE STAs that transmit the BlockAck frames and the Block Ack Starting Sequence Control subfield set to the Sequence Number field of the earliest A-MSDU of the GCR stream that has not been acknowledged by all group members and has not expired due to lifetime limits, in order to minimize buffering latency at receivers in the GCR group.

Change the following in 12th paragraph of section 10.24.10.3

If the beginning of such reception does not occur during the first slot time following a SIFS in case of a BlockAckReq frame or a [TBD IFS] in case of an MU-BAR, then the originator may perform error recovery by retransmitting a BlockAckReq frame or an MU-BAR PIFS after the previous BlockAckReq frame or an MU-BAR frame when both of the following conditions are met:

— The carrier sense mechanism (see 10.3.2.1 (CS mechanism)) indicates that the medium is idle at the TxPIFS slot boundary (defined in 10.3.7 (DCF timing relations)) after the expected start of a BlockAck frame, and

— The remaining duration of the GCR TXOP is longer than the total time required to retransmit the GCR BlockAckReq frame or an MU-BAR frame plus one slot time.

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10.44 Target wake time (TWT)

10.44.1 TWT overview

Change the 2nd paragraph of 9.44.1 as follows:

A TWT requesting STA communicates wake scheduling information to its TWT responding STA and the TWT responding STA devises a schedule and delivers TWT values to the TWT requesting STA when a TWT agreement has been established between them as described in 10.44.2 (Individual TWT agreements). When explicit TWT is employed, a TWT requesting STA wakes and performs a frame exchange and receives the next TWT information in a response from the TWT responding STA as described in 10.44.2.2 (Explicit TWT operation). When implicit TWT is used, the TWT requesting STA calculates the Next TWT by adding a fixed value to the current TWT value as described in 10.44.3 (Implicit TWT operation). An HE AP can additionally devise schedules and deliver TWT values to HE non-AP STAs without requiring that an individual TWT agreement has been established between them, as described in 10.44.4 (Broadcast TWT operation).

Insert a subclause heading after the 2nd paragraph of 10.44.1 (rest of dependent subclauses become dependent of this new subclause):

10.44.2 Individual TWT agreements

Change the 2 paragraphs (4th, 5th) of 9.44.1 as follows:

A STA with dot11TWTOptionActivated equal to true and that operates in the role of TWT requesting STA shall set the TWT Requester Support subfield to 1 in all S1G Capabilities or HE Capabilities elements that it transmits. A STA with dot11TWTOptionActivated equal to true and that operates in the role of TWT responding STA shall set the TWT Responder Support subfield to 1 in all S1G Capabilities or HE Capabilities elements that it transmits.

If the TWT Responder Support subfield of the S1G Capabilities or of the HE Capabilities element received from its associated AP is equal to 1, a non-AP STA with dot11TWTOptionActivated equal to true may transmit a TWT element to the AP with a value of Request TWT, Suggest TWT or Demand TWT in the TWT Command field and with the TWT Request field equal to 1.

Insert a new paragraph after the 9th paragraph as follows:

A STA that transmits a frame carrying a TWT element to an HE STA may set the Trigger subfield of the element to 1. Otherwise, the STA shall set the Trigger subfield to 0. In a TWT response, a Trigger field equal to 1 indicates a trigger-enabled TWT. The TWT responding STA of a trigger-enabled TWT agreement shall schedule for transmission a Trigger frame to the TWT requesting STA, as described in <reference> (UL MU operation), within each TWT SP for that TWT agreement. The TWT responding STA that intends to transmit additional Trigger frames during a trigger-enabled TWT SP shall set the Cascade Indication field of the Trigger frame to 1 to indicate that it will transmit another Trigger frame within the same TWT SP. Otherwise, it shall set the Cascade Indication field to 0.

Insert a sentence at the end of the 10th paragraph of 10.44.1 as follows:

An HE STA that transmits a TWT element to another HE STA shall set the Implicit subfield of the element to 1 and the NDP Paging Indicator subfield of the element to 0.

Insert a sentence at the end of the 12th paragraph of 10.44.1 as follows:

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A TWT requesting STA transmits a frame during a trigger-enabled TWT SP in response to a Trigger frame (see 25.5.2 (UL MU operation)).

Change the last 2 paragraphs of 10.44.1 as follows:

The Flow Type field in the TWT response that successfully set up a TWT agreement indicates the type of interaction between the TWT requesting STA and the TWT responding STA within each TWT SP for that TWT agreement. Flow Type field equal to 0 indicates an announced TWT. The TWT responding STA of an announced TWT agreement shall not transmit a frame, except for a Trigger frame within a trigger-enabled TWT SP, to the TWT requesting STA within a TWT SP until it has successfully received a PS-Poll frame or APSD trigger frame (see 10.2.2.5 (Power management with APSD)) from the TWT requesting STA. Flow Type field equal to 1 indicates an unannounced TWT. The TWT responding STA of an unannounced TWT agreement may transmit a frame to the TWT requesting STA within a TWT SP before it has successfully received a frame from the TWT requesting STA.

An S1G TWT requesting STA indicates which single channel it desires to use as a temporary primary channel during a TWT SP by setting a single bit to 1 within the TWT Channel field of the TWT element, according to the mapping described for that field. An S1G TWT responding STA indicates which single channel the TWT requesting STA is permitted to use as a temporary primary channel during a TWT SP by setting a single bit to 1 within the TWT Channel field of the TWT element, according to the mapping described for that field. During a TWT SP, access to a channel which is not the primary channel of the BSS shall be performed according to the procedure described in 9.49 (Subchannel Selective Transmission (SST)). An HE STA indicates TBD.

10.44.3 Implicit TWT operation

Change the 3rd paragraph of 9.44.4 of as follows:

A TWT requesting STA awake for an implicit TWT SP may transition to the doze state after AdjustedMinimumTWTWakeDuration time has elapsed from the TWT SP start time as identified by the TWT requesting STA. A TWT requesting STA awake for a trigger-enabled TWT SP may transition to the doze state if it receives a Trigger frame from the TWT responding STA with a Cascade Indicaion field equal to 0 that is not intended to it.

Insert a sentence at the end of the 4rd paragraph of 10.44.4 as follows:

An HE STA shall not generate BAT, TACK, or STACK frames.

Insert a new subclause, and dependent subclauses, at the end of 10.44 as follows:

10.44.4 Broadcast TWT operation

10.44.4.1 General

A TWT scheduling STA is an HE AP with dot11TWTOptionActivated equal to true that includes a TWT element in the Beacon frame, and follows the rules described in 9.44.3.2 (Rules for TWT scheduling STA).

A TWT scheduled STA is an HE non-AP STA that:

- TBD: Declares support of being a TWT scheduled STA
- Receives a broadcast TWT element transmitted by an HE AP that is a TWT scheduling STA and,
- Has not negotiated any implicit TWT agreement with the HE AP as described in 10.44.2 (Individual TWT agreements).

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A TWT scheduled STA follows the schedule provided by the TWT scheduling STA as described in Error! Reference source not found. (Rules for TWT scheduled STA). A TWT scheduled STA can negotiate the TBTT and listen interval for Beacon frames it intends to receive as described in 10.44.4.3 (Negotiation of TBTT and listen interval).

An example of broadcast TWT operation is shown in Figure 10-ax10 (Example of broadcast TWT operation), where the AP is the TWT scheduling STA and STA 1 and STA 2 are the TWT scheduled STAs.

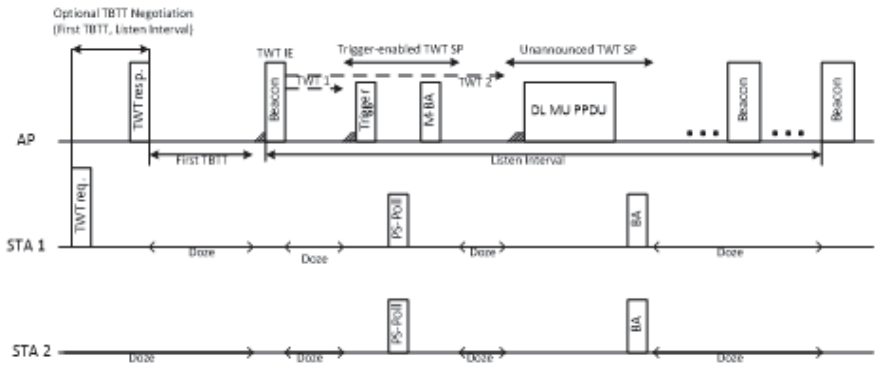

Figure 10-ax10—Example of broadcast TWT operation

10.44.4.2 Rules for TWT scheduling STA

A TWT scheduling STA may include a TWT element in a Beacon frame scheduled at a TBTT (see 10.1.3.2 (Beacon generation in non-DMG infrastructure networks)). The TWT scheduling STA shall include one or more TWT parameter sets in the TWT element, and each TWT parameter set may indicate a periodic occurrence of TWTs. Each TWT parameter set specifies the TWT parameters of a broadcast TWT that are valid within a broadcast TWT SP.

The TWT scheduling STA sets the TWT parameters of each set as described below:

— The TWT scheduling STA shall set the Trigger field to 1 to indicate a trigger-enabled TWT. Otherwise, it shall set the Trigger field to 0. The TWT scheduling STA shall schedule for transmission a Trigger frame intended to one or more TWT scheduled STAs during a trigger-enabled TWT SP. The TWT scheduling STA that intends to transmit additional Trigger frames during a trigger-enabled TWT SP shall set the Cascade Indication field of the Trigger frame to 1 to indicate that it will transmit another Trigger frame within the same TWT SP. Otherwise, it shall set the Cascade Indicaion field to 0.

— The TWT scheduling STA shall set the TWT Flow Identifier field according to Table 8.248n1 (TWT Flow Identifier field for a broadcast TWT element). The TWT scheduling STA should only send frames that satisfy the TWT flow identifier recommendations listed in Table 8.248n1 (TWT Flow Identifier field for a broadcast TWT element) during the TWT SP(s).

— The TWT scheduling STA shall set the TWT field to the TSF[TBD X: TBD Y] time at which the first TWT is scheduled.

— The TWT scheduling STA shall include the value of the TWT wake interval in the TWT Wake Interval Exponent and TWT Wake Interval Mantissa fields for a periodic TWT. The TWT parameters are valid for each successive TWT of the periodic TWT.

— TBD

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10.44.4.3 Negotiation of TBTT and listen interval

A TWT scheduled STA that intends to operate in power save mode (see 10.2.2.2 (STA Power Management modes)) may transmit a TWT request frame to the TWT scheduling STA that identifies the TBTT of the next Beacon frame the STA intends to receive and the interval between subsequent Beacon frames it intends to receive. The TWT request frame shall contain:

— The value of the requested first TBTT in the Target Wake Time field when the TWT Command field is Suggest TWT or Demand TWT.

— The value of the listen interval between consecutive TBTTs in the TWT Wake Interval Mantissa and TWT Wake Interval Exponent fields.

A TWT scheduling STA that receives a TWT request frame from a STA whose value of the TWT wake interval is equal to the STA's listen interval shall respond with a TWT response frame that contains either Accept TWT or Reject TWT in the TWT Command field and, in the case of an Accept TWT, it shall also contain:

— The value of the allocated first TBTT in the Target Wake Time field, and

— The value of the listen interval between consecutive TBTTs in the TWT Wake Interval Mantissa and TWT Wake Interval Exponent fields.

After successfully completing the negotiation, the TWT scheduled STA may go to doze state until its TSF matches the next negotiated TBTT provided that the STA is in power save mode, and no other condition requires the STA to remain awake. The TWT scheduled STA shall be in the awake state to listen to Beacon frames transmitted at negotiated TBTTs and shall operate as described in in Error! Reference source not found. (Rules for TWT scheduled STA).

Either STA can tear down an established negotiation following the tear down procedure described in 10.44.8 (TWT Teardown).

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Insert new Clauses 25 and 26 following Clause 24 as follows:

25. High Efficiency (HE) MAC specification

25.1 Introduction

25.2 Channel Access

25.2.1 Updating two NAVs

Mandatory or optional support of two NAVs is TBD.

For the two NAVs maintained by a HE STA, one is identified as Intra-BSS NAV, and the second one is identified as regular NAV.

A STA that receives at least one valid frame in a PSDU and identifies the frame as Intra-BSS can update its Intra-BSS NAV with the information from any valid Duration field in the PSDU.

A STA that receives at least one valid frame in a PSDU and identifies the frame as Inter-BSS can update its regular NAV with the information from any valid Duration field in the PSDU.

A STA that receives at least one valid frame in a PSDU and cannot identify the frame as Intra-BSS or Inter-BSS can update its regular NAV with the information from any valid Duration field in the PSDU.

A STA that receives a valid HE-SIG-A in a HE PPDU and identifies the HE-SIG-A as Intra-BSS can update its Intra-BSS NAV with the information from the TXOP Duration field in the HE-SIG-A.

A STA that receives a valid HE-SIG-A in a HE PPDU and identifies the HE-SIG-A as Inter-BSS can update its regular NAV with the information from the TXOP Duration field in the HE-SIG-A.

When the received frame's RA is equal to the STA's own MAC address, the STA shall not update its Intra-BSS NAV or regular NAV with the information from the Duration field.

When a STA receives both a valid HE-SIG-A in a HE PPDU and a valid frame in the PSDU of the HE PPDU, the STA shall not update its Intra-BSS NAV or regular NAV with the information from the TXOP Duration field in the HE-SIG-A.

For all other received frames that are identified by the STA as Intra-BSS, the STA shall update its Intra-BSS NAV when the received value of the Duration field is greater than the STA's current Intra-BSS NAV value.

For all other received frames that are identified by the STA as Inter-BSS or cannot be identified as Intra-BSS or Inter-BSS, the STA shall update its regular NAV when the received value of the Duration field is greater than the STA's current regular NAV value.

For all other received HE-SIG-As that are identified by the STA as Intra-BSS, the STA shall update its Intra-BSS NAV when the received value of the TXOP Duration field is greater than the STA's current Intra-BSS NAV value.

For all other received HE-SIG-As that are identified by the STA as Inter-BSS, the STA shall update its Inter-BSS NAV when the received value of the TXOP Duration field is greater than the STA's current regular NAV value.

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25.3 Fragmentation

25.3.1 General

An HE STA can dynamically fragment individually addressed MSDUs or MMPDUs and defragment received MPDUs as defined in this subclause, and using the fragmentation/defragmentation processes defined in 10.2.7 (Fragmentation/defragmentation overview) without being subject to the rules defined in that subclause.

25.3.2 Procedure at the originator

A dynamic fragment is an MPDU, the payload of which carries a portion of an MSDU or MMPDU, which generation follows the rules defined in 10.5 (Fragmentation), except for:

— Reception of dynamic fragments is not mandatory. An HE STA declares its capability of receiving dynamic fragments by setting the HE Fragmentation Support field of the HE Capabilities element it transmits to a nonzero value as described below.

— The length of each fragment is not required to be equal for all fragments. The length of each fragment may be of any nonzero value. Other conditions may be TBD.

An HE STA may transmit to a receiver STA an individually addressed (A)-MPDU that contains:

— One dynamic fragment of an MSDU or MMPDU in a VHT single MPDU if the receiver STA has indicated a nonzero value in the HE Fragmentation Support field of its HE Capabilities element
  - The originator STA shall follow the rules defined in 10.13.8 (Transport of VHT single MPDUs) for generating the VHT single MPDU

— Up to one dynamic fragment for each MSDU in an A-MPDU if the receiver STA has indicated a value of 2 in the HE Fragmentation Support field of its HE Capabilities element
  - The originator STA shall follow the rules defined in 10.24.7 (HT-immediate block ack extensions) for generating the A-MPDU

— Up to four dynamic fragments for each MSDU in an A-MPDU if the receiver STA has indicated a value of 3 in the HE Fragmentation Support field of its HE Capabilities element
  - The originator STA shall set the Fragment Number subfield of each MPDU to a value less than 4
  - The originator STA shall follow the rules defined in 10.24.7 (HT-immediate block ack extensions) for generating the A-MPDU with the following exceptions:
    - The A-MPDU should contain MPDUs whose range of the Sequence Number subfields does not exceed 16. Other conditions may be TBD.

An HE STA shall not transmit a PSDU that contains dynamic fragments of an MSDU or MMPDU whose number is greater than the maximum number of fragments or that are carried in an A-MPDU format that is not supported by the receiver STA, as determined by the value of the HE Fragmentation Support field of the HE Capabilities element sent by the receiver STA.

25.3.3 Procedure at the receiver

An HE STA that transmits an HE Capabilities element with a nonzero value in the HE Fragmentation Support subfield shall set dot11DynamicFragmentation to true. Otherwise, the HE STA may set dot11DynamicFragmentation to false.

Defragmentation of dynamic fragments shall follow the rules defined in 10.6 (Defragmentation), except for:

— The receiver STA may support the concurrent reception of dynamic fragments of TBD number of MSDUs/MMPDUs under TBD conditions

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NOTE—The receiver STA is still subject to the Receive Timer rules for each fo the MSDUs/MMPDUs as defined in 9.6 (Defragmentation).

Upon reception of a PSDU that carries one or more dynamic fragments, the receiver STA responds with:

— An Ack frame when the received fragment is contained in a VHT single MPDU that solicits the immediate response
  - The receiver STA shall follow the rules defined in 10.3.2.9 (Ack procedure) for generating the Ack frame

— A BlockAck frame when the received fragments, up to one fragment for each MSDU, are contained in the A-MPDU that solicits the immediate response and is sent by an HE STA whose HE Fragmentation Support subfield in its HE Capabilities element is 2
  - The receiver STA shall follow the rules defined in 10.24.7 (HT-immediate block ack extensions) for generating the BlockAck frame, except that the STA shall:
    - Set to 1 each bit of the Block Ack Bitmap field that corresponds to a Sequence Number subfield of a successfully received fragment contained in the soliciting A-MPDU
    - Update the corresponding block acknowledgement record when an MSDU that is received in fragments is successfully reconstructed (see 10.6 (Defragmentation)).

— A BlockAck frame when the received fragments, one or more fragments for each MSDU, are contained in an A-MPDU that solicits the immediate response and is sent by an HE STA whose HE Fragmentation Support subfield in its HE Capabilities element is 3
  - The receiver STA shall follow the rules in 10.24.7.5 (Generation and transmission of BlockAck frames by an HT STA or DMG STA) for generating the BlockAck frame, except that the STA shall:
    - Set to 1 the Fragment Number subfield in the Block Ack Starting Sequence Control subfield of the BlockAck frame
    - Set to 1 each bit in location B of the Block Ack Bitmap field that corresponds to a successfully received fragment and shall set it to 0 otherwise, with B calculated as:
      $B = SC - SSN$, where SC and SSN are treated as 14-bit unsigned integers
      SC is the value of the Sequence Control subfield of an MPDU containing the fragment for which the receive status is indicated
      SSN is the value of the Starting Sequence Number subfield of the Block Ack Starting Sequence Control subfield of the BlockAck frame
    - Update the corresponding block acknowledgement record when an MSDU that is received in fragments is successfully reconstructed (see 10.6 (Defragmentation)).

25.4 Block acknowledgement

25.4.1 Selection of BlockAck and BlockAckReq variants

An HE STA may send a Multi-STA BlockAck frame in response to an HE trigger-based PPDU. A Multi-STA BlockAck frame contains one or more BA Information fields with one or more AIDs and one or more different TIDs. A Multi-STA BlockAck frame with BA Information for multiple AIDs shall have RA field set to the broadcast address.

An HE STA that supports Multi-STA BA shall examine each received Multi-STA sent by an STA with which it has a BA agreement. On receiving such a Multi-STA BlockAck frame a STA performs the following for each BA Information field with its AID:

— If the ACK type field is 1 then the BA Start Sequence Control, TID and BA Bitmap of the BA information field are processed according the procedure given in 10.24.7 (HT-immediate block ack extensions).

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— If the ACK type field is 0, the field indicates an ACK of either a single MPDU or all MPDUs carried in the eliciting PPDU that was transmitted by the STA.

25.5 MU operation

25.5.1 HE DL MU operation

25.5.1.1 General

HE DL MU operation allows an AP to transmit simultaneously to one or more non-AP STAs in DL OFDMA, DL MU-MIMO or both.

An AP shall not transmit to a STA an HE MU PPDU with the HE-SIG-B allocating more than one RUs (see 26.3.9.8.3 (Time domain encoding)), unless the STA set the DL OFDMA Capable subfield of the HE Capabilities element to 1.

An AP shall not transmit to a STA a HE MU PPDU with the HE-SIG-B allocating spatial streams to more than one recipient STA, unless the STA set the DL MU MIMO Capable subfield of the HE Capabilities element to 1.

The transmission for all the STAs in an HE MU PPDU in either DL OFDMA or DL MU MIMO shall end at the same time, indicated by the L-SIG field as described in 26.3.9.5 (L-SIG).

The padding procedure for each A-MPDU in an HE MU PPDU is the same as for an A-MPDU in a VHT PPDU and defined in 10.13.6 (A-MPDU padding for VHT PPDU).

25.5.1.2 HE MU PPDU payload

The content of each individual A-MPDU in an HE MU PPDU is based on the rules specified in 10.13.1 (A-MPDU contents).

The frame type and address type (unicast, groupcast) of MPDUs may be different across A-MPDUs within a same HE MU PPPDU.

A groupcast frame in a groupcast RU of an HE MU PPDU shall not include information intended for a STA that is identified as the recipient of another RU in the same HE MU PPDU.

25.5.2 UL MU operation

25.5.2.1 General

The UL MU operation allows an AP to solicit immediate simultaneous response frames from one or more non-AP STAs. Non-AP STAs transmit their response frames in HE trigger-based PPDU format, in either UL MU OFDMA UL MU-MIMO, or both.

An HE STA with dot11ULMUOFDMAOptionImplemented set to true shall set the UL MU OFDMA Capable subfield of the HE Capabilities element it transmits to 1; otherwise, the STA shall set it to 0.

An HE STA with dot11ULMUMIMOOptionImplemented set to true shall set the UL MU MIMO Capable subfield of the HE Capabilities element it transmits to 1; otherwise, the STA shall set it to 0.

A non-AP STA with dot11ULMUOFDMAOptionImplemented or dot11ULMUMIMOOptionImplemented equal to true is referred to as an UL MU capable STA.

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25.5.2.2 Rules for soliciting UL MU frames

25.5.2.2.1 General

An AP shall not send to a STA a frame soliciting the transmission of a PPDU with the TXVECTOR parameter FORMAT set to HE_TRIG, unless the STA is UL MU Capable.

An AP may transmit a PPDU that elicits an HE trigger-based PPDU from one or more UL MU capable STAs by including in the PPDU at least one of:

— A Trigger frame that includes one or more per-User Info field addressed to the recipient STA(s).
  - For recipient STAs that are associated with the AP, the per-User Info field is addressed to a recipient STA if the value of the AID subfield of the Per-User Info field is equal to the AID of the STA.
  - For recipient STAs that are not associated with the AP, TBD

— An "Trigger Information TBD contained in the MAC Header" of individually addressed MPDUs contained in the PPDU

— The following two frames shall not be present at the same time in an A-MPDU

— A Trigger frame with a per-User Info field addressed to a STA

— an MPDU addressed to the same STA that includes "Trigger Information Field info in MAC header TBD"

If a Trigger frame is aggregated with other frames in an A-MPDU, the Trigger frame shall be the first frame in the A-MPDU.

25.5.2.2.2 Allowed settings of the Trigger frame fields

If dot11MultiBSSIDActivated is true and at least two of the Trigger frame recipient STAs are associated with two different BSSIDs, then the TA shall be set to a common address TBD; in all other cases the TA shall be set to the BSSID of the AP to which all recipient STAs are associated.

An AP shall not set any subfields of the Commin Info field to a value that is not supported by all the recipient STAs of the Trigger frame.

An AP shall not set any subfields of a Per User Info field to a value that is not supported by the recipient STAs of the Per User Info field.

If a Trigger frame is transmitted in a broadcast RU of a HE MU PPDU, then the Trigger frame shall not include any Per User Info fields addressed to a STA that is identified as recipient of another RU or spatial stream of the same HE MU PPDU.

25.5.2.2.3 AP access procedures for UL MU operation

An UL OFDMA MPDU/A-MPDU is the acknowledgement of the Trigger frame. When the AP receives MPDU correctly from at least one STA indicated by trigger frame, the frame exchange initiated by the trigger frame is successful.

25.5.2.3 STA behavior

A STA shall not transmit an HE trigger-based PPDU unless is it explicitly enabled by an AP in one of the operation modes described in this section.

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The inter frame space between a PPDU that contains a Trigger frame and the triggered HE trigger-based PPDU is SIFS.

A STA shall commence the transmission of an HE trigger-based PPDU at the SIFS time boundary after the end of a received PPDU, when all the following conditions are met

— The received PPDU contains a Trigger Frame with a Per User Info field addressed to the STA, or the PPDU contains an MPDU addressed to the STA which carries a "Trigger Information Field info in MAC header TBD". The Per User Info field is addressed to a STA if the AID subfield is equal to the AID of the STA, if the STA is associated with the AP. If the STA is not associated with the AP, TBD.

— The UL MU CS Condition described in 25.5.2.4 (UL MU CS mechanism) indicates the medium is idle, or the CS Required subfield in a Trigger frame is 0.

A STA transmitting an HE trigger-based PPDU shall set the TXVECTOR parameter as follows:

— The L_LENGTH parameter shall be set to the value indicated by the L-SIG Length field of the eliciting Trigger frame or of the "Trigger Information Field info in MAC header TBD".

— The CP_LTF_TYPE parameter shall be set to the value indicated by the CP-LTF subfield of the Common Info field of the eliciting Trigger frame

— The SIG-A_CONT parameter shall be set to the value indicated by the SIG-A subfield of the Common Info field of the eliciting Trigger frame [TBD, depending on how the TXVECTOR is defined we may spell out all the subfields of SIG-A]

— The DCM parameter shall be set to the value indicated by the DCM subfield of the per-User Info field of the eliciting Trigger frame

— The CODING_TYPE parameter shall be set to the value indicated by the Coding Type subfield of the Per User Info field of the eliciting Trigger frame

— The RU parameter shall be set to the value indicated by the RU Allocation field of the trigger frame

— The NSTS parameter shall be set to TBD

The MAC padding procedure is descried in 10.42.2.1.2

The content of each individual A-MPDU in an HE MU PPDU is based on the rules specified in 10.13.1 (A-MPDU contents) and the additional rules described in this clause.

If the Trigger Type value of a Trigger frame is not equal to 0, the STA shall include in the reponse A-MPDU at least one MPDU of the required type. If the STA does not have a frame of the required type, the STA should transmit QoS Null frame.

NOTE--The frame type of MPDUs may be different across A-MPDUs within a same HE trigger-based PPPDU

25.5.2.4 UL MU CS mechanism

The ED-based CCA and virtual CS functions are used to determine the state of the medium if CS is required before responding to a received Trigger frame. ED-based CCA is described in and virtual CS is defined in 10.3.2.1 (CS mechanism).

When two NAVs are supported by a STA, if one or both of the NAVs are considered and the considered NAV's counter is nonzero, then the virtual CS indicates busy. Otherwise, the virtual CS is idle.

When only one NAV is supported by a STA, if the NAV is considered and the NAV counter is nonzero, then virtual CS is busy. Otherwise, the virtual CS is idle.

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Editor's Note: The previous sentence is only needed if support for two NAVs is optional. Mandatory or optional support for two NAVs is still TBD.

A NAV is considered in virtual CS for a STA that is polled from a Trigger frame for UL MU transmission unless one of the following conditions is met:

- The NAV was set by a frame originating from the AP sending the Trigger frame
- The response generated by the STA contains an Ack frame or a BlockAck frame and the duration of the HE trigger-based PPDU is less than a TBD value
- The NAV was set by a frame originating from an intra-BSS STA
- The CS Required subfield in the Trigger frame is 0
- Other condition TBD

If the CS Required subfield in a Trigger frame is set to 1, the STA shall consider the status of the CCA (using Energy Detect) and the virtual carrier sense (NAV) before UL MU transmission in response to the Trigger Frame. In this case, the STA shall sense the medium using energy-detect (ED) after receiving the PPDU that contains the Trigger frame (i.e. during the SIFS time), and it shall perform the energy-detect (ED) at least in the subchannel that contains the STA's UL allocation, where the sensed subchannel consists of either a single 20 MHz channel or multiple of 20 MHz channels. The STA may transmit an HE trigger-based PPDU when the 20 MHz channels containing the allocated UL RUs in the Trigger frame are considered idle; if the STA detects that the 20 MHz channels containing the allocated UL RUs are not all idle, then the STA shall not transmit anything in the allocated UL RUs.

If the CS Required subfield in a Trigger frame is set to 0, the STA may transmit an HE trigger-based PPDU without the carrier sense.

The AP shall set the CS Required subfield to 1 except under the following conditions:

- All HE trigger-based PPDU(s) solicited by the Trigger frame containing ACK/BA and the length of the HE trigger-based PPDU is below a TBD threshold.
- Other conditions are TBD.

25.5.2.5 HE buffer status feedback operation for UL MU

The buffer status report from HE STAs may be utilized to support the efficient UL MU operation. An AP may poll HE STAs for buffer status reports using the frame carrying the trigger information. The frame may be a broadcast Trigger frame, a unicast Trigger frame, a Trigger frame for random access, or a Data type of frame carrying the trigger information. An AP may request an HE STA to send its buffer status information by TBD indication in the Trigger frame or in the HE A-Control field in a Data type of frame. In this case, an AP may indicate TBD granularity of the Queue Size for an HE STA to report (signaling method TBD). Upon reception of the frame including the TBD indication in the Trigger frame or in the HE A-Control field, the HE STA may respond with the frame including the Queue Size subfield in a QoS Control field or TBD HE A-Control field. To report the buffer status for a given TID, an HE STA shall set the Queue Size subfield in a QoS Data or a QoS Null frame to the amount of queued traffic present in the output queue belonging to the TID.

25.5.2.6 UL OFDMA-based random access

UL OFDMA-based distributed random access is a random access mechanism for HE STAs that randomly select resource units (RUs) assigned by an AP for transmission of UL PPDUs. The HE AP indicates a TBD parameter in the Trigger frame for HE STAs to initiate random access following the Trigger frame transmission.

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25.5.2.6.1 Random access procedure

In this sub-section, the random access procedure is described with respect to UL OFDMA contention parameters. The procedure is also illustrated in Figure 25-1 (Illustration of the UL OFDMA-based random access procedure). An HE STA that uses the random access procedure maintains an internal counter termed as OBO counter. The OFDMA contention window (OCW) is an integer with an initial value of OCWmin. Other parameters for random access are TBD.

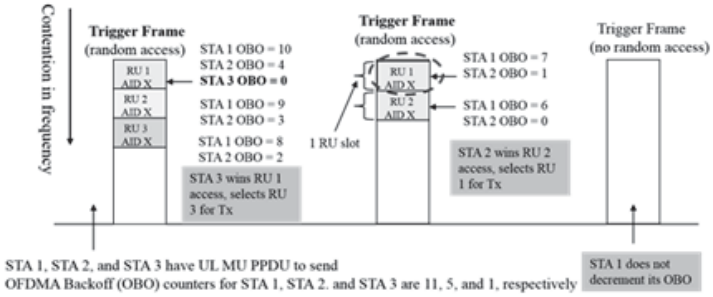

Figure 25-1—Illustration of the UL OFDMA-based random access procedure

An HE AP indicates the value of OCWmin for the random access operation. The method of indication of the OCWmin value is TBD.

The random access procedure initiates with an HE STA receiving a Trigger frame for random access.

For an initial UL PPDU transmission, when an HE STA obtains the value of OCWmin from the HE AP, it shall set the value of OCW to the OCWmin and shall initialize its OBO counter to a random value in the range of 0 and OCWmin.

If the OBO counter for an HE STA is smaller than the number of RUs assigned to AID value TBD in a Trigger frame, then the HE STA shall decrement its OBO counter to zero. Otherwise, the HE STA decrements its OBO counter by a value equal to the number of RUs assigned to AID value TBD in a Trigger frame. For instance, as shown in Figure 25-1 (Illustration of the UL OFDMA-based random access procedure), HE STA 1 and HE STA 2 decrement their non-zero OBO counters by 1 in every RU assigned to AID value TBD for random access within the Trigger frame.

If the OBO counter for an HE STA is a zero value or if the OBO counter decrements to 0, it randomly selects any one of the assigned RUs for random access and transmits its UL PPDU in the selected RU. Otherwise, the STA resumes with its OBO counter in the next Trigger frame for random access.

25.5.3 HE MU cascading operation

A TXOP can include both DL MU and UL MU transmissions.

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A HE AP can initiate a cascading sequence of MU PPDUs in a TXOP, allowing alternating HE MU PPDUs and HE trigger-based PPDUs starting with a DL MU PPDU in the same TXOP, as illustrated in Figure 25-2 (An example of cascading sequence of MU PPDUs).

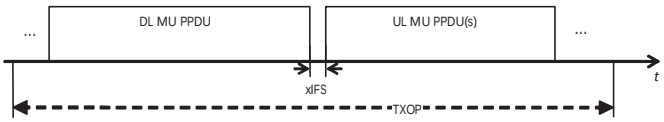

Figure 25-2—An example of cascading sequence of MU PPDUs

The cascading sequence has only one DL transmitter. The cascading sequence may have different UL transmitters within each HE trigger-base PPDU. The cascading sequence may have a different set of transmitters in HE trigger-based PPDUs as compared to the DL HE MU PPDU that follows the HE trigger-based PPDUs within the same TXOP.

25.6 HE sounding protocol

The HE sounding protocol is initiated by an AP sending an NDP Announcement frame (TBD) followed by an HE NDP transmitted a SIFS after the end of the PPDU carrying the NDP Announcement (TBD).

An HE AP may use the Trigger frame to solicit HE beamforming feedback from a STA provided that the UL MU Capable field of the most recently received HE Capabilities element from that STA is 1 (see 25.5.2 (UL MU operation)).

An HE AP may solicit beamforming feedback from multiple STAs sequentially through SU transmission.

An example of the HE sounding protocol using MU operation to solicit feedback is shown in Figure 25-3 (An example of the HE sounding protocol using MU operation).

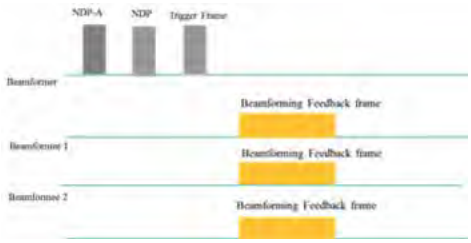

Figure 25-3—An example of the HE sounding protocol using MU operation

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25.7 TWT operation

25.8 Receive operating mode

25.8.1 General

An HE STA can change its operating mode setting either using the procedure described in 10.41 (Notificaion of operating mode changes), or the procedure describes in this subclause. Receive operating mode (ROM) indication is a procedure for a first HE STA to indicate the maximum operating channel width and the maximum number of spatial streams it can receive to a second HE STA.

When the first HE STA chooses to indicate its ROM setting, this can be signaled using the ROM subfield in the HE variant HT Control field sent in a frame of type Data. The ROM subfield is set to indicate that the first HE STA supports receiving frames with a bandwidth up to and including the value indicated by the Channel Width subfield and with a number of spatial streams up to and including the value indicated by the Rx NSS subfield (see [HE variant HT Control field]). The dot11ROMIOptionImplemented defines whether the HE AP implements the reception of the ROM setting and the AP transmits according to the ROM setting to the transmitter of the ROM setting. An HE AP shall set dot11ROMIOptionImplemented to true.

ROM indication allows an HE STA to adapt the maximum operating channel width or the maximum number of spatial streams it can receive. In doing so, an HE STA may save power by changing to a ROM setting that consumes less power, or by changing to a ROM setting that supports higher throughput operation. Unlike 11.41 (Notification of operating mode changes), ROM indication can be signaled in the MAC header of a Data frame as opposed to a management frame exchange. Hence, there is minimal impact on channel efficiency.

25.8.2 Rules for ROM indication

An HE STA may transmit an individually address frame of type Data that contains the ROM subfield to indicate that the transmitting HE STA supports receiving frames with a bandwidth up to and including the value indicated by the Channel Width subfield and with a number of spatial streams up to and including the value indicated by the Rx NSS subfield of the ROM subfield.

The transmitting HE STA shall support for receiving frames with a bandwidth up to and including the value indicated by the Channel Width subfield and with a number of spatial streams up to and including the value indicated by the Rx NSS subfield of the ROM subfield indicated in the eliciting frame immediately after receiving a successful acknowledgement from the responding HE STA.

If there is a change to the current maximum operating channel width or the maximum number of spatial streams, the transmitting HE shall adjust to the most recently sent ROM settings within a time TBD [Outage Time] following the receipt of an immediate acknowledgement response. The transmitting HE STA shall support receiving frames with a bandwidth up to and including the most recent value indicated by the Channel Width subfield and with a number of spatial streams up to and including the most recent value indicated by the Rx NSS subfield of the ROM subfield.

NOTE—In the event of transmission failures, the transmitting HE STA can attempt recovery procedure as defined in 9.19.2.4 (Multiple frame transmission in an EDCA TXOP), and can defer from changing to the new ROM settings indicated in the eliciting frame until a successful acknowledgement from the responding STA is received.

The responding HE STA shall use the value indicated by the Channel Width subfield most recently received from the transmitting HE STA as the current maximum operating channel width that the transmitting HE STA indicated as supported for receiving frames.

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The responding HE STA shall use the value indicated by the Rx NSS subfield most recently received from the transmitting HE STA as the current maximum number of spatial streams that the transmitting HE STA indicated as supported for receiving frames.

The responding HE STA shall not transmit a subsequent PPDU to the transmitting HE STA that uses a bandwith or a number of spatial stream not indicated as currently supported by the transmitting HE STA.

If there is a change to the current maximum operating channel width or the maximum number of spatial stream that the transmistting STA is capable of receiving, the responding HE STA shall not sent any PPDU to the transmitting HE STA within a time TBD [Outage Time] following the transmission of an immediate acknowledgement response.

25.9 Spatial reuse operation

25.9.1 General

The objective of the HE spatial reuse operation is to improve the system level performance and the utilization of the spectrum resources in dense deployment scenarios by early identification of signals from overlapping basic service sets (OBSSs) and interference management.

25.9.2 Color code based CCA rules

An STA determines whether a detected frame is an inter-BSS or an intra-BSS frame by using BSS color or MAC address in the MAC header. The detected frame is intra-BSS frame if one of the following conditions is true:

— The BSS color in the detected PPDUis same as the BSS color announced by its associated AP,

— The RA or TA of the detected frame is same as the BSSID or its bandwidth signaling variant of its associated AP

— Its associated AP is identified by TBD Multiple BSSID element and the RA or TA of the detected frame is same as one of the BSSID or its bandwidth signaling variant defined by TBD Multiple BSSID element

If the detected frame is an inter-BSS frame, under TBD condition, uses TBD OBSS PD level that is greater than the minimum receives sensitivity level.

A STA should regard an inter-BSS PPDU with a valid PHY header and that has receiving power/RSSI below the OBSS PD level used by the receiving STA and that meets additional TBD conditions, as not having been received at all (e.g., should not update its NAV), except that the medium condition shall indicate BUSY during the period of time that is taken by the receiving STA to validate that the PPDU is from an inter-BSS, but not longer than the time indicated as the length of the PPDU payload.

A STA should revise the NAV depending on TBD conditions at the recipient of the ongoing OBSS frame.

25.9.3 Adaptive CCA and transmit power control

When the color code based CCA rule is used, as described in Error! Reference source not found., an HE STA is allowed to adjust the OBSS_PD threshold in conjunction with transmit power control to improve the system level performance and the utilization of the spectrum resources.

To further improve the possibilities of spatial reuse, an STA is allowed to adjust the setting of one or more following parameters, CCA ED level, 802.11 signal detect CCA or TXPWR threshold values. The constraints on selecting threshold values are TBD.

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25.10 A-MPDU operation

25.10.1 General

A-MPDU operation for an HE PPDU is as defined in 10.13 (A-MPDU operation), except for A-MPDU padding, which is defined in 25.10.2 (A-MPDU padding) and except for an A-MPDU that includes QoS Data frames from from two or more different TSs, the rules for which are defined in 25.10.3 (A-MPDU with multiple TIDs).

25.10.2 A-MPDU padding

The A-MPDU padding per each HE STA in an HE MU PPDU follows the same procedure as for VHT STA11ac procedure as defined in Section 10.13.6 (A-MPDU padding for VHT PPDU).

A non-AP STA that transmits an HE trigger-based PPDU shall construct the PSDU carried in the HE trigger-based PPDU as follows.

The STA computes the PSDU_LENGTH based on the TXVECTOR parameters.

The STA may add A-MPDU subframes to the A-MPDU contained in the PSDU provided that the following constraints are fullfilled:

— The A-MPDU content constraints (see 10.13.1 (A-MPDU contents)) for the intended recipient

— The Length limit constraints (see 9.7.1 (A-MPDU format) and 10.13.2 (A-MPDU length limit rules)) for the intended recipient

— The MPDU start spacing constraints (see 10.13.3 (Minimum MPDU Start Spacing field)) for the intended recipient

And provided that

— The A-MPDU subframes have a value greater than 0 in the MPDU Length field, or have a value 0 in the MPDU Length field and a value 0 in the EOF field.

— After incrementing the A-MPDU_Length with the length of each such added A-MPDU subframe, the relationship A-MPDU_Length ≤ PSDU_LENGTH is true.

Then, padding shall be added such that the resulting A-MPDU contains exactly PSDU_LENGTH octets as follows:

— First, while A-MPDU_Length < PSDU_LENGTH and A-MPDU_Length mod 4 != 0, add an octet to the final A-MPDU subframe's Padding subfield and increment A-MPDU_Length by 1.

— Then, while A-MPDU_Length + 4 < PSDU_LENGTH, add an EOF padding subframe to the EOF Padding Subframes field and increment A-MPDU_Length by 4.

— Finally, while A-MPDU_Length < PSDU_LENGTH, add an octet to the EOF Padding Octets subfield and increment A-MPDU_Length by 1.

The STA shall not add an A-MPDU subframe with EOF equal to 0 after any A-MPDU subframe with EOF set to 1. The STA shall not add an an A-MPDU subframe with EOF equal to 1 and with MPDU Length field equal to 0 before an A-MPDU subframe that contains a VHT single MPDU (see 10.13.7 (Setting the EOF field of the MPDU delimiter)).

25.10.3 A-MPDU with multiple TIDs

An HE STA with dot11AMPDUwithMultipleTIDOptionImplemented set to true shall set the A-MPDU with Multiple TIDs Capable subfield of the HE Capabilities element it transmits to 1; otherwise, the HE STA shall set it to 0.

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An HE AP shall not send A-MPDU with multiple TIDs to an HE non-AP STA that associates with the AP, unless the HE non-AP STA is A-MPDU With Multiple TIDs capable.

An HE non-AP STA shall not send an A-MPDU with multiple TIDs to its associated HE AP, unless the HE AP is A-MPDU With Multiple TIDs capable.

In an HE MU PPDU, an HE STA may aggregate the frames in an A-MPDU with multiple TIDs as defined in Table 9-426a (Multiple TID A-MPDU contents in the data enabled immediate response context) or Table 9-426b (Multiple TID A-MPDU contents in the data enabled no immediate response context). An A-MPDU with multiple TIDs shall not be transmitted in an SU PPDU.

Multi-STA BlockAck frame shall be used to acknowledge the Multi-TID A-MPDU in MU PPDU. The value of TID field in Multi-STA BlockAck frame is TBD.

25.11 TXVECTOR parameters STA_ID_LIST, UPLINK_FLAG and BSS_COLOR for an HE PPDU

Each element of the TXVECTOR parameter STA_ID_LIST identifies the STA or group of STAs that is the recipient of an RU in the HE MU PPDU. If an RU is intended for a single STA, then the STA_ID_LIST element for that RU is set to the STA's AID. If an RU is intended for a group of STAs then the STA_ID_LIST element is set as follows:

— For a single BSS AP, if the RU is intended for all STAs in the BSS, the STA_ID_LIST element is set to 0;

— For a multiple BSS AP, if the RU is intended for all STAs in one of its BSSs, the STA_ID_LIST element is set to the group addressed AID assignment in the TIM according to the existing Multi-BSSID TIM operation;

— For a multiple BSS AP, if the RU is intended for all STAs on all its BSSs, the STA_ID_LIST element is set to 2047.

The Uplink Flag is carried in the TXVECTOR parameter UPLINK_FLAG of an HE SU PPDU, HE extended range SU PPDU, and HE MU PPDU and is set as follows:

— A STA transmitting an HE PPDU that is addressed to an AP shall set the TXVECTOR parameter UPLINK_FLAG to 1

— An AP transmitting an HE PPDU that is addressed to a non-AP STA shall set the TXVECTOR parameter UPLINK_FLAG to 0

— A STA transmitting an HE PPDU in a direct path to a (T)DLS peer STA, or to a member of an IBSS, shall set the TXVECTOR parameter UPLINK_FLAG to 0

NOTE—The (T) DLS peer STA or the member of an IBSS can identify that the HE PPDU is sent in a direct path from the To DS and From DS fields of the MAC header of its MPDU(s)

The TXVECTOR parameter UPLINK_FLAG is not present for HE trigger-based PPDUs.

The BSS Color is an identifier of the BSS and is used to assist a receiving STA in identifying the BSS from which a PPDU originates so that the STA can use the channel access rules as described in 9.X.Y (Spatial Reuse) or reduce power consumption as described in 25.13.1 (Intra-PPDU power save for HE non-AP STAs).

An HE AP shall select a value in the range 1 to TBD to include in the BSS Color subfield of the HE Operation elements that it transmits and shall maintain that single value of the BSS Color subfield for the duration of the existence of the BSS. An HE AP transmitting an HE PPDU shall set the TXVECTOR parameter BSS_COLOR to the value indicated in the BSS Color subfield of its HE Operation element.

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A non-AP HE STA transmitting an HE PPDU shall set the TXVECTOR parameter BSS_COLOR to the value indicated in the BSS Color subfield of the HE Operation element received from the AP with which it is associated.

The virtual APs which are defined by TBD Multiple BSSID element shall select a same BSS Color.

25.12 HE PPDU post FEC padding and packet extension

An HE STA with dot11PPEThresholdsRequired set to false may set the PPE Thresholds Present subfield in HE Capabilities elements that it transmits to 0.

An HE STA with dot11PPEThresholdsRequired set to true shall set the PPE Thresholds Present subfield in HE Capabilities elements that it transmits to 1.

A STA that sets the PPE Thresholds Present subfield in HE Capabilities elements that it transmits to 1 shall indicate its minimum post-FEC padding and packet extension duration value per constellation, NSS and RU allocation by setting the subfields of the PPE Thresholds field according to 9.4.2.213 (HE Capabilities element) and using the corresponding values from dot11PPEThresholdsMappingTable.

A STA transmitting an HE PPDU to a receiving STA shall include a minimum post-FEC padding asetermined by the post-FEC padding a-factor (see 26.3.10 (Data field) and after including the post-FEC padding, the transmitting STA shall include a packet extension that yields a total post-FEC padding plus packet extension that corresponds to at least the value indicated in the HE Capabilities element received from the receiving STA.

25.13 Power management

25.13.1 Intra-PPDU power save for HE non-AP STAs

An HE non-AP STA that is in awake state (see 11.2.2.2 (STA Power Management modes)) and has dot11IntraPPDUPowerSaveOptionActivated equal to true operates in intra-PPDU power save mode.

An HE non-AP STA that is in intra-PPDU power save mode may enter the doze state until the end of a received PPDU when one of the following conditions is met:

— The PPDU is an HE MU PPDU with:
  - The value of the RXVECTOR parameter BSS_COLOR equal to the BSS color of the BSS with which the STA is associated and,
  - The value of the RXVECTOR parameter UL_FLAG is equal to 0 and,
  - The values obtained from the RXVECTOR parameter STA_ID_LIST do not match the identifier of the STA or the broadcast identifier(s) intended for the STA

— The PPDU is an HE MU PPDU, HE SU PPDU, or HE extended range SU PPDU with:
  - The value of the RXVECTOR parameter BSS_COLOR equal to the BSS color of the BSS with which the STA is associated and,
  - The value of the RXVECTOR parameter UL_FLAG is equal to 1

— The PPDU is an HE trigger-based PPDU with:
  - The value of the RXVECTOR parameter BSS_COLOR equal to the BSS color of the BSS with which the STA is associated

An HE STA that is in intra-PPDU power save mode and has entered doze state shall continue to operate its NAV timer and consider the medium busy during doze state and shall transition into awake state at the end of the PPDU.

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NOTE—The STA can contend for access to the medium immediately on the expiry of the NAV timer.

25.13.2 Power save with UL OFDMA-based random access

This section illustrates the power save mechanisms for HE STAs using random access procedure (see 25.5.2.6.1 (Random access procedure)).

An HE AP may indicate values of one or multiple Trigger frame start time(s) for random access in the Beacon. The power save operation with the indication of one value of Trigger frame start time in a Beacon for random access is shown in Figure 25-4 (Illustration of Trigger frame (TF) Start Time in Beacon frame for power save operation with random access operation).

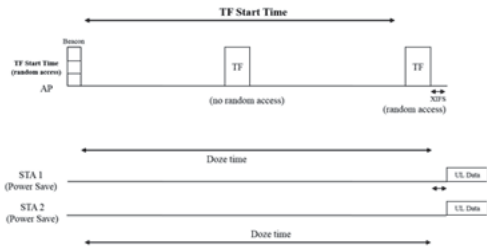

Figure 25-4—Illustration of Trigger frame (TF) Start Time in Beacon frame for power save operation with random access operation

When an HE STA receives a Beacon with the value of Trigger frame start time for random access, it may enter the doze state till the expiration of the value indicated in the Beacon.

If random acces is enabled by a sequence of Trigger frames, then all the Trigger frames in the sequence shall have the Cascade Indication field set to 1, except for the last Trigger frame in the sequence that shall have the Cascade Indication field set to 0.

An HE STA may use the value indicated in the Cascade Indication field in a Trigger frame to enter the doze state. If the OBO counter decrements to a non-zero value with the random access procedure in a Trigger frame with Cascade Indication field set to 0, it may enter the doze state immediately. If the OBO counter decrements to a non-zero value with the random access procedure in a Trigger frame with Cascade Indication field set to 1, it may remain awake for random access in the cascaded Trigger frame.

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26. High Efficiency (HE) PHY specification

26.1 Introduction

26.1.1 Introduction to the HE PHY

Clause 26 specifies the PHY entity for a high efficiency (HE) orthogonal frequency division multiplexing (OFDM) system. In addition to the requirements in Clause 26, an HE STA shall be capable of transmitting and receiving PPDUs that are compliant with the mandatory PHY specifications defined in Clause 20 and Clause 22.

The HE PHY is based on the VHT PHY defined in Clause 22, which in turn is based on the HT PHY defined in Clause 20, which in turn is further based on the OFDM PHY defined in Clause 18. The HE PHY extends the maximum number of users supported for downlink multi-user MIMO (MU-MIMO) transmissions to eight and provides support for downlink and uplink orthogonal frequency divisional multiple access (OFDMA) as well as for uplink MU-MIMO. Both downlink and uplink MU-MIMO transmissions are supported on portions of the PPDU bandwidth (on resource units greater than or equal to 106 tones) and in an MU-MIMO resource unit, there is support for up to eight users with up to four space-time streams per user with the total number of space-time streams not exceeding eight.

NOTE—An HE SU PPDU includes individually addressed and group addressed transmissions.

The HE PHY provides support for 20 MHz, 40 MHz, 80 MHz and 160 MHz contiguous channel widths and support for 80+80 MHz non-contiguous channel width. Tones of one or more secondary channels in 80 MHz and 160 (80+80) MHz could be nulled when using OFDMA PPDU transmission. The modes of non-contiguous channel bonding are TBD. The non-contiguous channels within primary or secondary 80 MHz only exists at AP side.

The HE PHY provides support for 800 ns, 1600 ns, and 3200 ns guard interval durations.

The HE PHY provides support for 3.2 μs (1x LTF), 6.4 μs (2x LTF), and 12.8 μs (4x LTF) LTF symbol durations (symbol duration not including the guard interval).

The HE PHY data subcarriers are modulated using binary phase shift keying (BPSK), quadrature phase shift keying (QPSK), 16-quadrature amplitude modulation (16-QAM), 64-QAM, 256-QAM and 1024-QAM. Forward error correction (FEC) coding (convolutional or LDPC coding) is used with coding rates of 1/2, 2/3, 3/4 and 5/6.

An HE STA shall support the following Clause 26 features:

— Binary convolutional coding for RU sizes less than or equal to 242 tones (transmit and receive)

— LDPC as the only coding scheme for RU sizes of 484 tones, 996 tones (transmit and receive)

— LDPC when declaring support for at least one of HE 80/160/80+80 SU-PPDU bandwidths, or declaring support for more than 4 spatial streams (transmit and receive)

— A combination of 2x LTF with 0.8 μs GI duration on both LTF and data

— A combination of 2x LTF with 1.6 μs GI duration on both LTF and data

— A combination of 4x LTF with 3.2 μs GI duration on both LTF and data

An HE STA may support the following Clause 26 features:

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— Other combinations of LTF durations and GI durations

— LDPC (transmit and receive) for RU sizes less than or equal to 242 tones

— LDPC (transmit and receive) when declaring support for less than or equal to 4 spatial streams

— Dual carrier modulation (transmit and receive)

NOTE—Once mandatory vs optional TBDs are decided, above text will have additions.

26.1.2 Scope

The services provided to the MAC by the HE PHY consist of the following protocol functions:

a) A function that defines a method of mapping the PSDUs into a framing format (PPDU) suitable for sending and receiving PSDUs between two or more STAs.

b) A function that defines the characteristics and method of transmitting and receiving data through a wireless medium between two or more STAs. Depending on the PPDU format, these STAs support a mixture of HE, Clause 22 (Very High Throughput (VHT) PHY specification), Clause 20 (High Throughput (HT) PHY specification) and Clause 18 (Orthogonal frequency division multiplexing (OFDM) PHY specification) PHYs.

26.1.3 HE PHY functions

26.1.3.1 General

The HE PHY contains two functional entities: the PHY function, and the physical layer management function (i.e., the PLME). Both of these functions are described in detail in 26.3 (HE PHY) and 26.4 (HE PLME). The HE PHY service is provided to the MAC through the PHY service primitives defined in Clause 7 (PHY service specification). The HE PHY service interface is described in 26.2 (HE PHY service interface).

26.1.3.2 PHY management entity (PLME)

The PLME performs management of the local PHY functions in conjunction with the MLME.

26.1.3.3 Service specification method

The models represented by figures and state diagrams are intended to be illustrations of the functions provided. It is important to distinguish between a model and a real implementation. The models are optimized for simplicity and clarity of presentation; the actual method of implementation is left to the discretion of the HE-PHY-compliant developer.

The service of a layer is the set of capabilities that it offers to a user in the next higher layer. Abstract services are specified here by describing the service primitives and parameters that characterize each service. This definition is independent of any particular implementation.

26.1.4 PPDU formats

The structure of the PPDU transmitted by an HE STA is determined by the TXVECTOR parameters as defined in Table 26-1 (TXVECTOR and RXVECTOR parameters).

The FORMAT parameter determines the overall structure of the PPDU:

— HE SU PPDU format (HE_SU) carries a single PSDU. With this format the HE-SIG-A field is not repeated. Support for the HE SU PPDU format is mandatory.

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— HE MU PPDU format (HE_MU) carries one or more PSDUs to one or more users. It is similar to the SU format, except that an HE-SIG-B field is present. Support for the HE MU PPDU format is mandatory.

— HE extended range SU PPDU format (HE_EXT_SU) carries a single PSDU. It is similar to the SU format, except that the HE-SIG-A field is repeated. Support for the HE extended range SU PPDU format is TBD (mandatory or optional).

— HE trigger-based PPDU format (HE_TRIG) carries a single PSDU and is sent in response to a PPDU that carries a Trigger frame. The preamble format prior to the HE-STF field is identical to the HE SU PPDU. Support for the HE trigger-based PPDU format is TBD (mandatory or optional).

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26.2 HE PHY service interface

26.2.1 Introduction

26.2.2 TXVECTOR and RXVECTOR parameters

The parameters in Table 26-1 (TXVECTOR and RXVECTOR parameters) are defined as part of the TXVECTOR parameter list in the PHY-TXSTART.request primitive and/or as part of the RXVECTOR parameter list in the PHY-RXSTART.indication primitive.

Table 26-1—TXVECTOR and RXVECTOR parameters

Parameter	Condition	Value	TXVECTOR	RXVECTOR
FORMAT		Determines the format of the PPDU. Enumerated type: NON_HT indicates Clause 18 (Orthogonal frequency division multiplexing (OFDM) PHY specification) or non-HT duplicate PPDU format. In this case, the modulation is determined by the NON_HT_MODULATION parameter. HT_MF indicates HT-mixed format. HT_GF indicates HT-greenfield format. VHT indicates VHT format. HE_SU indicates HE SU PPDU format. HE_MU indicates HE MU PPDU format HE_EXT_SU indicates HE extended range SU PPDU format HE_TRIG indicates HE trigger-based PPDU format the NON_HT_MODULATION parameter. HT_MF indicates HT-mixed format. HT_GF indicates HT-greenfield format. VHT indicates VHT format. HE_SU indicates HE SU PPDU format. HE_MU indicates HE MU PPDU format HE_EXT_SU indicates HE extended range SU PPDU format HE_TRIG indicates HE trigger-based PPDU format	Y	Y
PE_DURATION	FORMAT is HE_SU or HE_MU or HE_EXT_SU or HE_TRIG.	Determines the duration of PE field in an HE PPDU. Possible values are 0 μs, 4 μs, 8 μs, 12 μs and 16 μs.	Y	Y
BEAM_CHANGE	FORMAT is HE_SU	Indicates beam change between pre-HE and HE modulated fields. 1 indicates that the beam is changed between the two portions. NOTE—BEAM_CHANGE shall be set to 1 if $N_{SS} > 2$ or the PPDU is the first PPDU in a TXOP.		
	Otherwise	Set to 1		

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Table 26-1—TXVECTOR and RXVECTOR parameters *(continued)*

BSS_COLOR	FORMAT is HE_SU or HE_MU or HE_EXT_SU or HE_TRIG	Set to a value of the AP's choosing within the range 0 to TBD (see 25.11 (STA ID, Uplink Flag and BSS Color in HE PPDUs)).	Y	Y
	Otherwise	Not present	N	N
UPLINK_FLAG	FORMAT is HE_SU or HE_MU or HE_EXT_SU	Set to 1 if the HE PPDU is addressed to an AP Set to 0 otherwise (see 25.11 (STA ID, Uplink Flag and BSS Color in HE PPDUs)).	Y	Y
	Otherwise	Not present	N	N
STA_ID_LIST	FORMAT is HE_MU	Indicates the list of STA IDs for an HE MU PPDU (see 25.11 (STA ID, Uplink Flag and BSS Color in HE PPDUs)).	MU	Y
	Otherwise	Not present	N	N

NOTE—In the "TXVECTOR" and "RXVECTOR" columns, the following apply:
Y = Present;
N = Not present;
O = Optional;
MU indicates that the parameter is present once for an HE SU PPDU, HE extended range SU PPDU and HE trigger-based PPDU and present per user for an HE MU PPDU. Parameters specified to be present per user are conceptually supplied as an array of values indexed by u, where u takes values 0 to NUM_USERS-1.

26.3 HE PHY

26.3.1 Introduction

26.3.2 HE PPDU formats

Four HE PPDU formats are defined: HE SU PPDU, HE MU PPDU, HE extended range SU PPDU and HE trigger-based PPDU.

The format of the HE SU PPDU is defined as in Figure 26-1 (HE SU PPDU format). This PPDU is used for SU transmission and in this format the HE-SIG-A field is not repeated.

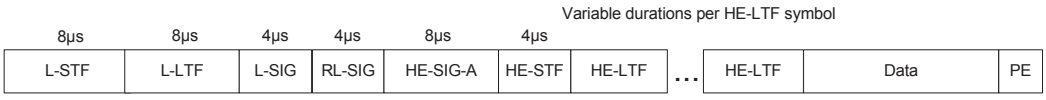

Figure 26-1—HE SU PPDU format

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The format of the HE MU PPDU is defined as in Figure 26-2 (HE MU PPDU format). This format is used for MU transmission that is not a response of a Trigger frame. An HE-SIG-B field is present in this format.

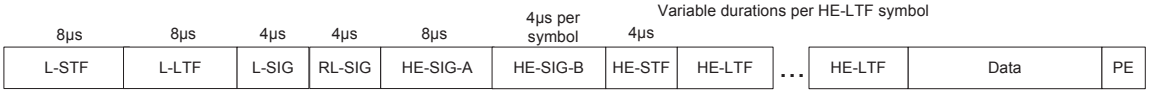

Figure 26-2—HE MU PPDU format

The format of the HE extended range SU PPDU is defined as in Figure 26-3 (HE extended range SU PPDU format). This format is used for SU transmission and in this format the HE-SIG-A field is repeated.

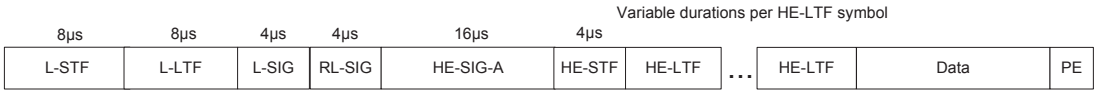

Figure 26-3—HE extended range SU PPDU format

The format of the HE extended range SU PPDU is defined as in Figure 26-4 (HE trigger-based PPDU format). This format is used for SU transmission and in this format the HE-SIG-A field is repeated.

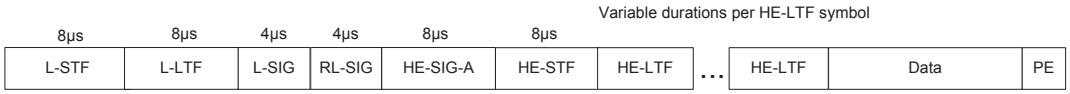

Figure 26-4—HE trigger-based PPDU format

The fields of the HE PPDU formats are summarized in Figure 26-2 (HE PPDU fields).

Table 26-2—HE PPDU fields

Field	Description
L-STF	Non-HT Short Training field
L-LTF	Non-HT Long Training field
L-SIG	Non-HT SIGNAL field
RL-SIG	Repeated Non-HT SIGNAL field
HE-SIG-A	HE Signal A field
HE-SIG-B	HE Signal B field
HE-STF	HE Short Training field
HE-LTF	HE Long Training field

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Table 26-2—HE PPDU fields *(continued)*

Data	The Data field carrying the PSDU(s)
Data	The Data field carries the PSDU(s)
PE	Packet Extension field

The RL-SIG, HE-SIG-A, HE-SIG-B, HE-STF, HE-LTF, and PE fields exist only in HE PPDUs. In the HE NDP PPDU the Data field is not present. The number of OFDM symbols in the HE-LTF field, $N_{HE\text{-}LTF}$, is 1, 2, 4, 6, or 8 and the duration of each symbol in the HE-LTF field is 3.2 µs, 6.4 µs, or 12.8 µs plus the GI duration. The HE-SIG-B field is present only in the HE MU PPDU. The duration of the PE field is determined by the TXVECTOR parameter PE_DURATION.

DL HE NDP is one DL HE sounding format.

The format of a HE NDP PPDU is shown in Figure 26-5 (HE NDP PPDU format).

Figure 26-5—HE NDP PPDU format

NOTE 1—The number of HE-LTF OFDM symbols, $N_{HE\text{-}LTF}$ in the NDP is a function of the total number of space-time streams N_{STS} as shown in Table 26-6 (Frequently used parameters).

NOTE 2—The combination of HE-LTF modes and GI duration is indicated in HE-SIG-A field.

NOTE 3—The duration of each HE-LTF OFDM symbol, $T_{HE\text{-}LTF}$, is defined in Table 26-3 (Timing-related constants).

NOTE 4—The presence and duration of PE are TBD.

The HE NDP PPDU has the following properties:

— It uses the HE SU PPDU format but without the Data field

— is an HE SU PPDU as implied by the value of L-Length field in L-SIG field

26.3.3 Transmitter block diagram

The generation of each field in a HE PPDU uses many of the following blocks:

a) pre-FEC PHY padding
b) Scrambler
c) FEC (BCC or LDPC) encoders
d) post-FEC PHY padding
e) Stream parser
f) Segment parser (for contiguous 160 MHz and noncontiguous 80+80 MHz transmissions)
g) BCC interleaver
h) Constellation mapper
i) DCM tone mapper
j) Pilot insertion
k) Replicate over multiple 20 MHz (if BW > 20 MHz)

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l) Multiply by 1st column of PVHTLTF
m) LDPC tone mapper
n) Segment deparser
o) Space time block code (STBC) encoder
p) Cyclic shift diversity (CSD) per STS insertion
q) Spatial mapper
r) Inverse discrete Fourier transform (IDFT)
s) Cyclic shift diversity (CSD) per chain insertion
t) Guard interval (GI) insertion
u) Windowing

Figure 26-6 (Transmitter block diagram for the L-SIG, RL-SIG and HE-SIG-A fields when the Beam Change field is 1) to Figure 26-13 (Transmitter block diagram for the Data field of an HE SU PPDU in 80+80 MHz with LDPC encoding) show example transmitter block diagrams. The actual structure of the transmitter is implementation dependent.

In particular, Figure 26-6 (Transmitter block diagram for the L-SIG, RL-SIG and HE-SIG-A fields when the Beam Change field is 1) shows the transmit process for the L-SIG, RL-SIG, and HE-SIG-A fields of a HE PPDU using one frequency segment, when the Beam Change subfield in HE-SIG-A field is set to 1. These transmit blocks are also used to generate the other pre-HE-SIG-B fields of the HE PPDU when the Beam Change subfield in HE-SIG-A field is set to 1, with the following exceptions applied:

— The BCC encoder and interleaver are not used when generating the L-STF and L-LTF fields.
— The BCC interleaver is not applied in the repeated HE-SIG-A symbols (i.e. the 2nd and the 4th OFDM symbols of HE-SIG-A field) in the HE extended range SU PPDU.

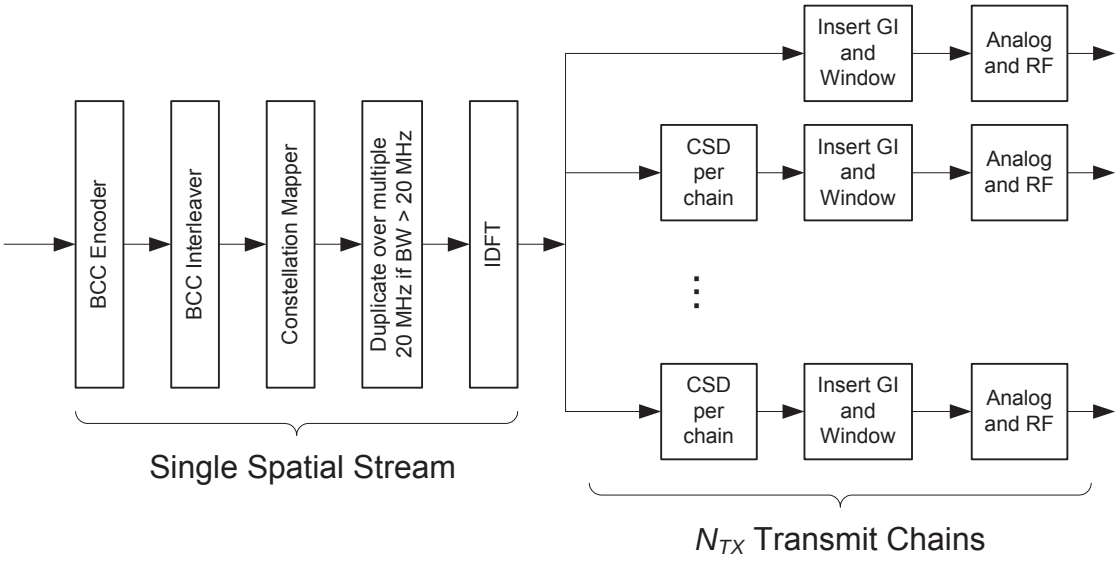

Figure 26-6—Transmitter block diagram for the L-SIG, RL-SIG and HE-SIG-A fields when the Beam Change field is 1

Figure 26-7 (Transmitter block diagram for the L-SIG, RL-SIG and HE-SIG-A fields when the Beam Change field is 0) shows the transmit process for the L-SIG, RL-SIG, and HE-SIG-A fields of a HE PPDU using one frequency segment, when the Beam Change subfield in HE-SIG-A field is set to 0. These transmit

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blocks are also used to generate the other pre-HE-SIG-B fields of the HE PPDU when the Beam Change subfield in HE-SIG-A field is set to 0, with the following exceptions:

— The BCC encoder and interleaver are not used when generating the L-STF and L-LTF fields.

— The BCC interleaver is not applied in the repeated HE-SIG-A field OFDM symbols (i.e., the 2nd and the 4th OFDM symbols of HE-SIG-A field) in the HE extended range SU PPDU.

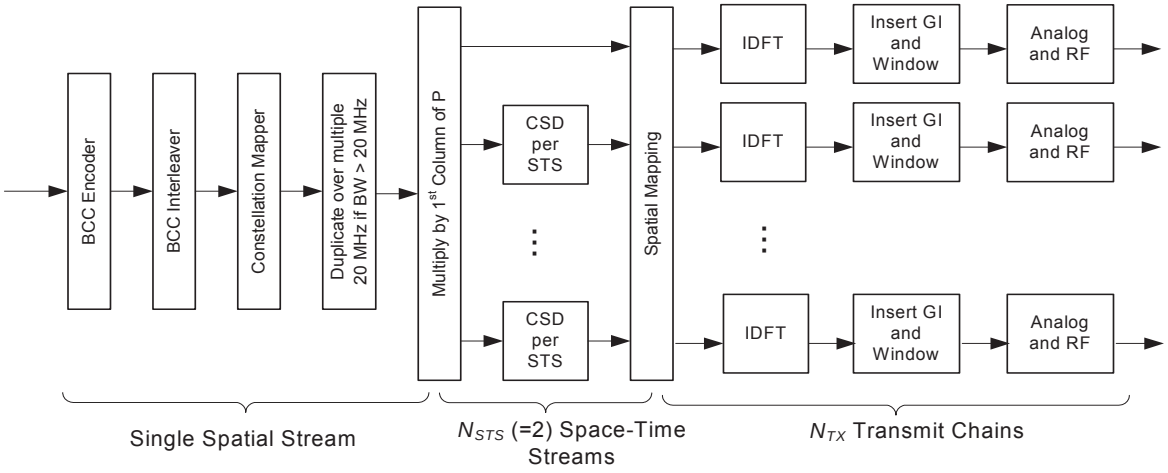

Figure 26-7—Transmitter block diagram for the L-SIG, RL-SIG and HE-SIG-A fields when the Beam Change field is 0

Figure 26-8 (Transmitter block diagram for the HE-SIG-B field) shows the transmit process for the HE-SIG-B field of an HE MU PPDU using one frequency segment. This block diagram is for transmitting HE-SIG-B in one 20 MHz subchannel. Refer to 26.3.9.8.1 (Encoding and modulation) for the methods of transmitting HE-SIG-B in 40 MHz, 80 MHz and 160 MHz. The DCM tone mapper is applied only if the DCM indication in HE-SIG-A field is set to 1. (TBD: MCS0-DCM)

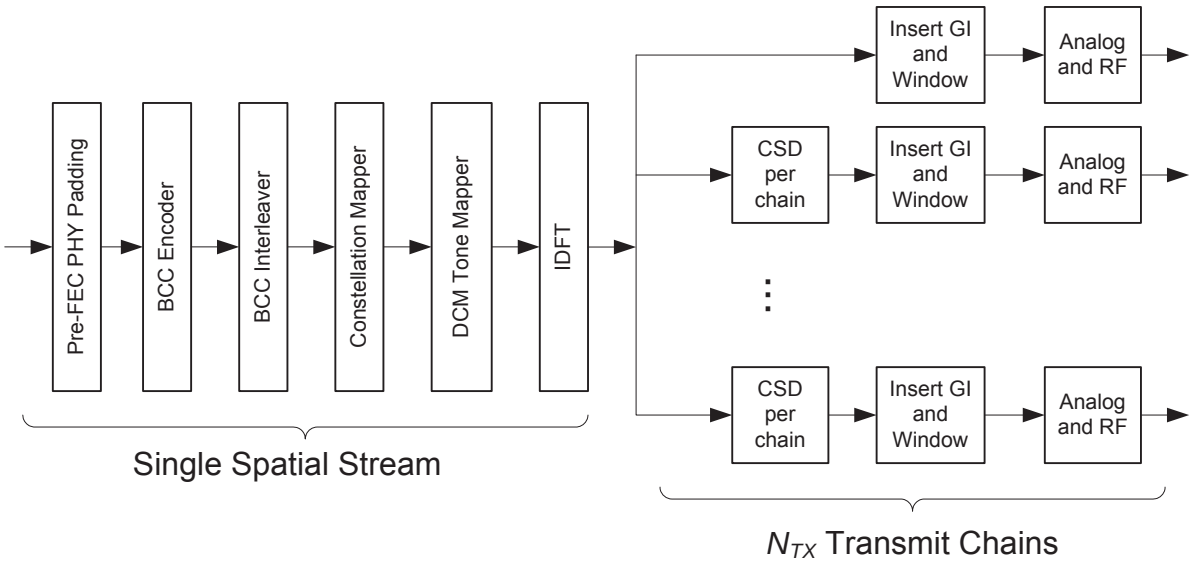

Figure 26-8—Transmitter block diagram for the HE-SIG-B field

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Figure 26-9 (Transmitter block diagram for the Data field of an HE SU transmission in a 26-, 52-, 106- or 242-RU with BCC encoding) shows the transmitter blocks used to generate the Data field of a single user HE transmission within a 26-, 52-, 106-, or 242-RU with BCC encoding for a single frequency segment when the number of spatial stream is less than or equal to 4. This also includes the SU transmission in an RU that is part of a downlink or uplink OFDMA PPDU, and a transmission from one STA that is part of an UL MU-MIMO transmission in current RU. The STBC block may be applied only for single spatial stream and only when DCM is not applied. The DCM tone mapper is applied only when the DCM indication for the RU is set to 1. A subset of these transmitter blocks consisting of the constellation mapper and CSD blocks, as well as the blocks to the right of, and including, the spatial mapping block, are also used to generate the HE-LTF fields. This is illustrated in Figure 26-29 (Generation of HE-LTF symbols per frequency segment in an HE SU PPDU, HE MU PPDU, HE extended range SU PPDU, and HE trigger-based PPDU using single stream pilots). A subset of these transmitter blocks consisting of the constellation mapper and CSD blocks, as well as the blocks to the right of, and including, the spatial mapping block, are also used to generate the HE-STF field. (TBD: MCS0-DCM). This figure also applies to the data field with BCC encoding in a HE trigger-based PPDU.

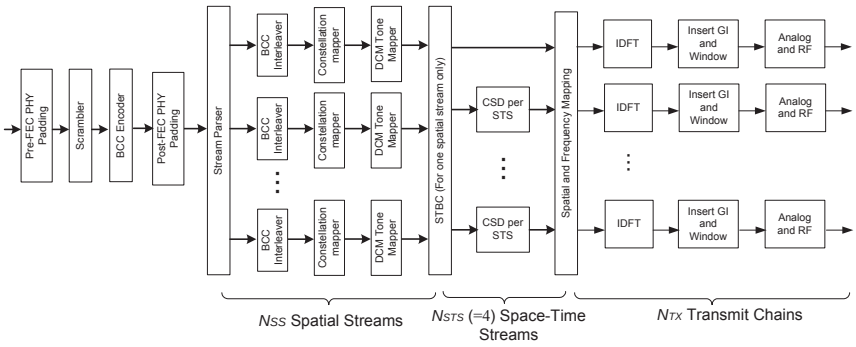

Figure 26-9—Transmitter block diagram for the Data field of an HE SU transmission in a 26-, 52-, 106- or 242-RU with BCC encoding

Figure 26-10 (Transmitter block diagram for the Data field of an HE SU transmission in 26-, 52-, 106-, 242-, 484- or 996-RU with LDPC encoding) shows the transmitter blocks used to generate the Data field of a single user HE transmission within a 26-, 52-, 106-, 242-, 484-, or 996-RU with LDPC encoding for a single frequency segment. This also includes the SU transmission in an RU that is part of a downlink or uplink OFDMA PPDU, and a transmission from one STA that is part of an UL MU-MIMO transmission in current RU. The STBC block may be applied only for single spatial stream and only when DCM is not applied. The

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DCM tone Mapper is applied only when the DCM indication for the RU is set to 1. (TBD: MCS0-DCM) This figure also applies to the data field with LDPC encoding in a HE trigger-based PPDU.

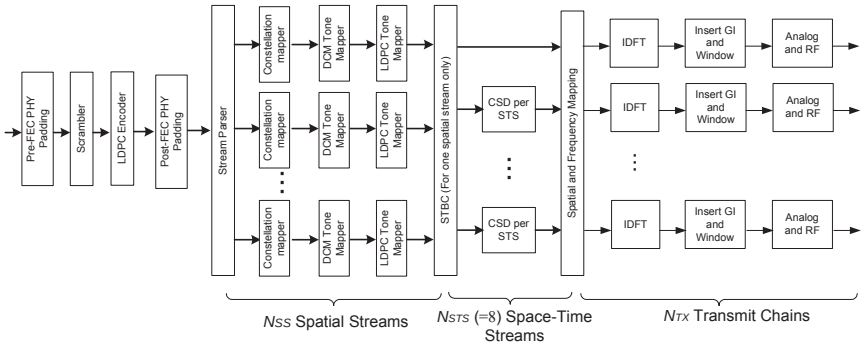

Figure 26-10—Transmitter block diagram for the Data field of an HE SU transmission in 26-, 52-, 106-, 242-, 484- or 996-RU with LDPC encoding

Figure 26-11 (Transmitter block diagram for the Data field of an HE downlink MU-MIMO transmission in 106-, 242-, 484- or 996-RU with LDPC encoding) shows the transmitter blocks used to generate the Data field of a HE downlink MU-MIMO transmission within a 106-, 242-, 484-, or 996-RU with LDPC encoding.

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This also includes the downlink MU-MIMO transmission in an RU that is part of a downlink or uplink OFDMA PPDU.

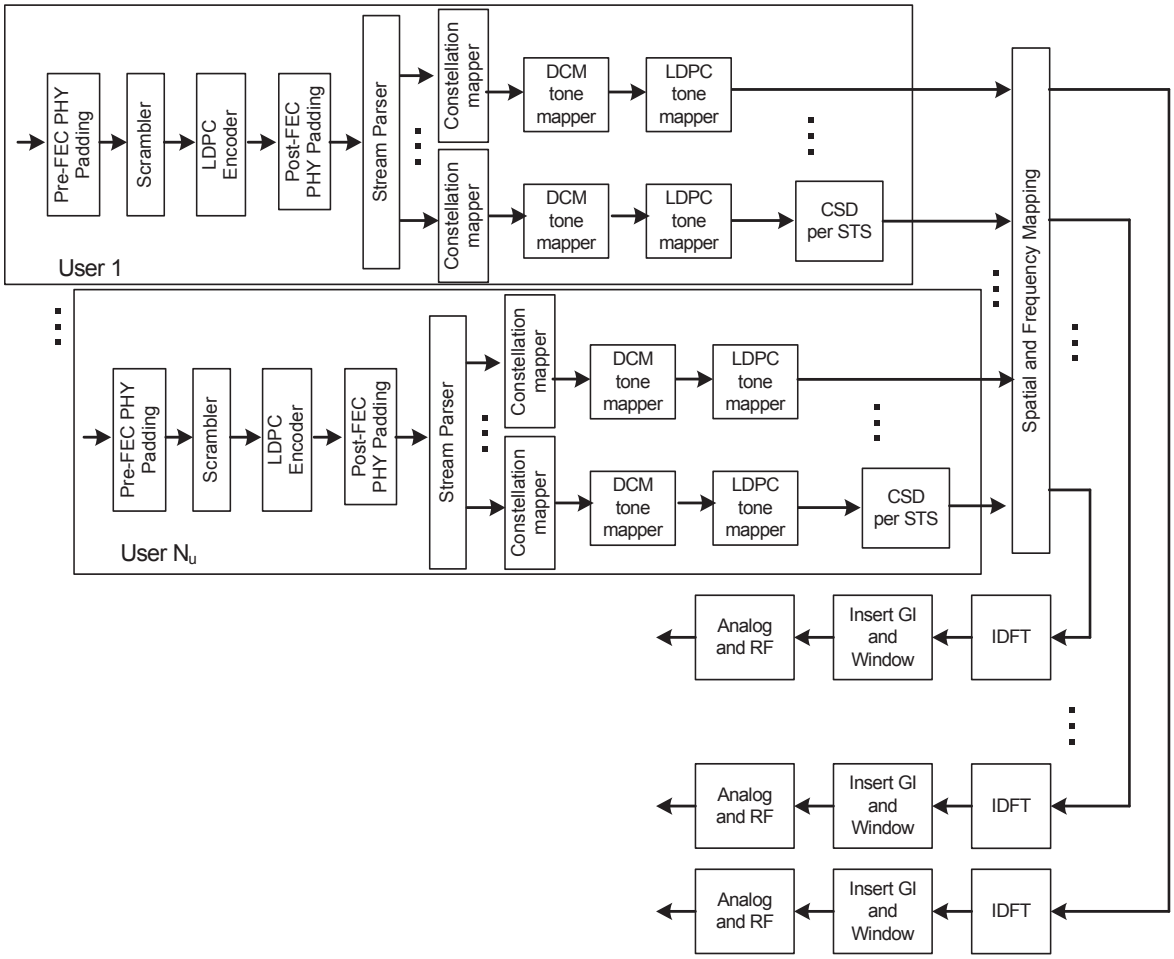

Figure 26-11—Transmitter block diagram for the Data field of an HE downlink MU-MIMO transmission in 106-, 242-, 484- or 996-RU with LDPC encoding

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Figure 26-12 (Transmitter block diagram for the Data field of an HE SU PPDU in 160 MHz with LDPC encoding) shows the transmitter blocks used to generate the Data field of a single-user HE transmission in 160 MHz with LDPC encoding.

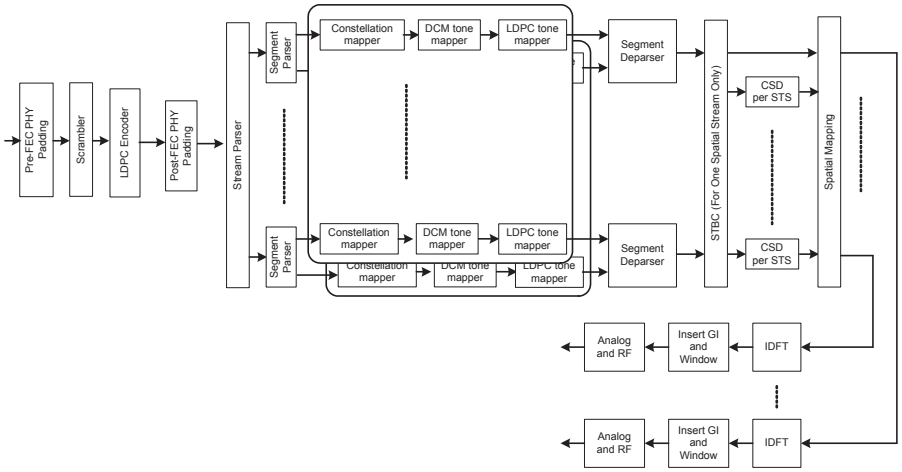

Figure 26-12—Transmitter block diagram for the Data field of an HE SU PPDU in 160 MHz with LDPC encoding

Figure 26-13 (Transmitter block diagram for the Data field of an HE SU PPDU in 80+80 MHz with LDPC encoding) shows the transmitter blocks used to generate the Data field of a single-user HE transmission in 80+80 MHz with LDPC encoding.

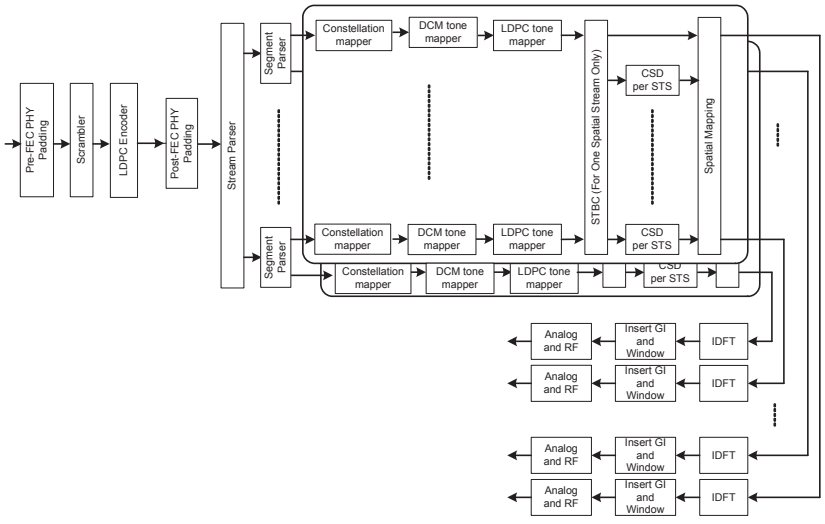

Figure 26-13—Transmitter block diagram for the Data field of an HE SU PPDU in 80+80 MHz with LDPC encoding

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26.3.4 Overview of the PPDU encoding process

26.3.5 HE modulation and coding schemes (HE-MCSs)

The HE-MCS is a value that determines the modulation and coding used in the HE-SIG-B field and the Data field of the PPDU. It is a compact representation that is carried in the HE-SIG-A field for the HE-SIG-B field in an HE MU PPDU and for the Data field in an HE SU PPDU and HE extended range SU PPDU and carried in the HE-SIG-B field for the Data field in an HE MU PPDU. Rate-dependent parameters for the full set of HE-MCSs are shown in Table 26-37 (HE-MCSs for TBD mandatory/optional 26-tone RU, NSS = 1) to Table 26-92 (HE-MCSs for optional non-OFDMA 160 MHz and 80+80 MHz, NSS = 8) (in 26.5 (1 Parameters for HE-MCSs)). These tables give rate-dependent parameters for HE-MCSs with indices 0 to 11, with number of spatial streams from 1 to 8, RU options of 26-tone, 52-tone, 106-tone, 242-tone, 484-tone and 996-tone, and bandwidth options of 20 MHz, 40 MHz, 80 MHz, and either 160 MHz or 80+80 MHz. HE-MCSs with indices 10 and 11 (1024-QAM) are optionally applied to the Data field of an HE PPDU with RUs equal to or larger than 242-tone. The HE extended range SU PPDU can only be transmitted with MCS0, MCS1, MCS2 and only with 1 spatial stream on the primary 20 MHz channel.

DCM is an optional modulation scheme used for the HE-SIG-B field and the Data field in an HE PPDU. It is indicated in the HE-SIG-A field for the HE-SIG-B field in an HE MU PPDU and for the Data field in HE SU PPDU, HE trigger-based PPDU and HE extended range SU PPDU and indicated in the HE-SIG-B field for the Data field in an HE MU PPDU. It is only applied for the HE-MCSs with indices 0, 1, 3 and 4.

26.3.6 Timing-related parameters

Refer to Table 20-6 and Table 22-5 (Timing-related constants) for timing-related parameters for non-HE PPDU formats.

Table 26-3 (Timing-related constants) defines the timing-related parameters for HE PPDU formats..

Table 26-3— Timing-related constants

Parameter	Values	Description
$\Delta_{F,\text{ Pre-HE}}$	312.5 kHz	Subcarrier frequency spacing for the pre-HE portion.
$\Delta_{F,\text{ HE}}$	78.125 kHz	Subcarrier frequency spacing for the HE portion.
$T_{DFT,Pre\text{-}HE}$	3.2 μs	IDFT/DFT period for the pre-HE portion.
$T_{DFT,HE}$	12.8 μs	IDFT/DFT period for the HE portion.
$T_{GI,Pre\text{-}HE}$	0.8 μs	Guard interval duration for the legacy preamble, RL-SIG, HE-SIG-A and HE-SIG-B
$T_{GI,HE\text{-}LTF}$	$T_{GI1,Data}$, $T_{GI2,Data}$ or $T_{GI4,Data}$ depending on the GI used for data	Guard interval duration for the HE-LTF field, same as $T_{GI,Data}$
$T_{GI,Data}$	$T_{GI1,Data}$, $T_{GI2,Data}$ or $T_{GI4,Data}$ depending on the GI used for data	Guard interval duration for the HE-Data field
$T_{GI1,Data}$	0.8 μs	Base guard interval duration for the HE-Data field.
$T_{GI2,Data}$	1.6 μs	Double guard interval duration for the HE-Data field.

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Table 26-3— Timing-related constants *(continued)*

$T_{GI4,Data}$	3.2 μs	Quadruple guard interval duration for the HE-Data field.
T_{SYM1}	13.6 μs = $T_{GI,HE-LTF} + T_{GI1,Data} = 1.0625 \times T_{DFT,HE}$	Normal GI symbol interval
T_{SYM2}	14.4 μs = $T_{GI,HE-LTF} + T_{GI2,Data} = 1.125 \times T_{DFT,HE}$	Double GI symbol interval
T_{SYM4}	16 μs = $T_{GI,HE-LTF} + T_{GI4,Data} = 1.25 \times T_{DFT,HE}$	Quadruple GI symbol interval
T_{SYM}	T_{SYM1}, T_{SYM2}, or T_{SYM4} depending on the GI used (see Table xx-x (Tone scaling factor and guard interval duration values for PHY fields))	Symbol interval
T_{L-STF}	8 μs = 10 × $T_{DFT,Pre-HE}$ /4	Non-HT Short Training field duration
T_{L-STF}	8 μs = 2 × $T_{DFT,Pre-HE} + T_{GI2,Data}$	Non-HT Long Training field duration
T_{L-SIG}	4 μs	Non-HT SIGNAL field duration
T_{RL-SIG}	4 μs	Repeated non-HT SIGNAL field duration
$T_{HE-SIG-A}$	8 μs = 2 × 4 μs	HE-SIG-A field duration in an HE SU PPDU, HE MU PPDU and HE trigger-based PPDU
$T_{HE-SIG-A-R}$	8 μs or 16 μs (TBD)	HE-SIG-A field duration in an HE extended range SU PPDU
$T_{HE-STF-T}$	8 μs = 5 × 1.6 μs	HE-STF field duration for an HE trigger-based PPDU
$T_{HE-STF-NT}$	4 μs = 5 × 0.8 μs	HE-STF field duration for an HE SU PPDU, HE extended range SU PPDU and HE MU PPDU
T_{HE-LTF}	$T_{HE-LTF-1X}$, $T_{HE-LTF-2X}$ or $T_{HE-LTF-4X}$ depending upon the LTF duration used	Duration of each HE-LTF field OFDM symbol without GI
$T_{HE-LTF-1X}$	3.2 μs	Duration of each 1x HE-LTF OFDM symbol without GI
$T_{HE-LTF-2X}$	6.4 μs	Duration of each 2x HE-LTF OFDM symbol without GI
$T_{HE-LTF-4X}$	12.8 μs	Duration of each 4x HE-LTF OFDM symbol without GI
$T_{HE-LTF-SYM}$	sum of T_{HE-LTF} and $T_{GI,HE-LTF}$	Duration of each HE-LTF OFDM symbol including GI
$T_{HE-SIG-B}$	4 μs = $T_{DFT,Pre-HE} + T_{GI,Pre-HE}$	Duration of each HE-SIG-B field OFDM symbol
$N_{service}$	16	Number of bits in the SERVICE field
N_{tail}	6	Number of tail bits per BCC encoder
T_{SYML}	4 μs	Symbol duration including GI prior to the HE-STF field

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Table 26-4 (Tone allocation related constants for Data field in a non-OFDMA HE PPDU) defines tone allocation related parameters for a non-OFDMA HE PPDU.

Table 26-4—Tone allocation related constants for Data field in a non-OFDMA HE PPDU

Parameter	CBW20	CBW40	CBW80	CBW80+80	CBW160	Description
N_{SD}	234	468	980	980	1960	Number of complex data numbers per frequency segment
N_{SP}	8	16	16	16	32	Number of pilot values per frequency segment
N_{ST}	242	484	996	996	1992	Total number of subcarriers per frequency segment
N_{SR}	122	244	500	500	1012	Highest data subcarrier index per frequency segment
N_{Seg}	1	1	1	2	1	Number of frequency segments
N_{DC}	3	5	5	5	23	Number of null tones at DC per segment
$N_{Guard,Left}$	6	12	12	12	12	Number of guard tones at the lower side of the spectrum
$N_{Guard,Right}$	5	11	11	11	11	Number of guard tones at the higher end of the spectrum
NOTE: $N_{ST} = N_{SD} + N_{SP}$						

Table 26-4 (Tone allocation related constants for Data field in a non-OFDMA HE PPDU) defines tone allocation related parameters for a OFDMA HE PPDU.

Table 26-5—Tone allocation related constants for RUs in an OFDMA HE PPDU

Parameter	RU Size (tones)						Description
	26	52	106	242	484	996	
N_{SD}	24	48	102	234	468	980	Number of complex data numbers per RU
N_{SP}	2	4	4	8	16	16	Number of pilot values per RU
N_{ST}	26	52	106	242	484	996	Total number of subcarriers per RU
NOTE: $N_{ST} = N_{SD} + N_{SP}$							

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Table 26-6 (Frequently used parameters) defines parameters used frequently in Clause 26.

Table 26-6—Frequently used parameters

Symbol	Explanation
N_{CBPS}, $N_{CBPS,r,u}$	Number of coded bits per symbol at r-th RU for user u, $r = 0, \ldots, N_{RU} - 1$, $u = 0, ..., N_{user,r} - 1$. For an HE SU PPDU, $N_{CBPS} = N_{CBPS,0}$ For an HE MU PPDU, N_{CBPS} is undefined
N_{CBPSS}, $N_{CBPSS,r,u}$	Number of coded bits per symbol per spatial stream. For the Data field, $N_{CBPSS,r,u}$ equals the number of coded bits per symbol per spatial stream at r-th RU for user u, $r = 0, \ldots, N_{RU} - 1$, $u = 0, ..., N_{user,r} - 1$. For the Data field of an HE SU PPDU, $N_{CBPSS} = N_{CBPSS,0,0}$ For the Data field of an HE MU PPDU, N_{CBPSS} is undefined
N_{DBPS}, $N_{DBPS,r,u}$	Number of data bits per symbol at r-th RU for user u, $r = 0, \ldots, N_{RU} - 1$, $u = 0, ..., N_{user,r} - 1$. For an HE SU PPDU, $N_{DBPS} = N_{DBPS,0,0}$ For an HE MU PPDU, N_{DBPS} is undefined
N_{BPSCS}, $N_{BPSCS,u}$	Number of coded bits per subcarrier per spatial stream at r-th RU for user u, $r = 0, \ldots, N_{RU} - 1$, $u = 0, ..., N_{user,r} - 1$. For an HE SU PPDU, $N_{BPSCS} = N_{BPSCS,0,0}$ For an HE MU PPDU, N_{BPSCS} is undefined
N_{RX}	Number of receive chains
N_{RU}	For pre-HE modulated fields, $N_{RU} = 1$. For HE modulated fields, N_{RU} represents the number of RUs in the transmission (equal to the TXVECTOR parameter NUM_RUS).
$N_{uset,r}$	For pre-HE modulated fields, $N_{uset,r} = 1$. For HE modulated fields, $N_{uset,r}$ represents the number of users at r-th RU in the transmission (summing over all RUs equals to the TXVECTOR parameter NUM_USERS_TOTAL).
N_{STS}, $N_{STS,r,u}$	For pre-HE modulated fields, $N_{STS,r,u} = 1$ (see NOTE 2). For HE modulated fields, $N_{STS,r,u}$ the number of space-time streams at r-th RU for user u, $u = 0, ..., N_{user,r} - 1$. In case of STBC, $N_{STS,r,u} = 2$ For an HE SU PPDU, $N_{STS} = N_{STS,0,0}$ For an HE MU PPDU, $N_{STS} = max_{r=0}^{N_{RU}-1} N_{STS,r,total}$
$N_{STS,r,total}$	For HE modulated fields, $N_{STS,total}$ is the total number of space-time streams at the r-th RU in a PPDU. $N_{STS,r,total} = \sum_{u=0}^{N_{user,r}-1} N_{STS,r,u}$ For pre-HE modulated fields, $N_{STS,r,total}$ is undefined. Note that $N_{STS,r,total} = N_{STS}$ for an HE SU PPDU.

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Table 26-6—Frequently used parameters *(continued)*

N_{SS}, $N_{SS,r,u}$	Number of spatial streams. For the Data field, $N_{SS,r,u}$ is the number of spatial streams at r-th RU for user u, $u = 0, ..., N_{user,r} - 1$ For the Data field of an HE SU PPDU, $N_{SS} = N_{SS,0,0}$ For the Data field of an HE MU PPDU, $N_{SS} = max_{r=0}^{N_{RU}-1} N_{SS,r,total}$
$N_{SS,r,total}$	For HE modulated fields, $N_{SS,r,total}$ is the total number of spatial streams at r-th RU in a PPDU. $N_{SS,r,total} = \sum_{u=0}^{N_{user,r}-1} N_{SS,r,u}$ For pre-HE modulated fields, $N_{SS,r,total}$ is undefined. Note that $N_{SS,r,total} = N_{SS}$ for an HE SU PPDU.
N_{TX}	Number of transmit chains
N_{ES}, $N_{ES,r,u}$	The number of BCC encoders. This parameter should be 1 in all BCC cases in 11ax. For a Data field encoded using BCC, $N_{ES,r,u}$ is the number of BCC encoders at r-th RU for user u, $u = 0, ..., N_{user,r} - 1$. For the Data field encoded using LDPC, $N_{ES} = 1$ for an HE SU PPDU and $N_{ES,r,u} = 1$ for an HE MU PPDU at r-th RU for user u, $u = 0, ..., N_{user,r} - 1$. For the Data field of an HE SU PPDU, $N_{ES} = N_{ES,0,0}$ For the Data field of an HE MU PPDU, N_{ES} is undefined.
$N_{HE\text{-}LTF}$	The number of OFDM symbols in the HE-LTF field (see 26.3.9.10 (HE-LTF))
$N_{HE\text{-}SIG\text{-}B}$	The number of OFDM symbols in the HE-SIG-B field
K_r	Set of subcarrier indices in the r-th RU
R, $R_{r,u}$	$R_{r,u}$ is the coding rate at r-th RU for user u, $u = 0, ..., N_{user,r} - 1$. For an HE SU PPDU, $R = R_{0,0}$ For an HE MU PPDU, R is undefined
$M_{r,u}$	For pre-HE modulated fields, $M_{r,u} = 0$. For HE modulated fields, $M_{r,0} = 0$ for $u = 0$ and $M_{r,u} = \sum_{u'=0}^{u-1} N_{STS,r,u'}$ for u, $u = 1, ..., N_{user,r} - 1$.

NOTE 1—Pre-HE modulated fields refer to the L-STF, L-LTF, L-SIG, RL-SIG, HE-SIG-A, HE-SIG-A-R, and HE-SIG-B fields, while HE modulated fields refer to the HE-STF, HE-LTF, and Data fields (see Timing boundaries for HE PPDU fields).

NOTE 2—For pre-HE modulated fields, u and r are zeros only since $N_{user,r} = 1$ and $N_{RU} = 1$.

26.3.7 OFDMA and SU tone allocation

Orthogonal Frequency Division Multiple Access (OFDMA) is the multi-user variant of the OFDM scheme where multiple-access is achieved by assigning subsets of subcarriers to different users, allowing

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simultaneous data transmission by several users. In OFDMA, the resources are allocated in two dimensional regions over time and frequency. In HE, the time region covers the entire data portion of an HE PPDU, and the frequency region includes a number of contiguous subcarriers with the exception of the RUs which straddle DC where nulls are placed in the middle of the band. The difference between OFDM and OFDMA is illustrated in Figure 26 14. Similar to OFDM, OFDMA employs multiple subcarriers, but the subcarriers are divided into several groups of subcarriers where each group is denoted as a resource unit (RU). The grouping of subcarriers into groups of resource units is referred to as subchannelization. In HE, the subcarriers that form a RU are physically adjacent (contiguous except at the middle of the band where nulls are placed at DC).

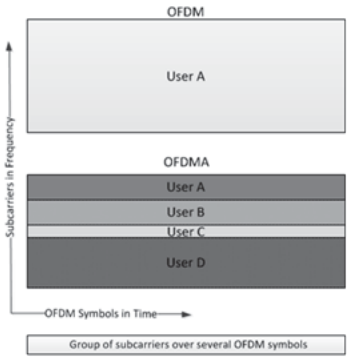

Figure 26-14—Illustration of OFDM and OFDMA concepts

Subchannelization defines subchannels that can be allocated to stations depending on their channel conditions and service requirements. Using subchannelization, an OFDMA system can potentially allocate different transmit powers to different allocations.

OFDMA is a method to add multiple access in OFDM systems and has been adopted by other wireless standards, and the HE amendment introduces OFDMA into 802.11 WLAN networks. The OFDMA parameters in HE satisfy general design criteria for OFDM systems as follows:

$$\begin{aligned} &T_{CP} \geq \tau_{RMS} \quad \text{(to prevent ISI due to delay spread)} \\ &T_{CP}\Delta f \ll 1 \quad \text{(for spectral efficiency improvement)} \end{aligned} \tag{26-1}$$

In OFDMA, an OFDM symbol is constructed of subcarriers, the number of which is a function of the FFT size. There are several subcarrier types: 1) Data subcarriers which are used for data transmission; defined in 26.3.7.1 (Resource unit, edge and DC tones), 2) Pilot subcarriers which are utilized for phase information and parameter tracking; defined in 26.3.7.3 (Pilot tones), and 3) unused subcarriers which are not used for data/pilot transmission. The unused subcarriers are the DC subcarrier (defined in 26.3.7.1 (Resource unit, edge and DC tones)), the Guard band subcarriers at the band edges (defined in 26.3.7.1 (Resource unit, edge and DC tones)), and the Null subcarriers (defined in 26.3.7.2 (Null subcarriers)).

26.3.7.1 Resource unit, edge and DC tones

The OFDMA structure consists of a 26-subcarrier resource unit (RU), 52-subcarrier RU, 106-subcarrier RU, 242-subcarrier RU, 484-subcarrier RU and 996-subcarrier RU. Resource allocations for single user (SU) consist of a 242 subcarrier RU, 484-subcarrier RU, 996-subcarrier RU and 2x996-subcarrier RU.

The 26-subcarrier RU and 52-subcarrier RU are used in the 20 MHz, 40 MHz, 80 MHz, 160 MHz and 80+80 MHz OFDMA HE PPDU formats. The 106-subcarrier RU is used in the 20 MHz, 40 MHz, 80 MHz, 160 MHz and 80+80 MHz OFDMA and MU-MIMO HE PPDU formats. The 242-subcarrier RU is used in

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the 40 MHz, 80 MHz, 160 MHz and 80+80 MHz OFDMA and MU-MIMO HE PPDU formats. The 484-subcarrier RU is used in the 80 MHz, 160 MHz and 80+80 MHz OFDMA and MU-MIMO HE PPDU formats. The 996-subcarrier RU is used in the 160 MHz and 80+80 MHz OFDMA and MU-MIMO HE PPDU formats.

The 242-subcarrier and larger RUs are used in the HE SU PPDU and non-OFDMA, MU-MIMO HE PPDU formats. The 242-subcarrier RU is used in the 20 MHz HE SU PPDU and MU-MIMO HE PPDU formats. The 484-subcarrier RU is used in the 40 MHz HE SU PPDU and MU-MIMO HE PPDU formats. The 996-subcarrier RU is used in the 80 MHz HE SU PPDU and MU-MIMO HE PPDU formats. The 2x996-subcarrier RU is used in the 160 MHz and 80+80 MHz HE SU PPDU and MU-MIMO HE PPDUs.

The maximum numbers of RUs in the 20 MHz, 40 MHz, 80 MHz, 160 MHZ and 80+80 MHz HE PPDU formats are defined in Table 26-7 (Total number of RUs for BWs). Cases of 1 RU indicate the HE SU and a HE MU-MIMO PPDU allocation.

Table 26-7—Total number of RUs for BWs

RU type	CBW20	CBW40	CBW80	CBW80+80 and CBW160
26-subcarrier RU	9	18	37	74
52-subcarrier RU	4	8	16	32
106-subcarrier RU	2	4	8	16
242-subcarrier RU	1-SU/MU-MIMO	2	4	8
484-subcarrier RU	N/A	1-SU/MU-MIMO	2	4
996-subcarrier RU	N/A	N/A	1-SU/MU-MIMO	2
2x996 subcarrier RU	N/A	N/A	N/A	1-SU/MU-MIMO

An OFDMA HE PPDU can carry a mixture of 26-subcarrier, 52-subcarrier and 106-subcarrier RUs within any of the 242-subcarrier RU boundaries.

Table 26-8—Subcarrier indices for RUs in a 20 MHz HE PPDU

RU type					
26-subcarrier RU	RU 1 [−120: −96]	RU 2 [−95: −70]	RU 3 [−68: −43]	RU 4 [−42: −17]	RU 5 [−16: −4, −4: 16]
	RU 6 [17: 42]	RU 7 [43: 68]	RU 8 [70: 95]	RU 9 [96: 121]	
52-subcarrier RU	RU 1 [−121: −70]	RU 2 [−68: −17]	RU 3 [17: 68]	RU 4 [70: 121]	
106-subcarrier RU	RU 1 [−122: −17]		RU 2 [17: 122]		
242-subcarrier RU	RU 1 [−122: −2, 2:122]				

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Table 26-9—Subcarrier indices for RUs in a 40 MHz HE PPDU

RU type					
26-subcarrier RU	RU 1 [−243: −218]	RU 2 [−217: −192]	RU 3 [−189: −164]	RU 4 [−163: −138]	RU 5 [−136: −111]
	RU 6 [−109: −84]	RU 7 [−83: −58]	RU 8 [−55: −30]	RU 9 [−29: −4]	
	RU 10 [4: 29]	RU 11 [30: 55]	RU 12 [58: 83]	RU 13 [84: 109]	RU 14 [111: 136]
	RU 15 [138: 163]	RU 16 [164: 189]	RU 17 [192: 217]	RU 18 [218: 243]	
52-subcarrier RU	RU 1 [−243: −192]	RU 2 [−189: −138]	RU 3 [−109: −58]	RU 4 [−55: −4]	
	RU 5 [4: 55]	RU 6 [58: 109]	RU 7 [138: 189]	RU 8 [192: 243]	
106-subcarrier RU	RU 1 [−243: −138]	RU 2 [−109: −4]	RU 3 [4: 109]	RU 4 [138: 243]	
242-subcarrier RU	RU 1 [−244: −3]		RU2 [3: 244]		
484-subcarrier RU	RU 1 [−244: −3, 3: 244]				

Table 26-10—Subcarrier indices for RUs in an 80 MHz HE PPDU

RU type					
26-subcarrier RU	RU 1 [−499: −474]	RU 2 [−473: −448]	RU 3 [−445: −420]	RU 4 [−419: −394]	RU 5 [−392: −367]
	RU 6 [−365: −340]	RU 7 [−339: −314]	RU 8 [−311: −286]	RU 9 [−285: −260]	
	RU 10 [−257: −232]	RU 11 [−231: −206]	RU 12 [−203: −178]	RU 13 [−177: −152]	RU 14 [−150: −125]
	RU 15 [−123: −98]	RU 16 [−97: −72]	RU 17 [−69: −44]	RU 18 [−43: −18]	RU 19 [−16: −4, 4: 16]
	RU 20 [18: 43]	RU 21 [44: 69]	RU 22 [72: 97]	RU 23 [98: 123]	RU 24 [125: 150]
	RU 25 [152: 177]	RU 26 [178: 203]	RU 27 [206: 231]	RU28 [232: 257]	
	RU 29 [260: 285]	RU 30 [286: 311]	RU 31 [314: 339]	RU 32 [340: 365]	RU 33 [367: 392]
	RU 34 [394: 419]	RU 35 [420: 445]	RU 36 [448: 473]	RU37 [474: 499]	

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Table 26-10—Subcarrier indices for RUs in an 80 MHz HE PPDU

52-subcarrier RU	RU 1 [−499: −448]	RU 2 [−445: −394]	RU 3 [−365: −314]	RU 4 [−311: −260]	
	RU 5 [−257: −206]	RU 6 [−203: −152]	RU 7 [−123 : −72]	RU 8 [−69: −18]	
	RU 9 [18: 69]	RU 10 [72: 123]	RU 11 [152: 203]	RU 12 [206: 257]	
	RU 13 [260: 311]	RU 14 [314: 365]	RU 15 [394: 445]	RU 16 [448: 499]	
106-subcarrier RU	RU 1 [−499: −394]	RU 2 [−365: −260]	RU 3 [−257: −152]	RU 4 [−123: −18]	
	RU 5 [18: 123]	RU 6 [152: 257]	RU 7 [260: 365]	RU 8 [394: 499]	
242-subcarrier RU	RU 1 [−500: −259]	RU 2 [−258: −17]	RU 3 [17: 258]	RU 4 [259: 500]	
484-subcarrier RU	RU 1 [−500: −17]		RU 2 [17, 500]		
996-subcarrier RU	RU 1 [−500: −3, 3: 500]				

A 26-subcarrier RU consists of 24 data subcarriers and 2 pilot subcarriers. The position of the pilots for the 26-subcarrier RU is defined in 26.3.7.3 (Pilot tones). The location of the 26-subcarrier RUs are fixed as defined in Table 26-8 (Subcarrier indices for RUs in a 20 MHz HE PPDU) and shown in Figure 26 15, Figure 26 16 and Figure 26 17 for the 20 MHz, 40 MHz and 80 MHz OFDMA HE PPDU formats, respectively. The same structure as used for the 80 MHz OFDMA HE PPDU is used for each 80 MHz frequency segment of the 160 MHz and 80+80 MHz OFDMA HE PPDU. The center 26-subcarrier RU in the 20 MHz and 80 MHz OFDMA HE PPDU (Figure 26-15 (RU locations in a 20 MHz HE PPDU) and Figure 26-17 (RU locations in an 80 MHz HE PPDU)) is located on subcarriers [−16: −4, 4: 16].

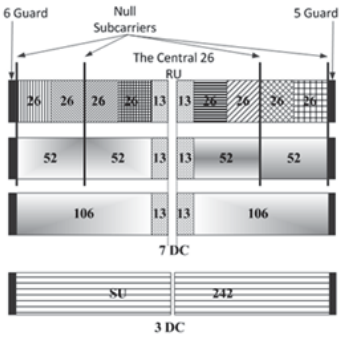

Figure 26-15—RU locations in a 20 MHz HE PPDU

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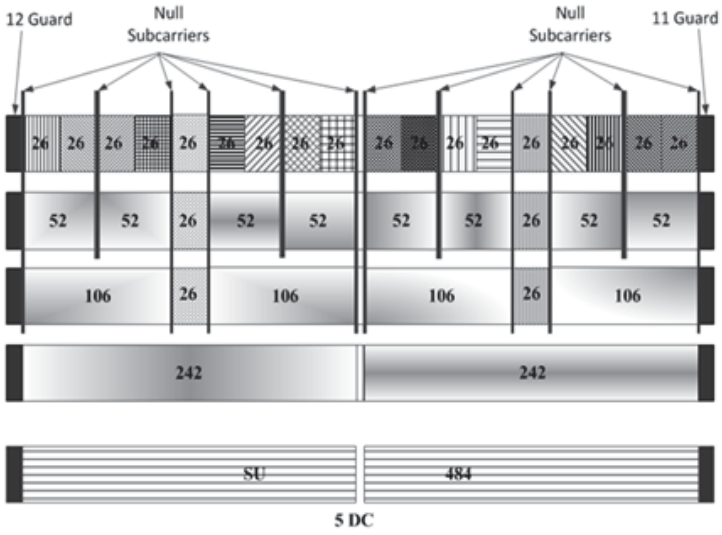

Figure 26-16—RU locations in a 40 MHz HE PPDU

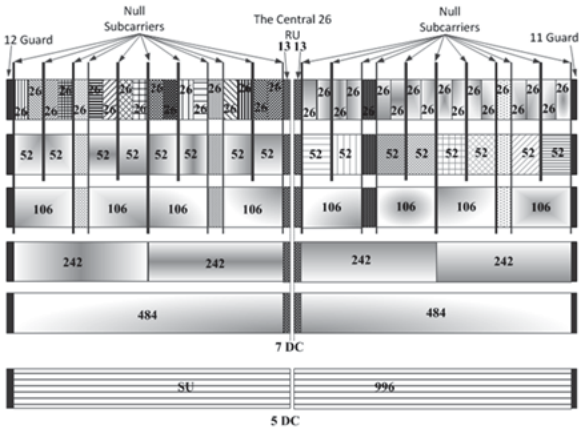

Figure 26-17—RU locations in an 80 MHz HE PPDU

A 52-subcarrier RU consists of 48 data subcarriers and 4 pilot subcarriers. The position of the pilots for the 52-subcarrier RU is defined in 26.3.7.3 (Pilot tones). The locations of the 52-subcarrier RUs are fixed as defined in Table 26-8 (Subcarrier indices for RUs in a 20 MHz HE PPDU), Table 26-9 (Subcarrier indices for RUs in a 40 MHz HE PPDU) and Table 26-10 (Subcarrier indices for RUs in an 80 MHz HE PPDU) and illustrated in Figure 26-15 (RU locations in a 20 MHz HE PPDU), Figure 26-16 (RU locations in a 40 MHz HE PPDU) and Figure 26-17 (RU locations in an 80 MHz HE PPDU) for the 20 MHz, 40 MHz and 80 MHz OFDMA HE PPDU formats, respectively. The same structure as used in the 80 MHz OFDMA HE PPDU format is used for each 80 MHz frequency segment of the 160 MHz and 80+80 MHz OFDMA HE PPDU formats.

A 106-subcarrier RU consists of 102 data subcarriers and 4 pilot subcarriers. The position of the pilots for the 106-subcarrier RU is defined in 26.3.7.3 (Pilot tones). The locations of the 106-subcarrier RUs are fixed as defined in Table 26-8 (Subcarrier indices for RUs in a 20 MHz HE PPDU), Table 26-9 (Subcarrier indices for RUs in a 40 MHz HE PPDU) and Table 26-10 (Subcarrier indices for RUs in an 80 MHz HE PPDU) and illustrated in Figure 26-15 (RU locations in a 20 MHz HE PPDU), Figure 26-16 (RU locations in a 40 MHz HE PPDU) and Figure 26-17 (RU locations in an 80 MHz HE PPDU) for the 20 MHz, 40 MHz and 80 MHz

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OFDMA HE PPDU formats, respectively. The same structure as used in the 80 MHz OFDMA HE PPDU formats is used for each 80 MHz frequency segment of the 160 MHz and 80+80 MHz OFDMA HE PPDU formats.

A 242-subcarrier RU consists of 234 data subcarriers and 8 pilot subcarriers. The position of pilots for the 242-subcarrier RU is defined in 26.3.7.3 (Pilot tones). The locations of the 242-subcarrier RUs are fixed as defined in Table 26-9 (Subcarrier indices for RUs in a 40 MHz HE PPDU) and Table 26-10 (Subcarrier indices for RUs in an 80 MHz HE PPDU) and illustrated in Figure 26-16 (RU locations in a 40 MHz HE PPDU) and Figure 26-17 (RU locations in an 80 MHz HE PPDU) for the 40 MHz, 80 MHz OFDMA HE PPDU formats, respectively. The same structure as used in the 80 MHz OFDMA HE PPDU formats is used for each 80 MHz frequency segment of the 160 MHz and 80+80 MHz OFDMA HE PPDU formats. A 20 MHz HE SU PPDU and MU-MIMO HE PPDU with a 242-subcarrier RU is shown in Figure 26-15 (RU locations in a 20 MHz HE PPDU).

A 484-subcarrier RU consists of 468 data subcarriers and 16 pilot subcarriers. The position of the pilots for the 484-subcarrier RU is defined in 26.3.7.3 (Pilot tones). The locations of the 484-subcarrier RUs are fixed as defined in Table 26-10 (Subcarrier indices for RUs in an 80 MHz HE PPDU) and illustrated in Figure 26-17 (RU locations in an 80 MHz HE PPDU) for the 80 MHz HE PPDU. The same structure as used for the 80 MHz OFDMA HE PPDU is used for each 80 MHz frequency segment of the 160 MHz and 80+80 MHz OFDMA HE PPDU. The 40 MHz HE SU PPDU and MU-MIMO HE PPDU with a 484-subcarrier RU is shown in Figure 26-16 (RU locations in a 40 MHz HE PPDU).

A 996-subcarrier RU consists of 980 data subcarriers and 16 pilot subcarriers. The position of the pilots for the 996-subcarrier RU is defined in 26.3.7.3 (Pilot tones). The locations of the 996-subcarrier RUs are fixed and located on subcarrier [−1012: −515, −509: −12] and [12: 509, 515: 1012] for each half of the BW, respectively, for 160/80+80 MHz HE OFDMA PPDUs.

The 20 MHz OFDMA HE PPDU has 7 DC subcarriers located at [−3:3]. The 20 MHz HE SU PPDU and 20 MHz MU-MIMO HE PPDU with a 242 subcarrier RU has 3 DC subcarriers located at [−1: 1]. The 40 MHz OFDMA HE PPDU, HE SU PPDU and a HE MU-MIMO PPDU with 484 subcarries have 5 DC subcarriers located at [−2: 2]. An 80 MHz HE OFDMA PPDU has 7 DC subcarriers located at [−3: 3]. The 80 MHz HE SU PPDU and 80 MHz HE MU-MIMO PPDU with 996 a subcarrier allocation have 5 DC subcarriers located at [−2: 2]. The same structure as used in the 80 MHz OFDMA HE PPDU is used for each 80 MHz frequency segment of the 160 MHz and 80+80 MHz OFDMA HE PPDU. The DC tones are located on subcarriers [−11: 11]. The same structure as used in the 80 MHz HE SU PPDU is used for each 80 MHz frequency segment of the 160 MHz and 80+80 MHz OFDMA HE PPDU.

The 20 MHz HE PPDU format has 11 guard subcarriers (6, 5) located at [−128: −123] and [123: 127] as shown in Figure 26-15 (RU locations in a 20 MHz HE PPDU). The 40 MHz HE PPDU has 23 guard subcarriers (12, 11) located at [−256: −245] and [245: 255] as shown in Figure 26-16 (RU locations in a 40 MHz HE PPDU). The 80 MHz HE PPDU has 23 guard subcarriers (12, 11) located at [−512: −501] and [501: 511] as shown in Figure 26-17 (RU locations in an 80 MHz HE PPDU). For 160 MHz and 80+80 MHz HE PPDUs, the same number of leftmost and rightmost guard subcarriers as 80 MHz are defined at each edge of the 160 MHz.

26.3.7.2 Null subcarriers

There are null subcarriers between the 26-, 52- and 106-subcarrier RU locations as illustrated in Figure 26-15 (RU locations in a 20 MHz HE PPDU), Figure 26-16 (RU locations in a 40 MHz HE PPDU) and

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Figure 26-17 (RU locations in an 80 MHz HE PPDU). The null subcarriers have zero energy. The indices of the null subcarrier are enumerated in Table 26-11 (Null subcarrier indices).

Table 26-11— Null subcarrier indices

Channel Width	RU Size	Null Subcarrier Indices
20 MHz	26, 52	±69, ±122
	106	none
	242	none
40 MHz	26, 52	±3, ±56, ±57, ±110, ±137, ±190, ±191, ±244
	106	±3, ±110, ±137, ±244
	242, 484	none
80 MHz	26, 52	±17, ±70, ±71, ±124, ±151, ±204, ±205, ±258, ±259, ±312, ±313, ±366, ±393, ±446, ±447, ±500
	106	±17, ±124, ±151, ±258, ±259, ±366, ±393, ±500
	242, 484	none
	996	none

26.3.7.3 Pilot tones

If pilot tones are present in the HE-LTF field, the pilot tone locations in the HE-LTF field and Data field shall be the same. The pilot tone locations for 20 MHz, 40 MHz and 80 MHz bandwidth are as shown in Figure 26-18 (Pilot tone locations for 20 MHz), Figure 26-19 (Pilot tone locations for 40 MHz) and Figure 26-20 (Pilot tone locations for 80 MHz), respectively. All pilot tones are at the even indices enumerated in Table 26-12 (Pilot tone indices).

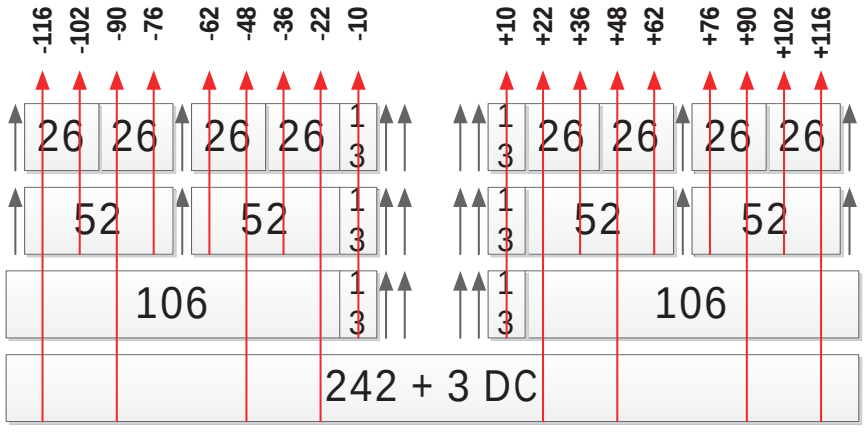

Figure 26-18—Pilot tone locations for 20 MHz

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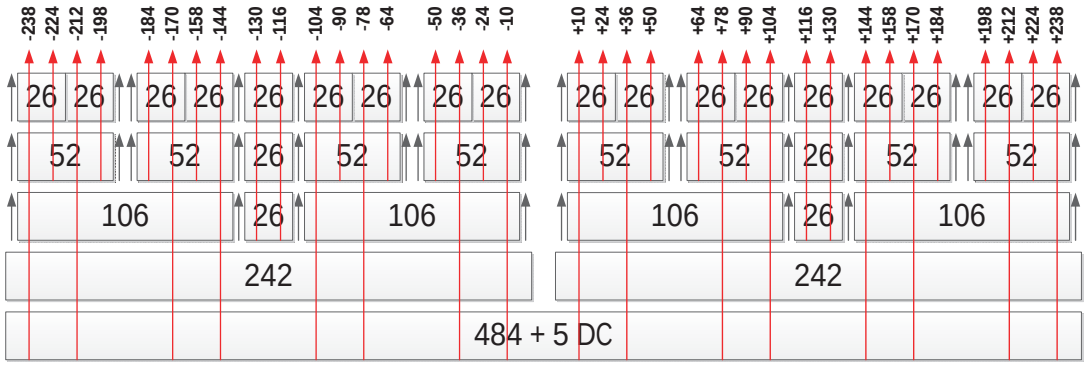

Figure 26-19—Pilot tone locations for 40 MHz

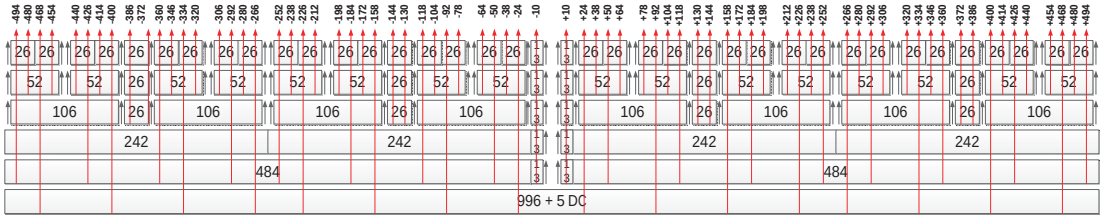

Figure 26-20—Pilot tone locations for 80 MHz

Table 26-12— Pilot tone indices

Channel Width	RU Size	Pilot Tone Indices
20 MHz	26, 52	±10, ±22, ±36, ±48, ±62, ±76, ±90, ±102, ±116
	106, 242	±22, ±48, ±90, ±116
40 MHz	26, 52	±10, ±24, ±36, ±50, ±64, ±78, ±90, ±104, ±116, ±130, ±144, ±158, ±170, ±184, ±198, ±212, ±224, ±238
	106, 242, 484	±10, ±36, ±78, ±104, ±144, ±170, ±212, ±238
80 MHz	26, 52	±10, ±24, ±38, ±50, ±64, ±78, ±92, ±104, ±118, ±130, ±144, ±158, ±172, ±184, ±198, ±212, ±226, ±238, ±252, ±266, ±280, ±292, ±306, ±320, ±334, ±346, ±360, ±372, ±386, ±400, ±414, ±426, ±440, ±454, ±468, ±480, ±494
	106, 242, 484	±24, ±50, ±92, ±118, ±158, ±184, ±226, ±252, ±266, ±292, ±334, ±360, ±400, ±426, ±468, ±494
	996	±24, ±92, ±158, ±226, ±266, ±334, ±400, ±468

The pilot tones locations for 160 MHz or 80+80 MHz shall use the same 80 MHz locations for both 80 MHz.

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26.3.8 Mathematical description of signals

For a description of the conventions used for the mathematical description of the signals, see 18.3.2.5 (Mathematical conventions in the signal descriptions). In addition, the following notational conventions are used in Clause 26:

$[Q]_{m,n}$ indicates the element in row m and column n of matrix, where $1 \leq m \leq N_{row}$, $1 \leq n \leq N_{col}$

N_{row} and N_{col} are the number of rows and columns, respectively, of the matrix Q.

$[Q]_{m:n}$ indicates a matrix consisting of columns M to N of matrix Q.

For a description on subcarrier indices over which the signal is transmitted for non-HT, HT and VHT PPDUs, see 22.3.7 (Mathematical description of signals).

For a 20 MHz HE Non-OFDMA PPDU transmission, the 20 MHz is divided into 256 subcarriers. The signal is transmitted on subcarriers –122 to –2 and 2 to 122, with 0 being the center (DC) subcarrier.

For a 20 MHz HE OFDMA PPDU transmission, the 20 MHz is divided into 256 subcarriers. The signal is transmitted on subcarriers –122 to –4 and 4 to 122, with 0 being the center (DC) subcarrier.

For a 40 MHz HE Non-OFDMA or OFDMA PPDU transmission, the 40 MHz is divided into 512 subcarriers. The signal is transmitted on subcarriers –244 to –3 and 3 to 244.

For an 80 MHz HE Non-OFDMA PPDU transmission, the 80 MHz is divided into 1024 subcarriers. The signal is transmitted on subcarriers –500 to –3 and 3 to 500.

For an 80 MHz HE OFDMA PPDU transmission, the 80 MHz is divided into 1024 subcarriers. The signal is transmitted on subcarriers –500 to –4 and 4 to 500.

For a 160 MHz HE PPDU transmission or a noncontiguous 80+80 MHz transmission, and each half 80 MHz bandwidth is divided into 1024 subcarriers, and the subcarriers on which the signal is transmitted in each 80 MHz bandwidth is identical to a 80 MHz HE PPDU transmission, depending on Non-OFDMA or OFDMA transmission within the correspond 80 MHz.

The transmitted signal is described in complex baseband signal notation. The actual transmitted signal is related to the complex baseband signal by the relation shown in Equation 26-2.

$$r_{RF}^{(i_{Seg},i_{TX})}(t) = \mathrm{Re}\left\{ \frac{1}{\sqrt{N_{Seg}}} r_{PPDU}^{(i_{Seg},i_{TX})}(t) \exp\left(j2\pi f_c^{(i_{Seg})} t \right) \right\},$$
$$i_{Seg} = 0,\ldots,N_{Seg}-1;\ i_{TX} = 1,\ldots,N_{TX} \qquad (26\text{-}2)$$

where

N_{Seg} represents the number of frequency segments in the transmit signal, as defined in Table 26 3;

$r_{PPDU}^{(i_{Seg}, i_{TX})}$ represents the complex baseband signal of frequency segment i_{Seg} and transmit chain i_{TX};

$f_c^{(i_{Seg})}$ represents the center frequency of the portion of the PPDU transmitted in frequency segment i_{Seg}.

The transmitted RF signal is derived by up-converting the complex baseband signal, which consists of several fields. The timing boundaries for the various fields are shown in Figure 26-21 (Timing boundaries for HE PPDU fields), where $N_{HE\text{-}LTF}$ is the number of HE-LTF symbols and is defined in Table 26-6

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(Frequently used parameters), $N_{HE\text{-}SIG\text{-}B}$ is the number of symbols in the HE-SIG-B field, and N_{SYM} is the number of symbols in the Data field.

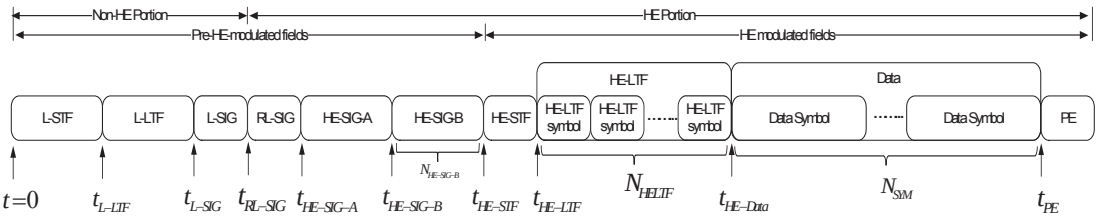

Figure 26-21—Timing boundaries for HE PPDU fields

The time offset, t_{Field}, determines the starting time of the corresponding field relative to the start of L-STF ($t = 0$).

The signal transmitted on frequency segment i_{Seg} of transmit chain i_{TX} shall be as shown in Equation (26 3).

$$\begin{aligned} r_{\text{PPDU}}^{(i_{Seg},i_{\text{TX}})}(t) = {} & r_{\text{L-STF}}^{(i_{Seg},i_{\text{TX}})}(t) + r_{\text{L-LTF}}^{(i_{Seg},i_{\text{TX}})}(t - t_{\text{L-LTF}}) \\ & + r_{\text{L-SIG}}^{(i_{Seg},i_{\text{TX}})}(t - t_{\text{L-SIG}}) + r_{\text{RL-SIG}}^{(i_{Seg},i_{\text{TX}})}(t - t_{\text{RL-SIG}}) \\ & + r_{\text{HE-SIG-A}}^{(i_{Seg},i_{\text{TX}})}(t - t_{\text{HE-SIG-A}}) + r_{\text{HE-SIG-B}}^{(i_{Seg},i_{\text{TX}})}(t - t_{\text{HE-SIG-B}}) \\ & + r_{\text{HE-STF}}^{(i_{Seg},i_{\text{TX}})}(t - t_{\text{HE-STF}}) + r_{\text{HE-LTF}}^{(i_{Seg},i_{\text{TX}})}(t - t_{\text{HE-LTF}}) \\ & + r_{\text{HE-Data}}^{(i_{Seg},i_{\text{TX}})}(t - t_{\text{HE-Data}}) + r_{\text{HE-PE}}^{(i_{Seg},i_{\text{TX}})}(t - t_{\text{HE-PE}}) \end{aligned} \quad (26\text{-}3)$$

where

$0 \le i_{Seg} \le N_{Seg} - 1$

$1 \le i_{TX} \le N_{TX}$

$t_{\text{L-LTF}} = T_{\text{L-STF}}$

$t_{\text{L-SIG}} = t_{\text{L-LTF}} + T_{\text{L-LTF}}$

$t_{\text{RL-SIG}} = t_{\text{L-SIG}} + T_{\text{L-SIG}}$

$t_{\text{HE-SIG-A}} = t_{\text{RL-SIG}} + T_{\text{RL-SIG}}$

$$t_{\text{HE-SIG-B}} = \begin{cases} t_{\text{HE-SIG-A}} + T_{\text{HE-SIG-A}}, & \text{for an HE MU PPDU} \\ undefined, & \text{otherwise} \end{cases}$$

$$t_{\text{HE-STF}} = \begin{cases} t_{\text{HE-SIG-A}} + T_{\text{HE-SIG-A}}, & \text{for an HE SU PPDU and HE trigger-based PPDU} \\ t_{\text{HE-SIG-A}} + T_{\text{HE-SIG-A-R}}, & \text{for an HE extended range SU PPDU} \\ t_{\text{HE-SIG-B}} + N_{\text{HE-SIG-B}} T_{\text{HE-SIG-B}}, & \text{for an HE MU PPDU} \end{cases}$$

where $N_{HE\text{-}SIG\text{-}B}$ is the number of OFDM symbols in the HE-SIG-B field

$$t_{\text{HE-LTF}} = \begin{cases} t_{\text{HE-STF}} + T_{\text{HE-STF-T}}, & \text{for an HE trigger-based PPDU} \\ t_{\text{HE-STF}} + T_{\text{HE-STF-NT}}, & \text{otherwise} \end{cases}$$

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$$t_{\text{HE-Data}} = \begin{cases} t_{\text{HE-LTF}} + N_{HELTF} \cdot (T_{\text{HE-LTF-1X}} + T_{\text{GI,HE-LTF}}), & \text{for 1x HE-LTF} \\ t_{\text{HE-LTF}} + N_{HELTF} \cdot (T_{\text{HE-LTF-2X}} + T_{\text{GI,HE-LTF}}), & \text{for 2x HE-LTF} \\ t_{\text{HE-LTF}} + N_{HELTF} \cdot (T_{\text{HE-LTF-4X}} + T_{\text{GI,HE-LTF}}), & \text{for 4x HE-LTF} \end{cases}$$

$$t_{PE} = t_{\text{HE-Data}} + N_{SYM} T_{SYM}$$

In an HE SU PPDU, HE MU PPDU and HE extended range SU PPDU, each field, $r_{Field}^{(i_{Seg}, i_{TX})}(t)$, is defined as the summation of one or more subfields, where each subfield is defined to be an inverse discrete Fourier transform as specified in EquationEquation 26-4.

$$r_{\text{Field}}^{(i_{Seg}, i_{\text{TX}})}(t) = \eta_{\text{Field}} w_{T_{\text{Field}}}(t) \sum_{r=0}^{N_{RU}-1} \frac{\alpha_r \beta_r}{\sqrt{N_{Norm,r}}} \sum_{k \in K_r} \sum_{u=0}^{N_{user,r}-1} \sum_{m=1}^{N_{STS,r,u}} \left[Q_k^{(i_{Seg})} \right]_{i_{TX},(M_{r,u}+m)} \Upsilon_{k,\text{BW}} X_{k,r,u}^{(i_{Seg},m)} \exp\left(j2\pi k \Delta_{F,\text{Field}} (t - T_{GI,Field} - T_{CS,HE}(M_{r,u}+m)) \right) \quad (26\text{-}4)$$

In an HE trigger-based PPDU, transmitted by user-*u* in the *r*-th RU, each field, $r_{Field}^{(i_{Seg}, i_{TX})}(t)$, is defined in Equation 26-5.

$$r_{\text{Field}}^{(i_{Seg}, i_{\text{TX}})}(t) = \frac{\eta_{\text{Field}} \alpha_r \beta_r}{\sqrt{N_{Norm,r}}} w_{T_{\text{Field}}}(t) \sum_{k \in K_r} \sum_{m=1}^{N_{STS,r,u}} \left[Q_k^{(i_{Seg})} \right]_{i_{TX},(M_{r,u}+m)} \Upsilon_{k,\text{BW}} X_{k,r,u}^{(i_{Seg},m)} \exp\left(j2\pi k \Delta_{F,\text{Field}} (t - T_{GI,Field} - T_{CS,HE}(M_{r,u}+m)) \right) \quad (26\text{-}5)$$

In the remainder of this subclause, pre-HE modulated fields refer to the L-STF, L-LTF, L-SIG, RL-SIG, HE-SIG-A, and HE-SIG-B fields, while HE modulated fields refer to the HE-STF, HE-LTF, Data, and PE fields, as shown in Figure 26-21 (Timing boundaries for HE PPDU fields). The total power of the time domain HE modulated field signals summed over all transmit chains should not exceed the total power of the time domain pre-HE modulated field signals summed over all transmit chains. For notational simplicity, the parameter BW is omitted from some bandwidth dependent terms.

In Equation 26-4 the following notions are used:

N_{Field}^{Tone} Table 26-13 (Tone scaling factor and guard interval duration values for HE PPDU fields) summarizes the various values of N_{Field}^{Tone} as a function of bandwidth per frequency segment. In the case of an HE OFDMA PPDU, the N_{Field}^{Tone} value of HE-STF, HE-LTF and HE-Data fields is variable, and is determined by which RUs of the current full bandwidth are transmitted in the PPDU.

Table 26-13—Tone scaling factor and guard interval duration values for HE PPDU fields

Field	N_{Field}^{Tone} as a function of bandwidth, and RU size per frequency segment				Guard interval duration
	20 MHz	40 MHz	80 MHz	160 MHz	
L-STF	12	24	48	96	-

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Table 26-13—Tone scaling factor and guard interval duration values for HE PPDU fields

L-LTF	52	104	208	416	$T_{GI2,Data}$
L-SIG	56	112	224	448	$T_{GI,LegacyPreamble}$
RL-SIG	56	112	224	448	$T_{GI,LegacyPreamble}$
HE-SIG-A	56	112	224	448	$T_{GI,LegacyPreamble}$
HE-SIG-B	56	112	224	448	$T_{GI,LegacyPreamble}$
HE-STF not in HE_TRIG	14	30	62	126	-
HE-STF in HE_TRIG	30	60	124	248	-
HE-LTF 1x Duration	60	122	250	500	$T_{GI,HE\text{-}LTF1}$
HE-LTF 2x Duration	122	242	498	996	$T_{GI,HE\text{-}LTF2}$
HE-LTF 4x Duration	242	484	996	1992	$T_{GI,HE\text{-}LTF4}$
HE-Data	242	484	996	1992	$T_{GI,Data}$, $T_{GI2,Data}$ or $T_{GI4,Data}$
NON_HT_DUP_OFDM-Data	56	112	224	448	$T_{GI,LegacyPreamble}$

NOTE—in the case of an HE OFDMA PPDU, the N_{Field}^{Tone} value of HE-STF, HE-LTF and HE-Data fields is variable, and is determined by which RUs of the current full bandwidth are transmitted in the PPDU.

$N_{Norm,r}$ If the TXVECTOR parameter BEAM_CHANGE is 1, then for pre-HE modulated fields, $N_{Norm,r} = N_{TX}$. If the TXVECTOR parameter BEAM_CHANGE is 0, then for pre-HE modulated fields $N_{Norm,r} = N_{STS,r,total}$, where $N_{STS,r,total}$ is given in Table 26-6 (Frequently used parameters). For HE modulated fields $N_{Norm,r} = N_{STS,r,total}$.

$w_{T_{Field}}(t)$ is a windowing function. An example function, $w_{T_{Field}}(t)$, is given in 18.3.2.5 (Mathematical conventions in the signal descriptions).

K_r For pre-HE modulated fields, Kr is the set of subcarriers indices from $-N_{SR}$ to N_{SR}. For HE modulated fields in a non-OFDMA HE PPDU, Kr is the set of subcarriers indices from $-N_{SR}$ to N_{SR}. For HE modulated fields in an OFDMA HE PPDU, K_r is the set of subcarrier indices for the tones in the *r*-th RU.

η_{Field} is the power boost factor per OFDM symbol, which is $\sqrt{2}$ for the L-STF and L-LTF fields in the HE extended range SU PPDU, and 1 otherwise.

α_r is the power boost factor for the *r*-th RU, where $\alpha_r \in [TBD_1, TBD_2]$

β_r is the per-RU power normalization factor and is defined in Equation 26-6

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$$\beta_r = \begin{cases} \dfrac{1}{\sqrt{N_{Field}^{Tone}}}, & \text{Pre-HE modulated fields when BEAM_CHANGE = 1} \\ \left(\sqrt{\dfrac{|K_r|}{|K_r^{Field}|}}\right) \Big/ \left(\sqrt{\sum_{r=1}^{N_{RU}} \alpha_r^2 |K_r|}\right), & \text{otherwise} \end{cases} \quad (26\text{-}6)$$

$|K_r|$ is the cardinality of the set of subcarriers K_r

K_r^{Field} is the set of subcarriers that have non-zero values within K_r in the HE-STF and Data fields, and defined in Equation 26-7 for the HE-LTF field.

$$K_r^{HELTF} = \begin{cases} |K_r|/4, & \text{for 1x HE-LTF} \\ |K_r|/2, & \text{for 2x HE-LTF} \\ |K_r|, & \text{for 4x HE-LTF} \end{cases} \quad (26\text{-}7)$$

$Q_k^{(i_{Seg})}$ is the spatial mapping matrix for the subcarrier k in frequency segment i_{Seg}. For HE modulated fields, $Q_k^{(i_{Seg})}$ is a matrix with N_{TX} rows and $N_{STS,total}$ columns. If the TXVECTOR parameter BEAM_CHANGE is 1, then for pre-HE modulated fields $Q_k^{(i_{Seg})}$ is a column vector with N_{TX} elements with element i_{TX} being $\exp(-j2\pi k\Delta_{F,Pre-HE}T_{CS}^{i_{TX}})$, where $T_{CS}^{i_{TX}}$ represents the cyclic shift for the transmitter chain whose values are TBD; otherwise it is identical to the spatial mapping $Q_k^{(i_{Seg})}$ for HE modulation fields.

$\Delta_{F,Field}$ is the subcarrier frequency spacing. For pre-HE modulated fields, $\Delta_{F,Field} = \Delta_{F,Pre-HE}$ given in Table 26 3. For HE modulated fields, $\Delta_{F,Field} = \Delta_{F,HE}$ given in Table 26-3 (Timing-related constants).

$X_{k,r,u}^{(i_{Seg},m)}$ is the frequency-domain symbol in subcarrier k of user u in the r-th RU for frequency segment i_{Seg} of space-time stream m. Some of the $X_{k,r,u}^{(i_{Seg},m)}$ within $-N_{SR} \le k \le N_{SR}$ have a value of zero. Examples of such cases include the DC tones, guard tones on each side of the transmit spectrum, the leftover tones in an HE OFDMA PPDU, as well as the unmodulated tones of L-STF, HE-STF, and HE-LTF fields. Note that the multiplication matrices A_{HE-LTF}^k are included in the calculation of $X_{k,r,u}^{(i_{Seg},m)}$ for the HE-STF and HE-LTF fields. When the TXVECTOR parameter BEAM_CHANGE is 0, the first column of the multiplication matrices A_{HE-LTF}^k are included in the calculation of $X_{k,r,u}^{(i_{Seg},m)}$ for the pre-HE modulated fields.

$T_{GI,Field}$ is the guard interval duration used for each OFDM symbol in the field. The value for each field is as defined in Table 25-2 (Tone scaling factor and guard interval duration values for PHY fields).

$T_{CS,HE}(l)$ For pre-HE modulated fields, $T_{CS,HE}(l) = 0$. For HE modulated fields, $T_{CS,HE}(l)$ represents the cyclic shift per space-time stream, whose value is defined in Table 25-xx (Cyclic shift values for the HE modulated fields of a PPDU).

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$\Upsilon_{k,BW}$ is used to represent a rotation of the tones. In HE modulated fields, in all the subcarriers. In pre-HE modulated fields, BW in $\Upsilon_{k,BW}$ is determined by the TXVECTOR parameter CH_BANDWIDTH as defined in Table 26 14.

Table 26-14—CH_BANDWIDTH and $\Upsilon_{k,BW}$ for pre-HE modulated fields

CH_BANDWIDTH	$\Upsilon_{k,\mathrm{BW}}$
CBW20	$\Upsilon_{k,20}$
CBW40	$\Upsilon_{k,40}$
CBW80	$\Upsilon_{k,80}$
CBW160	$\Upsilon_{k,160}$
CBW80+80	$\Upsilon_{k,80}$ per frequency segment

For a 20 MHz PPDU transmission,

$$\Upsilon_{k,20} = 1 \quad (26\text{-}8)$$

For a 40 MHz PPDU transmission,

$$\Upsilon_{k,40} = TBD \quad (26\text{-}9)$$

For an 80 MHz PPDU transmission,

$$\Upsilon_{k,80} = TBD \quad (26\text{-}10)$$

For a noncontiguous 80+80 MHz PPDU transmission, each 80 MHz frequency segment shall use the phase rotation for 80 MHz PPDU transmissions as defined in Equation 26-10.

For a contiguous 160 MHz PPDU transmission,

$$\Upsilon_{k,160} = TBD \quad (26\text{-}11)$$

26.3.9 HE preamble

26.3.9.1 Introduction

The HE portion of HE format preamble consists of pre-HE modulated fields and HE modulated fields. The HE modulated fields consist of HE-STF and HE-LTF fields. The pre-HE modulated fields depend on the structure of the PPDU and consist of the following:

— RL-SIG and HE-SIG-A fields of an HE SU PPDU
— RL-SIG, HE-SIG-A and HE-SIG-B fields of an HE MU PPDU
— RL-SIG, HE-SIG-A and repeated HE-SIG-A fields of an HE extended range SU PPDU

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— RL-SIG and HE-SIG-A fields of an HE trigger-based PPDU

26.3.9.2 Cyclic shift for pre-HE modulated fields

26.3.9.3 L-STF

If the TXVECTOR parameter BEAM_CHANGE is 1, the time domain representation of the L-STF field shall be as specified in Equation 26-12. The equation applies to all contiguous signals up to 160 MHz and non contiguous 80+80 MHz.

$$r_{\text{L-STF}}^{(i_{seg},i_{TX})}(t) = \frac{\eta}{\sqrt{N_{\text{TX}} \cdot N_{\text{L-STF}}^{\text{Tone}}}} w_{\text{T}_{\text{L-STF}}}(t) \sum_{i_{BW}=0}^{N_{20MHz}-1} \sum_{k=-26}^{26} \left(\begin{array}{l} \Upsilon_{(k-K_{\text{Shift}}(i_{BW})),\text{BW}} S_{k,20} \\ \cdot \exp\left(j2\pi \left(k - K_{\text{Shift}}\left(i_{\text{BW}}\right)\right) \Delta_{F,\text{Pre-HE}} \left(t - T_{GI,\text{LegacyPreamble}} - T_{CS}^{i_{TX}} \right) \right) \end{array} \right) \quad (26\text{-}12)$$

where

η is an PPDU format dependent scaling factor, with the following value

$$\eta = \begin{cases} \sqrt{2}, & \text{HEextended range SU PPDU} \\ 1, & \text{otherwise} \end{cases} \quad (26\text{-}13)$$

N_{20MHz} is defined in 22.3.8.3.4 (L-SIG definition)

$K_{Shift}(i) = (N_{20MHz} - 1 - 2i) \cdot 32$

$T_{CS}^{i_{TX}}$ represents the cyclic shift for transmitter chain i_{TX} with a value given in 26.3.9.2 (Cyclic shift for Pre-HE modulated fields).

$\Upsilon_{k,\,BW}$ is defined by Equation (22-14), Equation (22-15), Equation (22-16) and Equation (22-17).

$N_{\text{L-STF}}^{\text{Tone}}$ has the value given in Table 22-8 (Tone scaling factor and guard interval duration values for PHY fields(11ac)).

If the TXVECTOR parameter BEAM_CHANGE is 0, the time domain representation of the L-STF field of contiguous 20 MHz, 40 MHz, 80 MHz and 160 MHz transmission shall be as specified in Equation 26-14. The equation applies to all contiguous signals up to 160 MHz and non contiguous 80+80 MHz.

$$r_{\text{L-STF}}^{(i_{seg},i_{TX})}(t) = \frac{\eta}{\sqrt{N_{\text{TX}} \cdot N_{\text{L-STF}}^{\text{Tone}}}} w_{\text{T}_{\text{L-STF}}}(t) \sum_{i_{BW}=0}^{N_{20MHz}-1} \sum_{k=-26}^{26} \sum_{m=0}^{N_{STS,total}-1} \left(\begin{array}{l} \Upsilon_{(k-K_{\text{Shift}}(i_{BW})),\text{BW}} \left[Q_{4(k-K_{\text{Shift}}(i_{BW}))}^{(i_{seg})} \right]_{i_{TX},m} \left[A_{HELTF}^{4(k-K_{\text{Shift}}(i_{BW}))} \right]_{m,1} S_{k,20} \\ \cdot \exp\left(j2\pi \left(k - K_{\text{Shift}}\left(i_{\text{BW}}\right)\right) \Delta_{F,\text{Pre-HE}} \left(t - T_{GI,\text{LegacyPreamble}} - T_{CS}^{i_{TX}} \right) \right) \end{array} \right) \quad (26\text{-}14)$$

where

$T_{CS,\,HE}(n)$ is given in 26.3.9.2 (Cyclic shift for Pre-HE modulated fields)

$Q_k^{(i_{Seg})}$ is defined in <reference>

A_{HELTF}^{k} is defined in Equation (26-57)

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26.3.9.4 L-LTF

If the TXVECTOR parameter BEAM_CHANGE is 1, the time domain representation of the L-LTF field shall be as specified in Equation 26-15. The equation applies to all contiguous signals up to 160 MHz and non contiguous 80+80 MHz.

$$r_{\text{L-LTF}}^{(i_{seg},i_{TX})}(t)=\frac{\eta}{\sqrt{N_{\text{TX}}\cdot N_{\text{L-LTF}}^{\text{Tone}}}}w_{T_{\text{L-LTF}}}(t)\sum_{i_{BW}=0}^{N_{20MHz}-1}\sum_{k=-26}^{26}\left(\begin{array}{l}\Upsilon_{(k-K_{\text{Shift}}(i_{BW})),\text{BW}}L_{k,20}\\ \cdot\exp\left(j2\pi\left(k-K_{\text{Shift}}\left(i_{\text{BW}}\right)\right)\Delta_{F,\text{Pre-HE}}\left(t-T_{GI,\text{LegacyPreamble}}-T_{CS}^{i_{TX}}\right)\right)\end{array}\right) \quad (26\text{-}15)$$

η is an PPDU format dependent scaling factor, as defined in Equation (26 13).

N_{20MHz} is defined in 21.3.7.3 (Channel frequencies)

$K_{Shift}(i) = (N_{20MHz} - 1 - 2i) \cdot 32$

$T_{CS}^{i_{TX}}$ represents the cyclic shift for transmitter chain i_{TX} with a value given in 26.3.9.2 (Cyclic shift for Pre-HE modulated fields).

$\Upsilon_{k,\,BW}$ is defined by Equation (22-14), Equation (22-15), Equation (22-16) and Equation (22-17).

$N_{\text{L-LTF}}^{\text{Tone}}$ has the value given in Table 22-8 (Tone scaling factor and guard interval duration values for PHY ields(11ac)).

If the TXVECTOR parameter BEAM_CHANGE is 0, the time domain representation of the L-LTF field of contiguous 20 MHz, 40 MHz, 80 MHz and 160 MHz transmission shall be as specified in Equation (26 16). The equation applies to all contiguous signals up to 160 MHz and non contiguous 80+80 MHz.

$$r_{\text{L-LTF}}^{(i_{seg},i_{TX})}(t)=\frac{\eta}{\sqrt{N_{\text{TX}}\cdot N_{\text{L-LTF}}^{\text{Tone}}}}w_{T_{\text{L-LTF}}}(t)$$
$$\sum_{i_{BW}=0}^{N_{20MHz}-1}\sum_{k=-26}^{26}\sum_{m=0}^{N_{STS,total}-1}\left(\begin{array}{l}\Upsilon_{(k-K_{\text{Shift}}(i_{BW})),\text{BW}}\left[Q_{4(k-K_{\text{Shift}}(i_{BW}))}^{(i_{seg})}\right]_{i_{TX},m}\left[A_{HELTF}^{4(k-K_{\text{Shift}}(i_{BW}))}\right]_{m,1}L_{k,20}\\ \cdot\exp\left(j2\pi\left(k-K_{\text{Shift}}\left(i_{\text{BW}}\right)\right)\Delta_{F,\text{Pre-HE}}\left(t-T_{GI,\text{LegacyPreamble}}-T_{CS}^{i_{TX}}\right)\right)\end{array}\right) \quad (26\text{-}16)$$

where

$T_{CS,\,HE}(n)$ is given in 26.3.9.2 (Cyclic shift for Pre-HE modulated fields)

$Q_k^{(i_{Seg})}$ is defined in <reference>

A_{HELTF}^{k} is defined in Equation (26-57)

26.3.9.5 L-SIG

The L-SIG field is used to communicate rate and length information. The structure of the L-SIG field is defined in Figure 18-5 (SIGNAL field bit assignment).

In a HE PPDU, the RATE field shall be set to the value representing 6 Mb/s in the 20 MHz channel spacing column of Table 18-6 (Contents of the SIGNAL field). In a non-HT duplicate PPDU, the RATE field is defined in 18.3.4.2 (RATE field) using the L_DATARATE parameter in the TXVECTOR.

The LENGTH field shall be set to the value given by Equation 26-17.

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$$\text{Length} = \frac{\text{TXTIME} - 20}{4} \times 3 - 3 - m \tag{26-17}$$

where

TXTIME (in μs) is defined in 26.4.3 (TXTIME and PSDU_LENGTH calculation).

m is 1 for an HE MU PPDU and HE extended range SU PPDU, and 2 otherwise.

The LSB of the binary expression of the Length value shall be mapped to B5. In a non-HT duplicate PPDU, the LENGTH field is defined in 18.3.4.3 (LENGTH field) using the L_LENGTH parameter in the TXVECTOR.

The Reserved (R) field shall be set to 0.

The Parity (P) field has the even parity of bits 0-16.

The SIGNAL TAIL field shall be set to 0.

The L-SIG field shall be encoded, interleaved, and mapped following the steps described in 18.3.5.6 (Convolutional encoder), 18.3.5.7 (Data interleaving), and 18.3.5.8 (Subcarrier modulation mapping). The stream of 48 complex numbers generated by these steps is denoted by $d_k, k = 0, \ldots, 47$. Pilots shall be inserted as described in 18.3.5.9 (Pilot subcarriers). Extra 4 BPSK modulated tones are added, two at each edge of the subcarriers used by data and pilot tones. The 4 extra tones [-28, -27, 27, 28] of L-SIG in 20 MHz HE PPDU is [-1, -1, -1, 1].

If the TXVECTOR parameter BEAM_CHANGE is 1, the time domain waveform of the L-SIG field shall be as given by Equation 26-18.

$$r_{\text{L-SIG}}^{(i_{Seg}, i_{TX})}(t) = \frac{1}{\sqrt{N_{L-SIG}^{\text{Tone}} N_{TX}}} w_{T_{L-SIG}}(t) \cdot \sum_{i_{BW}=0}^{N_{20MHz}-1} \sum_{k=-28}^{28} \left(\begin{array}{l} \Upsilon_{(k-K_{\text{Shift}}(i_{BW})),\text{BW}} \left(D_{k,20} + p_0 P_k \right) \\ \cdot \exp\left(j2\pi \left(k - K_{\text{Shift}}\left(i_{\text{BW}} \right) \right) \Delta_{F,\text{Pre-HE}} \left(t - T_{GI,\text{LegacyPreamble}} - T_{CS}^{i_{TX}} \right) \right) \end{array} \right) \tag{26-18}$$

where

N_{20MHz} is defined in 21.3.7.3 (Channel frequencies)

$K_{Shift}(i) = (N_{20MHz} - 1 - 2i) \cdot 32$

$$D_{k,20} = \begin{cases} 0, k = 0, \pm 7, \pm 21 \\ \pm 1(\text{TBD}), k = \pm 27, \pm 28 \\ d_{M_{20}^r(k)}, \text{otherwise} \end{cases}$$

$$M_{20}^r(k) = \begin{cases} k + 26, -26 \le k \le -22 \\ k + 25, -20 \le k \le -8 \\ k + 24, -6 \le k \le -1 \\ k + 23, 1 \le k \le 6 \\ k + 22, 8 \le k \le 20 \\ k + 21, 22 \le k \le 26 \end{cases}$$

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P_k is defined in 18.3.5.10 (OFDM modulation)

P_0 is the first pilot value in the sequence defined in 18.3.5.10 (OFDM modulation)

$N_{\text{L-SIG}}^{\text{Tone}}$ has the value given in <reference>

$\Upsilon_{k,\,BW}$ is defined by Equation 26-8, Equation 26-9, Equation 26-10 and Equation 26-11.

$T_{CS}^{i_{TX}}$ represents the cyclic shift for transmitter chain i_{TX} with a value given in 26.3.9.2 (Cyclic shift for pre-HE modulated fields).

NOTE—$M_{20}^{r}(k)$ is a "reverse" function of the function $M(k)$ defined in 18.3.5.10 (OFDM modulation).

If the TXVECTOR parameter BEAM_CHANGE is 0, the time domain waveform of the L-SIG field shall be as given by Equation 26-19.

$$r_{L-SIG}^{(i_{seg},i_{TX})}(t)=\frac{1}{\sqrt{N_{\text{L-SIG}}^{\text{Tone}}N_{STS,total}}}w_{T_{L-SIG}}(t)\cdot\sum_{i_{BW}=0}^{N_{20MHz}-1}\sum_{k=-28}^{28}\sum_{m=0}^{N_{STS,total}-1}\left(\begin{array}{l}\left[Q_{4(k-K_{\text{Shift}}(i_{BW}))}^{(i_{seg})}\right]_{i_{TX},m}\left[A_{HELTF}^{4(k-K_{\text{Shift}}(i_{BW}))}\right]_{m,1}\left(D_{k,20}+p_0P_k\right)\\ \cdot\exp\left(j2\pi\left(k-K_{\text{Shift}}\left(i_{BW}\right)\right)\Delta_{F,\text{Pre-HE}}\left(t-T_{GI,\text{LegacyPreamble}}-T_{CS,HE}(m)\right)\right)\end{array}\right) \quad (26\text{-}19)$$

where

$T_{CS,\,HE}(n)$ is given in 26.3.9.2 (Cyclic shift for pre-HE modulated fields)

$Q_k^{(i_{Seg})}$ is defined in <reference>

A_{HELTF}^{k} is defined in Equation 26-57

26.3.9.6 RL-SIG

The RL-SIG field is used to identify a HE PPDU.

The time domain waveform of the RL-SIG field is generated by repeating the time domain waveform of the L-SIG field, as defined in Equation 26-20.

$$r_{RL-SIG}^{(i_{Seg},i_{TX})}(t)=r_{L-SIG}^{(i_{Seg},i_{TX})}(t) \quad (26\text{-}20)$$

26.3.9.7 HE-SIG-A

26.3.9.7.1 General

The HE-SIG-A field carries information required to interpret HE PPDUs. The structure of the HE-SIG-A field for the first part (HE-SIG-A1) and for the second part (HE-SIG-A2) is TBD.

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26.3.9.7.2 Content

The HE-SIG-A field for an HE SU PPDU or an HE extended range SU PPDU contains the fields listed in Table 26-15 (Fields in the HE-SIG-A for an HE SU PPDU and HE extended range SU PPDU).

Table 26-15—Fields in the HE-SIG-A for an HE SU PPDU and HE extended range SU PPDU

Two Parts of HE-SIG-A	Bit	Field	Number of bits	Description
	TBD	UL/DL	1	Indicates whether the PPDU is sent UL or DL. This field indicates DL for TDLS. NOTE—The TDLS peer can identify the TDLS frame by To DS and From DS fields in the MAC header of the MPDU.
	TBD	Format	1	Differentiate between an HE SU PPDU and an HE trigger-based PPDU or between an HE extended range SU PPDU and an HE trigger-based PPDU
	TBD	BSS Color	6	The BSS Color field is an identifier of the BSS
	TBD	Spatial Reuse	TBD	TBD
	TBD	TXOP Duration	TBD	Indicates the remaining time in the current TXOP. Details TBD
	TBD	Bandwidth	2	Set to 0 for 20 MHz, 1 for 40 MHz, 2 for 80 MHz, 3 for 160 MHz and 80+80 MHz
	TBD	MCS	4	HE-MCS index
	TBD	CP+LTF Size	3	To indicate the CP length and HE-LTF size, the current combinations are 1x HE-LTF + 0.8 μs, 2x HE-LTF + 0.8 μs, 2x HE-LTF + 1.6 μs and 4x HE-LTF + 3.2 μs. Other combinations are TBD.
	TBD	Coding	2	Indication of BCC/LDPC and presence of the extra OFDM symbol for LDPC. Detailed indication is TBD.
	TBD	Nsts	3	Indicates the number of spatial streams: Set to 0 for 1 space time stream Set to 1 for 2 space time streams Set to 2 for 3 space time streams Set to 3 for 4 space time streams Set to 4 for 5 space time streams Set to 5 for 6 space time streams Set to 6 for 7 space time streams Set to 7 for 8 space time streams
	TBD	STBC	1	Set to 1 if space time block coding is used and set to 0 otherwise.
	TBD	TxBF	1	Set to 1 if a Beamforming steering matrix is applied to the waveform in an SU transmission, set to 0 otherwise

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Table 26-15—Fields in the HE-SIG-A for an HE SU PPDU and HE extended range SU PPDU

	TBD	DCM	1	Set to 1 indicates that the payload of the SU PPDU is modulated with dual sub-carrier modulation for the MCS. Set to 0 indicates that the payload of the PPDU is not modulated with dual sub-carrier modulation for the MCS.
	TBD	Packet Extension	3	The first two bits indicate the "a-factor" and the third bit indicates the PE-Disambiguity.
	TBD	Beam Change	1	Set to 1 indicates that the pre-HE-STF portion of the SU PPDU is spatially mapped differently from HE-LTF1. Set to 0 indicates that the pre-HE-STF portion of the SU PPDU is spatially mapped the same way as HE-LTF1 on each tone.
	TBD	CRC	4	CRC of bits 0-41 in HT-SIG-A. See 22.3.9.7.1 (CRC calculation for HE-SIG-A). The first bit to be transmitted is bit C3 as explained in 20.3.9.7.1 (CRC calculation for HE-SIG).
	TBD	Tail	6	Used to terminate the trellis of the convolutional decoder. Set to 0.

NOTE—The HE-SIG-A field contents for the HE extended range SU PPDU may be subject to change.

The HE-SIG-A field of an HE MU PPDU contains the fields listed in Table 26-16 (Fields in the HE-SIG-A for an HE MU PPDU).

Table 26-16—Fields in the HE-SIG-A for an HE MU PPDU

Two Parts of HE-SIG-A	Bit	Field	Number of bits	Description
	TBD	UL/DL	1	Indicates whether the PPDU is sent UL or DL. This field indicates DL for TDLS. NOTE—The TDLS peer can identify the TDLS frame by To DS and From DS fields in the MAC header of the MPDU.
	TBD	BSS Color	6	The BSS Color field is an identifier of the BSS
	TBD	Spatial Reuse	TBD	TBD
	TBD	TXOP Duration	TBD	Indicates the remaining time in the current TXOP. Details TBD
	TBD	Bandwidth	>= 2	Set to 0 for 20 MHz, 1 for 40 MHz, 2 for 80 MHz, 3 for 160 MHz and 80+80 MHz

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Table 26-16—Fields in the HE-SIG-A for an HE MU PPDU *(continued)*

	TBD	SIGB MCS	3	Indication the MCS of HE-SIG-B. Set to 0 for MCS0 Set to 1 for MCS1 Set to 2 for MCS2 Set to 3 for MCS3 Set to 4 for MCS4 Set to 5 for MCS5
	TBD	SIGB DCM	1	Set to 1 indicates that the HE-SIG-B is modulated with dual sub-carrier modulation for the MCS. Set to 0 indicates that the HE-SIB-B is not modulated with dual sub-carrier modulation for the MCS.
	TBD	SIGB Number Of Symbols	4	Indciates the number of HE-SIG-B symbols.
	TBD	SIGB Compression	1	Set to 1 for full BW MU-MIMO. Set to 0 otherwise.
	TBD	Number of HE-LTF Symbols	3	Indicates the number of HE-LTF symbols.
	TBD	CP+LTF Size	3	To indicate the CP length and HE-LTF size, the current combinations are 1x HE-LTF + 0.8 μs, 2x HE-LTF + 0.8 μs, 2x HE-LTF + 1.6 μs and 4x HE-LTF + 3.2 μS. Other combinations are TBD.
	TBD	LPDC Extra Symbol	1	Indication of the presence of the extra OFDM symbol for LDPC.
	TBD	Packet Extension	3	The first two bits indicate the "a-factor" and the third bit indicates the PE-Disambiguity.
	TBD	CRC	4	CRC of bits 0-41 in HT-SIG-A. See 22.3.9.7.1 (CRC calculation for HE-SIG-A). The first bit to be transmitted is bit C3 as explained in 20.3.9.7.1 (CRC calculation for HE-SIG).
	TBD	Tail	6	Used to terminate the trellis of the convolutional decoder. Set to 0.

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The HE-SIG-A field for an HE trigger-based PPDU contains the fields listed in Table 26-17 (Fields in the HE-SIG-A for an HE trigger-based PPDU).

Table 26-17—Fields in the HE-SIG-A for an HE trigger-based PPDU

Two Parts of HE-SIG-A	Bit	Field	Number of bits	Description
	TBD	Format	1	Set to 0 for an HE SU PPDU Set to 1 for an HE trigger-based PPDU
	TBD	BSS Color	6	The BSS Color field is an identifier of the BSS
	TBD	Spatial Reuse	TBD	TBD
	TBD	TXOP Duration	TBD	Indicates the remaining time in the current TXOP. Details TBD
	TBD	Bandwidth	TBD	TBD
	TBD	Reserved	TBD	TBD
	TBD	CRC	4	CRC of bits 0-41 in HT-SIG-A. See 22.3.9.7.1 (CRC calculation for HE-SIG-A). The first bit to be transmitted is bit C3 as explained in 20.3.9.7.1 (CRC calculation for HE-SIG).
	TBD	Tail	6	Used to terminate the trellis of the convolutional decoder. Set to 0.

26.3.9.7.3 CRC computation

The CRC computation defined in this subclause applies to HE-SIG-A, the Common field of HE-SIG-B and the User Specific field of HE-SIG-B.

The CRC protects bits 0 to L of the HE-SIG ($L = 41$ for HE-SIG-A, or $L = x$ for each HE-SIG-B common block fields, or $L = x$ for HE-SIG-B user specific fields). The value of the CRC field shall be the 1s complement of

$$crc(D) = (M(D) + I(D))D^8 mod\ G(D)$$

where

$$M(D) = \sum_{i=0}^{L} m_{L-i} D^i$$

where

$$I(D) = \sum_{i=L-7}^{L} D^i$$

$G(D)$ and $crc(D)$ are defined in Equation (20-18)

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The CRC field is transmitted from *c5* to *c7* with *c7* first.

Figure 20-8 (HT-SIG CRC calculation) shows the operation of the CRC, where the serial input are from m_L to m_0, and the output is stopped at *c4*.

26.3.9.7.4 Encoding and modulation

For an HE SU PPDU, HE MU PPDU and HE trigger-based PPDU, the HE-SIG-A field is composed of two parts, HE-SIG-A1 and HE-SIG-A2, each containing 26 data bits. HE-SIG-A1 is transmitted before HE-SIG-A2. The HE-SIG-A symbols shall be BCC encoded at rate, R = 1/2, interleaved, mapped to a BPSK constellation, and have pilots inserted following the steps described in 18.3.5.6 (Convolutional encoder), 18.3.5.7 (Data interleaving), 18.3.5.8 (Subcarrier modulation mapping), and 18.3.5.9 (Pilot subcarriers), respectively. The constellation mappings of HE-SIG-A in HE SU PPDU, HE MU PPDU and HE trigger-based PPDU are shown in Figure 26 22. The first and second half of the stream of 104 complex numbers generated by these steps (before pilot insertion) is divided into two groups of 52 complex numbers, where respectively, the first 52 complex numbers form the first symbol of HE-SIG-A and the second 52 complex numbers form the second symbol of HE-SIG-A. If the TXVECTOR parameter BEAM_CHANGE is 1, the time domain waveform for the HE-SIG-A field of an HE SU PPDU, HE MU PPDU and HE trigger-based PPDU shall be as specified in Equation 26-21.

$$r_{\text{HE-SIG-A}}^{(i_{Seg},i_{TX})}(t)=\frac{1}{\sqrt{N_{HE-SIG-A}^{\text{Tone}}N_{TX}}}\sum_{n=0}^{1}w_{T_{SYML}}\left(t-nT_{SYML}\right)\cdot\sum_{i_{BW}=0}^{N_{20MHz}-1}\sum_{k=-28}^{28}\left(\begin{array}{l}\Upsilon_{\left(k-K_{\text{Shift}}\left(i_{BW}\right)\right),\text{BW}}\left(D_{k,n,BW}+p_{n+2}P_k\right)\\ \cdot\exp\left(j2\pi\left(k-K_{\text{Shift}}\left(i_{\text{BW}}\right)\right)\Delta_{F,\text{Pre-HE}}\left(t-nT_{SYML}-T_{GI,LEgacy\,\text{Preamble}}-T_{CS}^{i_{TX}}\right)\right)\end{array}\right) \quad (26\text{-}21)$$

N_{20MHz} is defined in 21.3.7.3 (Channel frequencies)

$K_{Shift}(i) = (N_{20MHz} - 1 - 2i) \cdot 32$

$$D_{k,\,n,\,20} = \begin{cases} 0,\ k = 0, \pm 7, \pm 21 \\ d_{M_{20}^{r}(k),\,n},\ \text{otherwise} \end{cases}$$

$$M_{20}^{r}(k) = \begin{cases} k + 28,\ -28 \le k \le -22 \\ k + 25,\ -20 \le k \le -8 \\ k + 24,\ -6 \le k \le -1 \\ k + 23,\ 1 \le k \le 6 \\ k + 22,\ 8 \le k \le 20 \\ k + 21,\ 22 \le k \le 28 \end{cases}$$

P_k and p_n are defined in 18.3.5.10 (OFDM modulation).

$N_{HE-SIG-A}^{Tone}$ has the value given in Error! Reference source not found.

$\Upsilon_{k,\,BW}$ is defined by Equation 26-8, Equation 26-9, Equation 26-10 and Equation 26-11.

$T_{CS}^{i_{TX}}$ represents the cyclic shift for transmitter chain i_{TX} with a value given in 26.3.9.2 (Cyclic shift for Pre-HE modulated fields).

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If the TXVECTOR parameter BEAM_CHANGE is 0, the time domain waveform of the HE-SIG-A field shall be as given by Equation 26-22.

$$r_{HE-SIG-A}^{(i_{seg},i_{TX})}(t)=\frac{1}{\sqrt{N_{\text{HE-SIG-A}}^{\text{Tone}}N_{STS,total}}}\sum_{n=0}^{1}w_{T_{SYML}}(t-nT_{SYML})$$
$$\cdot\sum_{i_{BW}=0}^{N_{20MHz}-1}\sum_{k=-28}^{28}\sum_{m=0}^{N_{STS,total}-1}\left(\begin{array}{l}\left[Q_{4(k-K_{\text{Shift}}(i_{BW}))}^{(i_{seg})}\right]_{i_{TX},m}\left[A_{HELTF}^{4(k-K_{\text{Shift}}(i_{BW}))}\right]_{m,1}\left(D_{k,20}+p_{n+2}P_k\right)\\ \cdot\exp\left(j2\pi\left(k-K_{\text{Shift}}(i_{BW})\right)\Delta_{F,\text{Pre-HE}}\left(t-nT_{SYML}-T_{GI,\text{LegacyPreamble}}-T_{CS,HE}(m)\right)\right)\end{array}\right) \quad (26\text{-}22)$$

where

$T_{CS,HE}(n)$ is given in 26.3.9.2 (Cyclic shift for pre-HE modulated fields)

$Q_k^{(i_{Seg})}$ is defined in <reference>

A_{HELTF}^{k} is defined in Equation 26-57

For an HE extended range SU PPDU, the HE-SIG-A field is composed of four parts, i.e. HE-SIG-A1, HE-SIG-A2, HE-SIG-A3 and HE-SIG-A4, each part containing 26 data bits. These four parts are transmitted sequentially from HE-SIG-A1 to HE-SIG-A4. HE-SIG-A1 and HE-SIG-A2 have the same data bits. HE-SIG-A3 and HE-SIG-A4 have same data bits. The data bits of HE-SIG-A1 and HE-SIG-A3 shall be BCC encoded at rate, R = 1/2, interleaved, mapped to a BPSK constellation, and have pilots inserted. HE-SIG-A2 shall be BCC encoded at rate, R=1/2, mapped to a QBPSK constellation and have pilots inserted. The constellation mappings of the HE-SIG-A field in an HE extended range SU PPDU is shown in Figure 26-22 (Data tone constellation of HE-SIG-A symbols). QBPSK constellation on HE-SIG-A2 is used to differentiate between an HE extended range SU PPDU and an HE MU PPDU. HE-SIG-A4 shall be BCC encoded at rate, R=1/2, mapped to a BPSK constellation and have pilots inserted. BCC encoding, Data interleaving, constellation mapping and pilot insertion follow the steps described in 18.3.5.6 (Convolutional encoder), 18.3.5.7 (Data interleaving), 18.3.5.8 (Subcarrier modulation mapping), and 18.3.5.9 (Pilot subcarriers), respectively.

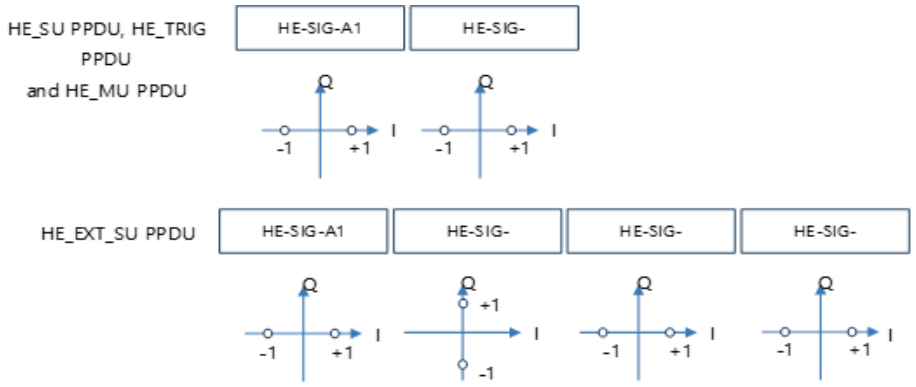

Figure 26-22—Data tone constellation of HE-SIG-A symbols

If the TXVECTOR parameter BEAM_CHANGE is 1, the time domain waveform for the HE-SIG-A field in an HE extended range SU PPDU, shall be as specified in Equation 26-23.

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$$r_{\text{HE-SIG-A}}^{(i_{Seg},i_{TX})}(t)=\frac{1}{\sqrt{N_{HE-SIG-A}^{\text{Tone}}N_{TX}}}\sum_{n=0}^{3}w_{T_{SYML}}(t-nT_{SYML})$$
$$\cdot\sum_{i_{BW}=0}^{N_{20MHz}-1}\sum_{k=-28}^{28}\left(\begin{array}{l}\Upsilon_{(k-K_{\text{Shift}}(i_{BW})),\text{BW}}\left(R_nD_{k,n,BW}+p_{n+2}P_k\right)\\ \cdot\exp\left(j2\pi\left(k-K_{\text{Shift}}(i_{\text{BW}})\right)\Delta_{F,\text{Pre-HE}}\left(t-nT_{SYML}-T_{GI,LEgacy\,\text{Preamble}}-T_{CS}^{i_{TX}}\right)\right)\end{array}\right) \quad (26\text{-}23)$$

where

R is a phase rotation vector defined as [1, *j*, 1, 1].

If the TXVECTOR parameter BEAM_CHANGE is 0, the time domain waveform for the HE-SIG-A field in an HE extended range SU PPDU, shall be as specified in Equation 26-24.

$$r_{HE-SIG-A}^{(i_{seg},i_{TX})}(t)=\frac{1}{\sqrt{N_{\text{HE-SIG-A}}^{\text{Tone}}N_{STS,total}}}\sum_{n=0}^{3}w_{T_{SYML}}(t-nT_{SYML})$$
$$\cdot\sum_{i_{BW}=0}^{N_{20MHz}-1}\sum_{k=-28}^{28}\sum_{m=0}^{N_{STS,total}-1}\left(\begin{array}{l}\left[Q_{4(k-K_{\text{Shift}}(i_{BW}))}^{(i_{seg})}\right]_{i_{TX},m}\left[A_{HELTF}^{4(k-K_{\text{Shift}}(i_{BW}))}\right]_{m,1}\left(R_nD_{k,20}+p_{n+2}P_k\right)\\ \cdot\exp\left(j2\pi\left(k-K_{\text{Shift}}(i_{BW})\right)\Delta_{F,\text{Pre-HE}}\left(t-nT_{SYML}-T_{GI,\text{LegacyPreamble}}-T_{CS,HE}(m)\right)\right)\end{array}\right) \quad (26\text{-}24)$$

26.3.9.8 HE-SIG-B

26.3.9.8.1 Encoding and modulation

The HE-SIG-B field is separately encoded on each 20 MHz band. The encoding structure in one such 20 MHz band is shown in Figure 26-23 (HE-SIG-B field encoding structure in each 20 MHz). It consists of a Common Block field followed by a User Specific field.

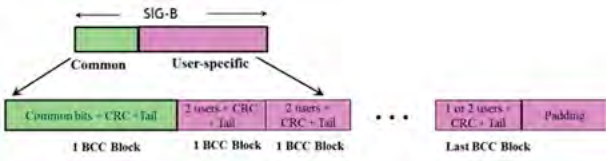

Figure 26-23—HE-SIG-B field encoding structure in each 20 MHz

The Common Block field contains information regarding the resource unit allocation such as the RU arrangement in frequency domain, the RUs allocated for MU-MIMO and the number of users in MU-MIMO allocations. The Common Block field is described in detail in 26.3.9.8.4 (HE-SIG-B common content).

The User Specific field consists of multiple User Block fields. Each User Block field contains information for two STAs to decode their payloads. The last User Block field may contain information for only one STA, if the number of user fields indicated by the RU allocation signaling in the common block is odd. See 26.3.9.8.5 (HE-SIG-B per-user content) for a description of the contents of the User Block field.

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26.3.9.8.2 Frequency domain mapping

For 20 MHz and 40 MHz PPDUs, the Common Block field and the User field for a STA are transmitted in the same 20 MHz band as the STA's data as shown in Figure 26-24 (HE-SIG-B content channel for a 20 MHz PPDU) and Figure 26-25 (HE-SIG-B content channel for a 40 MHz PPDU).

Figure 26-24—HE-SIG-B content channel for a 20 MHz PPDU

Figure 26-25—HE-SIG-B content channel for a 40 MHz PPDU

For an 80 MHz PPDU, the default frequency mapping of the Common Block field and User Specific fields is shown in Figure 26-26 (Default mapping of the two HE-SIG-B channels and their duplication in an 80 MHz PPDU). The HE-SIG-B field content in the 1st and 3rd 20 MHz bands from the top are identical. The information carried in either of these bands is called HE-SIG-B content channel 1. HE-SIG-B content channel 1 carries signaling information for all STAs whose payloads occupy some tones in A242 or C242. Similarly, the HE-SIG-B contents on the 2nd and 4th 20 MHz bands are identical. The information carried in either of these bands is called HE-SIG-B content channel 2. HE-SIG-B content channel 2 carries signaling information for all STAs whose payloads occupy some tones in B242 or D242.

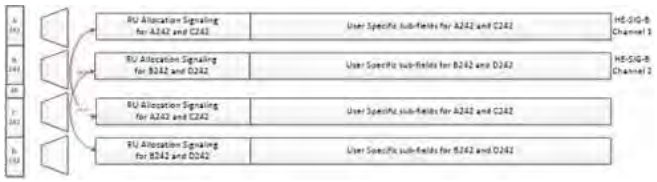

Figure 26-26—Default mapping of the two HE-SIG-B channels and their duplication in an 80 MHz PPDU

For a 160 MHz PPDU, the default frequency mapping of the Common Block field and User Specific fields is shown in Figure 26-27 (Default mapping of the two HE-SIG-B channels and their duplication in a 160 MHz PPDU). The HE-SIG-B content in the 1st, 3rd, 5th and 7th 20 MHz bands from top are all identical. The information carried in any of these bands is called HE-SIG-B content channel 1. HE-SIG-B content channel 1 carries signaling information for all STAs whose payloads occupy some tones in A1-242 or C1-242 or A2-242 or C2-242. Similarly, the HE-SIG-B contents in the 2nd, 4th, 6th and 8th 20 MHz bands from top are identical. The information carried in any of these bands is called HE-SIG-B content

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channel 2. HE-SIG-B content channel 2 carries signaling information for all STAs whose payloads occupy some tones in B1-242 or D1-242 or B2-242 or D2-242.

Figure 26-27—Default mapping of the two HE-SIG-B channels and their duplication in a 160 MHz PPDU

For MU-MIMO allocation of RU size > 20 MHz, the User Block subfields are dynamically split between the two HE-SIG-B content channels (1/2) and the split is decided by the AP (on a per case basis). See 25.3.9.2.5.2 and 25.3.9.2.5.3 for more details.

26.3.9.8.3 Time domain encoding

In each 20 MHz band, the bits in the Common Block field shall have CRC and tail bits added and then be BCC encoded at rate R = ½. Padding bits are not added after the common block.

In the User Specific field, in any 20 MHz band, the bits corresponding to two STAs (i.e. two User fields) are encoded together. Specifically, the STAs scheduled in the HE-MU-PPDU are split into groups of two. Each group of two User fields shall have CRC and tail bits added and then BCC encoded at rate R = ½ using the encoder described in 18.3.5.6. If the number of users is even, padding bits are added to round up the number of symbols to the nearest integer. If the number of users is odd, the User Block field corresponding to the last user, who is not grouped, is encoded after adding tail and CRC bits and only then are any padding bits added. The padding bits added ensure that both content channels have the same number of symbols. The specific method of generating padding bits is TBD. When the code rate is not equal to ½, the convolutional encoder output bits for each field (including padding bits) are concatenated, then the concatenated bit streams are punctured continuously as described in 18.3.5.6 (Convolutional encoder).

The number of data tones in each symbol is N_{SD} = 52. The coded bits are interleaved as in 22.3.10.8, with the parameter N_{col} = 13 (as in Table 22-17, for 20 MHz). The interleaved bits are mapped to constellation points from the MCS specified in HE-SIG-A and have pilots inserted following the steps described in 18.3.5.7 (Data Interleaving), 18.3.5.8 (Subcarrier modulation mapping) and 18.3.5.9 (Pilot subcarriers) respectively.

The cyclic prefix used for HE-SIG-B shall be 0.8 μs. The number of symbols in HE-SIG-B, denoted by $N_{SYM,HE\text{-}SIG\text{-}B}$, shall be signaled in HE-SIG-A in the default mode (see Section 25.3.9.2.4). For the c-th content channel (c = 1 or 2), denote the sample on the k-th subcarrier of the n-th symbol by $d_{k,n,c}$. The time domain waveform for the HE-SIG-B follows Equation 26-25.

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$$r_{HE-SIG-B}^{(i_{Seg},i_{Tx})}(t)=\frac{1}{\sqrt{N_{HE-SIG-B}^{Tone}N_{Tx}}}\sum_{n=0}^{N_{sym,HE-SIG-B}}w_{T_{HE-SIG-B}}(t-nT_{SYML})\sum_{i_{BW}=0}^{N_{20MHz}-1}\sum_{k=-N_{SR}}^{N_{SR}}\Upsilon_{(k-K_{shift}(i_{BW})),BW}$$
$$\left(D^{i_{Seg}}{}_{k,n,i_{BW}}+p_{n+4}P_k\right)\exp\left(j2\pi(k-K_{shift}(i_{BW}))\Delta_{F,Pre-HE}(t-nT_{SYML}-T_{GI,LEgacy\,Preamble}-T_{CS}^{i_{TX}})\right) \quad (26\text{-}25)$$

where

N_{20MHz} and $K_{Shift}(i)$ are defined in 22.3.8.2.4 (L-SIG definition)

$$D_{k,n,i_{BW}}^{i_{Seg}}=\begin{cases}0, k=0,\pm7,\pm21\\ d_{M_{20}^{r}(k),n,(i_{BW}mod\,2)+1}, \text{otherwise}\end{cases}$$

$$M_{20}^{r}(k)=\begin{cases}k+28, -28\le k\le -22\\ k+27, -20\le k\le -8\\ k+26, -6\le k\le -1\\ k+25, 1\le k\le 6\\ k+24, 8\le k\le 20\\ k+23, 22\le k\le 28\end{cases}$$

P_k and p_n are defined in 18.3.5.10 (OFDM modulation).

$\Upsilon_{k,BW}$ is defined by Equation 26-8, Equation 26-9, Equation 26-10 and Equation 26-11

$N_{sym,HE-SIG-B}$ his the number of symbols in HE-SIG-B

26.3.9.8.4 HE-SIG-B common content

The Common block field in the HE-SIG-B carries RU allocation subfields. Depending on the PPDU bandwidth, the Common block field can contain multiple RU allocation subfields.

An RU allocation subfield in the Common block field of HE-SIG-B consists of 8 bits that indicates the following for a 20 MHz PPDU BW:

— The RU arrangement in the frequency domain: indexes the size of the RUs and their placement in the frequency domain.

— Number of user fields in each RU in the HE-SIG-B content channel: the number of users multiplexed in the RUs indicated by the arrangement; for RUs of size greater than or equal to 106 tones that support MU-MIMO, it indicates the number of users multiplexed using MU-MIMO.

The mapping of the 8-bit RU allocation subfield to the RU arrangement and the number of user fields per RU is defined in the Table 26-18 (RU allocation signaling: Arrangement and number of MU-MIMO allocations). In the table, the number of entries column refers to the number of 8-bit indices that refer to the same RU arrangement in the frequency domain but differ in the number of users fields per RU. The RU

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arrangement and the number of user fields per RU together indicate the number of user-fields in the User specific field of HE-SIG-B. Signaling for the center 26 unit in 80 MHz is [TBD].

Table 26-18—RU allocation signaling: Arrangement and number of MU-MIMO allocations

8 bits indices	#1	#2	#3	#4	#5	#6	#7	#8	#9	Number of entries
000 0 0000	26	26	26	26	26	26	26	26	26	1
000 0 0001	26	26	26	26	26	26	26	52		1
000 0 0010	26	26	26	26	26	52		26	26	1
000 0 0011	26	26	26	26	26	52		52		1
000 0 0100	26	26	52		26	26	26	26	26	1
000 0 0101	26	26	52		26	26	26	52		1
000 0 0110	26	26	52		26	52		26	26	1
000 0 0111	26	26	52		52	52		52		1
000 0 1000	52		26	26	26	26	26	26	26	1
000 0 1001	52		26	26	26	26	26	52		1
000 0 1010	52		26	26	26	52		26	26	1
000 0 1011	52		26	26	26	52		52		1
000 0 1100	52		52		26	26	26	26	26	1
000 0 1101	52		52		26	26	26	52		1
000 0 1110	52		52		26	52		26	26	1
000 0 1111	52		52		52	52		52		1
000 1 xxxx	Definition TBD									16
00100 yyy	26	26	26	26	26	106				8
00101 yyy	26	26	52		52	106				8
00110 yyy	52		26	26	26	106				8
00111 yyy	52		52		26	106				8
01000 yyy	106				26	26	26	26	26	8
01001 yyy	106				26	26	26	52		8
01010 yyy	106				26	52		26	26	8

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Table 26-18—RU allocation signaling: Arrangement and number of MU-MIMO allocations

01011 yyy	106	26	52	52	8
011 xxxxx	Definition TBD				32
10 yyy yyy	106	26	106		64
11 0 00yyy	242				8
11 0 01yyy	484				8
11 0 10yyy	996				8
11 0 11yyy	2×996				8
11 1 xxxx	Definition TBD				32

NOTE: yyy' = 000~111 indicates number of STAs multiplexed in an RU. Binary vector yyy is indexed as [y[3]y[2]y[1]] indicates $2^2 \times y[3] + 2^1 \times y[2] + y[1] + 1$ STAs multiplexed in the RU.

The definition for entries with 'x' bits is TBD.

The number of RU allocation subfields in the HE-SIG-B common block field depends on the total PPDU bandwidth

— In the default mode, for 20 MHz and 40 MHz PPDU, each HE-SIG-B content channel contains one RU allocation subfield followed by multiple user fields. The position of the user-field in the user-specific field together with the 8-bit RU allocation subfield indicates the RU assignment to the user.

— In the default mode for the 80 MHz PPDU, each HE-SIG-B content channel contains two RU allocation subfields for a total of 16 bits of RU allocation signaling, one each for the RUs in the two 20 MHz segments of the HE-SIG-B content channel. The user fields corresponding to the first RU allocation signaling field are followed by the user fields indicated by the second RU allocation signaling field in the user specific field.

In the default mode for the 160 MHz PPDU, each HE-SIG-B content channel contains four RU allocation signaling fields for a total of 32 bits of RU allocation signaling, one each for the RUs in the four 20 MHz segments of the HE-SIG-B content channel. The user fields for each of the 20 MHz segments in the content channel are arranged by the order in which their RU allocation signaling fields appear in the common field.

26.3.9.8.5 HE-SIG-B per-user content

The user-specific field consists of multiple user fields. The user fields follow the common block field of HE-SIG-B. The RU allocation subfield in the Common block field and the position of the user field in the HE-SIG-B user specific field together identify the RU used to transmit a STA's data. An example for the mapping of the 8-bit RU allocation subfield and the position of the user field to an STA's data is illustrated in Figure 26-28 (Illustration for the mapping of the 8-bit RU allocation subfield and the position of the user-field to the STA's assignment). The RU arrangement signaling indicates an arrangement of 106 tone RU followed by five 26-tone RUs and that the 106-tone RU contains three user-fields, i.e., the 106-tone RU supports multiplexing of three users using MU-MIMO. The eight user fields in the HE-SIG-B user-specific

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field thus map to the 6 RUs, with the first three user fields indicating MU-MIMO allocations in the first 106-tone RU followed by user fields corresponding to the each of the five 26-tone RUs.

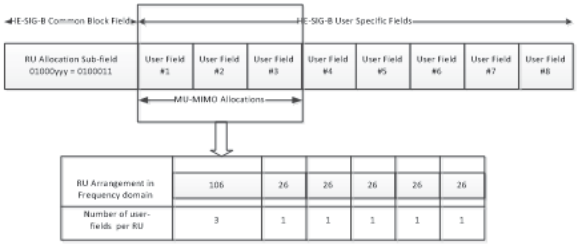

Figure 26-28—Illustration for the mapping of the 8-bit RU allocation subfield and the position of the user-field to the STA's assignment

The contents of the user field differ based on whether the field addresses a single-STA in an RU or a STA in a MU-MIMO allocation in an RU. Irrespective of whether the allocation is for a STA in a SU or an MU-MIMO allocation, the size of the user field is the same.

The HE-SIG-B user field for a SU allocation contain the subfields shown in Table 26-19 (Fields of the HE-SIG-B user field for a SU allocation).

Table 26-19—Fields of the HE-SIG-B user field for a SU allocation

Bit	Field	Number of bits	Description
TBD	STA-ID	11	The STA identifier that addresses a STA – reference to MAC section(?). For RUs that carry a broadcast allocation: For single BSS AP, the STAID for Broadcast will be 0; For Multiple BSS AP, the STAID for Broadcast to a specific BSS will follow the group addressed AID assignment in the TIM according to the existing Multi-BSSID TIM operation; For Multiple BSS AP, the STAID for Broadcast to all BSS of the AP will have a special STAID value reserved.
TBD	NSTS	3	Number of spatial streams
TBD	Tx Beam-forming	1	Use of transmit beamforming
TBD	MCS	4	Modulation and Coding Scheme
TBD	DCM	1	Indication for use of dual carrier modulation
TBD	Coding	1	Indication for use of LDPC

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The HE-SIG-B user field for an STA in MU-MIMO allocation contain the subfields shown in Table 26-20 (Fields of the HE-SIG-B user field for a MU-MIMO allocation).

Table 26-20—Fields of the HE-SIG-B user field for a MU-MIMO allocation

Bit	Field	Number of bits	Description
TBD	STA-ID	11	The STA identifier that addresses an STA – reference to MAC section(?)
TBD	Spatial Con-figuration	4	Indication for the number of spatial streams for a STA in a MU-MIMO allocation. See Table 26-21 (Spatial Configuration subfield encoding).
TBD	MCS	4	Modulation and Coding Scheme
TBD	DCM	1	Use of dual carrier modulation
TBD	Coding	1	Use of LDPC

A user field for an MU-MIMO allocation includes a Spatial Configuration subfield consisting of 4 bits that indicates the number of spatial streams for each STA and the total number of spatial streams in the MU-MIMO allocation. The subfield shown in Table 26-21 (Spatial Configuration subfield encoding) is constructed by using the entries corresponding to the value of number of users (N_{user}) multiplexed using MU-MIMO in an RU. When MU-MIMO is used in an RU of size ≤ 20 MHz, the number of users (Nuser) in an MU-MIMO allocation is equal to the number of user-fields per RU signaled for the RU in the RU allocation subfield of an HE-SIG-B Common block field. When MU-MIMO is used in RUs of size 20 MHz or greater, the number of users (N_{user}) in an MU-MIMO allocation is computed as the sum of the number of user-fields per RU indicated for the RU by the 8-bit RU allocation subfield in each HE-SIG-B content channel. For a given value of Nuser, the four bits of the spatial configuration subfield are used as follows: A STA with a STA-ID that matches the 11-bit ID signaled in the user field for an MU-MIMO allocation derives the number of spatial streams allocated to it using the row corresponding to the signaled 4-bit spatial configuration subfield and the column corresponding to the position of the user-field in the user-specific field. The starting stream index for the STA is computed by summing the Nsts in the columns prior to the column indicated by the STA's user-field position. In the case of load balancing for RUs of size > 20 MHz where user fields corresponding to the same MU-MIMO allocations are split into two HE-SIG-B content channels, the user-field positions are logically continuous with the user-field in the second HE-SIG-B content channel updating its position (and therefore, column index) from that of the last user-field in the first HE-SIG-B content channel.

Table 26-21—Spatial Configuration subfield encoding

N_{user}	B0...B3	Nsts [1]	Nsts [2]	Nsts [3]	Nsts [4]	Nsts [5]	Nsts [6]	Nsts [7]	Nsts [8]	Total Nsts	Number of entries

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Table 26-21—Spatial Configuration subfield encoding *(continued)*

2	0000-0011	1-4	1							2-5	10
	0100-0110	2-4	2							4-6	
	0111-1000	3-4	3							6-7	
	1001	4	4							8	
3	0000-0011	1-4	1	1						3-6	13
	0100-0110	2-4	2	1						5-7	
	0111-1000	3-4	3	1						7-8	
	1001-1011	2-4	2	2						6-8	
	1100	3	3	2						8	
4	0000-0011	1-4	1	1	1					4-7	11
	0100-0110	2-4	2	1	1					6-8	
	0111	3	3	1	1					8	
	1000-1001	2-3	2	2	1					7-8	
	1010	2	2	2	2					8	
5	0000-0011	1-4	1	1	1	1				5-8	6
	0100-0101	2-3	2	1	1	1				7-8	
6	0000-0010	1-3	1	1	1	1	1			6-8	4
	0011	2	2	1	1	1	1			8	
7	0000-0001	1-2	1	1	1	1	1	1		7-8	2
8	0000	1	1	1	1	1	1	1	1	8	1

26.3.9.9 HE-STF

The main purpose of the HE-STF field is to improve automatic gain control estimation in a MIMO transmission. The duration of the HE-STF field for HE PPDUs except HE trigger-based PPDUs is THE-STF-NT (periodicity of 0.8 μs with 5 periods) and the duration of the HE-STF field for an HE trigger-based PPDU is THE-STF-T (periodicity of 1.6 μs with 5 periods). The tone indices for HE-STF field for HE PPDUs except HE trigger-based PPDUs is defined in Equation 26-26.

$$i_{STF} \bmod 16 = 0, \lfloor N_{DC}/2 \rfloor < |i_{STF}| \leq N_{SR} \quad (26\text{-}26)$$

i_{STF} : HE-STF tone index

The tone indices for HE-STF fields for an HE trigger-based PPDU are defined in Equation 26-27.

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$$i_{STF} \bmod 8 = 0, \lfloor N_{DC}/2 \rfloor < |i_{STF}| \le N_{SR}$$
$$i_{STF} : \text{HE-STF tone index} \quad (26\text{-}27)$$

For the HE-STF field, the *M* sequence is defined by Equation 26-28.

$$M = \{-1, -1, -1, 1, 1, 1, -1, 1, 1, 1, -1, 1, 1, -1, 1\} \quad (26\text{-}28)$$

The HE-STF field is constructed from the M sequence(s) by multiplying integer coefficient(s) to each 20 MHz subchannel and inserting appropriate coefficients into tone indices which are null after mapping M sequences.

For a 20 MHz transmission, the frequency domain sequence for HE PPDUs except HE trigger-based PPDUs is given by Equation 26-29.

$$HES_{-112:16:112} = \{M\} \cdot (1+j)/\sqrt{2}$$
$$HES_0 = 0 \quad (26\text{-}29)$$

where $HES_{a:b:c}$ means coefficients of the HE-STF on every *b* tone indices from *a* to *c* tone indices and coefficients on other tone indices are set to zero.

For a 40 MHz transmission, the frequency domain sequence for HE PPDUs except HE trigger-based PPDUs is given by Equation 26-30.

$$HES_{-240:16:240} = \{M, 0, -M\} \cdot (1+j)/\sqrt{2} \quad (26\text{-}30)$$

For an 80 MHz transmission, the frequency domain sequence for HE PPDUs except HE trigger-based PPDUs is given by Equation 26-31.

$$HES_{-496:16:496} = \{M, 1, -M, 0, -M, 1, -M\} \cdot (1+j)/\sqrt{2} \quad (26\text{-}31)$$

For a 20 MHz transmission, the frequency domain sequence for HE trigger-based PPDUs is given by Equation 26-32.

$$HES_{-120:8:120} = \{M, 0, -M\} \cdot (1+j)/\sqrt{2} \quad (26\text{-}32)$$

For a 40 MHz transmission, the frequency domain sequence for HE trigger-based PPDUs is given by Equation 26-33.

$$HES_{-248:8:248} = \{M, -1, -M, 0, M, -1, M\} \cdot (1+j)/\sqrt{2}$$
$$HES_{\pm 248} = 0 \quad (26\text{-}33)$$

For an 80 MHz transmission, the frequency domain sequence for HE trigger-based PPDUs is given by Equation 26-34.

$$HES_{-504:8:504} = \{M, -1, M, -1, -M, -1, M, 0, -M, 1, M, 1, -M, 1, -M\} \cdot (1+j)/\sqrt{2}$$
$$HES_{\pm 504} = 0 \quad (26\text{-}34)$$

For an OFDMA transmission, the coefficients in Equation (25-3) to (25-8) are set to zero if those values are corresponding to tone indices on which no RUs defined in 25.3.7.1 are assigned.

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The time domain representation of the signal for HE PPDUs except HE trigger-based PPDUs on frequency segment i_{Seg} of transmit chain i_{TX} shall be as specified in Equation 26-35.

$$r_{\text{HE-STF}}^{(i_{Seg},i_{TX})}(t) = w_{T_{\text{HE-STF-NT}}}(t)\cdot\eta_{EXT}\cdot\sum_{r=0}^{N_{RU}-1}\frac{\alpha_r\beta_r}{\sqrt{N_{STS,r,total}}} \cdot\sum_{k\in K_r}\sum_{u=0}^{N_{user,r}-1}\sum_{m=1}^{N_{STS,r,u}}\left(\begin{array}{l}\left[Q_k^{(i_{Seg})}\right]_{i_{TX},(M_{r,u}+m)} HES_k \\ \cdot\exp\left(j2\pi k\Delta_{F,\text{HE}}\left(t-T_{\text{CS,HE}}\left(M_{r,u}+m\right)\right)\right)\end{array}\right) \quad (26\text{-}35)$$

where

α_r is the power boost factor for the r-th RU, where $\alpha_r \in [TBD_1, TBD_2]$

η_{EXT} is an PPDU format dependent scaling factor, with the following value

$$\eta_{EXT} = \begin{cases}\sqrt{2}, & \text{HE extended range SU PPDU}\\ 1, & \text{otherwise}\end{cases}$$

β_r is the per-RU power normalization factor and defined by

$$\beta_r = \left(\sqrt{\frac{|K_r|}{|K_r^{\text{HE-STF}}|}}\right) \Big/ \left(\sqrt{\sum_{r=1}^{N_{RU}}\alpha_r|K_r|}\right)$$

$|K_r|$ is the cardinality of the set of subcarriers K_r

$K_r^{\text{HE-STF}}$ is the set of subcarriers that have non-zero values within K_r in the HE-STF field

$T_{CS,HE}(n)$ is given in 26.3.9.2 (Cyclic shift for Pre-HE modulated fields)

$Q_k^{(i_{Seg})}$ is defined in 25.3.10.10.x (Transmission in HE format)

$w_{T_{\text{HE-STF-NT}}}$ is the windowing function for HE-STF field in the non-HE trigger-based PPDU.

The time domain representation of the signal for HE trigger-based PPDUs on frequency segment i_{Seg} of transmit chain i_{TX} shall be as specified in Equation 26-36.

$$r_{\text{HE-STF}}^{(i_{Seg},i_{TX})}(t) = \frac{\alpha_r\beta_r}{\sqrt{N_{STS,r,total}}} w_{T_{\text{HE-STF-T}}}(t) \cdot\sum_{k\in K_r}\sum_{m=1}^{N_{STS,r,u}}\left(\begin{array}{l}\left[Q_k^{(i_{Seg})}\right]_{i_{TX},(M_{r,u}+m)} HES_k \\ \cdot\exp\left(j2\pi k\Delta_{F,\text{HE}}\left(t-T_{\text{CS,HE}}\left(M_{r,u}+m\right)\right)\right)\end{array}\right) \quad (26\text{-}36)$$

where

$w_{T_{\text{HE-STF-T}}}$ is the windowing function for HE-STF field in the HE trigger-based PPDU.

26.3.9.10 HE-LTF

The HE Long Training field (HE-LTF) field provides a means for the receiver to estimate the MIMO channel between the set of constellation mapper outputs (or, if STBC is applied, the STBC encoder outputs) and the receive chains. In an HE SU PPDU, HE MU PPDU or HE extended range SU PPDU, the transmitter

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provides training for $N_{STS,r,total}$ space-time streams (spatial mapper inputs) used for the transmission of the PSDU(s) in the r-th RU; in an HE trigger-based PPDU, the transmitter of user-u in the r-th RU provides training for $N_{STS,r,u}$ space-time streams used for the transmission of the PSDU. For each tone in the r-th RU, the MIMO channel that can be estimated is an $N_{RX} \times N_{STS,r,total}$ matrix. A HE transmission has a preamble that contains HE-LTF symbols, where the data tones of each HE-LTF symbol are multiplied by entries belonging to a matrix $P_{HE\text{-}LTF}$, to enable channel estimation at the receiver. The pilot tones of each HE-LTF symbol are multiplied by the entries of a matrix $R_{HE\text{-}LTF}$ defined in the following text. The multiplication of the pilot tones in the HE-LTF symbol by the $R_{HE\text{-}LTF}$ matrix instead of the $P_{HE\text{-}LTF}$ matrix allows receivers to track phase and frequency offset during MIMO channel estimation using the HE-LTF. In an HE SU PPDU and HE extended range SU PPDU, the number of HE-LTF symbols, NHE-LTF, is a function of the total number of space-time streams N_{STS} as shown in <reference>. In an HE trigger-based PPDU, NHE-LTF is indicated in the Trigger frame that triggers the transmission of the PPDU. In an HE MU PPDU, NHE-LTF is indicated in the HE-SIG-A field. In an HE MU PPDU and HE trigger-based PPDU, NHE-LTF is selected to be not smaller than the maximum value of the functions for each $N_{STS,r,total}$. As a result the HE-LTF field consists of one, two, four, six or eight symbols.

A HE PPDU supports 3 HE-LTF modes, which are 1x HE-LTF, 2x HE-LTF, and 4x HE-LTF. It is optional to support 1x HE-LTF in an HE SU PPDU, HE extended range SU PPDU and HE MU PPDU. In an HE SU PPDU, HE MU PPDU or HE extended range SU PPDU, the combination of HE-LTF modes and GI duration is indicated in HE-SIG-A field. In an HE trigger-based PPDU, the combination of HE-LTF modes and GI duration is indicated in the Trigger frame that triggers the transmission of the PPDU. The mandatory combinations of HE-LTF modes and GI duration are:

— 2x HE-LTF, $T_{GI,Data}$

— 2x HE-LTF, $T_{GI,Data2}$

— 4x HE-LTF, $T_{GI,Data4}$

The optional combinations of HE-LTF mode and GI duration are:

— 1x HE-LTF, $T_{GI,Data}$ in a HE SU PPDU or HE extended SU PPDU

— 1x HE-LTF, $T_{GI,Data}$ in a non-OFDMA, MU-MIMO HE MU PPDU

— 1x HE-LTF, $T_{GI,Data2}$ in a non-OFDMA, MU-MIMO HE trigger-based PPDU

The duration of each HE-LTF symbol is THE-LTF is defined in Equation 26-37. In an HE SU PPDU, HE MU PPDU or HE extended range SU PPDU, the HE-LTF symbol duration is indicated in HE-SIG-A field. In an HE trigger-based PPDU, the HE-LTF symbol duration is indicated in the Trigger frame that triggers the transmission of the PPDU.

$$T_{HE-LTF} = \begin{cases} T_{HE-LTF-1X} & \text{if 1x HE-LTF} \\ T_{HE-LTF-2X} & \text{if 2x HE-LTF} \\ T_{HE-LTF-4X} & \text{if 4x HE-LTF} \end{cases} \quad (26\text{-}37)$$

where $T_{HE\text{-}LTF\text{-}1X}$, $T_{HE\text{-}LTF\text{-}2X}$, $T_{HE\text{-}LTF\text{-}4X}$ are defined in Table 26-3 (Timing-related constants).

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In a 20 MHz transmission, the 1x HE-LTF sequence transmitted is given by Equation 26-38.

$$HELTF_{-122,122} =$$
$$\{0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1,$$
$$0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -$$
$$1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0,$$
$$-1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, 0, 0, 0, 0, \quad (26\text{-}38)$$
$$-1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0,$$
$$0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0,$$
$$0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1,$$
$$0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0\}$$

In a 20 MHz transmission, the 2x HE-LTF sequence transmitted is given by Equation 26-39.

$$HELTF_{-122,122} =$$
$$\{-1, 0, -1, 0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1,$$
$$0, -1, 0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0, +1,$$
$$0, -1, 0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1,$$
$$0, +1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, +1, \quad (26\text{-}39)$$
$$0, +1, 0, +1, 0, -1, 0, -1, 0, +1, 0, 0, 0, +1, 0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, -1,$$
$$0, +1, 0, +1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0, +1,$$
$$0, +1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0, -1,$$
$$0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1,$$
$$0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1\}$$

In a 20 MHz transmission, the 4x HE-LTF sequence transmitted is given by Equation 26-40.

$$HELTF_{-122,122} =$$
$$\{-1, -1, +1, -1, +1, -1, +1, +1, +1, -1, +1, +1, +1, -1, -1, +1, -1, -1, -1, -1, -1, +1,$$
$$+1, -1, -1, -1, -1, +1, +1, -1, +1, -1, -1, +1, +1, -1, +1, +1,$$
$$+1, +1, -1, -1, +1, -1, -1, -1, +1, +1, +1, +1, -1, +1, +1, -1, -1, -1, -1, +1, -1, -1, +1,$$
$$+1, -1, +1, -1, -1, -1, -1, +1, -1, +1, -1, -1, -1, -1, -1, -1, +1, +1, -1, -1, -1, -1, -$$
$$1, +1, -1, -1, +1, +1, +1, -1, +1, +1, +1, -1, +1, -1, +1, -1, -1, -1, -1, -1, +1, +1, +1,$$
$$-1, -1, -1, +1, -1, +1, +1, +1, 0, 0, 0, -1, +1, -1, +1, -1, +1, +1, -1, +1, +1, +1, -1, -1, \quad (26\text{-}40)$$
$$+1, -1, -1, +1, -1, +1, -1, +1, +1, +1, -1, +1, +1, +1, -1, -1, -1, -1, -1, +1,$$
$$+1, -1, -1, -1, -1, -1, -1, +1, -1, +1, -1, -1, -1, -1, +1, -1, +1, +1, -1, -1, +1, -1, -$$
$$1, -1, -1, +1, +1, -1, +1, +1, +1, +1, +1, +1, +1, -1, +1, +1, -1, -1, -1, -1, +1, -1, -1,$$
$$+1, +1, -1, +1, -1, -1, -1, -1, +1, -1, +1, -1, -1, +1, +1, +1, +1, -1, -1, +1, +1, +1, +1,$$
$$+1, -1, +1, +1, -1, -1, -1, +1, -1, -1, -1, +1, -1, +1, -1, +1, +1\}$$

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In a 40 MHz transmission, the 1x HE-LTF sequence transmitted is given by Equation 26-41.

$HELTF_{-244,244}$ =

{+1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0,
0, −1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, −1, 0,
0, 0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, +1,
0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, −
1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0,
−1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0,
0, +1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0,
0, 0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, 0, 0, 0, 0, +1, 0, (26-41)
0, 0, +1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1,
0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, −
1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0,
−1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0,
0, −1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, +1, 0,
0, 0, −1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, −1,
0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0,
+1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1}

In a 40 MHz transmission, the 2x HE-LTF sequence transmitted is given by Equation 26-42.

$HELTF_{-244,244}$ =

{+1, 0, −1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0, +1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, −1,
0, −1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1,
0, −1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0, +1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, −1, 0, +1,
0, +1, 0, +1, 0, +1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1,
0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, +1, 0, +1,
0, +1, 0, +1, 0, +1, 0, −1, 0, −1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, +1,
0, +1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, −1,
0, −1, 0, −1, 0, +1, 0, +1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, +1,
0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, −1, 0, 0, 0, 0, 0, 0, 0, −1, 0, −1, 0, − (26-42)
1, 0, −1, 0, −1, 0, +1, 0, +1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0,
−1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, +1, 0, +1, 0,
+1, 0, +1, 0, −1, 0, −1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0,
−1, 0, +1, 0, −1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, +1, 0, +1, 0, +1, 0,
+1, 0, −1, 0, −1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, −1, 0,
+1, 0, +1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0,
−1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0,
+1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0,
−1, 0, −1, 0, +1, 0, −1, 0, +1, 0, −1, 0, +1}

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In a 40 MHz transmission, the 4x HE-LTF sequence transmitted is given by Equation 26-43.

$$
\begin{aligned}
&HELTF_{-244,244} = \\
&\{+1,-1,-1,-1,-1,+1,-1,-1,+1,+1,-1,+1,-1,+1,-1,+1,+1,-1,+1,-1,-1,-1,\\
&+1,+1,-1,-1,-1,-1,-1,-1,-1,+1,-1,-1,+1,+1,-1,+1,-1,-1,-1,-1,-1,+1,-1,\\
&+1,+1,+1,-1,-1,+1,+1,+1,-1,-1,+1,+1,+1,+1,-1,+1,+1,-1,-1,+1,-1,+1,-1,\\
&+1,-1,-1,+1,-1,+1,+1,+1,-1,-1,+1,+1,+1,-1,-1,-1,-1,+1,-1,-1,+1,+1,-1,\\
&+1,-1,-1,-1,-1,-1,+1,-1,+1,+1,+1,-1,-1,+1,+1,+1,+1,+1,+1,+1,+1,-1,+1,\\
&+1,-1,-1,+1,-1,+1,+1,+1,+1,+1,-1,+1,-1,-1,-1,+1,+1,-1,-1,-1,-1,-1,-1,\\
&-1,-1,+1,-1,-1,+1,+1,-1,+1,-1,+1,-1,+1,+1,-1,+1,-1,-1,-1,+1,+1,-1,-1,\\
&-1,-1,-1,-1,-1,+1,-1,-1,+1,+1,-1,+1,-1,-1,-1,-1,-1,+1,-1,+1,+1,+1,-1,\\
&-1,+1,+1,+1,-1,-1,-1,-1,-1,-1,+1,-1,-1,+1,+1,-1,+1,-1,+1,-1,+1,+1,-1,\\
&+1,-1,-1,-1,+1,+1,-1,-1,-1,+1,+1,+1,+1,-1,+1,+1,-1,-1,+1,-1,+1,+1,+1,\\
&+1,+1,-1,+1,-1,-1,-1,+1,+1,-1,-1,-1,+1,0,0,0,0,0,-1,+1,+1,+1,+1,-1,+1,\\
&+1,-1,-1,+1,-1,+1,-1,+1,-1,-1,+1,-1,+1,+1,+1,-1,-1,+1,+1,+1,+1,+1,+1,\\
&+1,-1,+1,+1,-1,-1,+1,-1,+1,+1,+1,+1,+1,-1,+1,-1,-1,-1,+1,+1,-1,-1,-1,\\
&+1,+1,-1,-1,-1,-1,+1,-1,-1,+1,+1,-1,+1,-1,+1,-1,+1,+1,-1,+1,-1,-1,-1,\\
&+1,+1,-1,-1,-1,+1,+1,+1,+1,-1,+1,+1,-1,-1,+1,-1,+1,+1,+1,+1,+1,-1,+1,\\
&-1,-1,-1,+1,+1,-1,-1,-1,+1,-1,-1,-1,-1,+1,-1,-1,+1,+1,-1,+1,-1,+1,-1,\\
&+1,+1,-1,+1,-1,-1,-1,+1,+1,-1,-1,-1,+1,-1,-1,-1,-1,+1,-1,-1,+1,+1,-1,\\
&+1,-1,+1,-1,+1,+1,-1,+1,-1,-1,-1,+1,+1,-1,-1,-1,-1,-1,-1,-1,+1,-1,-1,\\
&+1,+1,-1,+1,-1,-1,-1,-1,-1,+1,-1,+1,+1,+1,-1,-1,+1,+1,+1,-1,+1,-1,-1,\\
&-1,-1,+1,-1,-1,+1,+1,-1,+1,-1,+1,-1,+1,+1,-1,+1,-1,-1,-1,+1,+1,-1,-1,\\
&-1,+1,+1,+1,+1,-1,+1,+1,-1,-1,+1,-1,+1,+1,+1,+1,+1,-1,+1,-1,-1,-1,+1,\\
&+1,-1,-1,-1,-1\}
\end{aligned}
\tag{26-43}
$$

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In an 80 MHz transmission, the 1x HE-LTF sequence transmitted is given by Equation 26-44.

$$HELTF_{-500,500} =$$

$$\{-1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0,$$
$$0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0,$$
$$0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1,$$
$$0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -$$
$$1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0,$$
$$+1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0,$$
$$0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0,$$
$$0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1,$$
$$0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -$$
$$1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0,$$
$$+1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0,$$
$$0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0,$$
$$0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1,$$
$$0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -$$
$$1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0,$$
$$-1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0,$$
$$0, 0, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0,$$
$$0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0,$$
$$0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1,$$
$$0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0,$$
$$+1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0,$$
$$0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0,$$
$$0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1,$$
$$0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0,$$
$$+1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0,$$
$$0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0,$$
$$0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1,$$
$$0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0,$$
$$+1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0,$$
$$0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0,$$
$$0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1,$$
$$0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0,$$
$$+1, 0, 0, 0, +1\} \quad (26\text{-}44)$$

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In an 80 MHz transmission, the 2x HE-LTF sequence transmitted is given by Equation 26-45.

$$
\begin{aligned}
HELTF_{-500,500} = \\
&\{+1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, +1, 0, -1, 0, -1, 0, -1, \\
&0, +1, 0, -1, 0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, -1, 0, -1, 0, -1, 0, +1, \\
&0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, \\
&0, -1, 0, +1, 0, +1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0, -1, \\
&0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, \\
&0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1, \\
&0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, +1, 0, -1, 0, -1, 0, -1, 0, -1, 0, +1, 0, +1, 0, -1, \\
&0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, -1, 0, +1, \\
&0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, -1, 0, -1, 0, -1, 0, +1, \\
&0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, -1, 0, +1, \\
&0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, \\
&0, -1, 0, +1, 0, +1, 0, +1, 0, +1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0, +1, 0, +1, 0, -1, \\
&0, +1, 0, +1, 0, +1, 0, -1, 0, -1, 0, -1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, -1, 0, -1, 0, -1, \\
&0, +1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, -1, 0, +1, 0, +1, 0, +1, \\
&0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, +1, \\
&0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, \\
&0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, \\
&0, -1, 0, +1, 0, +1, 0, +1, 0, +1, 0, -1, 0, -1, 0, -1, 0, +1, 0, +1, 0, +1, 0, 0, 0, 0, 0, 0, 0, \\
&+1, 0, -1, 0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, +1, 0, +1, 0, +1, 0, +1, 0, \\
&-1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, \\
&+1, 0, +1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0, \\
&+1, 0, -1, 0, +1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, \\
&+1, 0, +1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, \\
&+1, 0, -1, 0, -1, 0, -1, 0, +1, 0, +1, 0, +1, 0, +1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0, \\
&+1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, \\
&+1, 0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, +1, 0, +1, 0, \\
&-1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, \\
&+1, 0, -1, 0, +1, 0, -1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, \\
&-1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, \\
&+1, 0, -1, 0, -1, 0, -1, 0, +1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, \\
&-1, 0, -1, 0, -1, 0, -1, 0, +1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, -1, 0, -1, 0, +1, 0, -1, 0, \\
&-1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, \\
&-1, 0, +1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, +1, 0, +1, 0, -1, 0, -1, 0, -1, 0, +1, 0, \\
&-1, 0, -1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, -1, 0, -1, 0, \\
&-1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, -1, 0, -1, 0, +1, 0, -1, 0, -1, 0, -1, 0, \\
&+1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1, 0, +1, 0, -1, 0, +1, 0, +1\}
\end{aligned}
\tag{26-45}
$$

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In an 80 MHz transmission, the 4x HE-LTF sequence transmitted is given by Equation 26-46.

$$
\begin{aligned}
HELTF_{-500,500} = \\
&\{+1, +1, -1, +1, -1, +1, -1, -1, -1, +1, -1, -1, -1, +1, +1, -1, +1, +1, +1, +1, +1, -1, -\\
&1, +1, +1, +1, +1, -1, +1, -1, +1, -1, -1, +1, +1, -1, +1, +1, +1, -1, -1, +1, -1, -1, -1,\\
&-1, +1, +1, +1, -1, -1, -1, -1, -1, -1, +1, +1, +1, +1, +1, +1, -1, +1, +1, +1, -1, +1, +1,\\
&-1, -1, -1, +1, -1, +1, -1, -1, +1, +1, -1, +1, -1, +1, +1, +1, +1, +1, -1, -1, +1, +1, +1,\\
&-1, +1, +1, -1, -1, -1, +1, -1, +1, +1, -1, +1, +1, -1, +1, -1, -1, +1, +1, +1, +1, -1, -1,\\
&+1, +1, +1, +1, +1, -1, +1, +1, -1, -1, -1, +1, -1, -1, -1, +1, -1, +1, -1, +1, +1, -1, +1,\\
&-1, +1, -1, +1, +1, +1, -1, +1, +1, +1, -1, -1, +1, -1, -1, -1, -1, -1, +1, +1, -1, -1, -1,\\
&-1, +1, -1, +1, -1, +1, +1, -1, -1, +1, -1, -1, -1, +1, +1, -1, +1, +1, +1, +1, -1, -1, -1,\\
&+1, +1, +1, +1, -1, +1, +1, +1, +1, +1, +1, +1, -1, +1, +1, +1, -1, +1, +1, -1, -1, -1, +1,\\
&-1, +1, -1, -1, +1, +1, -1, +1, -1, +1, +1, +1, +1, +1, -1, -1, +1, +1, +1, -1, +1, +1, -1,\\
&-1, -1, +1, -1, +1, +1, -1, +1, +1, -1, +1, -1, -1, +1, -1, +1, -1, +1, -1, +1, +1, +1, -1,\\
&+1, +1, +1, -1, -1, +1, -1, -1, -1, -1, -1, +1, +1, -1, -1, -1, -1, +1, +1, +1, -1, +1, +1,\\
&-1, -1, +1, -1, -1, -1, +1, +1, -1, +1, +1, +1, +1, -1, -1, -1, +1, +1, +1, +1, -1, +1, -1,\\
&-1, -1, -1, -1, -1, +1, -1, -1, -1, +1, -1, -1, +1, +1, +1, -1, +1, -1, +1, +1, -1, -1, +1,\\
&-1, +1, -1, -1, -1, -1, -1, +1, +1, -1, -1, -1, +1, -1, -1, +1, +1, +1, -1, +1, -1, -1, +1,\\
&-1, -1, +1, -1, +1, +1, +1, +1, +1, +1, -1, -1, +1, +1, +1, +1, +1, -1, +1, +1, -1, -1, -1,\\
&+1, -1, -1, -1, +1, -1, +1, -1, +1, +1, -1, +1, -1, +1, -1, +1, +1, +1, -1, +1, +1, +1, -1,\\
&-1, +1, -1, -1, -1, -1, -1, +1, +1, -1, -1, -1, -1, +1, -1, +1, -1, +1, +1, -1, -1, +1, -1,\\
&-1, -1, +1, +1, -1, +1, -1, +1, +1, +1, -1, -1, -1, +1, +1, +1, +1, -1, -1, +1, +1, +1, +1, +1,\\
&+1, -1, +1, +1, +1, -1, +1, +1, -1, -1, -1, +1, -1, +1, -1, -1, +1, +1, -1, +1, -1, +1, +1,\\
&+1, +1, +1, -1, -1, +1, +1, +1, -1, +1, +1, -1, -1, -1, +1, -1, +1, +1, -1, +1, +1, -1, +1,\\
&-1, -1, -1, +1, -1, +1, -1, -1, -1, -1, +1, +1, +1, -1, -1, +1, 0, 0, 0, 0, 0, +1, -1, -1, -\\
&1, -1, -1, -1, +1, -1, +1, +1, -1, -1, +1, +1, -1, +1, -1, +1, +1, -1, -1, +1, -1, +1, -1,\\
&-1, -1, +1, +1, -1, +1, +1, +1, -1, +1, +1, +1, +1, +1, +1, +1, -1, +1, -1, -1, +1, -1, -1,\\
&+1, -1, +1, +1, +1, -1, -1, +1, -1, -1, -1, +1, +1, -1, -1, -1, -1, -1, -1, +1, -1, -1, -1, -1,\\
&-1, +1, +1, -1, -1, -1, -1, -1, +1, -1, -1, +1, +1, +1, -1, +1, +1, +1, -1, +1, -1, +1, -1,\\
&-1, -1, -1, -1, +1, +1, +1, -1, -1, -1, -1, +1, -1, -1, +1, +1, +1, -1, +1, +1, -1, -1, +1,\\
&-1, +1, -1, -1, -1, -1, -1, -1, -1, +1, +1, -1, -1, -1, +1, -1, -1, +1, +1, +1, -1, +1, -1,\\
&-1, +1, -1, -1, +1, -1, +1, +1, +1, -1, +1, -1, -1, +1, +1, -1, +1, -1, +1, +1, +1, -1, -1,\\
&+1, -1, -1, -1, +1, -1, -1, -1, -1, -1, -1, -1, +1, -1, +1, +1, -1, +1, +1, -1, +1, -1, -1,\\
&-1, +1, +1, -1, +1, +1, +1, -1, -1, +1, +1, +1, +1, +1, +1, +1, -1, +1, -1, -1, -1, -1, +1, +1, -1,\\
&-1, -1, -1, -1, +1, -1, -1, +1, +1, +1, -1, +1, +1, +1, -1, +1, +1, -1, -1, +1, -1, +1, -1, +1,\\
&+1, +1, +1, -1, -1, -1, -1, +1, -1, -1, +1, +1, +1, -1, +1, +1, -1, -1, +1, -1, +1, -1, +1,\\
&+1, +1, -1, +1, -1, -1, +1, +1, -1, +1, -1, +1, +1, +1, -1, -1, +1, -1, -1, -1, +1, -1, -1,\\
&-1, -1, -1, -1, -1, +1, -1, +1, +1, -1, +1, +1, -1, +1, -1, -1, -1, +1, +1, -1, +1, +1, +1,\\
&-1, -1, +1, +1, +1, +1, +1, -1, +1, +1, +1, +1, +1, -1, -1, +1, +1, +1, +1, +1, -1, +1, +1,\\
&-1, -1, -1, +1, -1, -1, -1, +1, -1, +1, -1, +1, +1, +1, +1, +1, -1, -1, -1, +1, +1, +1, +1,\\
&-1, +1, +1, -1, -1, -1, +1, -1, -1, +1, +1, -1, +1, -1, +1, -1, -1, -1, -1, -1, -1, +1, +1,\\
&-1, -1, -1, +1, -1, -1, +1, +1, +1, -1, +1, -1, -1, +1, -1, -1, +1, -1, +1, -1, +1, -1, +1,\\
&-1, -1, +1, +1, -1, +1, -1, +1, +1, +1, -1, -1, +1, -1, -1, -1, +1, -1, -1, -1, -1, -1, -1,\\
&-1, +1, -1, +1, +1, -1, +1, +1, -1, +1, -1, -1, -1, +1, +1, -1, +1, +1, +1, -1, -1, +1, +1,\\
&+1, +1, +1, -1, +1, -1, -1, -1, -1, +1, +1, -1, -1, -1, -1, -1, +1, -1, -1, +1, +1, +1, -1,\\
&+1, +1, +1, -1, +1, -1, +1, -1, -1, -1, -1, -1, +1, +1, +1, -1, -1, -1, -1, +1, -1, -1, +1,\\
&+1, +1, -1, +1, +1, -1, -1, +1, -1, +1, -1, +1\}
\end{aligned}
\tag{26-46}
$$

In a 160 MHz transmission, the 1x HE-LTF sequence transmitted is given by Equation 26-47.

$$HELTF_{-1012,\,1012} = \{1\text{x LTF}_{\text{80MHz_primary}}, \text{zeros}(1, 23), 1\text{x LTF}_{\text{80MHz_secondary}}\} \tag{26-47}$$

where

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$1x\ LTF_{80MHz_primary} = \{L\text{-}LTF_{80MHz_1x}, 0, R\text{-}LTF_{80MHz_1x}\}$
$1x\ LTF_{80MHz_secondary} = \{L\text{-}LTF_{80MHz_1x}, 0, (-1)*R\text{-}LTF_{80MHz_1x}\}$

In a 160 MHz transmission, the 2x HE-LTF sequence transmitted is given by Equation 26-48.

$$HELTF_{-1012,\,1012} = \{2x\ LTF_{80MHz_primary}, zeros(1, 23), 2x\ LTF_{80MHz_secondary}\} \quad (26\text{-}48)$$

where

$2x\ LTF_{80MHz_primary} =$
$\{\{1^{st}\ 242\text{-RU}\}, \{2^{nd}\ 242\text{-RU}\}, \{central\ 26\text{-RU}\}, \{3^{rd}\ 242\text{-RU}\}, \{4^{th}\ 242\text{-RU}\}\}$ (26-49)

$2x\ LTF_{80MHz_secondary} =$
$\{\{1^{st}\ 242\text{-RU}\}, (-1)*\{2^{nd}\ 242\text{-RU}\}, \{central\ 26\text{-RU}\}, \{3^{rd}\ 242\text{-RU}\}, (-1)*\{4^{th}\ 242\text{-RU}\}\}$ (26-50)

In a 160 MHz transmission, the 4x HE-LTF sequence transmitted is given by Equation (26 51).

$$HELTF_{-1012,\,1012} = \{4x\ LTF_{80MHz_primary}, zeros(1, 23), 4x\ LTF_{80MHz_secondary}\} \quad (26\text{-}51)$$

where

$$4x\ LTF_{80MHz_primary} = \{L\text{-}LTF_{80MHz_4x}, 0, R\text{-}LTF_{80MHz_4x}\} \quad (26\text{-}52)$$

$$4x\ LTF_{80MHz_secondary} = \{L\text{-}LTF_{80MHz_4x}, 0, (-1)*R\text{-}LTF_{80MHz_4x}\} \quad (26\text{-}53)$$

For a noncontiguous 80+80 MHz transmission, the 1x HE-LTF sequence is given by Equation 26-54.

$$HELTF_{80+80MHz} = \{1x\ LTF_{80MHz_primary}, zeros(1, 23), 1x\ LTF_{80MHz_secondary}\} \quad (26\text{-}54)$$

For a noncontiguous 80+80 MHz transmission, the 2x HE-LTF sequence is given by Equation 26-55.

$$HELTF_{80+80MHz} = \{2x\ LTF_{80MHz_primary}, zeros(1, 23), 2x\ LTF_{80MHz_secondary}\} \quad (26\text{-}55)$$

For a noncontiguous 80+80 MHz transmission, the 4x HE-LTF sequence is given by Equation 26-56.

$$HELTF_{80+80MHz} = \{4x\ LTF_{80MHz_primary}, zeros(1, 23), 4x\ LTF_{80MHz_secondary}\} \quad (26\text{-}56)$$

The generation of the time domain HE-LTF symbols per frequency segment in an HE SU PPDU, HE MU PPDU, HE extended range SU PPDU, HE trigger-based PPDU using single stream pilots is shown in Figure 26-29 (Generation of HE-LTF symbols per frequency segment in an HE SU PPDU, HE MU PPDU,

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HE extended range SU PPDU, and HE trigger-based PPDU using single stream pilots) where A^k_{HELTF} is given by Equation 26-57.

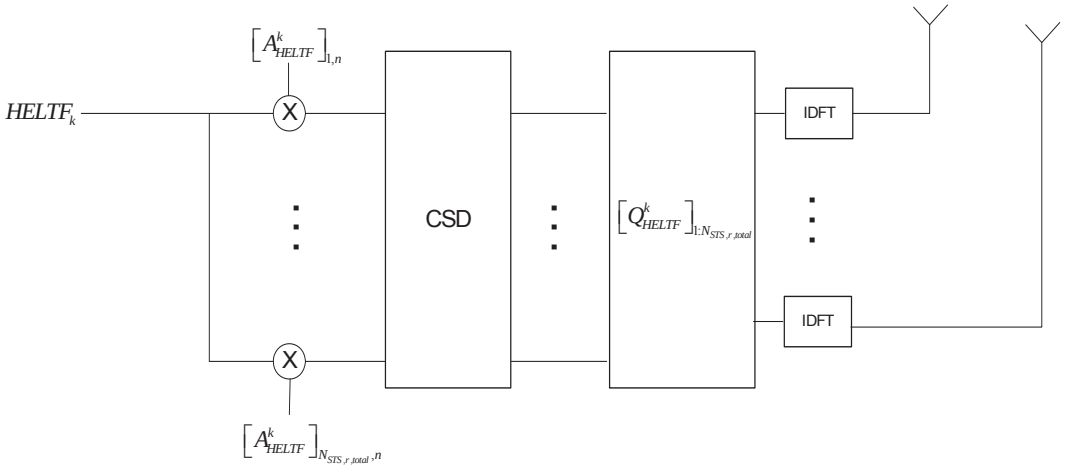

Figure 26-29—Generation of HE-LTF symbols per frequency segment in an HE SU PPDU, HE MU PPDU, HE extended range SU PPDU, and HE trigger-based PPDU using single stream pilots

The generation of time domain symbol of 1x HE-LTF is equivalent to modulating every 4 tones in an OFDM symbol of 12.8 μs excluding GI, and then only transmit the first ¼ of the OFDM symbol in the time domain, as shown in Figure 26-30 (Generation of 1x HE-LTF symbols per frequency segment).

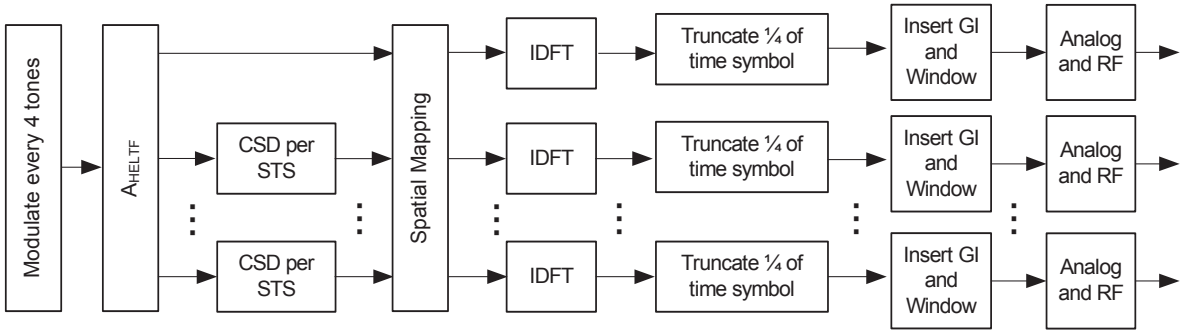

Figure 26-30—Generation of 1x HE-LTF symbols per frequency segment

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The generation of time domain symbol of 2x HE-LTF is equivalent to modulating every other tone in an OFDM symbol of 12.8 μs excluding GI, and then only transmit the first half of the OFDM symbol in time domain, as shown in Figure 26-31 (Generation of 2x HE-LTF symbols per frequency segment).

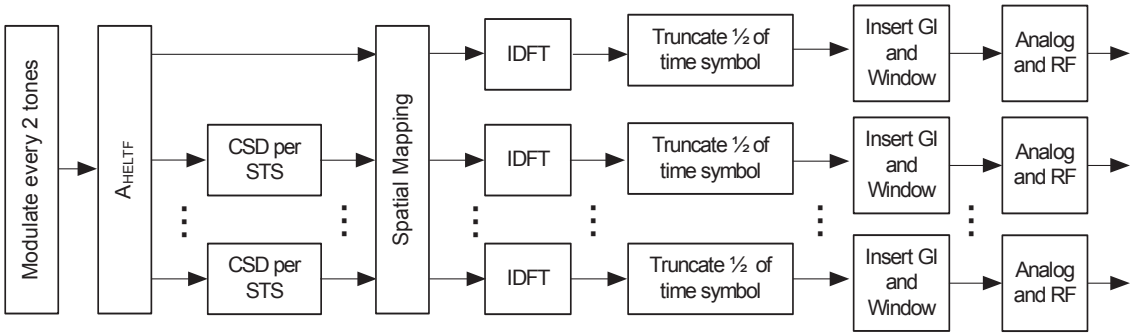

Figure 26-31—Generation of 2x HE-LTF symbols per frequency segment

A^{k}_{HELTF} is given by Equation 26-57.

$$A^{k}_{HELTF} = \begin{cases} R_{HELTF}, \text{ if } k \in K_{\text{Pilot}} \\ P_{HELTF}, \text{ otherwise} \end{cases} \tag{26-57}$$

where

K_{Pilot} is the set of subcarrier indices for the pilot tones as defined in 25.x (xx).

R_{HELTF} is a $N_{HELTF} \times N_{HELTF}$ matrix whose elements are defined in EEquation 26-58.

$$[R_{HELTF}]_{m,\,n} = [P_{HELTF}]_{1,\,n},\ 1 \le m, n \le N_{HELTF} \tag{26-58}$$

P_{HELTF} is defined in Equation 26-59.

$$P_{HELTF} = \begin{cases} P_{4\times 4}, N_{HELTF} \le 4 \\ P_{6\times 6}, N_{HELTF} = 6 \\ P_{8\times 8}, N_{HELTF} = 8 \end{cases} \tag{26-59}$$

where $P_{4\times 4}$ is defined in Equation (20-17), $P_{6\times 6}$ is defined in Equation (22-45), and $P_{8\times 8}$ is defined in Equation (22-46).

In an HE SU PPDU, HE MU PPDU, HE extended range SU PPDU and HE trigger-based PPDU using single stream pilots, the time domain representation of the waveform transmitted on frequency segment i_{Seg} of transmit chain i_{TX} shall be as described by Equation (26 60).

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$$r_{HE-LTF}^{(i_{seg},i_{TX})}(t)=\frac{\eta_{HE-LTF}\cdot\eta_{EXT}}{\sqrt{\sum_{r=1}^{N_{RU}}\alpha_r^2\left|K_r\right|}}\sum_{n=0}^{N_{HELTF}-1}w_{T_{HE-LTF}}\left(t-nT_{HE-LTF}\right)\sum_{r=0}^{N_{RU}-1}\frac{\alpha_r}{\sqrt{N_{STS,r,total}}}$$
$$\cdot\sum_{k\in K_r}\sum_{u=0}^{N_{user,r}-1}\sum_{m=1}^{N_{STS,r,u}}\left(\begin{array}{l}\left[Q_k^{(i_{seg})}\right]_{i_{TX},(M_{r,u}+m)}\left[A_{HELTF}^k\right]_{(M_{r,u}+m),(n+1)}HELTF_k\\\cdot\exp\left(j2\pi k\Delta_{F,HE}\left(t-nT_{HE-LTF}-T_{GI}-T_{CS,HE}\left(M_{r,u}+m\right)\right)\right)\end{array}\right) \quad (26\text{-}60)$$

where

α_r is the power boost factor for the *r*-th RU, where $\alpha_r \in [TBD_1, TBD_2]$

η_{EXT} is an PPDU format dependent scaling factor, with the following value

$$\eta_{EXT}=\begin{cases}\sqrt{2}, & \text{HE extended range SU PPDU}\\ 1, & \text{otherwise}\end{cases}$$

$N_{\text{HE-LTF}}^{\text{Tone}}$ has the value given in Table 25-xx (Tone scaling factor and guard interval duration values for PHY fields)

$T_{CS,HE}(n)$ is given in 26.3.9.2 (Cyclic shift for Pre-HE modulated fields)

$Q_k^{(i_{Seg})}$ is defined in 25.xx (Transmission in HE format)

A_{HELTF}^k is defined in Equation 26-57

K_r is the set of subcarrier indices for the tones in the *r*-th RU as defined in 25.x

$\eta_{\text{HE-LTF}}$ is the power scaling factor as defined in (25-xx)

$$\eta_{\text{HE-LTF}}=\begin{cases}2 & \text{for 1x HE-LTF}\\ \sqrt{2} & \text{for 2x HE-LTF}\\ 1 & \text{for 4x HE-LTF}\end{cases}$$

26.3.10 Data field

26.3.10.1 General

The number of OFDM symbols in the Data field is determined by the Length field in L-SIG (see Equation (25-x)), the preamble duration and the setting of the CP+LTF Size field in HE-SIG-A (see 26.3.9.7 (HE-SIG-A)). Data symbols in an HE PPDU shall use a DFT period of 12.8 μs and subcarrier spacing of 78.125 kHz. Data symbols in an HE PPDU shall support guard interval durations of 0.8 μs, 1.6 μs and 3.2 μs. HE PPDUs shall have single stream pilots in the Data field. In UL MU-MIMO transmissions, all streams use the same pilot sequence. The Data field in UL MU transmissions shall immediately follow the HE-LTF section.

When BCC encoding is used, the Data field shall consist of the SERVICE field, the PSDU, the tail bits, the post-FEC padding bits and the packet extension (bits for SU and bits for each user u in MU). When LDPC encoding is used, the Data field shall consist of the SERVICE field, the PSDU, the post-FEC padding bits and the packet extension. No tail bits are present when LDPC encoding is used.

The Data field of the HE PPDU contains data for one or more users.

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26.3.10.2 Pre-FEC encoding process

A two-step padding process is applied on all HE PPDUs. A pre-FEC padding with both MAC and PHY padding is applied before conducting FEC coding, and a post-FEC PHY padding is applied on the FEC encoded bits.

The pre-FEC padding may pad toward 4 possible boundaries in the last one (in the case of non STBC), or two (in the case of STBC) OFDM symbols of a HE PPDU, the 4 possible boundaries participate the FEC output bit stream of the last OFDM symbol(s) into 4 symbol segments. The 4 possible boundaries are represented by a parameter a, called *a-factor*.

Figure 26-32 (HE PPDU padding process in the last OFDM symbol (non STBC) when a = 1) illustrates these 4 possible symbol segments in the last OFDM symbol of a non STBC case, and the general padding process assuming the desired pre-FEC padding boundary, *a-factor*, is 1. In the case of STBC, the FEC output bits and post-FEC padding bits as shown in Figure 26-33 (HE PPDU padding process in the last OFDM symbol (STBC) when a = 1), are modulated into the last two OFDM symbols by STBC encoding, each with the same number of effective symbol segments, *a-factor*, being 1.

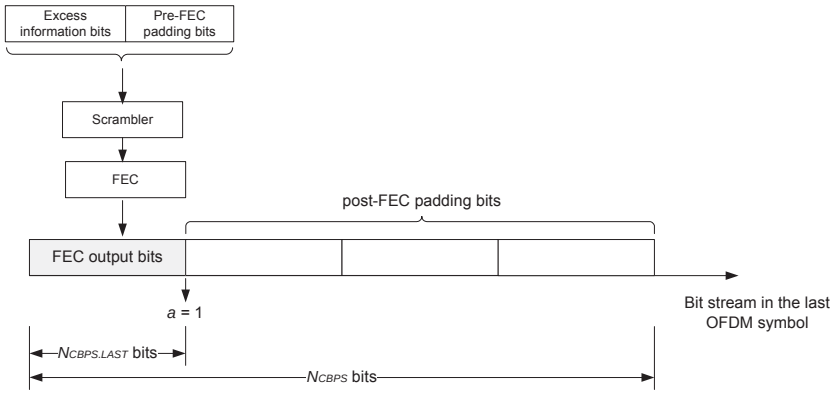

Figure 26-32—HE PPDU padding process in the last OFDM symbol (non STBC) when *a* = 1

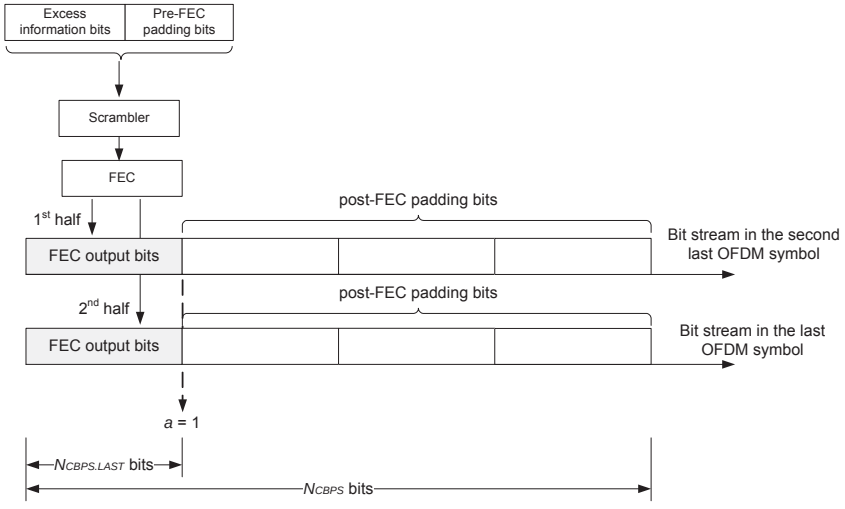

Figure 26-33—HE PPDU padding process in the last OFDM symbol (STBC) when *a* = 1

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The pre-FEC padding process is described in this subclause, and the encoding and post-FEC padding process are described in 26.3.10.3. While this subclause describes the pre-FEC padding processing of an SU transmission, its extension to MU transmission is described in 25.3.10.3.4 (Encoding Process for HE MU PPDUs).

In an HE SU PPDU transmission, the transmitter first computes the number of excess bits in the last OFDM symbol(s). Specifically, for HE SU PPDU with BCC encoding, the number of excess bits is calculated based on Equation 26-61.

$$N_{Excess} = mod(8 \cdot \text{APEP_LENGTH} + N_{Tail} + N_{service}, m_{STBC} \cdot N_{DBPS}) \quad (26\text{-}61)$$

where

m_{STBC} is 2 when STBC is used, and 1 otherwise;

APEP_LENGTH is the TXVECTOR parameter APEP_LENGTH.

For a HE SU PPDU with LDPC encoding, the number of excess bits is calculated based on Equation 26-62:

$$N_{Excess} = mod(8 \cdot \text{APEP_LENGTH} + N_{service}, m_{STBC} \cdot N_{DBPS}) \quad (26\text{-}62)$$

Then based on N_{Excess}, compute the initial number of symbol segments in the last OFDM symbol(s), a-factor value or a_{init}, as shown in Equation 26-63.

$$a_{init} = \begin{cases} 4, & \text{if } N_{Excess} = 0 \\ \left\lceil \dfrac{N_{Excess}}{m_{STBC} \cdot N_{DBPS,\,SHORT}} \right\rceil, & \text{otherwise} \end{cases} \quad (26\text{-}63)$$

where

$N_{DBPS,\,SHORT} = N_{CBPS,\,SHORT} \cdot R$, in which R is the coding rate, and

$N_{CBPS,\,SHORT} = N_{SD,\,SHORT} \cdot N_{SS} \cdot N_{BPSCS}$;

The parameter $N_{SD,SHORT}$ values for different RU sizes are as shown in Table 26-22 (NSD,SHORT values).

Table 26-22—$N_{SD,SHORT}$ values

RU Size	$N_{SD,SHORT}$	
	DCM = 0	DCM = 1
26	6	2 (TBD)
52	12	6 (TBD)
106	24	12 (TBD)
242	60	30 (TBD)

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Table 26-22—$N_{SD,SHORT}$ values

484	120	60 (TBD)
996	240	120 (TBD)
996x2	492	246 (TBD)

Given the a_{init} values, the initial number of data bits per symbol and the initial number of coded bits per symbol in the last OFDM symbol(s) are defined in Equation 26-64.

$$N_{DBPS.LAST.init} = \begin{cases} a_{init}.N_{DBPS.SHORT}, & \text{if } a_{init} < 4 \\ N_{DBPS,} & \text{if } a_{init} = 4 \end{cases}$$
$$N_{CBPS.LAST.init} = \begin{cases} a_{init}.N_{CBPS.SHORT}, & \text{if } a_{init} < 4 \\ N_{CBPS,} & \text{if } a_{init} = 4 \end{cases} \quad (26\text{-}64)$$

For a HE SU PPDU with BCC encoding, the number of pre-FEC pad bits is calculated using Equation 26-65.

$$N_{PAD,PRE-FEC} = (N_{SYM.init} - m_{STBC}).N_{DBPS} + m_{STBC}.N_{DBPS.Last.init} - 8.APEP_LENGTH - N_{Tail} - N_{service} \quad (26\text{-}65)$$

where $N_{SYM.init}$ is defined as in Equation (26 68) for BCC encoding, and Equation (26 73) for LDPC encoding.

For a HE SU PPDU with LDPC encoding, the number of pre-FEC pad bits is calculated using Equation 26-66.

$$N_{PAD,PRE-FEC} = (N_{SYM.init} - m_{STBC}).N_{DBPS} + m_{STBC}.N_{DBPS.Last.init} - 8.APEP_LENGTH - N_{service} \quad (26\text{-}66)$$

Among the pre-FEC padding bits, the MAC delivers a PSDU that fills the available octets in the Data field of the HE PPDU, toward the desired pre-FEC padding boundary, represented by a_init value, in the the last OFDM symbol(s). The PHY then determines the number of pad bits to add and appends them to the PSDU. The number of pre-FEC pad bits added by PHY will always be 0 to 7. The procedure is defined in Equation 26-67.

$$N_{PAD,PRE-FEC,MAC} = \left\lfloor \frac{N_{PAD,PRE-FEC}}{8} \right\rfloor \cdot 8$$
$$N_{PAD,PRE-FEC,PHY} = N_{PAD,PRE-FEC} \bmod 8 \quad (26\text{-}67)$$

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26.3.10.3 SERVICE field

The SERVICE field of HE PPDU is as shown in Table 26-23 (SERVICE field).

Table 26-23—SERVICE field

Bits	Field	Description
B0-B6	Scrambler Initialization	Set to 0
B7-B15	Reserved	Set to 0

26.3.10.4 Coding

The Data field shall be encoded using either the binary convolutional code (BCC) defined in 26.3.10.3.1 or the low density parity check (LDPC) code defined in 25.3.10.3.2 (LDPC coding). The encoder is selected by the Coding field in HE-SIG-A in an HE SU PPDU or an HE extended range SU PPDU, or HE-SIG-B per-user subfield(s) in a HE MU PPDU, as defined in 26.3.9.7 (HE-SIG-A) and 26.3.9.8 (HE-SIG-B) respectively.

When conducting BCC FEC encoding for an HE PPDU, the number of encoders is always 1.

LDPC is the only FEC coding scheme in the HE PPDU Data field for a 484-RU, a 996-RU or a 996x2-RU. Support of BCC code is limited to less than or equal to four spatial streams (per user in case of MU-MIMO), and is mandatory (for both transmit and receive) for RU sizes less than or equal to a 242-RU. Support of LDPC code (for both transmit and receive) is mandatory for HE STAs declaring support for at least one of HE 40/80/160/80+80 SU PPDU bandwidths, or for HE STAs declaring support for more than 4 spatial streams, according to HE capabilities field as defined in 9.4.2.213 (HE Capabilities element). Otherwise, support of LDPC code for either transmit or receive is optional.

26.3.10.4.1 Binary convolutional coding and puncturing

The information bits and pre-FEC padding bits of user u are encoded by a rate R = ½ convolutional encoder defined in 18.3.5.6 (Convolutional encoder). After encoding, the encoded data is punctured by the method defined in 18.3.5.6 (Convolutional encoder) (except for rate 5/6), to achieve the rate selected by the modulation and coding scheme. In the case that rate 5/6 coding is selected, the puncturing scheme will be the same as described in 20.3.11.6 (Binary convolutional coding and puncturing).

The initial number of OFDM symbols in the Data field with BCC encoding in a HE SU PPDU is calculated as in Equation 26-68.

$$N_{SYM,\,init} = m_{STBC} \cdot \left\lceil \frac{8 \cdot \text{APEP_LENGTH} + N_{Tail} N_{ES} + N_{service}}{m_{STBC} N_{DBPS}} \right\rceil \quad (26\text{-}68)$$

For a HE SU PPDU with BCC encoding,

$$N_{SYM} = N_{SYM.init} \quad (26\text{-}69)$$

and

$$a = a_{init} \quad (26\text{-}70)$$

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The number of coded bits per symbol in the last OFDM symbol(s) of a HE SU PPDU is

$$N_{CBPS,LAST} = \begin{cases} a \cdot N_{CBPS,SHORT}, & \text{if } a < 4 \\ N_{CBPS}, & \text{if } a = 4 \end{cases} \quad (26\text{-}71)$$

26.3.10.4.2 LDPC coding

For a HE SU PPDU using LDPC coding to encode the Data field, the LDPC code and encoding process described in 20.3.11.7 (LDPC codes) shall be used with the following modifications. First, all bits in the

Data field including the scrambled SERVICE, PSDU, and pre-FEC pad bits are encoded. Thus, N_{pld} for HE PPDUs shall be computed using Equation 26-72 instead of Equation (20-35).

$$N_{pld} = (N_{SYM.init} - m_{STBC}).N_{DBPS} + m_{STBC}.N_{DBPS.LAST.init} \quad (26\text{-}72)$$

where

$$N_{SYM.init} = m_{STBC} \cdot \left\lceil \frac{8.APEP_LENGTH + N_{service}}{m_{STBC}.N_{DBPS}} \right\rceil \quad (26\text{-}73)$$

Following the calculation of N_{pld}, N_{avbits} shall be computed using Equation 26-74 instead of Equation (20-36).

$$N_{avbits} = (N_{SYM,init} - m_{STBC}) \cdot N_{CBPS} + m_{STBC} \cdot N_{CBPS,LAST,init} \quad (26\text{-}74)$$

In addition, in step d) of LDPC encoding process as described in clause 20.3.11.7.5 (LDPC PPDU encoding process), if the following condition is met:

$(N_{punc} > 0.1 \times N_{CW} \times L_{LDPC} \times (1-R))$ AND $\left(N_{shrt} < 1.2 \times N_{punc} \times \frac{R}{1-R}\right)$ is true OR if

$N_{punc} > 0.3 \times N_{CW} \times L_{LDPC} \times (1-R)$ is true,

then the LDPC Extra OFDM Symbol field of HE-SIG-A shall be set to 1, and increment N_{avbits} by the following Equation 26-75 instead of Equations (20-39), followed by recomputing N_{punc} as in Equation (20-40):

$$N_{avbits} = \begin{cases} N_{avbits} + m_{STBC}.\left(N_{CBPS} - 3.N_{CBPS.SHORT}\right), & \text{if } a_{init} = 3 \\ N_{avbits} + m_{STBC}.N_{CBPS.SHORT}, & \text{otherwise} \end{cases} \quad (26\text{-}75)$$

and then update a and N_{SYM} values by the following Equation 26-76:

$$\begin{cases} N_{SYM} = N_{SYM.init} + m_{STBC}, \text{ and } a = 1, & \text{if } a_{init} = 4 \\ N_{SYM} = N_{SYM.init}, \text{ and } a = a_{init} + 1, & \text{otherwise} \end{cases} \quad (26\text{-}76)$$

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If in step d) of LDPC encoding process as described in clause 20.3.11.7.5 (LDPC PPDU encoding process), the above mentioned condition is not met, then the LDPC Extra OFDM Symbol field of HE-SIG-A shall be set to 0, and:

$$a = a_{init}, N_{SYM} = N_{SYM, init} \tag{26-77}$$

With the final *a-factor* value a, update the N_{CBPS} of the last symbol as:

$$N_{CBPS.LAST} = \begin{cases} a \cdot N_{CBPS.SHORT}, & \text{if } a < 4 \\ N_{CBPS}, & \text{if } a = 4 \end{cases} \tag{26-78}$$

LDPC codes used in HE MU PPDUs shall also follow the definitions in 20.3.11.7 (LDPC codes). Refer to 25.3.10.3.4 (Encoding process for HE MU PPDUs) for a description of the LDPC encoding process for HE MU PPDUs.

26.3.10.4.3 Post-FEC padding

The number of post-FEC padding bits in each of the last m_{STBC} symbol(s) is computed by:

$$N_{PAD.POST\text{-}FEC} = N_{CBPS} - N_{CBPS.LAST} \tag{26-79}$$

$N_{PAD.POST\text{-}FEC}$ bits with arbitrary 0 or 1 values (TBD) are appended after the FEC output bits in each of the last m_{STBC} OFDM symbols.

26.3.10.4.4 Encoding process for an HE MU PPDU

For an HE MU PPDU, all the users shall use a common *a-factor* value and a common N_{SYM} value. The padding process is described as follows.

First compute initial *a-factor* value ($a_{init,u}$) for each user u using Equation 26-63, and the initial number of OFDM symbols ($N_{init,u}$) for each user u using Equation 26-68 if user u is BCC encoded, or Equation 26-73 if user u is LDPC encoded. Among all the users, derive the user index with the longest encoded packet duration, as in Equation 26-80.

$$u_{\max} = \arg\max_{u=0}^{N_U - 1} (N_{SYM.init.u} - m_{STBC} + 0.25.m_{STBC}.a_{init.u}) \tag{26-80}$$

where m_{STBC} is the common STBC setting among all the users, as described in 26.3.10.8.

Then the common a_{init} and N_{init} values among all the users are derived by Equation 26-81:

$$\begin{aligned} N_{SYM.init} &= N_{SYM.init.u_{\max}} \\ a_{init} &= a_{init.u_{\max}} \end{aligned} \tag{26-81}$$

Update each user's initial number of coded bits in its last symbol as below:

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$$N_{DBPS.LAST.init.u} = \begin{cases} a_{init}.N_{DBPS.SHORT.u}, & \text{if } a_{init} < 4 \\ N_{DBPS.u,} & \text{if } a_{init} = 4 \end{cases}$$
$$N_{CBPS.LAST.init.u} = \begin{cases} a_{init}.N_{CBPS.SHORT.u}, & \text{if } a_{init} < 4 \\ N_{CBPS.u,} & \text{if } a_{init} = 4 \end{cases} \quad (26\text{-}82)$$

For each user with LDPC encoding, the number of pre-FEC padding bits is computed as in Equation 26-83:

$$N_{PAD,PRE-FEC,u} = (N_{SYM.init} - m_{STBC}).N_{DBPS.u} + m_{STBC}.N_{DBPS.LAST.init.u} - 8APEP_LENGTH_u - N_{service} \quad (26\text{-}83)$$

For each user with LDPC encoding, the parameters $N_{pld,u}$ and $N_{avbits,u}$ are computed using Equation 26-84 and Equation 26-85 respectively:

$$N_{pld,u} = (N_{SYM.init} - m_{STBC}).N_{DBPS,u} + m_{STBC}.N_{DBPS.LAST.init,u} \quad (26\text{-}84)$$

$$N_{avbits,u} = (N_{SYM.init} - m_{STBC}).N_{CBPS,u} + m_{STBC}.N_{CBPS.LAST.init,u} \quad (26\text{-}85)$$

Each user with LDPC encoding continue LDPC encoding process as in clause 20.3.11.7.5 (LDPC PPDU encoding process) starting with the parameters $N_{pld,u}$ and $_{avbits,u}$. If there is at least one user with LDPC encoding, where step d) of its LDPC encoding process of clause 20.3.11.7.5 (LDPC PPDU encoding process), meets the following condition:

$(N_{punc,u} > 0.1 \times N_{CW,u} \times L_{LDPC,u} \times (1 - R_u))$ AND $\left(N_{shrt,u} < 1.2 \times N_{punc,u} \times \frac{R_u}{1 - R_u}\right)$ is true OR if

$N_{punc,u} > 0.3 \times N_{CW,u} \times L_{LDPC,u} \times (1 - R_u)$ is true,

where $N_{punc,u}$, $N_{CW,u}$, $L_{LDPC,u}$ and $N_{shrt,u}$ are the LDPC encoding parameters for user u, as defined in 20.3.11.7.5 (LDPC PPDU encoding process), and R_u is the coding rate of user u, then the LDPC Extra symbol bit in HE-SIG-A shall be set to 1, and all the users with LDPC encoding shall increment N_{avbits} and recomputed N_{punc}, by the following two equations once:

$$N_{avbits,u} = \begin{cases} N_{avbits,u} + m_{STBC} \cdot \left(N_{CBPS,u} - 3.N_{CBPS.SHORT,u}\right), & \text{if } a_{init} = 3 \\ N_{avbits,u} + m_{STBC}.N_{CBPS.SHORT,u}, & \text{otherwise} \end{cases} \quad (26\text{-}86)$$

$$N_{punc,u} = \max\left(0,\ (N_{CW,u} \times L_{LDPC,u}) - N_{avbits,u} - N_{shrt,u}\right) \quad (26\text{-}87)$$

Update the common *a-factor* and N_{SYM} values for all users by the following equation:

$$\begin{cases} N_{SYM} = N_{SYM.init} + m_{STBC}, \text{ and } a = 1, & \text{if } a_{init} = 4 \\ N_{SYM} = N_{SYM.init}, \text{ and } a = a_{init} + 1, & \text{otherwise} \end{cases} \quad (26\text{-}88)$$

Note that users with BCC encoding shall also use the common N_{SYM} and a parameters as in Equation 26-76.

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If among all the users with LDPC encoding, in step d) of clause 20.3.11.7.5 (LDPC PPDU encoding process), the above mentioned condition is not met, or if all the users in the HE MU PPDU are BCC encoded, then the LDPC Extra symbol bit in HE-SIG-A shall be set to 0, and:

$$a = a_{init}, N_{SYM} = N_{SYM,\,init} \tag{26-89}$$

Update the N_{CBPS} and N_{DBPS} of the last symbol for each user as:

$$N_{DBPS.LAST.u} = \begin{cases} a.N_{DBPS.SHORT.u}, & \text{if } a < 4 \\ N_{CBPS.u,} & \text{if } a = 4 \end{cases}$$
$$N_{CBPS.LAST.u} = \begin{cases} a.N_{CBPS.SHORT.u}, & \text{if } a < 4 \\ N_{CBPS.u,} & \text{if } a = 4 \end{cases} \tag{26-90}$$

For the users with BCC encoding, the number of pre-FEC padding bits is shown in Equation (26 91).

$$N_{PAD,PRE-FEC,u} = (N_{SYM} - m_{STBC}).N_{DBPS.u} + m_{STBC}.N_{DBPS.LAST.u} - 8APEP_LENGTH_u - N_{Tail} - N_{service} \tag{26-91}$$

For each user with either LDPC or BCC encoding, the number of post-FEC padding bits in each of the last m_{STBC} symbol(s) is computed as in Equation 26-92:

$$N_{PAD,POST-FEC,u} = m_{STBC}.(N_{CBPS,u} - N_{CBPS.LAST,u}) \tag{26-92}$$

26.3.10.4.5 Encoding process for an HE trigger-based PPDU

The AP indicates the common N_{SYM}, *a-factor*, STBC indication and LDPC Extra Symbol in the Trigger frame.

For an HE trigger-based PPDU with BCC encoding, follow the HE SU PPDU padding and encoding process as introduced in 25.3.10.1.1 (pre-FEC padding process), 26.3.10.4.1 (Binary convolutional coding and puncturing), and 26.3.10.4.3 (Post-FEC padding), with initial parameters setting to $N_{SYM.init} = N_{SYM}$, and $a_{init} = a$, where N_{SYM} and a are the common number of symbols and *a-factor* parameters indicated in the Trigger frame, respectively.

For an HE trigger-based PPDU with LDPC encoding, follow the HE SU PPDU padding and encoding process as introduced in 26.3.10.2 (Pre-FEC encoding process), 26.3.10.4.2 (LDPC coding), and 26.3.10.4.3 (Post-FEC padding), with the following exceptions:

When the Trigger frame indicates LDPC Extra Symbol = 1, set the initial parameters following Equation 26-93:

$$\begin{cases} a_{init} = 4,\ N_{SYM.init} = N_{SYM} - m_{STBC}, & \text{if } a = 1 \\ a_{init} = a - 1,\ N_{SYM.init} = N_{SYM}, & \text{otherwise} \end{cases} \tag{26-93}$$

where N_{SYM} and a are the common number of symbols and *a-factor* parameters indicated in the Trigger frame respectively, and m_{STBC} is 2 if the Trigger frame indicates STBC and 1 otherwise. Then continue with

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the LDPC encoding process as in clause 20.3.11.7.5 (LDPC PPDU encoding process), during which in step d) of clause 20.3.11.7.5 (LDPC PPDU encoding process), always increment N_{avbits} as in Equation 26-75, and always recompute N_{punc} as in Equation (20-40), followed by updating $a = a_{init} + 1$ if $a_{init} < 4$, or $a = 1$ if $a_{init} = 4$.

When the Trigger frame indicates LDPC Extra Symbol = 0, set initial parameters to $N_{SYM,init} = N_{SYM}$, and $a_{init} = a$, where N_{SYM} and a are the common number of symbols and a-factor parameters indicated in the Trigger frame respectively. Then continue with the LDPC encoding process as in clause 20.3.11.7.5 (LDPC PPDU encoding process), during which in step d) of clause 20.3.11.7.5 (LDPC PPDU encoding process), N_{avbits} and N_{punc} are not changed, and $a = a_{init}$.

26.3.10.5 Stream parser

After coding, puncturing and post-FEC padding, the data bit streams at the output of the FEC encoder are processed in groups of N_{CBPS} bits. Each of these groups is re-arranged into N_{SS} blocks of N_{CBPSS} bits ($N_{SS,u}$ blocks of $N_{CBPSS,u}$ bits in the case of a HE MU transmission). This operation is referred to as "stream parsing" and is described in this section.

The description is given in terms of an SU transmission. For MU transmissions, the rearrangements are carried out in the same way per user.

The number of bits assigned to a single axis (real or imaginary) in a constellation point in a spatial stream is denoted by Equation 26-94.

$$s = max(1, \frac{N_{BPSCS}}{2}) \quad (26\text{-}94)$$

The sum of these over all streams is $S = N_{SS} \cdot s$.

Consecutive blocks of s bits are assigned to different spatial streams in a round robin fashion.

Let

$$N_{\text{Block}} = \left\lfloor \frac{N_{CBPS}}{S} \right\rfloor \quad (26\text{-}95)$$

For the $N_{\text{Block}} \cdot S$ bits of each OFDM symbol, S bits from the output of the encoder are divided among all spatial streams, s bits per stream.

Note that in all the different RU sizes, $N_{CBPS} = N_{\text{Block}} \cdot S$, therefore the coded bits of each OFDM symbol are always evenly allocated to N_{SS} spatial streams.

The following equations are an equivalent description to the above procedure. Bit i at the output of the encoder is assigned to input bit k of spatial stream i_{SS} where

$$i = (i_{SS} - 1)s + S \cdot \left\lfloor \frac{k}{s} \right\rfloor + k \bmod s, \quad k = 0,1,\ldots, N_{Block} \cdot s - 1$$

where

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$i_{SS} = 1,\ 2,\ \ldots,\ N_{SS}$

$i = 0,\ 1,\ \ldots,\ N_{CBPS} - 1$

$k = 0,\ 1,\ \ldots,\ N_{CBPS} - 1$

26.3.10.6 Segment parser

For a 160 MHz and 80+80 MHz HE SU PPDU, a 160 MHz and 80+80 MHz HE MU PPDU, and a HE trigger-based PPDU with the RU spanning the entire PPDU bandwidth, the output bits of each stream parser are segment parsed as specified in 22.3.10.7.

26.3.10.7 BCC interleavers

Editor's Note: There is some duplication here. I think we need to delete the Table 25-24 and its reference sentence.

The BCC interleaver parameters are defined in Table 26-24 (BCC interleaver and LDPC tone mapper parameter).

Table 26-24—BCC interleaver and LDPC tone mapper parameter

RU Size (tones)	BCC		LDPC
	N_{col}	N_{rot}	D_{TM}
26	8	2	1
52	16	11	3
106	17	29	6
242	26	58	9
484	-	-	12
996	-	-	20

For ease of explanation, the operation of the interleaver is described only for the SU case. For user *u* in the *r*-th RU of an MU transmission, the interleaver operates in the same way on the output bits for the user from the stream parser by replacing N_{SS}, N_{CBPSS}, N_{CBPSSI}, and N_{BPSCS} with $N_{SS,r,u}$, $N_{CBPSS,r,u}$, $N_{CBPSSI,r,u}$ and $N_{BPSCS,r,u}$, respectively. That is, the operation of the interleaver is the same as if the transmission were an SU one, consisting of bits from only that user.

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The BCC interleaver operation is specified in 22.3.10.8 (BCC interleaver). The values of the interleaver parameters, N_{COL}, N_{ROW}, and N_{ROT} are selected based on the RU size of the user, and are given in Table 26-25 (BCC interleaver parameters).

Table 26-25—BCC interleaver parameters

Parameter	RU Size (tones)			
	26	52	106	242
N_{COL}	8	16	17	26
N_{ROW}	$3 \times N_{BPSCS}$	$3 \times N_{BPSCS}$	$6 \times N_{BPSCS}$	$9 \times N_{BPSCS}$
N_{ROT} ($N_{SS} \leq 4$)	2	11	29	58

26.3.10.8 Constellation mapping

The mapping between the input bits of the constellation mapper and complex constellation points for BPSK, QPSK, 16-QAM, 64-QAM and 256-QAM is as defined in 22.3.10.9 (constellation mapping).

1024-QAM is used as an optional feature for SU and MU using resource units equal to or larger than 242 tones in 11ax. For 1024-QAM, the constellation mapping is TBD.

Dual sub-carrier modulation (DCM) is an optional modulation scheme for the HE-SIG-B and Data fields. DCM is only applied to BPSK, QPSK and 16-QAM modulations.

When DCM is employed, bit sequences are mapped to a pair symbols $(d_k, d_{q(k)})$ where k is in the range of $0 \leq k \leq \frac{N_{SD}}{2} - 1$ and $q(k)$ is in the range of $\frac{N_{SD}}{2} \leq k \leq N_{SD} - 1$ in order to exploit frequency diversity. To maximize the frequency diversity, the indices of a pair of DCM subcarriers $(k, q(k))$ is $q(k) = k + N_{SD}/2$.

For QPSK modulation with DCM, the input stream is broken into groups of N_{CBPS} or $N_{CBPS,ru}$ bits $(B_0, B_1, \ldots, B_{N_{CBPS,ru}-1})$. Each pair of bits (B_{2k}, B_{2k+1}) is QPSK modulated to a symbol d_k. This generates the constellation points for the lower half the data subcarriers in the RU. For the upper half of the data subcarriers in the RU, $d_{q(k)} = conj(d_k)$.

For BPSK and 16-QAM modulation with DCM, the constellation mapping is TBD.

26.3.10.9 Space-time block coding

This subclause defines a set of optional robust transmission techniques that are applicable only when using STBC coding. For an HE PPDU, STBC is allowed only with single spatial stream and two space-time streams, and its application is as indicated by the STBC bit in HE-SIG-A (TBD: undecided whether in HE-SIG-A for HE_MU). In an HE MU PPDU, STBC coding is used in all RUs or not used in any of the RUs. If in an RU, DL MU-MIMO is applied, STBC shall not be used in any RU in the HE MU PPDU.

The STBC encoding process is as described in clause 22.3.10.9.4 (Space-time block coding), with $N_{SS,0} = 1$ and $N_{STS,0} = 2$.

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26.3.10.10 LDPC tone mapper

The LDPC tone mapper parameters are defined in Table 26-24 (BCC interleaver and LDPC tone mapper parameter).

The LDPC tone mapping shall be performed on all LDPC encoded streams mapped in a RU as described in this subclause. LDPC tone mapping shall not be performed on streams that are encoded using BCC. When DCM is applied to LDPC encoded streams, DTM_DCM shall be applied on both the lower half data subcarriers in a RU and the upper half data subcarriers of the RU. The LDPC tone-mapping distance parameter D_{TM} and D_{TM_DCM} are constant for each RU size and the values for different RU sizes are given in Table 26-26 (LDPC tone mapping distance for each RU size).

Table 26-26—LDPC tone mapping distance for each RU size

Parameter	RU Size (tones)						
	26	52	106	242	484	996	2x996
D_{TM}	1	3	6	9	12	20	20
D_{TM_DCM}	1	1	3	9	9	14	20

For an HE PPDU without DCM, the LDPC tone mapping for the LDPC encoded stream for user u in the r-th RU is done by permuting the stream of complex numbers generated by the constellation mappers (see 26.3.10.7) to

$$d''_{t(k),i,n,l,r,u} = d'_{k,i,n,l,r,u};\ k = 0,1,...,N_{SD}-1 \text{ for a RU of 26, 52, 106, 242, 484, and 996 tones}$$
$$k = 0,1,...,\frac{N_{SD}}{2}-1 \text{ for a RU of } 996\times 2 \text{ tones}$$
$$i = 1,\ldots,N_{SS,r,u}$$
$$n = 0,1,\ldots,N_{SYM}-1$$
$$l = 0 \text{ for a RU of 26, 52, 106, 242, 494, and 996 tones}$$
$$l = 0,1 \text{ for a RU of } 996\times 2 \text{ tones}$$
$$u = 0,\ldots,N_{user,r}-1$$
$$r = 0,\ldots,N_{RU}-1 \qquad (26\text{-}96)$$

where N_{SD} is the number of data tones in the r-th RU.

$$t(k) = \begin{cases} D_{TM}\left(k \bmod \frac{N_{SD}}{D_{TM}}\right) + \left\lfloor \frac{k\cdot D_{TM}}{N_{SD}} \right\rfloor, & \text{for a RU of 26, 52, 106, 242, 484, and 996 tones} \\ D_{TM}\left(k \bmod \frac{N_{SD}/2}{D_{TM}}\right) + \left\lfloor \frac{k\cdot D_{TM}}{N_{SD}/2} \right\rfloor, & \text{for a RU of } 996\times 2 \text{ tones} \end{cases} \qquad (26\text{-}97)$$

For a HE PPDU with DCM, the LDPC tone mapping for the LDPC encoded stream corresponding to user u in the r-th RU is done by permuting the stream of complex numbers generated by the constellation mappers (see 25.3.10.7) to

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$$d''_{t(k),i,n,l,r,u} = \begin{cases} d'_{k,i,n,l,r,u}; \\ d'_{k',i,n,l,r,u}; \end{cases} \quad (26\text{-}98)$$

where

$k = 0,1,...,\frac{N_{SD}}{2} - 1$

$k' = k - \frac{N_{SD}}{2}$, *for* $k = \frac{N_{SD}}{2}, \frac{N_{SD}}{2} + 1,..., N_{SD}\text{-}1$

$i = 1,\ldots, N_{SS,r,u}$

$n = 0,1,\ldots, N_{SYM} - 1$

$l = 0$ for a RU of 26, 52, 106, 242, 494, and 996 tones

$l = 0,1$ for a RU of 996×2 tones

$u = 0,\ldots, N_{user,r} - 1$

$r = 0,\ldots, N_{RU} - 1$

N_{SD} is the number of data tones in the *r*-th RU and

$$t(k) = \begin{cases} D_{TM_DCM}\left(k \bmod \frac{N_{SD}/2}{D_{TM_DCM}}\right) + \left\lfloor \frac{k \cdot D_{TM_DCM}}{N_{SD}/2} \right\rfloor, & \text{for a RU of 26, 52, 106, 242, 484, and 996 tones} \\ D_{TM_DCM}\left(k' \bmod \frac{N_{SD}/2}{D_{TM_DCM}}\right) + \left\lfloor \frac{k' \cdot D_{TM_DCM}}{N_{SD}/2} \right\rfloor + \frac{N_{SD}}{2}, & \text{for a RU of 26, 52, 106, 242, 484, and 996 tones} \\ D_{TM_DCM}\left(k \bmod \frac{N_{SD}/2}{D_{TM_DCM}}\right) + \left\lfloor \frac{k \cdot D_{TM_DCM}}{N_{SD}/2} \right\rfloor, & \text{for a RU of } 996 \times 2 \text{ tones} \end{cases} \quad (26\text{-}99)$$

D_{TM_DCM} is the LDPC tone mapping distance for the r-th RU when DCM is applied.

NOTE—LDPC tone mapper for a 26-, 52-, 106-, 242-, 484- and 996-tone RU is defined as one segement. LDPC tone mapping is performed separately for the upper and lower 80 MHz frequency segments of a 2x996-tone RU as indicated by the frequency subblock index l in Error! Reference source not found. and Error! Reference source not found.

Since LDPC tone mapping is not performed on BCC-coded streams, for BCC-coded streams, the following applies:

$d''_{k,i,n,l,r,u} = d'_{k,i,n,l,r,u}$; $k = 0,1,..., N_{SD} - 1$ for a RU of 26, 52, 106, 242, 484, and 996 tones

$k = 0,1,..., \frac{N_{SD}}{2} - 1$ for a RU of 996×2 to*nes*

$i = 1,\ldots, N_{SS,r,u}$

$n = 0,1,\ldots, N_{SYM} - 1$

$l = 0$ for a RU of 26, 52, 106, 242, 494, and 996 tones

$l = 0,1$ for a RU of 996×2 tones

$u = 0,\ldots, N_{user,r} - 1$

$r = 0,\ldots, N_{RU} - 1$ (26-100)

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26.3.10.11 Segment deparser

In a transmission over a RU of 26, 52, 106, 242, 484 and 996 subcarriers, the segment deparsing is not performed (see EEquation 26-90).

For a 160 MHz HE SU PPDU, or a 160 MHz HE MU PPDU or HE trigger-based PPDU with the RU spanning the entire PPDU bandwidth, the two frequency subblocks at the output of the LDPC tone mapper are combined into one frequency segment as specified in Equation 26-89.

In an 80+80 MHz HE PPDU transmission, the segment deparsing is not performed (see Equation 26-91).

26.3.10.12 Pilot subcarriers

For a user transmitting on the *i*-th 26-tone RU in a given PPDU BW, two pilot tones shall be inserted in subcarriers $k \in K_{R26_i}$, where K_{R26_i} is given by *i*-th pilot index set in the row of given PPDU BW of Table 26-27 (Pilot indices for 26-tone RU transmission).

Table 26-27—Pilot indices for 26-tone RU transmission

PPD BW	K_{R26_i}
20 MHz, *i* = 1:9	−116/−102, −90/−76, −62/−48, −36/−22, −10/10, 22/36, 48/62, 76/90, 102/116
40 MHz, *i* = 1:18	−238/−224, −212/−198, −184/−170, −158/−144, −130/−116, −104/−90, −78/−64, −50/−36, −24/−10, 10/24, 36/50, 64/78, 90/104, 116/130, 144/158, 170/184, 198/212, 224/238
80 MHz, *i* = 1:37	−494/−480, −468/−454, −440/−426, −414/−400, −386/−372, −360/−346, −334/−320, −306/−292, −280/−266, −252/−238, −226/−212, −198/−184, −172/−158, −144/−130, −118/−104, −92/−78, −64/−50, −38/−24, −10/10, 24/38, 50/64, 78/92, 104/118, 130/144, 158/172, 184/198, 212/226, 238/252, 266/280, 292/306, 320/334, 346/360, 372/386, 400/414, 426/440, 454/468, 480/494
160 MHz, *i* = 1:74	{pilot tone indices in 80 MHz −512, pilot tone indices in 80 MHz +512}

The pilot mapping P_k^k for subcarrier *k* for symbol *n* shall be as specified in Equation 26-101.

$$P_n^{K_{R26_i}} = \{\Psi_{i,n \bmod 2}, \Psi_{i,(n+1) \bmod 2}\}$$
$$P_n^{k \notin K_{R26_i}} = 0 \qquad (26\text{-}101)$$

where

$\Psi_{i,m}$ is TBD for Pilot values for *i*-th 26-tone RU in a given PPDU BW.

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For a user transmitting on the *i*-th 52-tone RU in a given PPDU BW, four pilot tones shall be inserted in subcarriers $k \in K_{R52_i}$, where K_{R52_i} is given by *i*-th pilot index set in the row of given PPDU BW of Table 26-28 (Pilot indices for 52-tone RU transmission).

Table 26-28—Pilot indices for 52-tone RU transmission

PPD BW	K_{R52_i}
20 MHz, *i* = 1:4	−116/−102/−90/−76, −62/−48/−36/−22, 22/36/48/62, 76/90/102/116
40 MHz, *i* = 1:8	−238/−224/−212/−198, −184/−170/−158/−144, −104/−90/−78/−64, −50/−36/−24/−10, 10/24/36/50, 64/78/90/104, 144/158/170/184, 198/212/224/238
80 MHz, *i* = 1:16	−494/−480/−468/−454, −440/−426/−414/−400, −360/−346/−334/−320, −306/−292/−280/−266, −252/−238/−226/−212, −198/−184/−172/−158, −118/−104/−92/−78, −64/−50/−38/−24, 24/38/50/64, 78/92/104/118, 158/172/184/198, 212/226/238/252, 266/280/292/306, 320/334/346/360, 400/414/426/440, 454/468/480/494
160 MHz, *i* = 1:32	{pilot tone indices in 80 MHz −512, pilot tone indices in 80 MHz +512}

The pilot mapping P_k^k for subcarrier *k* for symbol *n* shall be as specified in Equation 26-102.

$$P_n^{K_{R52_i}} = \{\Psi_{i,n \bmod 4}, \Psi_{i,(n+1) \bmod 4}, \Psi_{i,(n+2) \bmod 4}, \Psi_{i,(n+3) \bmod 4}\}$$
$$P_n^{k \notin K_{R52_i}} = 0 \qquad (26\text{-}102)$$

where

$\Psi_{i,m}$ is TBD for pilot values for the *i*-th 52-tone RU in a given PPDU BW.

For a user transmitting on the *i*-th 106-tone RU in a given PPDU BW, four pilot tones shall be inserted in subcarriers $k \in K_{R106_i}$, where K_{R106_i} is given by *i*-th pilot index set in the row of given PPDU BW of Table 26-29 (Pilot indices for 106-tone RU transmission).

Table 26-29—Pilot indices for 106-tone RU transmission

PPD BW	K_{R106_i}
20 MHz, *i* = 1:2	−116/−90/−48/−22, 22/48/90/116
40 MHz, *i* = 1:4	−238/−212/−170/−144, −104/−78/−36/−10, 10/36/78/104, 144/170/212/238
80 MHz, *i* = 1:8	−494/−468/−426/−400, −360/−334/−292/−266, −252/−226/−184/−158, −118/−92/−50/−24, 24/50/92/118, 158/184/226/252, 266/292/334/360, 400/426/468/494
160 MHz, *i* = 1:16	{pilot tone indices in 80 MHz −512, pilot tone indices in 80 MHz +512}

The pilot mapping P_k^k for subcarrier *k* for symbol *n* shall be as specified in Equation 26-103.

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$$P_n^{K_{\mathrm{R106}_i}} = \{\Psi_{i,n \bmod 4}, \Psi_{i,(n+1) \bmod 4}, \Psi_{i,(n+2) \bmod 4}, \Psi_{i,(n+3) \bmod 4}\}\}$$
$$P_n^{k \notin K_{\mathrm{R106}_i}} = 0 \quad (26\text{-}103)$$

where

$\Psi_{i,m}$ is TBD for pilot values for the *i*-th 106-tone RU in a given PPDU BW.

For a user transmitting on the *i*-th 242-tone RU in a given PPDU BW, eight pilot tones shall be inserted in subcarriers $k \in K_{R242_i}$, where K_{R242_i} is given by *i*-th pilot index set in the row of given PPDU BW of Table 26-30 (Pilot indices for 242-tone RU transmission).

Table 26-30—Pilot indices for 242-tone RU transmission

PPD BW	K_{R242_i}
20 MHz, *i* = 1	−116/−90/−48/−22/22/48/90/116
40 MHz, *i* = 1:2	−238/−212/−170/−144/−104/−78/−36/−10, 10/36/78/104/144/170/212/238
80 MHz, *i* = 1:4	−494/−468/−426/−400/−360/−334/−292/−266,−252/−226/−184/−158/−118/−92/−50/−24, 24/50/92/118/158/184/226/252, 266/292/334/360/ 400/426/468/494
160 MHz, *i* = 1:8	{pilot tone indices in 80 MHz −512, pilot tone indices in 80 MHz +512}

The pilot mapping P_k^k for subcarrier *k* for symbol *n* shall be as specified in Equation 26-104.

$$P_n^{K_{\mathrm{R242}_i}} = \{\Psi_{i,n \bmod 8}, \Psi_{i,(n+1) \bmod 8}, \Psi_{i,(n+2) \bmod 8}, \Psi_{i,(n+3) \bmod 8}, \Psi_{i,(n+4) \bmod 8}, \Psi_{i,(n+5) \bmod 8}, \Psi_{i,(n+6) \bmod 8}, \Psi_{i,(n+7) \bmod 8}\}$$
$$P_n^{k \notin K_{\mathrm{R242}_i}} = 0 \quad (26\text{-}104)$$

where

$\Psi_{i,m}$ is TBD for pilot values for the *i*-th 242-tone RU in a given PPDU BW.

For a user transmitting on the *i*-th 484-tone RU in a given PPDU BW, sixteen pilot tones shall be inserted in subcarriers $k \in K_{R484_i}$, where K_{R484_i} is given by *i*-th pilot index set in the row of given PPDU BW of Table 26-31 (Pilot indices for 484-tone RU transmission).

Table 26-31—Pilot indices for 484-tone RU transmission

PPD BW	K_{R484_i}
40 MHz, *i* = 1	−238/−212/−170/−144/−104/−78/−36/−10/10/36/78/104/144/170/212/238
80 MHz, *i* = 1:2	−494/−468/−426/−400/−360/−334/−292/−266/−252/−226/−184/−158/−118/−92/−50/−24, 24/50/92/118/158/184/226/252/266/292/334/360/400/426/468/494
160 MHz, *i* = 1:4	{pilot tone indices in 80 MHz −512, pilot tone indices in 80 MHz +512}

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The pilot mapping P_k^k for subcarrier *k* for symbol *n* shall be as specified in Equation 26-105.

$$P_n^{K_{\mathrm{R484}_i}} = \{\Psi_{i,n \bmod 8}, \Psi_{i,(n+1) \bmod 8}, \Psi_{i,(n+2) \bmod 8}, \Psi_{i,(n+3) \bmod 8}, \Psi_{i,(n+4) \bmod 8}, \Psi_{i,(n+5) \bmod 8}, \Psi_{i,(n+6) \bmod 8}, \Psi_{i,(n+7) \bmod 8}, \cdots$$
$$\Psi_{i,(n+8) \bmod 8}, \Psi_{i,(n+9) \bmod 8}, \Psi_{i,(n+10) \bmod 8}, \Psi_{i,(n+11) \bmod 8}, \Psi_{i,(n+12) \bmod 8}, \Psi_{i,(n+13) \bmod 8}, \Psi_{i,(n+14) \bmod 8}, \Psi_{i,(n+15) \bmod 8}\}$$
$$P_n^{k \notin K_{\mathrm{R484}_i}} = 0 \quad (26\text{-}105)$$

where

$\Psi_{i,m}$ is TBD for pilot values for the *i*-th 484-tone RU in a given PPDU BW.

For a user transmitting on the *i*-th 996-tone RU in a given PPDU BW, sixteen pilot tones shall be inserted in subcarriers $k \in K_{R996_i}$, where K_{R996_i} is given by *i*-th pilot index set in the row of given PPDU BW of Table 26-32 (Pilot indices for 996-tone RU transmission).

Table 26-32—Pilot indices for 996-tone RU transmission

PPD BW	K_{R996_i}
80 MHz, *i* = 1	−468/−400/−334/−266/−226/−158/−92/−24/24/92/158/226/266/334/400/468
160 MHz, *i* = 1:2	{pilot tone indices in 80 MHz −512, pilot tone indices in 80 MHz +512}: −980/−912/−846/−778/−738/−670/−604/−536/−488/−420/−354/−286/−246/−178/−112/−44, 44/112/178/246/286/354/420/488/536/604/670/738/778/846/912/980

The pilot mapping P_k^k for subcarrier *k* for symbol *n* shall be as specified in Equation 26-106.

$$P_n^{K_{\mathrm{R996}_i}} = \{\Psi_{i,n \bmod 8}, \Psi_{i,(n+1) \bmod 8}, \Psi_{i,(n+2) \bmod 8}, \Psi_{i,(n+3) \bmod 8}, \Psi_{i,(n+4) \bmod 8}, \Psi_{i,(n+5) \bmod 8}, \Psi_{i,(n+6) \bmod 8}, \Psi_{i,(n+7) \bmod 8}, \cdots$$
$$\Psi_{i,(n+8) \bmod 8}, \Psi_{i,(n+9) \bmod 8}, \Psi_{i,(n+10) \bmod 8}, \Psi_{i,(n+11) \bmod 8}, \Psi_{i,(n+12) \bmod 8}, \Psi_{i,(n+13) \bmod 8}, \Psi_{i,(n+14) \bmod 8}, \Psi_{i,(n+15) \bmod 8}\}$$
$$P_n^{k \notin K_{\mathrm{R996}_i}} = 0 \quad (26\text{-}106)$$

where

$\Psi_{i,m}$ is TBD for pilot values for the *i*-th 996-tone RU in a given PPDU BW.

For a 160 MHz transmission, the 80 MHz pilot mapping is replicated in the two 80 MHz subchannels of the 160 MHz transmission. Specifically, thirty-two pilot tones shall be inserted in subcarriers $k \in K_{\mathrm{R2x996}_i}$, where K_{R2x996_i} is given by {–980, –912, –846, –778, –738, –670, –604, –536, –488, –420, –354, –286, –246, –178, –112, –44, 44, 112, 178, 246, 286, 354, 420, 488, 536, 604, 670, 738, 778, 846, 912, 980}. The pilot mapping Pnk for subcarrier *k* for symbol *n* shall be as specified in Equation 26-107.

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$$
\begin{aligned}
P_n^{K_{\mathrm{R2x996}}} &= \{\Psi_{i,n \bmod 8}, \Psi_{i,(n+1) \bmod 8}, \Psi_{i,(n+2) \bmod 8}, \Psi_{i,(n+3) \bmod 8}, \Psi_{i,(n+4) \bmod 8}, \Psi_{i,(n+5) \bmod 8}, \Psi_{i,(n+6) \bmod 8}, \Psi_{i,(n+7) \bmod 8}, \cdots \\
&\quad \Psi_{i,(n+8) \bmod 8}, \Psi_{i,(n+9) \bmod 8}, \Psi_{i,(n+10) \bmod 8}, \Psi_{i,(n+11) \bmod 8}, \Psi_{i,(n+12) \bmod 8}, \Psi_{i,(n+13) \bmod 8}, \Psi_{i,(n+14) \bmod 8}, \Psi_{i,(n+15) \bmod 8}, \cdots \\
&\quad \Psi_{i,n \bmod 8}, \Psi_{i,(n+1) \bmod 8}, \Psi_{i,(n+2) \bmod 8}, \Psi_{i,(n+3) \bmod 8}, \Psi_{i,(n+4) \bmod 8}, \Psi_{i,(n+5) \bmod 8}, \Psi_{i,(n+6) \bmod 8}, \Psi_{i,(n+7) \bmod 8}, \cdots \\
&\quad \Psi_{i,(n+8) \bmod 8}, \Psi_{i,(n+9) \bmod 8}, \Psi_{i,(n+10) \bmod 8}, \Psi_{i,(n+11) \bmod 8}, \Psi_{i,(n+12) \bmod 8}, \Psi_{i,(n+13) \bmod 8}, \Psi_{i,(n+14) \bmod 8}, \Psi_{i,(n+15) \bmod 8}\} \\
P_n^{k \notin K_{\mathrm{R2x996}}} &= 0
\end{aligned}
\tag{26-107}
$$

where

$\Psi_{i,\,m}$ is TBD for pilot values for the *i*-th 996-tone RU in a given PPDU BW.

For a noncontiguous 80+80 MHz transmission, each frequency segment shall follow the 80 MHz pilot tone allocation and values defined for 996-tone RU in 80 MHz transmission as specified in Equation 26-106 and TBD pilot values for 996-tone RU in 80 MHz PPDU BW.

The above pilot mapping shall be copied to all space-time streams before the space-time stream cyclic shifts are applied.

26.3.10.13 OFDM modulation

The time domain waveform of the Data field of an HE PPDU that is not an HE trigger-based PPDU, from transmit chain i_{TX}, $1 \le i_{TX} \le N_{TX}$, shall be as defined in Equation 26-108.

$$
\begin{aligned}
r_{\mathrm{HE\text{-}Data}}^{(i_{seg}, i_{TX})}(t) = & \frac{1}{\sqrt{\sum_{r=1}^{N_{RU}} \alpha_r^2 \left|K_r\right|}} \sum_{n=0}^{N_{SYM}-1} w_{T_{HE-Data}}\left(t - nT_{SYM}\right) \sum_{r=0}^{N_{RU}-1} \frac{\alpha_r}{\sqrt{N_{STS,r,total}}} \\
& \cdot \sum_{k \in K_r} \sum_{u=0}^{N_{user,r}-1} \sum_{m=1}^{N_{STS,r,u}} \left(\begin{array}{l} \left[Q_k^{(i_{seg})} \right]_{i_{TX},\left(M_{r,u}+m\right)} \left(\tilde{D}_{k,m,n,r}^{(i_{Seg},u)} + p_{n+2+N_{HE-SIG-A}+N_{HE-SIG-B}} P_n^k \right) \\ \cdot \exp\left(j2\pi k \Delta_{F,HE} \left(t - nT_{SYM} - T_{\mathrm{GI,Data}} - T_{CS,HE}\left(M_{r,u}+m\right) \right) \right) \end{array} \right)
\end{aligned}
\tag{26-108}
$$

where

p_n is defined in 18.3.5.10 (OFDM modulation)

P_n^k is defined in Error! Reference source not found.

$\tilde{D}_{k,\,m,\,n,\,BW}^{(i_{Seg,\,r,\,u})}$ is the transmitted constellation for user *u* in the *r*-th RU at subcarrier *k*, space-time stream *m*, and Data field OFDM symbol *n* and is defined in Error! Reference source not found..

$N_{\mathrm{HE\text{-}Data}}^{\mathrm{Tone}}$ has the value given in Error! Reference source not found.

$T_{CS,\,HE}(n)$ is given in 26.3.9.2 (Cyclic shift for Pre-HE modulated fields)

$T_{\mathrm{GI,Data}}$ is the guard interval duration as defined in Table 26-3 (Timing-related constants)

$$
\tilde{D}_{k,m,n,r}^{(i_{Seg},u)} = \begin{cases} 0, k \in K_{\mathrm{Pilot}} \\ \tilde{d}_{M_r(k),m,n,r,u}^{(i_{Seg})}, \text{otherwise} \end{cases}
\tag{26-109}
$$

where

K_{Pilot} is the set of subcarrier indices of pilot tones, as defined in 26.3.7.3 (Pilot tones)

$M_r(k)$ is defined in Equation 26-110

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$$M_r(k) = k - K_{r,\min} - \left| \left\{ k' : K_{r,\min} \le k' < k \right\} \cap K_{\text{Pilot}} \right| \tag{26-110}$$

where

$K_{r,min}$ is the minimum value of the set K_r

$|\Phi|$ is the cardinality of a set Φ

NOTE – Mr(k) translates a subcarrier index k ($-N_{SR} \le k \le N_{SR}$) into the index of data symbols in a transmission over a RU ($0 \le M_r(k) \le N_{SD,r}$). The subcarrier index k for the data tone is first offset by the minimum value of subcarrier index $K_{r,min}$ (for the lower edge tone) in this RU, and then subtracted by the number of pilot tones falling in between the data tone and the edge tone.

In a noncontiguous 80+80 MHz transmission, each frequency segment shall follow the 80 MHz HE subcarrier mapping as specified in 26.3.7 (OFDMA and SU tone allocation).

The time domain waveform of the Data field of an HE trigger-based PPDU for user u in the r-th RU from transmit chain i_{TX}, $1 \le i_{TX} \le N_{TX}$ shall be as defined in Equation 26-111.

$$r_{\text{HE-Data}}^{(i_{seg}, i_{TX})}(t) = \frac{\alpha_r}{\sqrt{\sum_{r=1}^{N_{RU}} \alpha_r^2 |K_r|}} \sum_{n=0}^{N_{SYM}-1} w_{T_{HE-Data}}(t - nT_{SYM}) \frac{1}{\sqrt{N_{STS,r,total}}} \cdot \sum_{k \in K_r} \sum_{m=1}^{N_{STS,r,u}} \left(\begin{array}{l} \left[Q_k^{(i_{seg})} \right]_{i_{TX},(M_{r,u}+m)} \left(\tilde{D}_{k,m,n,r}^{(i_{Seg},u)} + p_{n+4} P_n^k \right) \\ \cdot \exp\left(j2\pi k \Delta_{F,HE} \left(t - nT_{SYM} - T_{\text{GI,Data}} - T_{CS,HE}(M_{r,u}+m) \right) \right) \end{array} \right) \tag{26-111}$$

where

$Q_k^{(i_{Seg})}$ is a spatial mapping/steering matrix with N_{TX} rows and $N_{STS,r,total}$ columns for subcarrier k in frequency segment i_{Seg}. $Q_k^{(i_{Seg})}$ may be frequency dependent, and the dimension may be variant in each RU. Refer to the descriptions in 22.3.10.11.1 (Transmission in VHT format) for examples of $Q_k^{(i_{Seg})}$.

26.3.10.14 Dual carrier modulation

Dual sub-carrier modulation (DCM) modulates the same information on a pair of sub-carriers. DCM is an optional modulation scheme for the HE-SIG-B and Data fields. DCM is only applied to BPSK, QPSK and 16-QAM modulations.

The constellation mapper for DCM is defined in 26.3.10.8 (Constellation mapping). The DCM tone mapper is TBD.

26.3.10.15 Packet extension

A HE PPDU may have a Packet Extension (PE) field appended at the end of the PPDU, with possible durations being 0 μs, 4 μs, 8 μs, 12 μs, or 16 μs. The PE field, when present, shall be transmitted with the same average power as the Data field, and its content is arbitrary (PE content TBD).

The PE field is applied for the recipient of the PPDU to obtain longer processing time at the end of a HE PPDU, and its duration is determined by both the *a-factor* value in the last OFDM symbol(s) of the Data field, and the maximum PE duration requested by the recipient for the signal bandwidth (or RU size), the

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number of spatial streams, and the constellation size of the current PPDU, which is based on the Maximum PE capabilities as defined in HE capabilities field (8.4.2.1 (HE Capabilities Element)).

For a HE PPDU, the maximum PE durations as defined by the Maximum PE capabilities in HE capabilities (8.4.2.1 (HE Capabilities Element)) are 0 μs, 8 μs and 16 μs.

— A 0 μs maximum PE duration means no PE is present.

— A 8 μs maximum PE duration means that a PE field of 0 μs, 0 μs, 4 μs, and 8 μs are appended at the end of the PPDU, corresponding to *a-factor* being 1, 2, 3 and 4, respectively, as shown in Figure 26-34 (PE field when maximum PE duration is 8 μs (non STBC)).

— A 16 μs maximum PE duration means that a PE field of 4 μs, 8 μs, 12 μs, and 16 μs are appended at the end of the PPDU, corresponding to *a-factor* being 1, 2, 3 and 4, respectively, as shown in Figure 26-35 (PE field when maximum PE duration is 16 μs (non STBC)).

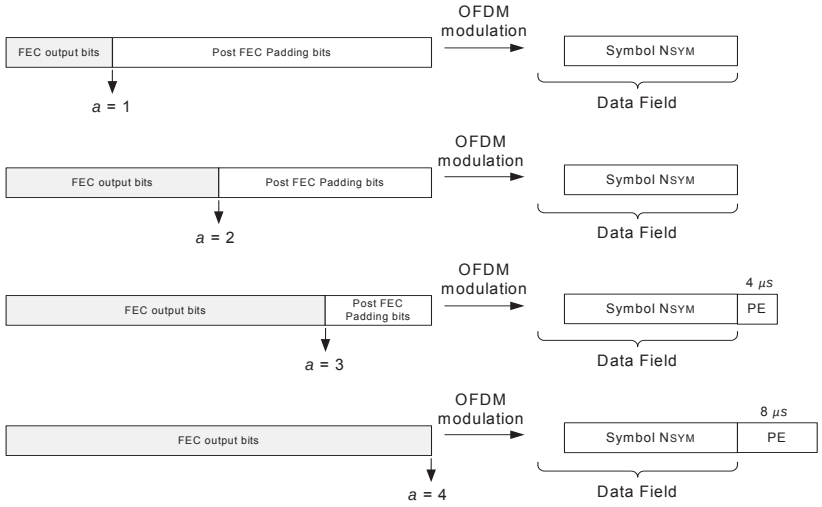

Figure 26-34—PE field when maximum PE duration is 8 μs (non STBC)

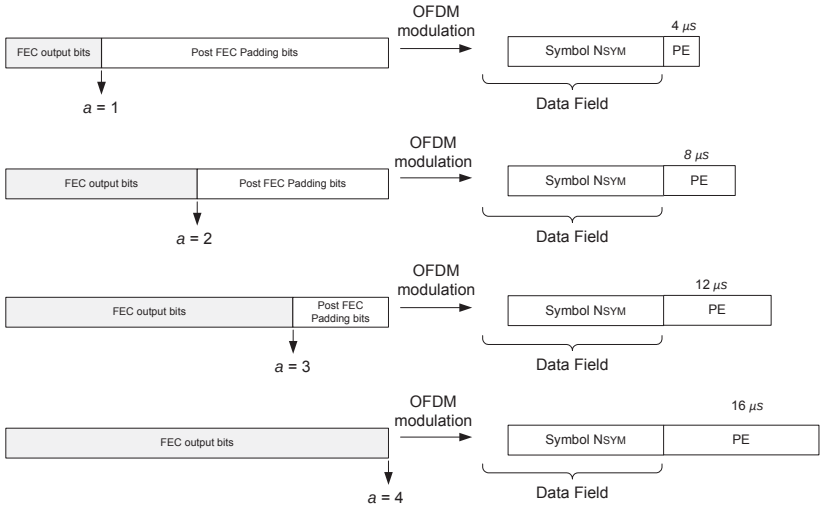

Figure 26-35—PE field when maximum PE duration is 16 μs (non STBC)

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For an HE MU PPDU, the AP computes the PE duration, $T_{PE,u}$, for each user u, according to the common a-factor value among all users as described in 26.3.10.4.4 (Encoding process for an HE MU PPDU), the Maximum PE Duration capabilities, the RU size, the number of spatial streams and constellation size for user u. The AP shall choose the largest PE duration among all the users as the common PE duration of the current HE MU PPDU as:

$$T_{PE} = \max_{u}\left(T_{PE,u}\right) \tag{26-112}$$

and then append the PE field at the end of the current HE MU PPDU, with duration T_{PE}.

For an HE trigger-based PPDU, the AP indicates the common PE duration, T_{PE}, for all the users in the Trigger frame. Each user, when responding the Trigger frame with an HE trigger-based PPDU, shall append PE field at the end of the current HE trigger-based PPDU, with a duration T_{PE}. The value of TPE is TBD.

Editor's Note: The HE-SIG-A bits definition below should be moved into 26.3.9.7 (HE-SIG-A)

The 3-bit Packet Extension field in HE-SIG-A are defined as in Table 26-33 (Packet Extension field in HE-SIG-A).

Table 26-33—Packet Extension field in HE-SIG-A

Name	bits	Definition
a-factor	B0-B1	Indicates a-factor value of current PPDU
PE Disambiguity	B2	Indicates PE disambiguity

The a-factor subfield of the Packet Extension field is encoded as shown in Table 26-34 (a-factor subfield encoding).

Table 26-34—a-factor subfield encoding

a-factor value	a-factor subfield encoding
1	b01
2	b10
3	b11
4	b00

The PE Disabmbituity subfield of the Packet Extension field shall be set to 1 if the condition in Equation (26 113) is met, otherwise it shall be set to 0.

$$T_{PE} + 4 \times \left(\left\lceil \frac{\text{TXTIME} - 20}{4} \right\rceil - \left(\frac{\text{TXTIME} - 20}{4} \right) \right) \geq T_{SYM} \tag{26-113}$$

where

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T_{PE} is the PE field duration

T_{SYM} is the symbol duration of the Data field as defined in 26.3.6 (Timing-related parameters)

TXTIME (in μs) is defined in 26.4.3 (TXTIME and PSDU_LENGTH calculation).

Based on PE disambiguity field and a-factor field, the recipient shall compute N_{SYM} and T_{PE} listed in 26.3.15.

26.3.11 Non-HT duplicate transmission

When the TXVECTOR parameter FORMAT is NON_HT and the TXVECTOR parameter NON_HT_MODULATION is NON_HT_DUP_OFDM, the transmitted PPDU is a non-HT duplicate. Non-HT duplicate transmission is used to transmit to non-HT OFDM STAs, HT STAs, VHT STAs, HE STAs that may be present in a part of a 40 MHz, 80 MHz, or 160 MHz channel (see Error! Reference source not found.). The RL-SIG, HE-SIG-A, HE-SIG-B, HE-STF, and HE-LTF fields are not transmitted. The L-STF, L-LTF, and L-SIG fields shall be transmitted in the same way as in the HE transmission when the TXVECTOR parameter BEAM_CHANGE is 0, with the exceptions for the Rate and Length fields which shall follow 18.3.4 (SIGNAL field).

In a 40 MHz non-HT duplicate transmission, the Data field shall be as defined by Equation 26-61.

For 80 MHz and 160 MHz non-HT duplicate transmissions, the Data field shall be as defined by Error! Reference source not found..

In a noncontiguous 80+80 MHz non-HT duplicate transmission, data transmission in each frequency segment shall be as defined for an 80 MHz non-HT duplicate transmission in Error! Reference source not found..

26.3.12 MU-MIMO

26.3.12.1 Introduction

DL MU MIMO is specified in 22.3.11 for full band transmission. In this amendment, MU-MIMO is also applicable on a subset of active RUs within PPDU bandwidth in both DL and UL. The non-AP STAs in the same MU-MIMO group are allocated the same resource unit. The combination of SU-MIMO and MU-MIMO on different RU for different non-AP STA in one PPDU is supported.

26.3.12.2 Minimum RU size in MU MIMO transmission

Both DL and UL MU MIMO shall transmit on the RU of at least 106 tones.

26.3.12.3 DL MU-MIMO

26.3.12.3.1 Introduction

For DL MU-MIMO beamforming in RU r, the receive signal vector in subcarrier k (where subcarrier k is one of the subcarriers in RU r, $k \in K_r$) at beamformee u, $\boldsymbol{y}_{k,u} = [y_{k,0}, y_{k,1}, \ldots, y_{k,N_{RX_u}-1}]^T$, is shown in Equation 26-114, where $\boldsymbol{x}_k = [\boldsymbol{x}_{k,0}^T, \boldsymbol{x}_{k,1}^T, \ldots, \boldsymbol{x}_{k,N_{user,r}-1}^T]^T$ denotes the transmit signal vector in subcarrier k for all N_{user} beamformees, with $\boldsymbol{x}_{k,u} = [x_{k,0}, x_{k,1}, \ldots, x_{k,N_{STS,r,u}-1}]^T$ being the transmit signal for beamformee u.

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$$\boldsymbol{y}_{k,u} = \boldsymbol{H}_{k,u} \times [Q_{k,0}, Q_{k,1}, \ldots, Q_{k,N_{user}-1}] \times \boldsymbol{x}_k + \boldsymbol{n} \quad (26\text{-}114)$$

where

$\boldsymbol{H}_{k,u}$ is the channel matrix from the beamformer to beamformee u in subcarrier k with dimensions $N_{RX_u} \times N_{TX}$

N_{RX_u} is the number of receive antennas at beamformee u

$Q_{k,u}$ is a steering matrix for beamformee u in subcarrier k with dimensions $N_{TX} \times N_{STS,r,u}$

N_{user} is the number of VHT MU PPDU recipients (see Table 26-6 (Frequently used parameters))

$\boldsymbol{n}$ is a vector of additive noise and may include interference

The DL MU-MIMO steering matrix $Q_k = [Q_{k,0}, Q_{k,1}, \ldots, Q_{k,N_{user,r}-1}]$ can be determined by the beamformer using the beamforming feedback for subcarrier k from beamformee u, where $u = 0, 1, \ldots, N_{user,r} - 1$. The feedback report format is TBD. The steering matrix that is computed (or updated) using new beamforming feedback from some or all of participating beamformees might replace the existing steering matrix Q_k for the next DL MU-MIMO data transmission. The beamformee group for the DL MU transmission is signaled in HE-SIG-B (see 26.3.9.8.3 (Time domain encoding) and 26.3.12.3.4 (Resource indication and STA self identification)).

26.3.12.3.2 Beamforming feedback

TBD

26.3.12.3.3 Maximum number of total spatial streams in a VHT MU PPDU

A DL MU-MIMO capable STA shall support reception of DL MU PPDUs with the total number of space-time streams across the N_{user} users being less than or equal to its DL MU-MIMO STS Capability in the HE Capabilities.

26.3.12.3.4 Resource indication and STA self identification

AP shall transmit HE MU PPDU. The UL/DL field in the HE-SIG-A shall be set TBD (for DL). If the value of SIGB Compression field in HE-SIG-A is 0, the RU allocation signaling in the HE-SIG-B common field indicates the combination of RUs in current PPDU bandwidth and the number of STAs on each RU for SU/ MU MIMO transmission. The number of users in RU r for MU-MIMO transmission, $N_{user,r}$ is indicated together with the RU allocation as defined in Table 26-18 (RU allocation signaling: Arrangement and number of MU-MIMO allocations). If the value of SIGB Compression field in HE-SIG-A is 1, there is no RU allocation signaling in HE-SIG-B common field. The number of STAs in the MU MIMO group is indicated in the TBD field in HE-SIG-A. the number of spatial streams $N_{SS,r,u}$ is indicated by NSTS field in user specific block as defined in Table 26 19 and Table 26 20.The allocated spatial streams for a designated MU MIMO user and the total number of spatial streams on the RU are indicated in spatial configuration field of user specific block containing the STA ID of designated MU MIMO STA as defined in Table 26-21 (Spatial Configuration subfield encoding).

When processing the HE-SIG-B, a STA will look at information of each RU to find out its Membership Status, i.e., if it belongs to a beamformee group in a certain RU. If $N_{user,r}$ STAs are scheduled in RU r, there are $N_{user,r}$ user specific blocks for RU r. Each user specific block has an 11-bit field indicating the STA ID. A STA identifies itself as a member in the beamformee group in the RU, if its STA ID matches one of the STA IDs. The user position is indicated by the block index. From a multiplexing information lookup table for $N_{user,r}$, the ordered number of spatial streams for all members in the beamformee group in RU r, $N_{SS,r,u}$,

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$u = 1, \ldots, N_{user,r}$ could be obtained. The spatial streams of different users are ordered in accordance to user position values, i.e., the spatial streams for the user in user position 0 come first, followed by the spatial streams for the user in position 1, followed by the spatial streams for the user in position 2, and followed by the spatial streams for the user in position 3, and so on.

A STA is also able to identify the space-time streams intended for other STAs that act as interference. HE-LTF symbols in the HE DL MU PPDU are used to measure the channel for the space-time streams intended for the STA and can also be used to measure the channel for the interfering space-time streams. To successfully demodulate the space-time streams intended for the STA, it is recommended that the STA uses the channel knowledge for all space-time streams to reduce the effect of interfering space-time streams.

If a STA finds that it is a member of the beamformee group in RU r, its corresponding $N_{STS,r,u}$ interpreted from the HE-SIG-B user specific blocks shall not be zero for the STA in the PPDU. If a STA finds that it is not a member of the beamformee group in RU *r*, then the STA may elect not to process RU *r* in the remainder of the PPDU.

26.3.12.4 UL MU-MIMO

26.3.12.4.1 Introduction

UL MU-MIMO is a technique to allow multiple STAs to transmit simultaneously over the same frequency resource to the receiver. The concept is very similar to SU-MIMO where multiple space-time streams are transmitted simultaneously over the same frequency resource utilizing spatial multiplexing through multiple antennas at the transmitter and receiver. The key difference from SU-MIMO is that in UL MU-MIMO, the transmitted streams originate at multiple transmitters.

For UL MU-MIMO transmissions, support for both single stream pilots and the masking the LTF sequence of each spatial stream by a distinct orthogonal code is mandatory at the transmitter side (non-AP STA).

26.3.12.4.2 Resource indication and STA self identification

UL MU-MIMO transmissions are preceded by a Trigger frame from the AP. Similar as UL OFDMA cases, the Trigger frame indicates the transmitting STAs in the common part about when to transmit the UL MU-MIMO PPDUs, the duration of the payload, and packet-extension. The CP length for UL OFDMA/MU-MIMO transmissions shall also be explicitly indicated by AP in the Trigger frame. The value of CP length for all users addressed by the Trigger frame shall be the same. The Trigger frame shall use 1 bit to indicate whether the UL MU-MIMO transmission following it uses single stream pilots or a mask on each spatial stream of the LTF sequence by a distinct orthogonal code. When single stream pilot is used, no masking is applied to the HE LTF. The allocated RU and spatial streams are carried in the fields of RU allocation info and SS allocation of Per User Info field, where Address field is set as the AID of designated MU MIMO STA. Details TBD.

If a STA finds that there is no Per User Info field in Trigger frame carrying the STA's AID in the Address field, then the STA will not transmit in the following HE trigger-based PPDU.

26.3.12.4.3 Pre-corrections in UL MU-MIMO

Since multiple transmitters take part in an UL MU-MIMO transmission, it requires time, frequency, sampling clock and power pre-correction by the participating STAs to mitigate the synchronization related issues at the AP. Frequency and sampling clock pre-corrections are needed to prevent inter-carrier interference. Power pre-correction is done through power control described in Error! Reference source not found.. The Trigger frame serves as a reference DL frame for the STAs to do the aforementioned pre-

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corrections to the UL PPDUs. The accuracy requirements on these pre-corrections are specified in section x.x.x.

26.3.12.4.4 Power control in UL MU-MIMO

TBD

26.3.12.4.5 Maximum number of spatial streams in UL MU-MIMO PPDUs

An UL MU-MIMO capable STA shall support transmission of UL MU PPDUs with the number of space-time streams being less than or equal to its UL MU-MIMO STS Capability in HE Capabilities.

26.3.12.4.6 Requirements for STAs transmitting HE trigger-based PPDUs

A STA that transmits an HE trigger-based PPDU shall support per chain max(*P*-32, –10 dBm) as the minimum transmit power, with P the maximum power the STA can transmit at the antenna connector of that chain using MCS0 while meeting the TX EVM and spectral mask requirements. A STA transmitting at and above the minimum power shall support the EVM requirements for MCS7 (TBD whether support for higher MCS).

A STA that transmits an HE trigger-based PPDU shall support the absolute transmit power requirements and the RSSI measurement accuracy requirements defined in Table 26-35 (Transmit power and RSSI measurement accuracy).

Table 26-35—Transmit power and RSSI measurement accuracy

Parameter	Minimum Requirement		Comments
	Class A	Class B	
Absolute transmit power accuracy	±3 dB	±9 dB	Accuracy of achieving a specified transmit power
RSSI measurement accuracy	±2 dB	±5 dB	Difference between the actual RSSI and the measured RSSI Requirements are valid from minimum Rx to maximum Rx input power

A STA that transmits an HE trigger-based PPDU shall pre-compensate for carrier frequency offset (CFO) error and timing drift. After compensation, the absolute value of residual CFO error with respect to the PPDU carrying the associated Trigger frame shall not exceed 350 Hz for data subcarriers when measured as the 10% point of CCDF of CFO errors in AWGN at a received power of -60 dBm in the primary 20MHz. The residual CFO error measurement shall be made on the HE trigger-based PPDU following the HE-SIG-A field.

A STA that transmits an HE trigger-based PPDU shall have timing accuracy of ±0.4 μs relative to the PPDU carrying the Trigger frame. This requirement does not include round trip delay.

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26.3.13 Transmit specification

26.3.13.1 Transmit spectral mask

26.3.13.2 Spectral flatness

26.3.13.3 Transmit center frequency and symbol clock frequency tolerance

Transmit center frequency and the symbol clock frequency for all transmit antennas and frequency segments shall be derived from the same reference oscillator.

26.3.13.4 Modulation accuracy

26.3.13.4.1 Introduction to modulation accuracy tests

26.3.13.4.2 Transmit center frequency leakage

The TX LO leakage requirement for all transmission modes shall be the following. The power measured at the location of the RF LO using resolution BW 78.125 kHz shall not exceed the maximum of –32 dB relative to the total transmit power and –20 dBm, or equivalently max(P–32, –20), where P is the transmit power per antenna in dBm. The transmit center frequency leakage is specified per antenna.

26.3.13.4.3 Transmitter constellation error

26.3.14 HE transmit procedure

26.3.15 HE receive procedure

26.4 HE PLME

26.4.1 PLME_SAP sublayer management primitives

Table 25-1 (HE PHY MIB attributes (11ax)) lists the MIB attributes that may be accessed by the PHY entities and the intralayer of higher level LMEs. These attributes are accessed via the PLME-GET, PLME-SET, PLME-RESET, and PLME-CHARACTERISTICS primitives defined in 6.5 (PLME SAP interface).

26.4.2 PHY MIB

TBD

26.4.3 TXTIME and PSDU_LENGTH calculation

The value of the TXTIME parameter returned by the PLME-TXTIME.confirm primitive shall be calculated for a HE PPDU using Equation 26-115 for an HE SU PPDU and HE trigger-based PPDU, Equation 26-116 for an HE MU PPDU and Equation 26-117 for an HE extended range SU PPDU.

$$\text{TXTIME} = T_{\text{LEG_PREAMBLE}} + T_{\text{L-SIG}} + T_{\text{RL-SIG}} + T_{\text{HE-SIG-A}} + T_{\text{HE_PREAMBLE}} + N_{SYM}T_{SYM} + T_{PE} \quad (26\text{-}115)$$

$$\text{TXTIME} = T_{LEG_PREAMBLE} + T_{L-SIG} + T_{RL-SIG} + T_{HE-SIG-A} + N_{HE-SIG-B}T_{HE-SIG-B} + T_{HE_PREAMBLE} + N_{SYM}T_{SYM} + T_{PE} \quad (26\text{-}116)$$

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$$\text{TXTIME} = T_{LEG_PREAMBLE} + T_{L-SIG} + T_{RL-SIG} + T_{HE-SIG-A} + T_{HE-SIG-A-R} + T_{HE_PREAMBLE} + N_{SYM} T_{SYM} + T_{PE} \quad (26\text{-}117)$$

where

$T_{\text{LEG_PREAMBLE}} = T_{L-STF} + T_{L-LTF}$

$$T_{\text{HE_PREAMBLE}} = \begin{cases} T_{\text{HE-STF-T}} + N_{HELTF} T_{\text{HE-LTF,SYM}}, & \text{for an HE trigger-based PPDU} \\ T_{\text{HE-STF-NT}} + N_{HELTF} T_{\text{HE-LTF,SYM}}, & \text{otherwise} \end{cases}$$

$T_{L\text{-}STF}$, $T_{L\text{-}LTF}$, $T_{HE\text{-}STF\text{-}T}$, $T_{HE\text{-}STF\text{-}NT}$, $T_{HE\text{-}LTF,SYM}$, $T_{L\text{-}SIG}$, $T_{RL\text{-}SIG}$, $T_{HE\text{-}SIG\text{-}A}$, $T_{HE\text{-}SIG\text{-}A\text{-}R}$, $T_{HE\text{-}SIG\text{-}B}$, and T_{SYM} are defined in Table 26-3 (Timing-related constants)

$N_{HE\text{-}SIG\text{-}B}$ and $N_{HE\text{-}LTF}$ are defined in Table 26-6 (Frequently used parameters)

For an HE NDP PPDU, there is no Data field and $N_{SYM} = 0$.

For an HE SU PPDU and HE extended range SU PPDU using BCC encoding, the total number of OFDM symbols in the Data field is given by Equation 26-118.

$$N_{SYM} = m_{STBC} \times \left\lceil \frac{8 \cdot \text{APEP_LENGTH} + N_{service} + N_{tail} \cdot N_{ES}}{m_{STBC} \cdot N_{DBPS}} \right\rceil \quad (26\text{-}118)$$

where

m_{STBC} is equal to 2 when STBC is used, and 1 otherwise.

For an HE SU PPDU and HE extended range SU PPDU using LDPC encoding, the total number of OFDM symbols in the Data field, N_{SYM}, is given in 26.3.10.4.2 (LDPC coding).

For an HE MU PPDU (including both MU-MIMO and OFDMA), the total number of OFDM symbols in the Data field, NSYM, is given in 26.3.10.4.4 (Encoding process for an HE MU PPDU).

For an HE trigger-based PPDU, the total number of OFDM symbols in the Data field, N_{SYM}, is given in 26.3.10.4.5 (Encoding process for an HE trigger-based PPDU).

T_{PE} is given by Equation 26-112.

The value of the PSDU_LENGTH parameter returned in the PLME-TXTIME.confirm primitive for an HE SU PPDU and HE extended range SU PPDU is calculated using Equation 26-119.

$$\text{PSDU_LENGTH} = \begin{cases} \left\lfloor \frac{(N_{SYM.init} - m_{STBC}).N_{DBPS} + m_{STBC}.N_{DBPS.Last.init} - N_{service} - N_{tail} \cdot N_{ES}}{8} \right\rfloor & \text{for BCC encoding} \\ \left\lfloor \frac{(N_{SYM.init} - m_{STBC}).N_{DBPS} + m_{STBC}.N_{DBPS.Last.init} - N_{service}}{8} \right\rfloor & \text{for LDPC encoding} \end{cases} \quad (26\text{-}119)$$

where

$N_{SYM,init}$ is given by Equation 26-68 for BCC encoding and by Equation 26-73 for LDPC encoding;

m_{STBC} is 2 when STBC is used, and 1 otherwise;

N_{DBPS} is given in 26.5 (Parameters for HE-MCSs);

$N_{DBPS,Last,init}$ is given by Equation 26-64

The value of the PSDU_LENGTH parameter for user u returned in the PLME-TXTIME.confirm primitive and in the RXVECTOR for a HE MU PPDU is calculated using Equation 26-120.

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$$\text{PSDU_LENGTH}_u = \begin{cases} \left\lfloor \frac{(N_{SYM,init} - m_{STBC}).N_{DBPS,u} + m_{STBC}.N_{DBPS,LAST,u} - N_{service} - N_{tail} \cdot N_{ES}}{8} \right\rfloor & \text{when BCC is used for user } u \\ \left\lfloor \frac{(N_{SYM,init} - m_{STBC}).N_{DBPS,u} + m_{STBC}.N_{DBPS,LAST,init,u} - N_{service}}{8} \right\rfloor & \text{when LDPC is used for user } u \end{cases} \quad (26\text{-}120)$$

$N_{SYM,init}$ is given by Equation 26-81

$N_{DBPS,Last,init}$ is given by Equation 26-82

The value of the PSDU_LENGTH parameter returned in the PLME-TXTIME.confirm primitive for an HE NDP PPDU is 0.

26.4.4 HE PHY

The static HE PHY characteristics, provided through the PLME-CHARACTERISTICS service primitive, shall be as shown in Table 20-25 (HT PHY characteristics) unless otherwise listed in Table 26-36 (HE PHY characteristics). The definitions for these characteristics are given in 6.5 (PLME SAP interface).

Table 26-36—HE PHY characteristics

Characteristic	Value
aTxPHYDelay	Implementation dependent
aRxPHYDelay	Implementation dependent
aCCAMidTIme	25 μs
aPPDUMaxTime	5.484 ms
aPSDUMaxLength	TBD

26.5 1 Parameters for HE-MCSs

The rate-dependent parameters for 26-tone RU, 52-tone RU, 106-tone RU, 242-tone RU and non-OFDMA 20 MHz, 484-tone RU and non-OFDMA 40 MHz, 996-tone RU and non-OFDMA 80 MHz, non-OFDMA 160 MHz and 80+80 MHz N_{SS} = 1, …, 8 are given in Table 26-85 (HE-MCSs for optional non-OFDMA 160 MHz and 80+80 MHz, NSS = 1) through Table 26-92 (HE-MCSs for optional non-OFDMA 160 MHz and 80+80 MHz, NSS = 8). Support for HE-MCS 8, 9, 10, and 11 (when valid) is optional in all cases. HE-MCS 10 and 11 (1024-QAM) are applicable only to RU sizes equal to or larger than 242 tones.

Dual sub-carrier modulation (DCM) is an optional modulation scheme for any OFDMA and non OFDMA transmissions. DCM is only applicable to MCS 0, 1, 3 and 4 with up to TBD number of streams and for TBD RU sizes. A HE STA shall support single spatial stream HE-MCSs within the range HE-MCS 0 to HE-MCS 7 for all channel widths for which it has indicated support regardless of the Tx or Rx Highest Supported Long GI Data Rate subfield values in the Supported HE-MCS and NSS Set field. When more than one spatial stream is supported, the Tx or Rx Highest Supported Long GI Data Rate subfield values in the Supported HE-MCS and NSS Set field may result in a reduced HE-MCS range (cut-off) for N_{SS} = 2, …, 8. Support for OFDMA 26-tone RU, 52-tone RU, 106-tone RU, 242-tone RU and 996-tone RU with N_{SS} = 1 is TBD mandatory/optional. Support for non-OFDMA 20 MHz, 40 MHz, and 80 MHz with N_{SS} = 1 is mandatory. Support for more than one spatial stream is optional in all cases. Support for OFDMA and non-OFDMA 160 MHz and 80+80 MHz with N_{SS} = 1, …, 8 is optional. N_{ES} values were chosen to yield an integer number of punctured blocks for each BCC encoder per OFDM symbol.

Table 26-37 (HE-MCSs for TBD mandatory/optional 26-tone RU, NSS = 1) to Table 26-92 (HE-MCSs for optional non-OFDMA 160 MHz and 80+80 MHz, NSS = 8) define HE-MCSs not only for SU transmission but also for user *u* at *r*-th RU of an MU transmission. In the case of HE-MCSs for MU transmissions, the parameters, N_{SS}, R, N_{BPSCS}, N_{CBPS}, N_{DBPS}, and N_{ES} are replaced with $N_{SS,r,u}$, $R_{r,u}$, $N_{BPSCS,r,u}$, $N_{CBPS,r,u}$, $N_{DBPS,r,u}$, and $N_{ES,r,u}$, respectively.

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In the tables below, the number of streams and RU sizes that DCM is applicable to are TBD.

Table 26-37—HE-MCSs for TBD mandatory/optional 26-tone RU, N_{SS} = 1

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mbps)		
										0.8 μs GI	1.6 μs GI	3.2 μs GI
0	1	BPSK	1/4	1	24	2	24	6	1	0.4	0.4	0.4
0	0		1/2	1			24	12	1	0.9	0.8	0.8
1	1	QPSK	1/4	2			48	12	1	0.9	0.8	0.8
1	0		1/2	2			48	24	1	1.8	1.7	1.5
2	N/A		3/4	2			48	36	1	2.6	2.5	2.3
3	1	16-QAM	1/4	4			96	24	1	1.8	1.7	1.5
3	0		1/2	4			96	48	1	3.5	3.3	3.0
4	1		3/8	4			96	36	1	2.6	2.5	2.3
4	0		3/4	4			96	72	1	5.3	5.0	4.5
5	N/A	64-QAM	2/3	6			144	96	1	7.1	6.7	6.0
6			3/4	6			144	108	1	7.9	7.5	6.8
7			5/6	6			144	120	1	8.8	8.3	7.5
8		256-QAM	3/4	8			192	144	1	10.6	1.0	9.0
9			5/6	8			192	160	1	11.8	11.1	10.0

Table 26-38—HE-MCSs for TBD mandatory/optional 26-tone RU, N_{SS} = 2

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mbps)		
										0.8 μs GI	1.6 μs GI	3.2 μs GI

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Table 26-38—HE-MCSs for TBD mandatory/optional 26-tone RU, N_{SS} = 2

0	1	BPSK	1/4	1	24	2	48	12	1	0.9	0.8	0.8
0	0		1/2	1			48	24	1	1.8	1.7	1.5
1	1	QPSK	1/4	2			96	24	1	1.8	1.7	1.5
1	0		1/2	2			96	48	1	3.5	3.3	3.0
2	N/A		3/4	2			96	72	1	5.3	5.0	4.5
3	1	16-QAM	1/4	4			192	48	1	3.5	3.3	3.0
3	0		1/2	4			192	96	1	7.1	6.7	6.0
4	1		3/8	4			192	72	1	5.3	5.0	4.5
4	0		3/4	4			192	144	1	10.6	10.0	9.0
5	N/A	64-QAM	2/3	6			288	192	1	14.1	13.3	12.0
6			3/4	6			288	216	1	15.9	15.0	13.5
7			5/6	6			288	240	1	17.6	16.7	15.0
8		256-QAM	3/4	8			384	288	1	21.2	20.0	18.0
9			5/6	8			384	320	1	23.5	22.2	20.0

Table 26-39—HE-MCSs for TBD mandatory/optional 26-tone RU, N_{SS} = 3

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	24	2	72	18	1	1.3	1.3	1.1
0	0		1/2	1			72	36	1	2.6	2.5	2.3
1	1	QPSK	1/4	2			144	36	1	2.6	2.5	2.3
1	0		1/2	2			144	72	1	5.3	5.0	4.5
2	N/A		3/4	2			144	108	1	7.9	7.5	6.8
3	1	16-QAM	1/4	4			288	72	1	5.3	5.0	4.5
3	0		1/2	4			288	144	1	10.6	10.0	9.0
4	1		3/8	4			288	108	1	7.9	7.5	6.8
4	0		3/4	4			288	216	1	15.9	15.0	13.5
5	N/A	64-QAM	2/3	6			432	288	1	21.2	20.0	18.0
6			3/4	6			432	324	1	23.8	22.5	20.3
7			5/6	6			432	360	1	26.5	25.0	22.5
8		256-QAM	3/4	8			576	432	1	31.8	30.0	27.0
9			5/6	8			576	480	1	35.3	33.3	30.0

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Table 26-40—HE-MCSs for TBD mandatory/optional 26-tone RU, N_{SS} = 4

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	24	2	96	24	1	1.8	1.7	1.5
0	0		1/2	1			96	48	1	3.5	3.3	3.0
1	1	QPSK	1/4	2			192	48	1	3.5	3.3	3.0
1	0		1/2	2			192	96	1	7.1	6.7	6.0
2	N/A		3/4	2			192	144	1	10.6	10.0	9.0
3	1	16-QAM	1/4	4			384	96	1	7.1	6.7	6.0
3	0		1/2	4			384	192	1	14.1	13.3	12.0
4	1		3/8	4			384	144	1	10.6	10.0	9.0
4	0		3/4	4			384	288	1	21.2	20.0	18.0
5	N/A	64-QAM	2/3	6			576	384	1	28.2	26.7	24.0
6			3/4	6			576	432	1	31.8	30.0	27.0
7			5/6	6			576	480	1	35.3	33.3	30.0
8		256-QAM	3/4	8			768	576	1	42.4	40.0	36.0
9			5/6	8			768	640	1	47.1	44.4	40.0

Table 26-41—HE-MCSs for TBD mandatory/optional 26-tone RU, N_{SS} = 5

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	24	2	120	30	1	2.2	2.1	1.9
0	0		1/2	1			120	60	1	4.4	4.2	3.8
1	1	QPSK	1/4	2			240	60	1	4.4	4.2	3.8
1	0		1/2	2			240	120	1	8.8	8.3	7.5
2	N/A		3/4	2			240	180	1	13.2	12.5	11.3
3	1	16-QAM	1/4	4			480	120	1	8.8	8.3	7.5
3	0		1/2	4			480	240	1	17.6	16.7	15.0
4	1		3/8	4			480	180	1	13.2	12.5	11.3
4	0		3/4	4			480	360	1	26.5	25.0	22.5
5	N/A	64-QAM	2/3	6			720	480	1	35.3	33.3	30.0
6			3/4	6			720	540	1	39.7	37.5	33.8
7			5/6	6			720	600	1	44.1	41.7	37.5
8		256-QAM	3/4	8			960	720	1	52.9	50.0	45.0
9			5/6	8			960	800	1	58.8	55.6	50.0

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Table 26-42—HE-MCSs for TBD mandatory/optional 26-tone RU, N_{SS} = 6

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	24	2	144	36	1	2.6	2.5	2.3
0	0		1/2	1			144	72	1	5.3	5.0	4.5
1	1	QPSK	1/4	2			288	72	1	5.3	5.0	4.5
1	0		1/2	2			288	144	1	10.6	10.0	9.0
2	N/A		3/4	2			288	216	1	15.9	15.0	13.5
3	1	16-QAM	1/4	4			576	144	1	10.6	10.0	9.0
3	0		1/2	4			576	288	1	21.2	20.0	18.0
4	1		3/8	4			576	216	1	15.9	15.0	13.5
4	0		3/4	4			576	432	1	31.8	30.0	27.0
5	N/A	64-QAM	2/3	6			864	576	1	42.4	40.0	36.0
6			3/4	6			864	648	1	47.6	45.0	40.5
7			5/6	6			864	720	1	52.9	50.0	45.0
8		256-QAM	3/4	8			1152	864	1	63.5	60.0	54.0
9			5/6	8			1152	960	1	70.6	66.7	60.0

Table 26-43—HE-MCSs for TBD mandatory/optional 26-tone RU, N_{SS} = 7

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	24	2	168	42	1	3.1	2.9	2.6
0	0		1/2	1			168	84	1	6.2	5.8	5.3
1	1	QPSK	1/4	2			336	84	1	6.2	5.8	5.3
1	0		1/2	2			336	168	1	12.4	11.7	10.5
2	N/A		3/4	2			336	252	1	18.5	17.5	15.8
3	1	16-QAM	1/4	4			672	168	1	12.4	11.7	10.5
3	0		1/2	4			672	336	1	24.7	23.3	21.0
4	1		3/8	4			672	252	1	18.5	17.5	15.8
4	0		3/4	4			672	504	1	37.1	35.0	31.5
5	N/A	64-QAM	2/3	6			1008	672	1	49.4	46.7	42.0
6			3/4	6			1008	756	1	55.6	52.5	47.3
7			5/6	6			1008	840	1	61.8	58.3	52.5
8		256-QAM	3/4	8			1344	1008	1	74.1	70.0	63.0
9			5/6	8			1344	1120	1	82.4	77.8	70.0

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Table 26-44—HE-MCSs for TBD mandatory/optional 26-tone RU, N_{SS} = 8

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	24	2	192	48	1	3.5	3.3	3.0
0	0		1/2	1			192	96	1	7.1	6.7	6.0
1	1	QPSK	1/4	2			384	96	1	7.1	6.7	6.0
1	0		1/2	2			384	192	1	14.1	13.3	12.0
2	N/A		3/4	2			384	288	1	21.2	20.0	18.0
3	1	16-QAM	1/4	4			768	192	1	14.1	13.3	12.0
3	0		1/2	4			768	384	1	28.2	26.7	24.0
4	1		3/8	4			768	288	1	21.2	20.0	18.0
4	0		3/4	4			768	576	1	42.4	40.0	36.0
5	N/A	64-QAM	2/3	6			1152	768	1	56.5	53.3	48.0
6			3/4	6			1152	864	1	63.5	60.0	54.0
7			5/6	6			1152	960	1	70.6	66.7	60.0
8		256-QAM	3/4	8			1536	1152	1	84.7	80.0	72.0
9			5/6	8			1536	1280	1	94.1	88.9	80.0

Table 26-45—HE-MCSs for TBD mandatory/optional 52-tone RU, N_{SS} = 1

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	48	4	48	12	1	0.9	0.8	0.8
0	0		1/2	1			48	24	1	1.8	1.7	1.5
1	1	QPSK	1/4	2			96	24	1	1.8	1.7	1.5
1	0		1/2	2			96	48	1	3.5	3.3	3.0
2	N/A		3/4	2			96	72	1	5.3	5.0	4.5
3	1	16-QAM	1/4	4			192	48	1	3.5	3.3	3.0
3	0		1/2	4			192	96	1	7.1	6.7	6.0
4	1		3/8	4			192	72	1	5.3	5.0	4.5
4	0		3/4	4			192	144	1	10.6	10.0	9.0
5	N/A	64-QAM	2/3	6			288	192	1	14.1	13.3	12.0
6			3/4	6			288	216	1	15.9	15.0	13.5
7			5/6	6			288	240	1	17.6	16.7	15.0
8		256-QAM	3/4	8			384	288	1	21.2	20.0	18.0
9			5/6	8			384	320	1	23.5	22.2	20.0

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Table 26-46—HE-MCSs for TBD mandatory/optional 52-tone RU, N_{SS} = 2

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	48	4	96	24	1	1.8	1.7	1.5
0	0		1/2	1			96	48	1	3.5	3.3	3.0
1	1	QPSK	1/4	2			192	48	1	3.5	3.3	3.0
1	0		1/2	2			192	96	1	7.1	6.7	6.0
2	N/A		3/4	2			192	144	1	10.6	10.0	9.0
3	1	16-QAM	1/4	4			384	96	1	7.1	6.7	6.0
3	0		1/2	4			384	192	1	14.1	13.3	12.0
4	1		3/8	4			384	144	1	10.6	10.0	9.0
4	0		3/4	4			384	288	1	21.2	20.0	18.0
5	N/A	64-QAM	2/3	6			576	384	1	28.2	26.7	24.0
6			3/4	6			576	432	1	31.8	30.0	27.0
7			5/6	6			576	480	1	35.3	33.3	30.0
8		256-QAM	3/4	8			768	576	1	42.4	40.0	36.0
9			5/6	8			768	640	1	47.1	44.4	40.0

Table 26-47—HE-MCSs for TBD mandatory/optional 52-tone RU, N_{SS} = 3

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	48	4	144	36	1	2.6	2.5	2.3
0	0		1/2	1			144	72	1	5.3	5.0	4.5
1	1	QPSK	1/4	2			288	72	1	5.3	5.0	4.5
1	0		1/2	2			288	144	1	10.6	10.0	9.0
2	N/A		3/4	2			288	216	1	15.9	15.0	13.5
3	1	16-QAM	1/4	4			576	144	1	10.6	10.0	9.0
3	0		1/2	4			576	288	1	21.2	20.0	18.0
4	1		3/8	4			576	216	1	15.9	15.0	13.5
4	0		3/4	4			576	432	1	31.8	30.0	27.0
5	N/A	64-QAM	2/3	6			864	576	1	42.4	40.0	36.0
6			3/4	6			864	648	1	47.6	45.0	40.5
7			5/6	6			864	720	1	52.9	50.0	45.0
8		256-QAM	3/4	8			1152	864	1	63.5	60.0	54.0
9			5/6	8			1152	960	1	70.6	66.7	60.0

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Table 26-48—HE-MCSs for TBD mandatory/optional 52-tone RU, N_{SS} = 4

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	48	4	192	48	1	3.5	3.3	3.0
0	0		1/2	1			192	96	1	7.1	6.7	6.0
1	1	QPSK	1/4	2			384	96	1	7.1	6.7	6.0
1	0		1/2	2			384	192	1	14.1	13.3	12.0
2	N/A		3/4	2			384	288	1	21.2	20.0	18.0
3	1	16-QAM	1/4	4			768	192	1	14.1	13.3	12.0
3	0		1/2	4			768	384	1	28.2	26.7	24.0
4	1		3/8	4			768	288	1	21.2	20.0	18.0
4	0		3/4	4			768	576	1	42.4	40.0	36.0
5	N/A	64-QAM	2/3	6			1152	768	1	56.5	53.3	48.0
6			3/4	6			1152	864	1	63.5	60.0	54.0
7			5/6	6			1152	960	1	70.6	66.7	60.0
8		256-QAM	3/4	8			1536	1152	1	84.7	80.0	72.0
9			5/6	8			1536	1280	1	94.1	88.9	80.0

Table 26-49—HE-MCSs for TBD mandatory/optional 52-tone RU, N_{SS} = 5

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	48	4	240	60	1	4.4	4.2	3.8
0	0		1/2	1			240	120	1	8.8	8.3	7.5
1	1	QPSK	1/4	2			480	120	1	8.8	8.3	7.5
1	0		1/2	2			480	240	1	17.6	16.7	15.0
2	N/A		3/4	2			480	360	1	26.5	25.0	22.5
3	1	16-QAM	1/4	4			960	240	1	17.6	16.7	15.0
3	0		1/2	4			960	480	1	35.3	33.3	30.0
4	1		3/8	4			960	360	1	26.5	25.0	22.5
4	0		3/4	4			960	720	1	52.9	50.0	45.0
5	N/A	64-QAM	2/3	6			1440	960	1	70.6	66.7	60.0
6			3/4	6			1440	1080	1	79.4	75.0	67.5
7			5/6	6			1440	1200	1	88.2	83.3	75.0
8		256-QAM	3/4	8			1920	1440	1	105.9	100.0	90.0
9			5/6	8			1920	1600	1	117.6	111.1	100.0

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Table 26-50—HE-MCSs for TBD mandatory/optional 52-tone RU, N_{SS} = 6

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	48	4	288	72	1	5.3	5.0	4.5
0	0		1/2	1			288	144	1	10.6	10.0	9.0
1	1	QPSK	1/4	2			576	144	1	10.6	10.0	9.0
1	0		1/2	2			576	288	1	21.2	20.0	18.0
2	N/A		3/4	2			576	432	1	31.8	30.0	27.0
3	1	16-QAM	1/4	4			1152	288	1	21.2	20.0	18.0
3	0		1/2	4			1152	576	1	42.4	40.0	36.0
4	1		3/8	4			1152	432	1	31.8	30.0	27.0
4	0		3/4	4			1152	864	1	63.5	60.0	54.0
5	N/A	64-QAM	2/3	6			1728	1152	1	84.7	80.0	72.0
6			3/4	6			1728	1296	1	95.3	90.0	81.0
7			5/6	6			1728	1440	1	105.9	100.0	90.0
8		256-QAM	3/4	8			2304	1728	1	127.1	120.0	108.0
9			5/6	8			2304	1920	1	141.2	133.3	120.0

Table 26-51—HE-MCSs for TBD mandatory/optional 52-tone RU, N_{SS} = 7

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	48	4	336	84	1	6.2	5.8	5.3
0	0		1/2	1			336	168	1	12.4	11.7	10.5
1	1	QPSK	1/4	2			672	168	1	12.4	11.7	10.5
1	0		1/2	2			672	336	1	24.7	23.3	21.0
2	N/A		3/4	2			672	504	1	37.1	35.0	31.5
3	1	16-QAM	1/4	4			1344	336	1	24.7	23.3	21.0
3	0		1/2	4			1344	672	1	49.4	46.7	42.0
4	1		3/8	4			1344	504	1	37.1	35.0	31.5
4	0		3/4	4			1344	1008	1	74.1	70.0	63.0
5	N/A	64-QAM	2/3	6			2016	1344	1	98.8	93.3	84.0
6			3/4	6			2016	1512	1	111.2	105.0	94.5
7			5/6	6			2016	1680	1	123.5	116.7	105.0
8		256-QAM	3/4	8			2688	2016	1	148.2	140.0	126.0
9			5/6	8			2688	2240	1	164.7	155.6	140.0

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Table 26-52—HE-MCSs for TBD mandatory/optional 52-tone RU, N_{SS} = 8

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	48	4	384	96	1	7.1	6.7	6.0
0	0		1/2	1			384	192	1	14.1	13.3	12.0
1	1	QPSK	1/4	2			768	192	1	14.1	13.3	12.0
1	0		1/2	2			768	384	1	28.2	26.7	24.0
2	N/A		3/4	2			768	576	1	42.4	40.0	36.0
3	1	16-QAM	1/4	4			1536	384	1	28.2	26.7	24.0
3	0		1/2	4			1536	768	1	56.5	53.3	48.0
4	1		3/8	4			1536	576	1	42.4	40.0	36.0
4	0		3/4	4			1536	1152	1	84.7	80.0	72.0
5	N/A	64-QAM	2/3	6			2304	1536	1	112.9	106.7	96.0
6			3/4	6			2304	1728	1	127.1	120.0	108.0
7			5/6	6			2304	1920	1	141.2	133.3	120.0
8		256-QAM	3/4	8			3072	2304	1	169.4	160.0	144.0
9			5/6	8			3072	2560	1	188.2	177.8	160.0

Table 26-53—HE-MCSs for TBD mandatory/optional 106-tone RU, N_{SS} = 1

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	102	4	102	25	1	1.8	1.7	1.6
0	0		1/2	1			102	51	1	3.8	3.5	3.2
1	1	QPSK	1/4	2			204	51	1	3.8	3.5	3.2
1	0		1/2	2			204	102	1	7.5	7.1	6.4
2	N/A		3/4	2			204	153	1	11.3	10.6	9.6
3	1	16-QAM	1/4	4			408	102	1	7.5	7.1	6.4
3	0		1/2	4			408	204	1	15.0	14.2	12.8
4	1		3/8	4			408	153	1	11.3	10.6	9.6
4	0		3/4	4			408	306	1	22.5	21.3	19.1
5	N/A	64-QAM	2/3	6			612	408	1	30.0	28.3	25.5
6			3/4	6			612	459	1	33.8	31.9	28.7
7			5/6	6			612	510	1	37.5	35.4	31.9
8		256-QAM	3/4	8			816	612	1	45.0	42.5	38.3
9			5/6	8			816	680	1	50.0	47.2	42.5

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Table 26-54—HE-MCSs for TBD mandatory/optional 106-tone RU, N_{SS} = 2

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	102	4	204	51	1	3.8	3.5	3.2
0	0		1/2	1			204	102	1	7.5	7.1	6.4
1	1	QPSK	1/4	2			408	102	1	7.5	7.1	6.4
1	0		1/2	2			408	204	1	15.0	14.2	12.8
2	N/A		3/4	2			408	306	1	22.5	21.3	19.1
3	1	16-QAM	1/4	4			816	204	1	15.0	14.2	12.8
3	0		1/2	4			816	408	1	30.0	28.3	25.5
4	1		3/8	4			816	306	1	22.5	21.3	19.1
4	0		3/4	4			816	612	1	45.0	42.5	38.3
5	N/A	64-QAM	2/3	6			1224	816	1	60.0	56.7	51.0
6			3/4	6			1224	918	1	67.5	63.8	57.4
7			5/6	6			1224	1,020	1	75.0	70.8	63.8
8		256-QAM	3/4	8			1632	1,224	1	90.0	85.0	76.5
9			5/6	8			1632	1,360	1	100.0	94.4	85.0

Table 26-55—HE-MCSs for TBD mandatory/optional 106-tone RU, N_{SS} = 3

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	102	4	306	76	1	5.6	5.3	4.8
0	0		1/2	1			306	153	1	11.3	10.6	9.6
1	1	QPSK	1/4	2			612	153	1	11.3	10.6	9.6
1	0		1/2	2			612	306	1	22.5	21.3	19.1
2	N/A		3/4	2			612	459	1	33.8	31.9	28.7
3	1	16-QAM	1/4	4			1224	306	1	22.5	21.3	19.1
3	0		1/2	4			1224	612	1	45.0	42.5	38.3
4	1		3/8	4			1224	459	1	33.8	31.9	28.7
4	0		3/4	4			1224	918	1	67.5	63.8	57.4
5	N/A	64-QAM	2/3	6			1836	1,224	1	90.0	85.0	76.5
6			3/4	6			1836	1,377	1	101.3	95.6	86.1
7			5/6	6			1836	1,530	1	112.5	106.3	95.6
8		256-QAM	3/4	8			2448	1,836	1	135.0	127.5	114.8
9			5/6	8			2448	2,040	1	150.0	141.7	127.5

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Table 26-56—HE-MCSs for TBD mandatory/optional 106-tone RU, N_{SS} = 4

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	102	4	408	102	1	7.5	7.1	6.4
0	0		1/2	1			408	204	1	15.0	14.2	12.8
1	1	QPSK	1/4	2			816	204	1	15.0	14.2	12.8
1	0		1/2	2			816	408	1	30.0	28.3	25.5
2	N/A		3/4	2			816	612	1	45.0	42.5	38.3
3	1	16-QAM	1/4	4			1632	408	1	30.0	28.3	25.5
3	0		1/2	4			1632	816	1	60.0	56.7	51.0
4	1		3/8	4			1632	612	1	45.0	42.5	38.3
4	0		3/4	4			1632	1,224	1	90.0	85.0	76.5
5	N/A	64-QAM	2/3	6			2448	1,632	1	120.0	113.3	102.0
6			3/4	6			2448	1,836	1	135.0	127.5	114.8
7			5/6	6			2448	2,040	1	150.0	141.7	127.5
8		256-QAM	3/4	8			3264	2,448	1	180.0	170.0	153.0
9			5/6	8			3264	2,720	1	200.0	188.9	170.0

Table 26-57—HE-MCSs for TBD mandatory/optional 106-tone RU, N_{SS} = 5

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	102	4	510	127	1	9.3	8.8	7.9
0	0		1/2	1			510	255	1	18.8	17.7	15.9
1	1	QPSK	1/4	2			1020	255	1	18.8	17.7	15.9
1	0		1/2	2			1020	510	1	37.5	35.4	31.9
2	N/A		3/4	2			1020	765	1	56.3	53.1	47.8
3	1	16-QAM	1/4	4			2040	510	1	37.5	35.4	31.9
3	0		1/2	4			2040	1,020	1	75.0	70.8	63.8
4	1		3/8	4			2040	765	1	56.3	53.1	47.8
4	0		3/4	4			2040	1,530	1	112.5	106.3	95.6
5	N/A	64-QAM	2/3	6			3060	2,040	1	150.0	141.7	127.5
6			3/4	6			3060	2,295	1	168.8	159.4	143.4
7			5/6	6			3060	2,550	1	187.5	177.1	159.4
8		256-QAM	3/4	8			4080	3,060	1	225.0	212.5	191.3
9			5/6	8			4080	3,400	1	250.0	236.1	212.5

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Table 26-58—HE-MCSs for TBD mandatory/optional 106-tone RU, N_{SS} = 6

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	102	4	612	153	1	11.3	10.6	9.6
0	0		1/2	1			612	306	1	22.5	21.3	19.1
1	1	QPSK	1/4	2			1224	306	1	22.5	21.3	19.1
1	0		1/2	2			1224	612	1	45.0	42.5	38.3
2	N/A		3/4	2			1224	918	1	67.5	63.8	57.4
3	1	16-QAM	1/4	4			2448	612	1	45.0	42.5	38.3
3	0		1/2	4			2448	1,224	1	90.0	85.0	76.5
4	1		3/8	4			2448	918	1	67.5	63.8	57.4
4	0		3/4	4			2448	1,836	1	135.0	127.5	114.8
5	N/A	64-QAM	2/3	6			3672	2,448	1	180.0	170.0	153.0
6			3/4	6			3672	2,754	1	202.5	191.3	172.1
7			5/6	6			3672	3,060	1	225.0	212.5	191.3
8		256-QAM	3/4	8			4896	3,672	1	270.0	255.0	229.5
9			5/6	8			4896	4,080	1	300.0	283.3	255.0

Table 26-59—HE-MCSs for TBD mandatory/optional 106-tone RU, N_{SS} = 7

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	102	4	714	178	1	13.1	12.4	11.1
0	0		1/2	1			714	357	1	26.3	24.8	22.3
1	1	QPSK	1/4	2			1428	357	1	26.3	24.8	22.3
1	0		1/2	2			1428	714	1	52.5	49.6	44.6
2	N/A		3/4	2			1428	1,071	1	78.8	74.4	66.9
3	1	16-QAM	1/4	4			2856	714	1	52.5	49.6	44.6
3	0		1/2	4			2856	1,428	1	105.0	99.2	89.3
4	1		3/8	4			2856	1,071	1	78.8	74.4	66.9
4	0		3/4	4			2856	2,142	1	157.5	148.8	133.9
5	N/A	64-QAM	2/3	6			4284	2,856	1	210.0	198.3	178.5
6			3/4	6			4284	3,213	1	236.3	223.1	200.8
7			5/6	6			4284	3,570	1	262.5	247.9	223.1
8		256-QAM	3/4	8			5712	4,284	1	315.0	297.5	267.8
9			5/6	8			5712	4,760	1	350.0	330.6	297.5

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Table 26-60—HE-MCSs for TBD mandatory/optional 106-tone RU, N_{SS} = 8

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	102	4	816	204	1	15.0	14.2	12.8
0	0		1/2	1			816	408	1	30.0	28.3	25.5
1	1	QPSK	1/4	2			1632	408	1	30.0	28.3	25.5
1	0		1/2	2			1632	816	1	60.0	56.7	51.0
2	N/A		3/4	2			1632	1,224	1	90.0	85.0	76.5
3	1	16-QAM	1/4	4			3264	816	1	60.0	56.7	51.0
3	0		1/2	4			3264	1,632	1	120.0	113.3	102.0
4	1		3/8	4			3264	1,224	1	90.0	85.0	76.5
4	0		3/4	4			3264	2,448	1	180.0	170.0	153.0
5	N/A	64-QAM	2/3	6			4896	3,264	1	240.0	226.7	204.0
6			3/4	6			4896	3,672	1	270.0	255.0	229.5
7			5/6	6			4896	4,080	1	300.0	283.3	255.0
8		256-QAM	3/4	8			6528	4,896	1	360.0	340.0	306.0
9			5/6	8			6528	5,440	1	400.0	377.8	340.0

Table 26-61—HE-MCSs for TBD mandatory/optional 242-tone RU and mandatory non-OFDMA 20 MHz, N_{SS} = 1

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	234	8	234	58	1	4.3	4.0	3.6
0	0		1/2	1			234	117	1	8.6	8.1	7.3
1	1	QPSK	1/4	2			468	117	1	8.6	8.1	7.3
1	0		1/2	2			468	234	1	17.2	16.3	14.6
2	N/A		3/4	2			468	351	1	25.8	24.4	21.9
3	1	16-QAM	1/4	4			936	234	1	17.2	16.3	14.6
3	0		1/2	4			936	468	1	34.4	32.5	29.3
4	1		3/8	4			936	351	1	25.8	24.4	21.9
4	0		3/4	4			936	702	1	51.6	48.8	43.9
5	N/A	64-QAM	2/3	6			1404	936	1	68.8	65.0	58.5
6			3/4	6			1404	1,053	1	77.4	73.1	65.8
7			5/6	6			1404	1,170	1	86.0	81.3	73.1
8		256-QAM	3/4	8			1872	1,404	1	103.2	97.5	87.8
9			5/6	8			1872	1,560	1	114.7	108.3	97.5
10		1024-QAM	3/4	10			2340	1,755	1	129.0	121.9	109.7
11			5/6	10			2340	1,950	1	143.4	135.4	121.9

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Table 26-62—HE-MCSs for TBD mandatory/optional 242-tone RU and mandatory non-OFDMA 20 MHz, N_{SS} = 2

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	234	8	468	117	1	8.6	8.1	7.3
0	0		1/2	1			468	234	1	17.2	16.3	14.6
1	1	QPSK	1/4	2			936	234	1	17.2	16.3	14.6
1	0		1/2	2			936	468	1	34.4	32.5	29.3
2	N/A		3/4	2			936	702	1	51.6	48.8	43.9
3	1	16-QAM	1/4	4			1872	468	1	34.4	32.5	29.3
3	0		1/2	4			1872	936	1	68.8	65.0	58.5
4	1		3/8	4			1872	702	1	51.6	48.8	43.9
4	0		3/4	4			1872	1,404	1	103.2	97.5	87.8
5	N/A	64-QAM	2/3	6			2808	1,872	1	137.6	130.0	117.0
6			3/4	6			2808	2,106	1	154.9	146.3	131.6
7			5/6	6			2808	2,340	1	172.1	162.5	146.3
8		256-QAM	3/4	8			3744	2,808	1	206.5	195.0	175.5
9			5/6	8			3744	3,120	1	229.4	216.7	195.0
10		1024-QAM	3/4	10			4680	3,510	1	258.1	243.8	219.4
11			5/6	10			4680	3,900	1	286.8	270.8	243.8

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Table 26-63—HE-MCSs for TBD mandatory/optional 242-tone RU and mandatory non-OFDMA 20 MHz, N_{SS} = 3

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	234	8	702	175	1	12.9	12.2	10.9
0	0		1/2	1			702	351	1	25.8	24.4	21.9
1	1	QPSK	1/4	2			1404	351	1	25.8	24.4	21.9
1	0		1/2	2			1404	702	1	51.6	48.8	43.9
2	N/A		3/4	2			1404	1,053	1	77.4	73.1	65.8
3	1	16-QAM	1/4	4			2808	702	1	51.6	48.8	43.9
3	0		1/2	4			2808	1,404	1	103.2	97.5	87.8
4	1		3/8	4			2808	1,053	1	77.4	73.1	65.8
4	0		3/4	4			2808	2,106	1	154.9	146.3	131.6
5	N/A	64-QAM	2/3	6			4212	2,808	1	206.5	195.0	175.5
6			3/4	6			4212	3,159	1	232.3	219.4	197.4
7			5/6	6			4212	3,510	1	258.1	243.8	219.4
8		256-QAM	3/4	8			5616	4,212	1	309.7	292.5	263.3
9			5/6	8			5616	4,680	1	344.1	325.0	292.5
10		1024-QAM	3/4	10			7020	5,265	1	387.1	365.6	329.1
11			5/6	10			7020	5,850	1	430.1	406.3	365.6

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Table 26-64—HE-MCSs for TBD mandatory/optional 242-tone RU and mandatory non-OFDMA 20 MHz, N_{SS} = 4

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	234	8	936	234	1	17.2	16.3	14.6
0	0		1/2	1			936	468	1	34.4	32.5	29.3
1	1	QPSK	1/4	2			1872	468	1	34.4	32.5	29.3
1	0		1/2	2			1872	936	1	68.8	65.0	58.5
2	N/A		3/4	2			1872	1,404	1	103.2	97.5	87.8
3	1	16-QAM	1/4	4			3744	936	1	68.8	65.0	58.5
3	0		1/2	4			3744	1,872	1	137.6	130.0	117.0
4	1		3/8	4			3744	1,404	1	103.2	97.5	87.8
4	0		3/4	4			3744	2,808	1	206.5	195.0	175.5
5	N/A	64-QAM	2/3	6			5616	3,744	1	275.3	260.0	234.0
6			3/4	6			5616	4,212	1	309.7	292.5	263.3
7			5/6	6			5616	4,680	1	344.1	325.0	292.5
8		256-QAM	3/4	8			7488	5,616	1	412.9	390.0	351.0
9			5/6	8			7488	6,240	1	458.8	433.3	390.0
10		1024-QAM	3/4	10			9360	7,020	1	516.2	487.5	438.8
11			5/6	10			9360	7,800	1	573.5	541.7	487.5

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Table 26-65—HE-MCSs for TBD mandatory/optional 242-tone RU and mandatory non-OFDMA 20 MHz, N_{SS} = 5

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	234	8	1170	292	1	21.5	20.3	18.3
0	0		1/2	1			1170	585	1	43.0	40.6	36.6
1	1	QPSK	1/4	2			2340	585	1	43.0	40.6	36.6
1	0		1/2	2			2340	1,170	1	86.0	81.3	73.1
2	N/A		3/4	2			2340	1,755	1	129.0	121.9	109.7
3	1	16-QAM	1/4	4			4680	1,170	1	86.0	81.3	73.1
3	0		1/2	4			4680	2,340	1	172.1	162.5	146.3
4	1		3/8	4			4680	1,755	1	129.0	121.9	109.7
4	0		3/4	4			4680	3,510	1	258.1	243.8	219.4
5	N/A	64-QAM	2/3	6			7020	4,680	1	344.1	325.0	292.5
6			3/4	6			7020	5,265	1	387.1	365.6	329.1
7			5/6	6			7020	5,850	1	430.1	406.3	365.6
8		256-QAM	3/4	8			9360	7,020	1	516.2	487.5	438.8
9			5/6	8			9360	7,800	1	573.5	541.7	487.5
10		1024-QAM	3/4	10			11700	8,775	1	645.2	609.4	548.4
11			5/6	10			11700	9,750	1	716.9	677.1	609.4

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Table 26-66—HE-MCSs for TBD mandatory/optional 242-tone RU and mandatory non-OFDMA 20 MHz, N_{SS} = 6

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	234	8	1404	351	1	25.8	24.4	21.9
0	0		1/2	1			1404	702	1	51.6	48.8	43.9
1	1	QPSK	1/4	2			2808	702	1	51.6	48.8	43.9
1	0		1/2	2			2808	1,404	1	103.2	97.5	87.8
2	N/A		3/4	2			2808	2,106	1	154.9	146.3	131.6
3	1	16-QAM	1/4	4			5616	1,404	1	103.2	97.5	87.8
3	0		1/2	4			5616	2,808	1	206.5	195.0	175.5
4	1		3/8	4			5616	2,106	1	154.9	146.3	131.6
4	0		3/4	4			5616	4,212	1	309.7	292.5	263.3
5	N/A	64-QAM	2/3	6			8424	5,616	1	412.9	390.0	351.0
6			3/4	6			8424	6,318	1	464.6	438.8	394.9
7			5/6	6			8424	7,020	1	516.2	487.5	438.8
8		256-QAM	3/4	8			11232	8,424	1	619.4	585.0	526.5
9			5/6	8			11232	9,360	1	688.2	650.0	585.0
10		1024-QAM	3/4	10			14040	10,530	1	774.3	731.3	658.1
11			5/6	10			14040	11,700	1	860.3	812.5	731.3

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Table 26-67—HE-MCSs for TBD mandatory/optional 242-tone RU and mandatory non-OFDMA 20 MHz, N_{SS} = 7

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	234	8	1638	409	1	30.1	28.4	25.6
0	0		1/2	1			1638	819	1	60.2	56.9	51.2
1	1	QPSK	1/4	2			3276	819	1	60.2	56.9	51.2
1	0		1/2	2			3276	1,638	1	120.4	113.8	102.4
2	N/A		3/4	2			3276	2,457	1	180.7	170.6	153.6
3	1	16-QAM	1/4	4			6552	1,638	1	120.4	113.8	102.4
3	0		1/2	4			6552	3,276	1	240.9	227.5	204.8
4	1		3/8	4			6552	2,457	1	180.7	170.6	153.6
4	0		3/4	4			6552	4,914	1	361.3	341.3	307.1
5	N/A	64-QAM	2/3	6			9828	6,552	1	481.8	455.0	409.5
6			3/4	6			9828	7,371	1	542.0	511.9	460.7
7			5/6	6			9828	8,190	1	602.2	568.8	511.9
8		256-QAM	3/4	8			13104	9,828	1	722.6	682.5	614.3
9			5/6	8			13104	10,920	1	802.9	758.3	682.5
10		1024-QAM	3/4	10			16380	12,285	1	903.3	853.1	767.8
11			5/6	10			16380	13,650	1	1,003.7	947.9	853.1

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Table 26-68—HE-MCSs for TBD mandatory/optional 242-tone RU and mandatory non-OFDMA 20 MHz, N_{SS} = 8

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	234	8	1872	468	1	34.4	32.5	29.3
0	0		1/2	1			1872	936	1	68.8	65.0	58.5
1	1	QPSK	1/4	2			3744	936	1	68.8	65.0	58.5
1	0		1/2	2			3744	1,872	1	137.6	130.0	117.0
2	N/A		3/4	2			3744	2,808	1	206.5	195.0	175.5
3	1	16-QAM	1/4	4			7488	1,872	1	137.6	130.0	117.0
3	0		1/2	4			7488	3,744	1	275.3	260.0	234.0
4	1		3/8	4			7488	2,808	1	206.5	195.0	175.5
4	0		3/4	4			7488	5,616	1	412.9	390.0	351.0
5	N/A	64-QAM	2/3	6			11232	7,488	1	550.6	520.0	468.0
6			3/4	6			11232	8,424	1	619.4	585.0	526.5
7			5/6	6			11232	9,360	1	688.2	650.0	585.0
8		256-QAM	3/4	8			14976	11,232	1	825.9	780.0	702.0
9			5/6	8			14976	12,480	1	917.6	866.7	780.0
10		1024-QAM	3/4	10			18720	14,040	1	1,032.4	975.0	877.5
11			5/6	10			18720	15,600	1	1,147.1	1,083.3	975.0

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Table 26-69—HE-MCSs for TBD mandatory/optional 484-tone RU and mandatory non-OFDMA 40 MHz, N_{SS} = 1

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	468	16	468	117	1	8.6	8.1	7.3
0	0		1/2	1			468	234	1	17.2	16.3	14.6
1	1	QPSK	1/4	2			936	234	1	17.2	16.3	14.6
1	0		1/2	2			936	468	1	34.4	32.5	29.3
2	N/A		3/4	2			936	702	1	51.6	48.8	43.9
3	1	16-QAM	1/4	4			1872	468	1	34.4	32.5	29.3
3	0		1/2	4			1872	936	1	68.8	65.0	58.5
4	1		3/8	4			1872	702	1	51.6	48.8	43.9
4	0		3/4	4			1872	1,404	1	103.2	97.5	87.8
5	N/A	64-QAM	2/3	6			2808	1,872	1	137.6	130.0	117.0
6			3/4	6			2808	2,106	1	154.9	146.3	131.6
7			5/6	6			2808	2,340	1	172.1	162.5	146.3
8		256-QAM	3/4	8			3744	2,808	1	206.5	195.0	175.5
9			5/6	8			3744	3,120	1	229.4	216.7	195.0
10		1024-QAM	3/4	10			4680	3,510	1	258.1	243.8	219.4
11			5/6	10			4680	3,900	1	286.8	270.8	243.8

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Table 26-70—HE-MCSs for TBD mandatory/optional 484-tone RU and mandatory non-OFDMA 40 MHz, N_{SS} = 2

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	468	16	936	234	1	17.2	16.3	14.6
0	0		1/2	1			936	468	1	34.4	32.5	29.3
1	1	QPSK	1/4	2			1872	468	1	34.4	32.5	29.3
1	0		1/2	2			1872	936	1	68.8	65.0	58.5
2	N/A		3/4	2			1872	1,404	1	103.2	97.5	87.8
3	1	16-QAM	1/4	4			3744	936	1	68.8	65.0	58.5
3	0		1/2	4			3744	1,872	1	137.6	130.0	117.0
4	1		3/8	4			3744	1,404	1	103.2	97.5	87.8
4	0		3/4	4			3744	2,808	1	206.5	195.0	175.5
5	N/A	64-QAM	2/3	6			5616	3,744	1	275.3	260.0	234.0
6			3/4	6			5616	4,212	1	309.7	292.5	263.3
7			5/6	6			5616	4,680	1	344.1	325.0	292.5
8		256-QAM	3/4	8			7488	5,616	1	412.9	390.0	351.0
9			5/6	8			7488	6,240	1	458.8	433.3	390.0
10		1024-QAM	3/4	10			9360	7,020	1	516.2	487.5	438.8
11			5/6	10			9360	7,800	1	573.5	541.7	487.5

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Table 26-71—HE-MCSs for TBD mandatory/optional 484-tone RU and mandatory non-OFDMA 40 MHz, N_{SS} = 3

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	468	16	1404	351	1	25.8	24.4	21.9
0	0		1/2	1			1404	702	1	51.6	48.8	43.9
1	1	QPSK	1/4	2			2808	702	1	51.6	48.8	43.9
1	0		1/2	2			2808	1,404	1	103.2	97.5	87.8
2	N/A		3/4	2			2808	2,106	1	154.9	146.3	131.6
3	1	16-QAM	1/4	4			5616	1,404	1	103.2	97.5	87.8
3	0		1/2	4			5616	2,808	1	206.5	195.0	175.5
4	1		3/8	4			5616	2,106	1	154.9	146.3	131.6
4	0		3/4	4			5616	4,212	1	309.7	292.5	263.3
5	N/A	64-QAM	2/3	6			8424	5,616	1	412.9	390.0	351.0
6			3/4	6			8424	6,318	1	464.6	438.8	394.9
7			5/6	6			8424	7,020	1	516.2	487.5	438.8
8		256-QAM	3/4	8			11232	8,424	1	619.4	585.0	526.5
9			5/6	8			11232	9,360	1	688.2	650.0	585.0
10		1024-QAM	3/4	10			14040	10,530	1	774.3	731.3	658.1
11			5/6	10			14040	11,700	1	860.3	812.5	731.3

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Table 26-72—HE-MCSs for TBD mandatory/optional 484-tone RU and mandatory non-OFDMA 40 MHz, N_{SS} = 4

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	468	16	1872	468	1	34.4	32.5	29.3
0	0		1/2	1			1872	936	1	68.8	65.0	58.5
1	1	QPSK	1/4	2			3744	936	1	68.8	65.0	58.5
1	0		1/2	2			3744	1,872	1	137.6	130.0	117.0
2	N/A		3/4	2			3744	2,808	1	206.5	195.0	175.5
3	1	16-QAM	1/4	4			7488	1,872	1	137.6	130.0	117.0
3	0		1/2	4			7488	3,744	1	275.3	260.0	234.0
4	1		3/8	4			7488	2,808	1	206.5	195.0	175.5
4	0		3/4	4			7488	5,616	1	412.9	390.0	351.0
5	N/A	64-QAM	2/3	6			11232	7,488	1	550.6	520.0	468.0
6			3/4	6			11232	8,424	1	619.4	585.0	526.5
7			5/6	6			11232	9,360	1	688.2	650.0	585.0
8		256-QAM	3/4	8			14976	11,232	1	825.9	780.0	702.0
9			5/6	8			14976	12,480	1	917.6	866.7	780.0
10		1024-QAM	3/4	10			18720	14,040	1	1,032.4	975.0	877.5
11			5/6	10			18720	15,600	1	1,147.1	1,083.3	975.0

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Table 26-73—HE-MCSs for TBD mandatory/optional 484-tone RU and mandatory non-OFDMA 40 MHz, N_{SS} = 5

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	468	16	2340	585	1	43.0	40.6	36.6
0	0		1/2	1			2340	1,170	1	86.0	81.3	73.1
1	1	QPSK	1/4	2			4680	1,170	1	86.0	81.3	73.1
1	0		1/2	2			4680	2,340	1	172.1	162.5	146.3
2	N/A		3/4	2			4680	3,510	1	258.1	243.8	219.4
3	1	16-QAM	1/4	4			9360	2,340	1	172.1	162.5	146.3
3	0		1/2	4			9360	4,680	1	344.1	325.0	292.5
4	1		3/8	4			9360	3,510	1	258.1	243.8	219.4
4	0		3/4	4			9360	7,020	1	516.2	487.5	438.8
5	N/A	64-QAM	2/3	6			14040	9,360	1	688.2	650.0	585.0
6			3/4	6			14040	10,530	1	774.3	731.3	658.1
7			5/6	6			14040	11,700	1	860.3	812.5	731.3
8		256-QAM	3/4	8			18720	14,040	1	1,032.4	975.0	877.5
9			5/6	8			18720	15,600	1	1,147.1	1,083.3	975.0
10		1024-QAM	3/4	10			23400	17,550	1	1,290.4	1,218.8	1,096.9
11			5/6	10			23400	19,500	1	1,433.8	1,354.2	1,218.8

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Table 26-74—HE-MCSs for TBD mandatory/optional 484-tone RU and mandatory non-OFDMA 40 MHz, N_{SS} = 6

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	468	16	2808	702	1	51.6	48.8	43.9
0	0		1/2	1			2808	1,404	1	103.2	97.5	87.8
1	1	QPSK	1/4	2			5616	1,404	1	103.2	97.5	87.8
1	0		1/2	2			5616	2,808	1	206.5	195.0	175.5
2	N/A		3/4	2			5616	4,212	1	309.7	292.5	263.3
3	1	16-QAM	1/4	4			11232	2,808	1	206.5	195.0	175.5
3	0		1/2	4			11232	5,616	1	412.9	390.0	351.0
4	1		3/8	4			11232	4,212	1	309.7	292.5	263.3
4	0		3/4	4			11232	8,424	1	619.4	585.0	526.5
5	N/A	64-QAM	2/3	6			16848	11,232	1	825.9	780.0	702.0
6			3/4	6			16848	12,636	1	929.1	877.5	789.8
7			5/6	6			16848	14,040	1	1,032.4	975.0	877.5
8		256-QAM	3/4	8			22464	16,848	1	1,238.8	1,170.0	1,053.0
9			5/6	8			22464	18,720	1	1,376.5	1,300.0	1,170.0
10		1024-QAM	3/4	10			28080	21,060	1	1,548.5	1,462.5	1,316.3
11			5/6	10			28080	23,400	1	1,720.6	1,625.0	1,462.5

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Table 26-75—HE-MCSs for TBD mandatory/optional 484-tone RU and mandatory non-OFDMA 40 MHz, N_{SS} = 7

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	468	16	3276	819	1	60.2	56.9	51.2
0	0		1/2	1			3276	1,638	1	120.4	113.8	102.4
1	1	QPSK	1/4	2			6552	1,638	1	120.4	113.8	102.4
1	0		1/2	2			6552	3,276	1	240.9	227.5	204.8
2	N/A		3/4	2			6552	4,914	1	361.3	341.3	307.1
3	1	16-QAM	1/4	4			13104	3,276	1	240.9	227.5	204.8
3	0		1/2	4			13104	6,552	1	481.8	455.0	409.5
4	1		3/8	4			13104	4,914	1	361.3	341.3	307.1
4	0		3/4	4			13104	9,828	1	722.6	682.5	614.3
5	N/A	64-QAM	2/3	6			19656	13,104	1	963.5	910.0	819.0
6			3/4	6			19656	14,742	1	1,084.0	1,023.8	921.4
7			5/6	6			19656	16,380	1	1,204.4	1,137.5	1,023.8
8		256-QAM	3/4	8			26208	19,656	1	1,445.3	1,365.0	1,228.5
9			5/6	8			26208	21,840	1	1,605.9	1,516.7	1,365.0
10		1024-QAM	3/4	10			32760	24,570	1	1,806.6	1,706.3	1,535.6
11			5/6	10			32760	27,300	1	2,007.4	1,895.8	1,706.3

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Table 26-76—HE-MCSs for TBD mandatory/optional 484-tone RU and mandatory non-OFDMA 40 MHz, N_{SS} = 8

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	468	16	3744	936	1	68.8	65.0	58.5
0	0		1/2	1			3744	1,872	1	137.6	130.0	117.0
1	1	QPSK	1/4	2			7488	1,872	1	137.6	130.0	117.0
1	0		1/2	2			7488	3,744	1	275.3	260.0	234.0
2	N/A		3/4	2			7488	5,616	1	412.9	390.0	351.0
3	1	16-QAM	1/4	4			14976	3,744	1	275.3	260.0	234.0
3	0		1/2	4			14976	7,488	1	550.6	520.0	468.0
4	1		3/8	4			14976	5,616	1	412.9	390.0	351.0
4	0		3/4	4			14976	11,232	1	825.9	780.0	702.0
5	N/A	64-QAM	2/3	6			22464	14,976	1	1,101.2	1,040.0	936.0
6			3/4	6			22464	16,848	1	1,238.8	1,170.0	1,053.0
7			5/6	6			22464	18,720	1	1,376.5	1,300.0	1,170.0
8		256-QAM	3/4	8			29952	22,464	1	1,651.8	1,560.0	1,404.0
9			5/6	8			29952	24,960	1	1,835.3	1,733.3	1,560.0
10		1024-QAM	3/4	10			37440	28,080	1	2,064.7	1,950.0	1,755.0
11			5/6	10			37440	31,200	1	2,294.1	2,166.7	1,950.0

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Table 26-77—HE-MCSs for TBD mandatory/optional 996-tone RU and mandatory non-OFDMA 80 MHz, N_{SS} = 1

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	980	16	980	245	1	18.0	17.0	15.3
0	0		1/2	1			980	490	1	36.0	34.0	30.6
1	1	QPSK	1/4	2			1960	490	1	36.0	34.0	30.6
1	0		1/2	2			1960	980	1	72.1	68.1	61.3
2	N/A		3/4	2			1960	1,470	1	108.1	102.1	91.9
3	1	16-QAM	1/4	4			3920	980	1	72.1	68.1	61.3
3	0		1/2	4			3920	1,960	1	144.1	136.1	122.5
4	1		3/8	4			3920	1,470	1	108.1	102.1	91.9
4	0		3/4	4			3920	2,940	1	216.2	204.2	183.8
5	N/A	64-QAM	2/3	6			5880	3,920	1	288.2	272.2	245.0
6			3/4	6			5880	4,410	1	324.3	306.3	275.6
7			5/6	6			5880	4,900	1	360.3	340.3	306.3
8		256-QAM	3/4	8			7840	5,880	1	432.4	408.3	367.5
9			5/6	8			7840	6,533	1	480.4	453.7	408.3
10		1024-QAM	3/4	10			9800	7,350	1	540.4	510.4	459.4
11			5/6	10			9800	8,166	1	600.4	567.1	510.4

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Table 26-78—HE-MCSs for TBD mandatory/optional 996-tone RU and mandatory non-OFDMA 80 MHz, N_{SS} = 2

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	980	16	1960	490	1	36.0	34.0	30.6
0	0		1/2	1			1960	980	1	72.1	68.1	61.3
1	1	QPSK	1/4	2			3920	980	1	72.1	68.1	61.3
1	0		1/2	2			3920	1,960	1	144.1	136.1	122.5
2	N/A		3/4	2			3920	2,940	1	216.2	204.2	183.8
3	1	16-QAM	1/4	4			7840	1,960	1	144.1	136.1	122.5
3	0		1/2	4			7840	3,920	1	288.2	272.2	245.0
4	1		3/8	4			7840	2,940	1	216.2	204.2	183.8
4	0		3/4	4			7840	5,880	1	432.4	408.3	367.5
5	N/A	64-QAM	2/3	6			11760	7,840	1	576.5	544.4	490.0
6			3/4	6			11760	8,820	1	648.5	612.5	551.3
7			5/6	6			11760	9,800	1	720.6	680.6	612.5
8		256-QAM	3/4	8			15680	11,760	1	864.7	816.7	735.0
9			5/6	8			15680	13,066	1	960.7	907.4	816.6
10		1024-QAM	3/4	10			19600	14,700	1	1,080.9	1,020.8	918.8
11			5/6	10			19600	16,333	1	1,201.0	1,134.2	1,020.8

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Table 26-79—HE-MCSs for TBD mandatory/optional 996-tone RU and mandatory non-OFDMA 80 MHz, N_{SS} = 3

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	980	16	2940	735	1	54.0	51.0	45.9
0	0		1/2	1			2940	1,470	1	108.1	102.1	91.9
1	1	QPSK	1/4	2			5880	1,470	1	108.1	102.1	91.9
1	0		1/2	2			5880	2,940	1	216.2	204.2	183.8
2	N/A		3/4	2			5880	4,410	1	324.3	306.3	275.6
3	1	16-QAM	1/4	4			11760	2,940	1	216.2	204.2	183.8
3	0		1/2	4			11760	5,880	1	432.4	408.3	367.5
4	1		3/8	4			11760	4,410	1	324.3	306.3	275.6
4	0		3/4	4			11760	8,820	1	648.5	612.5	551.3
5	N/A	64-QAM	2/3	6			17640	11,760	1	864.7	816.7	735.0
6			3/4	6			17640	13,230	1	972.8	918.8	826.9
7			5/6	6			17640	14,700	1	1,080.9	1,020.8	918.8
8		256-QAM	3/4	8			23520	17,640	1	1,297.1	1,225.0	1,102.5
9			5/6	8			23520	19,600	1	1,441.2	1,361.1	1,225.0
10		1024-QAM	3/4	10			29400	22,050	1	1,621.3	1,531.3	1,378.1
11			5/6	10			29400	24,500	1	1,801.5	1,701.4	1,531.3

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Table 26-80—HE-MCSs for TBD mandatory/optional 996-tone RU and mandatory non-OFDMA 80 MHz, N_{SS} = 4

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	980	16	3920	980	1	72.1	68.1	61.3
0	0		1/2	1			3920	1,960	1	144.1	136.1	122.5
1	1	QPSK	1/4	2			7840	1,960	1	144.1	136.1	122.5
1	0		1/2	2			7840	3,920	1	288.2	272.2	245.0
2	N/A		3/4	2			7840	5,880	1	432.4	408.3	367.5
3	1	16-QAM	1/4	4			15680	3,920	1	288.2	272.2	245.0
3	0		1/2	4			15680	7,840	1	576.5	544.4	490.0
4	1		3/8	4			15680	5,880	1	432.4	408.3	367.5
4	0		3/4	4			15680	11,760	1	864.7	816.7	735.0
5	N/A	64-QAM	2/3	6			23520	15,680	1	1,152.9	1,088.9	980.0
6			3/4	6			23520	17,640	1	1,297.1	1,225.0	1,102.5
7			5/6	6			23520	19,600	1	1,441.2	1,361.1	1,225.0
8		256-QAM	3/4	8			31360	23,520	1	1,729.4	1,633.3	1,470.0
9			5/6	8			31360	26,133	1	1,921.5	1,814.8	1,633.3
10		1024-QAM	3/4	10			39200	29,400	1	2,161.8	2,041.7	1,837.5
11			5/6	10			39200	32,666	1	2,401.9	2,268.5	2,041.6

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Table 26-81—HE-MCSs for TBD mandatory/optional 996-tone RU and mandatory non-OFDMA 80 MHz, N_{SS} = 5

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	980	16	4900	1,225	1	90.1	85.1	76.6
0	0		1/2	1			4900	2,450	1	180.1	170.1	153.1
1	1	QPSK	1/4	2			9800	2,450	1	180.1	170.1	153.1
1	0		1/2	2			9800	4,900	1	360.3	340.3	306.3
2	N/A		3/4	2			9800	7,350	1	540.4	510.4	459.4
3	1	16-QAM	1/4	4			19600	4,900	1	360.3	340.3	306.3
3	0		1/2	4			19600	9,800	1	720.6	680.6	612.5
4	1		3/8	4			19600	7,350	1	540.4	510.4	459.4
4	0		3/4	4			19600	14,700	1	1,080.9	1,020.8	918.8
5	N/A	64-QAM	2/3	6			29400	19,600	1	1,441.2	1,361.1	1,225.0
6			3/4	6			29400	22,050	1	1,621.3	1,531.3	1,378.1
7			5/6	6			29400	24,500	1	1,801.5	1,701.4	1,531.3
8		256-QAM	3/4	8			39200	29,400	1	2,161.8	2,041.7	1,837.5
9			5/6	8			39200	32,666	1	2,401.9	2,268.5	2,041.6
10		1024-QAM	3/4	10			49000	36,750	1	2,702.2	2,552.1	2,296.9
11			5/6	10			49000	40,833	1	3,002.4	2,835.6	2,552.1

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Table 26-82—HE-MCSs for TBD mandatory/optional 996-tone RU and mandatory non-OFDMA 80 MHz, N_{SS} = 6

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	980	16	5880	1,470	1	108.1	102.1	91.9
0	0		1/2	1			5880	2,940	1	216.2	204.2	183.8
1	1	QPSK	1/4	2			11760	2,940	1	216.2	204.2	183.8
1	0		1/2	2			11760	5,880	1	432.4	408.3	367.5
2	N/A		3/4	2			11760	8,820	1	648.5	612.5	551.3
3	1	16-QAM	1/4	4			23520	5,880	1	432.4	408.3	367.5
3	0		1/2	4			23520	11,760	1	864.7	816.7	735.0
4	1		3/8	4			23520	8,820	1	648.5	612.5	551.3
4	0		3/4	4			23520	17,640	1	1,297.1	1,225.0	1,102.5
5	N/A	64-QAM	2/3	6			35280	23,520	1	1,729.4	1,633.3	1,470.0
6			3/4	6			35280	26,460	1	1,945.6	1,837.5	1,653.8
7			5/6	6			35280	29,400	1	2,161.8	2,041.7	1,837.5
8		256-QAM	3/4	8			47040	35,280	1	2,594.1	2,450.0	2,205.0
9			5/6	8			47040	39,200	1	2,882.4	2,722.2	2,450.0
10		1024-QAM	3/4	10			58800	44,100	1	3,242.6	3,062.5	2,756.3
11			5/6	10			58800	49,000	1	3,602.9	3,402.8	3,062.5

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Table 26-83—HE-MCSs for TBD mandatory/optional 996-tone RU and mandatory non-OFDMA 80 MHz, N_{SS} = 7

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	980	16	6860	1,715	1	126.1	119.1	107.2
0	0		1/2	1			6860	3,430	1	252.2	238.2	214.4
1	1	QPSK	1/4	2			13720	3,430	1	252.2	238.2	214.4
1	0		1/2	2			13720	6,860	1	504.4	476.4	428.8
2	N/A		3/4	2			13720	10,290	1	756.6	714.6	643.1
3	1	16-QAM	1/4	4			27440	6,860	1	504.4	476.4	428.8
3	0		1/2	4			27440	13,720	1	1,008.8	952.8	857.5
4	1		3/8	4			27440	10,290	1	756.6	714.6	643.1
4	0		3/4	4			27440	20,580	1	1,513.2	1,429.2	1,286.3
5	N/A	64-QAM	2/3	6			41160	27,440	1	2,017.6	1,905.6	1,715.0
6			3/4	6			41160	30,870	1	2,269.9	2,143.8	1,929.4
7			5/6	6			41160	34,300	1	2,522.1	2,381.9	2,143.8
8		256-QAM	3/4	8			54880	41,160	1	3,026.5	2,858.3	2,572.5
9			5/6	8			54880	45,733	1	3,362.7	3,175.9	2,858.3
10		1024-QAM	3/4	10			68600	51,450	1	3,783.1	3,572.9	3,215.6
11			5/6	10			68600	57,166	1	4,203.4	3,969.9	3,572.9

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Table 26-84—HE-MCSs for TBD mandatory/optional 996-tone RU and mandatory non-OFDMA 80 MHz, N_{SS} = 8

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	980	16	7840	1,960	1	144.1	136.1	122.5
0	0		1/2	1			7840	3,920	1	288.2	272.2	245.0
1	1	QPSK	1/4	2			15680	3,920	1	288.2	272.2	245.0
1	0		1/2	2			15680	7,840	1	576.5	544.4	490.0
2	N/A		3/4	2			15680	11,760	1	864.7	816.7	735.0
3	1	16-QAM	1/4	4			31360	7,840	1	576.5	544.4	490.0
3	0		1/2	4			31360	15,680	1	1,152.9	1,088.9	980.0
4	1		3/8	4			31360	11,760	1	864.7	816.7	735.0
4	0		3/4	4			31360	23,520	1	1,729.4	1,633.3	1,470.0
5	N/A	64-QAM	2/3	6			47040	31,360	1	2,305.9	2,177.8	1,960.0
6			3/4	6			47040	35,280	1	2,594.1	2,450.0	2,205.0
7			5/6	6			47040	39,200	1	2,882.4	2,722.2	2,450.0
8		256-QAM	3/4	8			62720	47,040	1	3,458.8	3,266.7	2,940.0
9			5/6	8			62720	52,266	1	3,843.1	3,629.6	3,266.6
10		1024-QAM	3/4	10			78400	58,800	1	4,323.5	4,083.3	3,675.0
11			5/6	10			78400	65,333	1	4,803.9	4,537.0	4,083.3

Table 26-85—HE-MCSs for optional non-OFDMA 160 MHz and 80+80 MHz, N_{SS} = 1

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	1960	32	1960	490	1	36.0	34.0	30.6
0	0		1/2	1			1960	980	1	72.1	68.1	61.3
1	1	QPSK	1/4	2			3920	980	1	72.1	68.1	61.3
1	0		1/2	2			3920	1,960	1	144.1	136.1	122.5
2	N/A		3/4	2			3920	2,940	1	216.2	204.2	183.8
3	1	16-QAM	1/4	4			7840	1,960	1	144.1	136.1	122.5
3	0		1/2	4			7840	3,920	1	288.2	272.2	245.0
4	1		3/8	4			7840	2,940	1	216.2	204.2	183.8
4	0		3/4	4			7840	5,880	1	432.4	408.3	367.5
5	N/A	64-QAM	2/3	6			11760	7,840	1	576.5	544.4	490.0
6			3/4	6			11760	8,820	1	648.5	612.5	551.3
7			5/6	6			11760	9,800	1	720.6	680.6	612.5
8		256-QAM	3/4	8			15680	11,760	1	864.7	816.7	735.0
9			5/6	8			15680	13,066	1	960.7	907.4	816.6
10		1024-QAM	3/4	10			19600	14,700	1	1,080.9	1,020.8	918.8
11			5/6	10			19600	16,333	1	1,201.0	1,134.2	1,020.8

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Table 26-86—HE-MCSs for optional non-OFDMA 160 MHz and 80+80 MHz, N_{SS} = 2

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	1960	32	3920	980	1	72.1	68.1	61.3
0	0		1/2	1			3920	1,960	1	144.1	136.1	122.5
1	1	QPSK	1/4	2			7840	1,960	1	144.1	136.1	122.5
1	0		1/2	2			7840	3,920	1	288.2	272.2	245.0
2	N/A		3/4	2			7840	5,880	1	432.4	408.3	367.5
3	1	16-QAM	1/4	4			15680	3,920	1	288.2	272.2	245.0
3	0		1/2	4			15680	7,840	1	576.5	544.4	490.0
4	1		3/8	4			15680	5,880	1	432.4	408.3	367.5
4	0		3/4	4			15680	11,760	1	864.7	816.7	735.0
5	N/A	64-QAM	2/3	6			23520	15,680	1	1,152.9	1,088.9	980.0
6			3/4	6			23520	17,640	1	1,297.1	1,225.0	1,102.5
7			5/6	6			23520	19,600	1	1,441.2	1,361.1	1,225.0
8		256-QAM	3/4	8			31360	23,520	1	1,729.4	1,633.3	1,470.0
9			5/6	8			31360	26,133	1	1,921.5	1,814.8	1,633.3
10		1024-QAM	3/4	10			39200	29,400	1	2,161.8	2,041.7	1,837.5
11			5/6	10			39200	32,666	1	2,401.9	2,268.5	2,041.6

Table 26-87—HE-MCSs for optional non-OFDMA 160 MHz and 80+80 MHz, N_{SS} = 3

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	1960	32	5880	1,470	1	108.1	102.1	91.9
0	0		1/2	1			5880	2,940	1	216.2	204.2	183.8
1	1	QPSK	1/4	2			11760	2,940	1	216.2	204.2	183.8
1	0		1/2	2			11760	5,880	1	432.4	408.3	367.5
2	N/A		3/4	2			11760	8,820	1	648.5	612.5	551.3
3	1	16-QAM	1/4	4			23520	5,880	1	432.4	408.3	367.5
3	0		1/2	4			23520	11,760	1	864.7	816.7	735.0
4	1		3/8	4			23520	8,820	1	648.5	612.5	551.3
4	0		3/4	4			23520	17,640	1	1,297.1	1,225.0	1,102.5
5	N/A	64-QAM	2/3	6			35280	23,520	1	1,729.4	1,633.3	1,470.0
6			3/4	6			35280	26,460	1	1,945.6	1,837.5	1,653.8
7			5/6	6			35280	29,400	1	2,161.8	2,041.7	1,837.5
8		256-QAM	3/4	8			47040	35,280	1	2,594.1	2,450.0	2,205.0
9			5/6	8			47040	39,200	1	2,882.4	2,722.2	2,450.0
10		1024-QAM	3/4	10			58800	44,100	1	3,242.6	3,062.5	2,756.3
11			5/6	10			58800	49,000	1	3,602.9	3,402.8	3,062.5

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Table 26-88—HE-MCSs for optional non-OFDMA 160 MHz and 80+80 MHz, N_{SS} = 4

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	1960	32	7840	1,960	1	144.1	136.1	122.5
0	0		1/2	1			7840	3,920	1	288.2	272.2	245.0
1	1	QPSK	1/4	2			15680	3,920	1	288.2	272.2	245.0
1	0		1/2	2			15680	7,840	1	576.5	544.4	490.0
2	N/A		3/4	2			15680	11,760	1	864.7	816.7	735.0
3	1	16-QAM	1/4	4			31360	7,840	1	576.5	544.4	490.0
3	0		1/2	4			31360	15,680	1	1,152.9	1,088.9	980.0
4	1		3/8	4			31360	11,760	1	864.7	816.7	735.0
4	0		3/4	4			31360	23,520	1	1,729.4	1,633.3	1,470.0
5	N/A	64-QAM	2/3	6			47040	31,360	1	2,305.9	2,177.8	1,960.0
6			3/4	6			47040	35,280	1	2,594.1	2,450.0	2,205.0
7			5/6	6			47040	39,200	1	2,882.4	2,722.2	2,450.0
8		256-QAM	3/4	8			62720	47,040	1	3,458.8	3,266.7	2,940.0
9			5/6	8			62720	52,266	1	3,843.1	3,629.6	3,266.6
10		1024-QAM	3/4	10			78400	58,800	1	4,323.5	4,083.3	3,675.0
11			5/6	10			78400	65,333	1	4,803.9	4,537.0	4,083.3

Table 26-89—HE-MCSs for optional non-OFDMA 160 MHz and 80+80 MHz, N_{SS} = 5

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	1960	32	9800	2,450	1	180.1	170.1	153.1
0	0		1/2	1			9800	4,900	1	360.3	340.3	306.3
1	1	QPSK	1/4	2			19600	4,900	1	360.3	340.3	306.3
1	0		1/2	2			19600	9,800	1	720.6	680.6	612.5
2	N/A		3/4	2			19600	14,700	1	1,080.9	1,020.8	918.8
3	1	16-QAM	1/4	4			39200	9,800	1	720.6	680.6	612.5
3	0		1/2	4			39200	19,600	1	1,441.2	1,361.1	1,225.0
4	1		3/8	4			39200	14,700	1	1,080.9	1,020.8	918.8
4	0		3/4	4			39200	29,400	1	2,161.8	2,041.7	1,837.5
5	N/A	64-QAM	2/3	6			58800	39,200	1	2,882.4	2,722.2	2,450.0
6			3/4	6			58800	44,100	1	3,242.6	3,062.5	2,756.3
7			5/6	6			58800	49,000	1	3,602.9	3,402.8	3,062.5
8		256-QAM	3/4	8			78400	58,800	1	4,323.5	4,083.3	3,675.0
9			5/6	8			78400	65,333	1	4,803.9	4,537.0	4,083.3
10		1024-QAM	3/4	10			98000	73,500	1	5,404.4	5,104.2	4,593.8
11			5/6	10			98000	81,666	1	6,004.9	5,671.3	5,104.1

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Table 26-90—HE-MCSs for optional non-OFDMA 160 MHz and 80+80 MHz, N_{SS} = 6

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	1960	32	11760	2,940	1	216.2	204.2	183.8
0	0		1/2	1			11760	5,880	1	432.4	408.3	367.5
1	1	QPSK	1/4	2			23520	5,880	1	432.4	408.3	367.5
1	0		1/2	2			23520	11,760	1	864.7	816.7	735.0
2	N/A		3/4	2			23520	17,640	1	1,297.1	1,225.0	1,102.5
3	1	16-QAM	1/4	4			47040	11,760	1	864.7	816.7	735.0
3	0		1/2	4			47040	23,520	1	1,729.4	1,633.3	1,470.0
4	1		3/8	4			47040	17,640	1	1,297.1	1,225.0	1,102.5
4	0		3/4	4			47040	35,280	1	2,594.1	2,450.0	2,205.0
5	N/A	64-QAM	2/3	6			70560	47,040	1	3,458.8	3,266.7	2,940.0
6			3/4	6			70560	52,920	1	3,891.2	3,675.0	3,307.5
7			5/6	6			70560	58,800	1	4,323.5	4,083.3	3,675.0
8		256-QAM	3/4	8			94080	70,560	1	5,188.2	4,900.0	4,410.0
9			5/6	8			94080	78,400	1	5,764.7	5,444.4	4,900.0
10		1024-QAM	3/4	10			117600	88,200	1	6,485.3	6,125.0	5,512.5
11			5/6	10			117600	98,000	1	7,205.9	6,805.6	6,125.0

Table 26-91—HE-MCSs for optional non-OFDMA 160 MHz and 80+80 MHz, N_{SS} = 7

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	1960	32	13720	3,430	1	252.2	238.2	214.4
0	0		1/2	1			13720	6,860	1	504.4	476.4	428.8
1	1	QPSK	1/4	2			27440	6,860	1	504.4	476.4	428.8
1	0		1/2	2			27440	13,720	1	1,008.8	952.8	857.5
2	N/A		3/4	2			27440	20,580	1	1,513.2	1,429.2	1,286.3
3	1	16-QAM	1/4	4			54880	13,720	1	1,008.8	952.8	857.5
3	0		1/2	4			54880	27,440	1	2,017.6	1,905.6	1,715.0
4	1		3/8	4			54880	20,580	1	1,513.2	1,429.2	1,286.3
4	0		3/4	4			54880	41,160	1	3,026.5	2,858.3	2,572.5
5	N/A	64-QAM	2/3	6			82320	54,880	1	4,035.3	3,811.1	3,430.0
6			3/4	6			82320	61,740	1	4,539.7	4,287.5	3,858.8
7			5/6	6			82320	68,600	1	5,044.1	4,763.9	4,287.5
8		256-QAM	3/4	8			109760	82,320	1	6,052.9	5,716.7	5,145.0
9			5/6	8			109760	91,466	1	6,725.4	6,351.8	5,716.6
10		1024-QAM	3/4	10			137200	102,900	1	7,566.2	7,145.8	6,431.3
11			5/6	10			137200	114,333	1	8,406.8	7,939.8	7,145.8

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Table 26-92—HE-MCSs for optional non-OFDMA 160 MHz and 80+80 MHz, N_{SS} = 8

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	1960	32	15680	3,920	1	288.2	272.2	245.0
0	0		1/2	1			15680	7,840	1	576.5	544.4	490.0
1	1	QPSK	1/4	2			31360	7,840	1	576.5	544.4	490.0
1	0		1/2	2			31360	15,680	1	1,152.9	1,088.9	980.0
2	N/A		3/4	2			31360	23,520	1	1,729.4	1,633.3	1,470.0
3	1	16-QAM	1/4	4			62720	15,680	1	1,152.9	1,088.9	980.0
3	0		1/2	4			62720	31,360	1	2,305.9	2,177.8	1,960.0
4	1		3/8	4			62720	23,520	1	1,729.4	1,633.3	1,470.0
4	0		3/4	4			62720	47,040	1	3,458.8	3,266.7	2,940.0
5	N/A	64-QAM	2/3	6			94080	62,720	1	4,611.8	4,355.6	3,920.0
6			3/4	6			94080	70,560	1	5,188.2	4,900.0	4,410.0
7			5/6	6			94080	78,400	1	5,764.7	5,444.4	4,900.0
8		256-QAM	3/4	8			125440	94,080	1	6,917.6	6,533.3	5,880.0
9			5/6	8			125440	104,533	1	7,686.3	7,259.2	6,533.3
10		1024-QAM	3/4	10			156800	117,600	1	8,647.1	8,166.7	7,350.0
11			5/6	10			156800	130,666	1	9,607.8	9,074.0	8,166.6

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Annex C

(normative)

ASN.1 encoding of the MAC and PHY MIB

C.3 MIB Detail

Insert the following (after getting some sucker to validate MIB compilation, etc.):

```
dot11PPEThresholdsRequired OBJECT-TYPE
SYNTAX TruthValue
MAX-ACCESS read-only
STATUS current
DESCRIPTION
"This is a capability variable.
Its value is determined by device capabilities.
This attribute, when true, indicates that Post-FEC Padding and Packet Extension
       Thresholds exist and are provided in the dot11PPEThresholdsTable MIB."
DEFVAL { false }
::= { dot11StationConfigEntry <ANA> }

--------------------------------------------------------------------
-- ********************************************************************
-- * dot11PPEThresholdsMappings TABLE
-- ********************************************************************
dot11PPEThresholdsMappingsTable OBJECT-TYPE
SYNTAX SEQUENCE OF Dot11PPEThresholdsMappingsEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"Conceptual table for PPE Thresholds Mappings. The MIB supports the ability to
       share separate PPE Thresholds for each NSS/RU pair. The Thresholds Map-
       pings Table contains one entry for each NSS/RU pair and contains two
       fields for each entry: PPET8 and PPET16. The PPE Thresholds mappings are
       logically WRITE-ONLY. Attempts to read the entries in this table return
       unsuccessful status and values of null or 0. The default value for all
       PPET8 fields is NONE."
REFERENCE "IEEE Std 802.11-<year>, 9.47 (HE Post-FEC Padding and Packet Exten-
       sion)"
::= { dot11smt 4 }

dot11PPEThresholdsMappingsEntry OBJECT-TYPE
SYNTAX Dot11PPEThresholdsMappingsEntry
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"An Entry (conceptual row) in the PPE Thresholds Mappings Table. ifIndex - Each
       IEEE Std 802.11 interface is represented by an ifEntry. Interface tables
       in this MIB module are indexed by ifIndex."
INDEX { ifIndex, dot11PPEThresholdsMappingIndex }
::= { dot11PPEThresholdsMappingsTable 1 }

Dot11PPEThresholdsMappingsEntry ::=
SEQUENCE {
dot11PPEThresholdsMappingIndexUnsigned32,
dot11PPEThresholdsMappingNSSInteger,
dot11PPEThresholdsMappingRUIndexInteger,
dot11PPEThresholdsMappingPPET8Integer,
dot11PPEThresholdsMappingPPET16Integer,
```

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```
dot11PPEThresholdsMappingStatusRowStatus }

dot11PPEThresholdsMappingIndex OBJECT-TYPE
SYNTAX Unsigned32
MAX-ACCESS not-accessible
STATUS current
DESCRIPTION
"The auxiliary variable used to identify instances of the columnar objects in the
      PPE Thresholds Mappings Table."
::= { dot11PPEThresholdsMappingsEntry 1 }

dot11PPEThresholdsMappingNSS OBJECT-TYPE
SYNTAX Integer
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"The NSS value portion of the NSS/RU pair for which the values from this Thresh-
      olds mapping entry are to be used."
::= { dot11PPEThresholdsMappingsEntry 2 }

dot11PPEThresholdsMappingRUIndex OBJECT-TYPE
SYNTAX Integer
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"The index of the RU value portion of the NSS/RU pair for which the values from
      this Thresholds mapping entry are to be used. The index values map to an
      RU as follows: RU Index of 0 is 996 tones, 1 is 448 tones, 2 is TBD tones,
      3 is reserved."
::= { dot11PPEThresholdsMappingsEntry 3 }

dot11PPEThresholdsMappingPPET8 OBJECT-TYPE
SYNTAX TruthValue
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"An index that determines a constellation value at or above which a Post FEC Pad-
      ding and Packet Extension value of at least 8 us is required for the given
      NSS/RU pair corresponding to the row of the entry. The index values are
      mapped as follows: 0 is BPSK, 1 is QPSK, 2 is 16QAM, 3 is 64QAM, 4 is
      256QAM, 5 is 1024QAM, 6 is reserved, 7 is the special value of NONE."
::= { dot11PPEThresholdsMappingsEntry 4 }


dot11PPEThresholdsMappingPPET16 OBJECT-TYPE
SYNTAX TruthValue
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"An index that determines a constellation value at or above which a Post FEC Pad-
      ding and Packet Extension value of 16 us is required for the given NSS/RU
      pair corresponding to the row of the entry. The index values are mapped as
      follows: 0 is BPSK, 1 is QPSK, 2 is 16QAM, 3 is 64QAM, 4 is 256QAM, 5 is
      1024QAM, 6 is reserved, 7 is the special value of NONE."
::= { dot11PPEThresholdsMappingsEntry 5 }

dot11PPEThresholdsMappingStatus OBJECT-TYPE
SYNTAX RowStatus
MAX-ACCESS read-create
STATUS current
DESCRIPTION
"The status column used for creating, modifying, and deleting instances of the
      columnar objects in the PPE Thresholds mapping Table."
DEFVAL { active }
```


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::= { dot11PPEThresholdsMappingsEntry 6 }

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-- * End of dot11PPEThresholdsMappings TABLE
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Appendix I

IEEE P802.11ax™/D0.5, September 2016
(amendment to IEEE P802.11REVmc™/D8.0
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IEEE P802.11ah™/D9.0,
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IEEE P802.11ak™/D2.0,
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IEEE P802.11ax™/D0.5

Draft Standard for Information technology— Telecommunications and information exchange between systems Local and metropolitan area networks— Specific requirements

Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications

Amendment 6: Enhancements for High Efficiency WLAN(#1121)

Prepared by the 802.11 Working Group of the

LAN/MAN Standards Committee
of the
IEEE Computer Society

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Abstract: This amendment defines modifications to both the IEEE 802.11 physical layer (PHY) and the medium access control (MAC) sublayer for high efficiency operation in frequency bands between 1 GHz and 6 GHz.

Keywords: high efficiency, PHY, physical layer, MAC, medium access control, OFDMA, orthogonal frequency division multiple access, wireless local area network, WLAN

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This introduction is not part of IEEE P802.11ax /D0.5, September 2016, IEEE Standard for Information technology—Telecommunications and information exchange between systems—Local and metropolitan area network—Specific requirements—Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications—Amendment 6: Enhancements for High Efficiency WLAN(#1121).

This amendment defines modifications to both the IEEE 802.11 physical layer (PHY) and the medium access control (MAC) sublayer for high efficiency operation in frequency bands between 1 GHz and 6 GHz.

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IEEE P802.11ax™/D0.5

Draft STANDARD for Information Technology— Telecommunications and information exchange between systems— Local and metropolitan area networks— Specific requirements

Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications

Amendment 6: Enhancements for High Efficiency WLAN(#1121)

[This amendment is based on IEEE P802.11REVmc/D6.0(#2111) amended by IEEE P802.11ai/D4.0, IEEE P802.11ah/D5.0, IEEE P802.11aq/D3.0, IEEE P802.11ak/D1.0 and IEEE P802.11aj/D1.0]

NOTE—The editing instructions contained in this amendment define how to merge the material contained therein into the existing base standard and its amendments to form the comprehensive standard.

The editing instructions are shown in ***bold italic***. Four editing instructions are used: change, delete, insert, and replace. ***Change*** is used to make corrections in existing text or tables. The editing instruction specifies the location of the change and describes what is being changed by using ~~strikethrough~~ (to remove old material) and underscore (to add new material). ***Delete*** removes existing material. ***Insert*** adds new material without disturbing the existing material. Insertions may require renumbering. If so, renumbering instructions are given in the editing instruction. ***Replace*** is used to make changes in figures or equations by removing the existing figure or equation and replacing it with a new one. Editorial instructions, change markings and this NOTE will not be carried over into future editions because the changes will be incorporated into the base standard.

Editorial Notes

Editor's Note: Editorial Notes in the body of the standard appear like this. They will be removed before publication. They may highlight some issue that the editor has had to address during the implementation of a change. Where there may be any technical impact from an editing issue, the editor will raise a technical letter ballot comment. There is no need for voters to comment on such issues unless they have a specific resolution they wish to present.

Editor's Note: Headings with empty content or Headings preceding editing instructions that modify the contents of the referenced subclause are there to provide context to the reader of this document, they have no other significance.

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These tags will be hidden in versions of the draft sent out to letter ballot - i.e., they are present only to assist the editorial review panel in checking that changes have been properly applied.

Tags are shown close to the point of change. When a whole subclause is new, the heading is tagged.

Otherwise, when a whole paragraph is new, the paragraph is tagged. Otherwise tags are placed after a section of changes within a paragraph or at the end of the paragraph if the changes are substantial.

New tables are tagged in the table caption (if there is one), or in the introductory paragraph. Otherwise, new rows in existing tables are tagged only in the first column, to avoid distraction. Otherwise, a modified cell is tagged.

Finally, any other changes made by the editor (e.g., for grammar, language, style & consistency with other comment resolutions, baseline, etc.) are tagged (#Ed).

Editor's Note: A cumulative status of the versions of this draft is shown below.

Table 1—Draft Status

Draft	Date	Status
D0.1	2016-03-03	Converted to FrameMaker from 16/0024r1 Proposed draft specification
D0.2	2016-06-06	Includes tentative resolutions for most editorials. Includes resolutions for technical comments motioned in May 2016 session.
D0.3	2016-08-11	Includes resolutions for technical comments motioned in July 2016 session.
D0.4	2016-08-26	Included motioned draft changes from July 2016 session and corrected errors
D0.5	2016-09-30	Included comment resolutions and other changes motioned at the September 2016 session

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3. Definitions, acronyms, and abbreviations

3.2 Definitions specific to IEEE 802.11

Insert the following definitions maintaining alphabetical order:

non-orthogonal frequency division multiple access (non-OFDMA): A full bandwidth HE transmission with 242-tone RU, 484-tone RU, 996-tone RU, 2×996-tone RU, or 2×996-tone RU allocated for 20 MHz, 40 MHz, 80 MHz, 160 MHz, or 80+80 MHz transmission, respectively.(#355)

target wake time (TWT) scheduling STA: A STA that schedules broadcast TWTs and provides these schedules in a broadcast TWT element.

target wake time (TWT) scheduled STA: A STA that follows the schedules provided in a broadcast TWT element.(#544)

3.4 Abbreviations and acronyms

Insert the following acronym definitions (maintaining alphabetical order):

DCM	Dual carrier modulation(#2567)
DL	Downlink(#2401)
DL MU	Downlink multi-user
HE	High efficiency
OBO	Orthogonal frequency division multiple access (OFDMA) backoff(#1747)
OCW	Orthogonal frequency division multiple access (OFDMA) contention window(#1747)
OFDMA	Orthogonal frequency-division multiple access
OMI	Operation mode indication(#2200)(#2328)
PPE	PHY padding extension(#1723)
MU-RTS	Multi-user request to send
UL	Uplink
UL MU	Uplink multi-user(#545)

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4. General description

4.3 Components of the IEEE Std 802.11 architecture

Insert a new subclause after subclause 4.3.12 as follows:

4.3.12a High efficiency (HE) STA

The IEEE 802.11 HE STA operates in frequency bands between 1 GHz and 6 GHz.

An HE STA is VHT STA or HT non-AP STA that, in addition to the features supported as a VHT STA or HT non-AP STA respectively, supports the MAC features defined in Clause 25 and the PHY features defined in Clause 26.(PHY Motion #163)

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6. Layer management

6.1 Overview of management model

6.2 Generic management primitives

6.3 MLME SAP interface

6.3.3 Scan

6.3.3.3 MLME-SCAN.confirm

6.3.3.3.2 Semantics of the service primitive

(#2306)Insert the following rows at the end of the BSSDescription table:

Name	Type	Valid range	Description	IBSS adoption
HE Capabilities	As defined in frame format	As defined in 9.4.2.218 (HE Capabilities element)	Specifies the parameters within the HE Capabilities element that are supported by the STA. The parameter is present if dot11HEOptionImplemented is true; otherwise, this parameter is not present.	Do not adopt
HE Operation	As defined in frame format	As defined in 9.4.2.219 (HE Operation element)	Specifies the parameters within the HE Operation element that are supported by the AP. The parameter is present if dot11HEOptionImplemented is true.	Adopt

6.3.4 Synchronization

6.3.4.2 MLME-JOIN.request

6.3.4.2.2 Semantics of the service primitive

Change the primitive parameters as follows (note that not all existing parameters in the baseline are shown):

The primitive parameters are as follows:

MLME-JOIN.request(

...

AdvertisementProtocolInfo,

HE Capabilities,(#1227)(#1238)

VendorSpecificInfo

)

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Insert the following entry into the unnumbered table in this subclause:

Name	Type	Valid range	Description
HE Capabilities	As defined in HE Capabilities element.(#1122)	As defined in 9.4.2.218 (HE Capabilities element)	Specifies the parameters within the HE Capabilities element that are supported by the STA. The parameter is present if dot11HEOptionImplemented is true; otherwise, this parameter is not present.

6.3.7 Associate

6.3.7.4 MLME-ASSOCIATE.indication

6.3.7.4.2 Semantics of the service primitive

Change the primitive parameters as follows (not all existing parameters in the baseline are shown):

The primitive parameters are as follows:

MLME-ASSOCIATE.indication(

...,

HE Capabilities,(#1227)(#1239)(#1240)(#2294)

VendorSpecificInfo

)

Insert the following entry into the unnumbered table in this subclause:

Name	Type	Valid range	Description
HE Capabilities	As defined in HE Capabilities element.(#1122)	As defined in 9.4.2.218 (HE Capabilities element)	Specifies the parameters within the HE Capabilities element that are supported by the peer STA. The parameter is present if it is present in the Association Request frame received from the STA; otherwise, this parameter is not present.

6.3.8 Reassociate

6.3.8.4 MLME-REASSOCIATE.indication

6.3.8.4.2 Semantics of the service primitive

Change the primitive parameters as follows (not all existing parameters in the baseline are shown):

The primitive parameters are as follows:

MLME-REASSOCIATE.indication(

...

HE Capabilities,(#1227)(#1239)(#1240)

VendorSpecificInfo

)

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Insert the following entry into the unnumbered table in this subclause:

Name	Type	Valid range	Description
HE Capabilities	As defined in HE Capabilities element.(#1122)	As defined in 9.4.2.218 (HE Capabilities element)	Specifies the parameters within the HE Capabilities element that are supported by the peer STA. The parameter is present if it is present in the Reassociation Request frame received from the STA; otherwise, this parameter is not present.

6.3.11 Start

6.3.11.2 MLME-START.request

6.3.11.2.2 Semantics of the service primitive

Change the primitive parameters as follows (not all existing parameters in the baseline are shown):

MLME-START.request(

...,

HE Capabilities,

HE Operation,

VendorSpecificInfo

)

Insert the following entry into the unnumbered table in this subclause:

Name	Type	Valid range	Description
HE Capabilities	As defined in HE Capabilities element.(#1122)	As defined in 9.4.2.218 (HE Capabilities element)	Specifies the parameters within the HE Capabilities element that are supported by the MAC entity. The parameter is (#1230)present if dot11HEOptionImplemented is true; otherwise, this parameter is not present.
HE Operation	As defined in HE Operation element.(#1122)	As defined in 9.4.2.219 (HE Operation element)	The additional HE capabilities to be advertised for the BSS. The parameter is present if (#1152)dot11HEOptionImplemented is true; otherwise, this parameter is not present.

6.3.27 Management of direct links

6.3.27.4 6.3.27.4 MLME-DLS.indication

6.3.27.4.2 6.3.27.4.2 Semantics of the service primitive

Change the primitive parameters as follows (not all existing parameters in the baseline are shown):

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MLME-DLS.indication(
...,
HE Capabilities,
VendorSpecificInfo
)(#1352)

Insert the following entry to the unnumbered table in this subclause:

Name	Type	Valid range	Description
HE Capabilities	As defined in HE Capabilities element.	As defined in 9.4.2.218 (HE Capabilities element)	Specifies the parameters within the HE Capabilities element that are supported by the MAC entity. The parameter is optionally present if dot11HEOptionImplemented is true; otherwise, not present.

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8. PHY service specification

8.3 Detailed PHY service specifications

8.3.5 PHY SAP detailed service specification

8.3.5.2 PHY-DATA.request

8.3.5.2.2 Semantics of the service primitive

Change the subclause as follows:

The primitive provides the following parameter:

PHY-DATA.request(

DATA
USER_INDEX
STA_INDEX(#2420)
)

The DATA parameter is an octet of value X'00' to X'FF'.

The USER_INDEX parameter (typically identified as u for a VHT STA; see NOTE 1 at the end of Table 21-1 (TXVECTOR and RXVECTOR parameters)) is present for a VHT MU PPDU and indicates the index of the user in the TXVECTOR to which the accompanying DATA octet applies; otherwise, this parameter is not present.

The STA_INDEX parameter (obtained from STA_ID_LIST in Table 26-1 (TXVECTOR and RXVECTOR parameters(#1780)) is present for a HE MU PPDU and indicates the index of the user in the TXVECTOR to which the accompanying DATA octet applies; otherwise, this parameter is not present.

8.3.5.3 PHY-DATA.indication

8.3.5.3.2 Semantics of the service primitive

Change the subclause as follows:

The primitive provides the following parameter:

PHY-DATA.request(

DATA
STA_INDEX(#2420)
)

The DATA parameter is an octet of value X'00' to X'FF'.

The STA_INDEX parameter is present for an HE trigger-based PPDU and indicates the index of the user in the RXVECTOR to which the accompanying DATA octet applies; otherwise, this parameter is not present.

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9. Frame formats

9.2 MAC frame formats

9.2.4 Frame fields

9.2.4.1 Frame Control field

9.2.4.1.3 Type and Subtype fields

Change the row below and insert a new row immediately after it in Table 9-1 (Valid type and subtype combinations) as follows:

Table 9-1—Valid type and subtype combinations

Type value B3 B2	Type description	Subtype value B7 B6 B5 B4	Subtype description
01	Control	0000–~~0011~~<ANA>	Reserved
01	Control	<ANA>	Trigger

9.2.4.1.10 Order field

Change this subclause as follows:

The Order field is 1 bit in length. The setting of the Order field is as follows:

- It is set to 1 in a non-QoS Data frame transmitted by a non-QoS STA to indicate that the frame contains an MSDU, or fragment thereof, that is being transferred using the StrictlyOrdered service class.
- It is set to 1 in a QoS Data or Management frame transmitted with a value of HT_GF, HT_MF, VHT, HE or S1G for the FORMAT parameter of the TXVECTOR to indicate that the frame contains an HT Control field.
- It is set to 1 in an S1G RTS frame to indicate that the intended recipient of the frame has permission to extend the TXOP as described in 10.51.5.4 (Relay-shared TXOP protection mechanisms).

Otherwise, the Order field is set to 0.

NOTE—The Order field is always set to 0 for frames transmitted by a DMG STA.

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9.2.4.5 QoS Control field

9.2.4.5.4 Ack Policy subfield

Change Table 9-9 (Ack Policy subfield in QoS Control field of QoS Data frames) as follows (only relevant row shown):

Table 9-9—Ack Policy subfield in QoS Control field of QoS Data frames

Bits in QoS Control field		Meaning
Bit 5	Bit 6	
0	1	No explicit acknowledgment or PSMP Ack. When bit 6 of the Frame Control field (see 9.2.4.1.3 (Type and Subtype subfields)) is set to 1: There might be a response frame to the frame that is received, but it is neither the Ack frame nor any Data frame of subtype +CF-Ack. The Ack Policy subfield for QoS CF-Poll and QoS CF-Ack +CF-Poll Data frames is set to this value. When bit 6 of the Frame Control field (see 9.2.4.1.3 (Type and Subtype subfields)) is set to 0: The acknowledgment for a frame indicating PSMP Ack when it appears in a PSMP downlink transmission time (PSMP-DTT) is to be received in a later PSMP uplink transmission time (PSMP-UTT). The acknowledgment for a frame indicating PSMP Ack when it appears in a PSMP-UTT is to be received in a later PSMP-DTT. For a frame that is carried in a DL HE MU PPDU: The Ack Policy subfield for the frame that solicits an immediate response in a HE Trigger-based PPDU is set to this value (MU Ack). The addressed recipient returns an Ack, BlockAck, or Multi-STA BlockAck frame in the HE trigger-based PPDU format after a SIFS period, according to the procedures defined in 10.3.2.11.2 (Acknowledgement procedure for HE MU PPDU in MU format) and 25.5.2 (UL MU operation).(#2445) NOTE—Bit 6 of the Frame Control field (see 9.2.4.1.3 (Type and Subtype subfields)) indicates the absence of a data Frame Body field. When equal to 1, the QoS Data frame contains no Frame Body field, and any response is generated in response to a QoS CF-Poll or QoS CF-Ack +CF-Poll frame, but does not signify an acknowledgment of data. When set to 0, the QoS Data frame contains a Frame Body field, which is acknowledged as described in 10.29.2.7 (PSMP acknowledgment rules).

9.2.4.5.6 Queue Size subfield

Change subclause 9.2.4.5.6 as follows:

The Queue Size subfield is an 8-bit field that indicates the amount of buffered traffic for a given TC or TS at the STA sending this frame. A non-AP HE STA uses the Queue Size subfield to indicate the amount of buffered traffic intended for the STA identified by the receive address of the frame containing the QoS Control field.(MAC Motion #85) The Queue Size subfield is present in QoS Data and QoS Null frames sent by non-AP STAs with bit 4 of the QoS Control field equal to 1. The AP ~~might~~ can use information contained in the Queue Size subfield to determine the TXOP duration assigned to the STA or to determine the UL resources assigned to the HE STA (see 25.5.2 (UL MU operation)).(#172)

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The queue size value is the total size, rounded up to the nearest multiple of 256 octets and expressed in units of 256 octets, of all MSDUs and A-MSDUs buffered at the STA (excluding the MSDU or A-MSDU of the present QoS Data frame sent by a non-HE STA and including the MSDUs or A-MSDUs contained in the present (A-)MPDU sent by an HE STA) in the delivery queue used for MSDUs and A-MSDUs with TID values equal to the value in the TID subfield of this QoS Control field. A queue size value of 0 is used solely to indicate the absence of any buffered traffic in the queue used for the specified TID. A queue size value of 254 is used for all sizes greater than 64 768 octets. A queue size value of 255 is used to indicate an unspecified or unknown size. If a QoS Data frame is fragmented and is not carried in an A-MPDU, the queue size value can remain constant in all fragments even if the amount of queued traffic changes as successive fragments are transmitted. If a QoS Data frame is fragmented and is carried in an A-MPDU, the queue size value is set as defined in 10.13.1 (A-MPDU contents).(#172)

9.2.4.6 HT Control field

9.2.4.6.1 General

Remove Figure 9-8 (HT Control field).

Insert Table 9-9a(#2373) as follows:

Table 9-9a—HT Control field

Variant	Bit 0 (value)	Bit 1 (value)	Bit 2-29	Bit 30	Bit 31
HT variant	VHT (0)	HT Control Middle		AC Constraint	RDG/More PPDU
VHT variant	VHT (1)	HE (0)	VHT Control Middle(#548)	AC Constraint	RDG/More PPDU
HE variant	VHT (1)	HE (1)	Aggregated Control		

Change the paragraphs below of 9.2.4.6.1 as follows:

The HT Control field has ~~two~~ three forms~~,~~:(#359)(#1878) the HT variant, ~~and~~ (#1879)the VHT variant, and the HE variant. These forms differ in the values of the VHT and(#711) HE subfields and in their formats, which are shown in Table 9-9a (HT Control field). ~~The two forms differ in the format of the HT Control Middle subfield, described in 9.2.4.6.2 (HT variant) for the HT variant and in 9.2.4.6.3 (VHT variant) for the VHT variant and in the value of the VHT subfield.~~

The VHT subfield, which is B0 of the HT Control field, and the HE subfield, which is B1 of the HT Control field, indicate the variant of the HT Control field.(#1750)(#1244) The VHT subfield is set to 0 to indicate an(#2829) HT variant HT Control field. The VHT subfield is set to 1 and the HE subfield is set to 0 to indicate a VHT variant HT Control field. The VHT subfield is set to 1 and the HE subfield is set to 1 to indicate an(#2829) HE variant HT Control field(#960)(#1127).

The HT Control Middle subfield is defined in 9.2.4.6.2 (HT variant)(#2203) and the VHT Control Middle subfield is defined in 9.2.4.6.3 (VHT variant).

The Aggregated Control subfield is defined in 9.2.4.6.4 (A-Control)(#2203)(#58).

~~The VHT subfield of the HT Control field indicates whether the HT Control Middle subfield is the VHT Variant or the HT Variant. The VHT subfield is set to 1 to indicate that the HT Control Middle subfield is the VHT Variant and is set to 0 to indicate that the HT Control Middle subfield is the HT Variant.~~

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9.2.4.6.3 VHT variant

Change the paragraph below as follows:

The format of the VHT Control Middle subfield of the VHT variant HT Control field is shown in Figure 9-13 (VHT Control Middle subfield of the VHT variant HT Control field).(#550)

Change Figure 9-13 (VHT Control Middle subfield of the VHT variant HT Control field) as follows (remove Reserved field and change title):

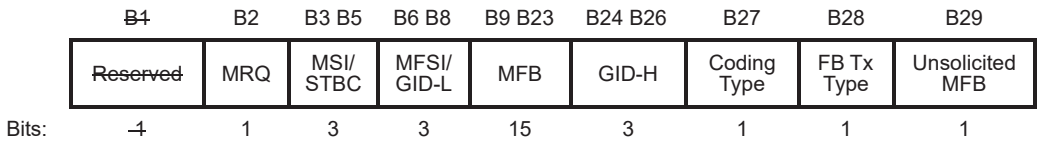

Figure 9-13—VHT Control Middle subfield of the VHT variant HT Control field

Insert a new subclause 9.2.4.6.4 following 9.2.4.6.3:

9.2.4.6.4 A-Control

9.2.4.6.4.1 General

The format of the Aggregated Control (A-Control) subfield of the HE variant HT Control field(#1132) is shown in Figure 9-15a (Aggregated Control subfield of the HE variant HT Control field(#360)(#792)(#1711)(#2204)).

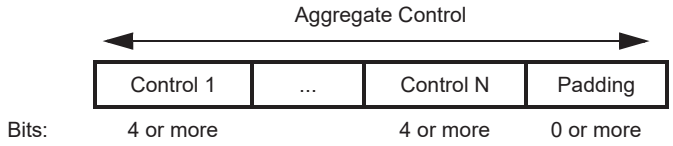

Figure 9-15a—Aggregated Control subfield of the HE variant HT Control field(#360)(#792)(#1711)(#2204)

The A-Control subfield contains a sequence of one or more Control subfields. The format of each Control subfield is defined in Figure 9-15b (Control subfield format). The Control subfield with Control ID subfield equal to 0, if present, is the first subfield of the sequence.

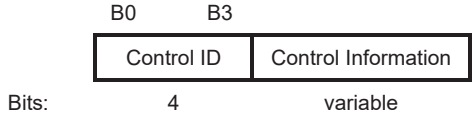

Figure 9-15b—Control subfield format

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The Control ID subfield indicates the type of information carried in the Control Information subfield. The length of the Control Information subfield is fixed for each value of the Control ID subfield that is not reserved.(#1251)(#1133) The values of the Control ID subfield and the associated length of the Control Information subfield are defined in Table 9-18a (Control ID subfield values).

Table 9-18a—Control ID subfield values

Control ID value	Meaning	Length of the Control Information subfield (bits)	Content of the Control Information subfield
0	UL MU response scheduling	26	See 9.2.4.6.4.2 (UL MU response scheduling)
1	Operating Mode(#2209)	16	See 9.2.4.6.4.3 (Operating Mode(#2209))
2	HE link adaptation	TBD	See 9.2.4.6.4.4 (HE link adaptation)
3	Buffer Status Report (BSR)(#824)	26	See 9.2.4.6.5 (Buffer Status Report (BSR)(#824))
4	UL Power Headroom(#340)	8	See 9.2.4.6.5.1 (UL power headroom)
5-15	Reserved		

(#1252)The Padding subfield, if present, follows the last Control subfield and is set to a sequence of zeros so that the length of the A-Control subfield carried in the HT Control field is 30 bits.(#792)(#793)(#363)

9.2.4.6.4.2 UL MU response scheduling

If the Control ID subfield is 0, the Control Information subfield contains(#1257) scheduling information for an HE trigger-based PPDU that carries an immediate acknowledgment and follows the HE MU PPDU containing the Control Information subfield (see 25.5.2.2 (Rules for soliciting UL MU frames)).(#2208)

The format of the Control Information subfield is defined in Figure 9-15c (Control Information subfield format when Control ID subfield is 0).

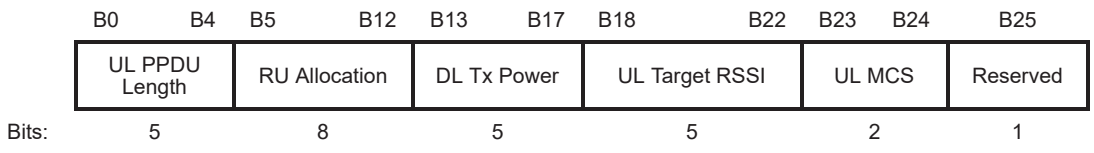

Figure 9-15c—Control Information subfield format when Control ID subfield is 0

The UL PPDU Length subfield indicates the length of the HE trigger-based PPDU response and is set to the number of OFDM symbols the Data field of the HE trigger-based PPDU minus 1(#Ed). The duration of the HE trigger-based PPDU is calculated as defined in 26.4.2 (TXTIME and PSDU_LENGTH calculation).(#94)

(#1)The RU Allocation subfield indicates the resource unit (RU) assigned for transmitting the HE trigger-based PPDU response and is defined in 9.3.1.23 (Trigger frame format).

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The DL TX Power subfield indicates the AP transmit power, combined over all TX antennas and averaged in 20 MHz BW, used for the soliciting frame, in units of dBm. The transmit power, P_{TX}, is calculated as $P_{TX} = -20 + 2 \times F_{Val}$, where F_{Val} is the value of the DL TX Power subfield, except for the value 31, which is reserved.

The UL Target RSSI subfield indicates the AP target receive power, i.e., averaged RSSI over all AP's antennas, for the responding STA when transmitting the HE trigger-based PPDU, in units of dBm. The target receive power, TRSSI, is calculated as $T_{RSSI} = -90 + 2 \times F_{Val}$, except for the value 31 that indicates to the STA to transmit at maximum power for the assigned MCS.

NOTE—It is possible that a STA can not satisfy the target RSSI due to its hardware or regulatory limitation.

The UL MCS subfield indicates the MCS, from MCS0 to MCS3, to be used by the receiving STA for the HE trigger-based PPDU (see 26.5 (Parameters for HE-MCSs(#552))).

9.2.4.6.4.3 Operating Mode(#2209)

If the Control ID subfield is 1, the Control Information subfield contains(#1257) information related to the operating mode change(#2209)(#95) of the STA transmitting the frame containing this information (see 25.8 (Operating mode indication)).

The format of the Control Information subfield is defined in Figure 9-15d (Control Information subfield format when Control ID subfield is 1).

	B0 B2	B3 B4	B5	B6 B8	B9 B11
	Rx NSS	Channel Width	UL MU Disable	Tx NSS	Reserved
Bits:	3	2	1(#95)	3(#95)	3

Figure 9-15d—Control Information subfield format when Control ID subfield is 1

The Rx NSS subfield indicates the maximum number of spatial streams, N_{SS}, that the STA can receive(#1258) and is set to $N_{SS} - 1$.

The Channel Width subfield indicates the operating channel width supported by the STA in reception, and is set to 0 for 20 MHz, 1 for 40 MHz, 2 for 80 MHz, and 3 for 160 MHz and 80+80 MHz. (#365)(#656)(#794)(#1135)(1260)(#2407)

The UL MU Disable subfield indicates whether UL MU operation is suspended or resumed by the non-AP STA. The UL MU Disable subfield is set to 1 to indicate that UL MU operation is suspended; otherwise it is set to 0 to indicate that UL MU operation is resumed. An AP sets the UL MU Disable subfield to 0.

The Tx NSS subfield indicates the maximum number of spatial streams, N_{SS}, that the STA can transmit and is set to $N_{SS} - 1$.(#2463)

9.2.4.6.4.4 HE link adaptation

If the Control ID subfield is 2, the Control Information subfield contains(#1257) information related to the HE link adaptation procedure (see 9.31.4 (Link adaptation using the HE variant HT Control field)).

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The format of the Control Information subfield is defined in Figure 9-15e (Control Information subfield format when Control ID subfield is 2).

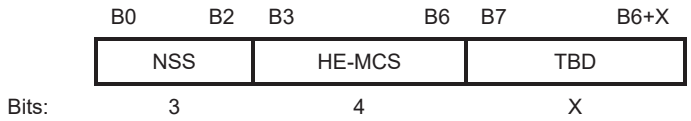

Figure 9-15e—Control Information subfield format when Control ID subfield is 2

The NSS subfield indicates the recommended number of spatial streams, N_{SS}, and is set to $N_{SS} - 1$.

The HE-MCS subfield indicates the recommended HE-MCS, and is set to the HE-MCS Index value (defined in 26.5 (Parameters for HE-MCSs(#552))).

9.2.4.6.5 Buffer Status Report (BSR)(#824)

The Control Information subfield, when the Control ID subfield is 3, contains buffer status information used for UL MU operation (see 25.5.2.5 (HE buffer status feedback operation for UL MU)).

The format of the Control Information subfield is defined in Figure 9-15f (Control Information subfield format when Control ID subfield is 3).

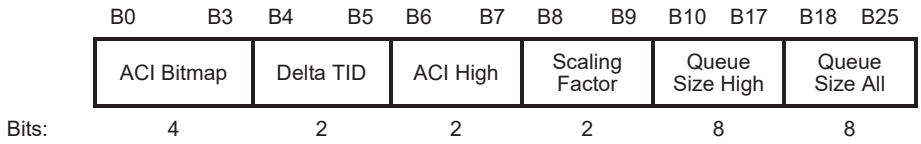

Figure 9-15f—Control Information subfield format when Control ID subfield is 3

The ACI Bitmap subfield indicates the access categories for which the buffer status is reported and its encoding is shown in Table 9-18b (ACI Bitmap subfield encoding). Each bit of the bitmap is set to 1 to indicate that the buffer status of the AC, which ACI is identified by the location of the bit in the ACI Bitmap subfield, is reported and set to 0 otherwise.

Table 9-18b—ACI Bitmap subfield encoding

B0	B1	B2	B3
AC_BE	AC_BK	AC_VI	AC_VO

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The Delta TID subfield, together with the values of the AC Bitmap subfield, indicate the number of TIDs for which the STA is reporting the buffer status. The encoding of the Delta TID subfield is defined in Table 9-18c (Delta TID subfield encoding).

Table 9-18c—Delta TID subfield encoding

Number of bits in the ACI Bitmap subfield that are set to 1	Mapping of Delta TID subfield value and number of TIDs, N_{TID}
0	Values 0 to 2 are not applicable; Value 3 indicates 8 TIDs (i.e., all ACs have traffic)
1	Value 0 indicates 1 TID; Value 1 indicates 2 TIDs; Values 2 to 3 are not applicable;
2	Value 0 indicates 2 TID; Value 1 indicates 3 TIDs; Value 2 indicates 4 TIDs; Value 3 is not applicable;
3	Value 0 indicates 3 TID; Value 1 indicates 4 TIDs; Value 2 indicates 5 TIDs; Value 3 indicates 6 TIDs;
4	Value 0 indicates 4 TID; Value 1 indicates 5 TIDs; Value 2 indicates 6 TIDs; Value 3 indicates 7 TIDs;
NOTE—The number of TIDs can be obtained as $N_{TID} = N_{ones} + F_{Val}$, where N_{ones} is the number of bits set to one in the AC Bitmap subfield, and F_{Val} is the value of the Delta TID subfield except when N_{ones} is equal to 0 for which there is the $N_{TID} = 8$ case.	

The ACI High subfield indicates the ACI of the AC for which the BSR is indicated in the Queue Size High subfield.

The Scaling Factor subfield indicates the unit *SF*, in octets, of the Queue Size subfields. *SF* is equal to:

16 if the Scaling Factor subfield is 0

128 if the Scaling Factor subfield is 1

2 048 if the Scaling Factor subfield is 2

16 384 if the Scaling Factor subfield is 3

The Queue Size High subfield indicates the amount of buffered traffic, in units of *SF* octets, for the AC identified by the ACI High subfield.

The Queue Size All subfield indicates the amount of buffered traffic, in units of *SF* octets, for all the ACs identified by the ACI Bitmap subfield.

The queue size values in the Queue Size High and Queue Size All subfields are the total sizes, rounded up to the nearest multiple of SF octets, of all MSDUs and A-MSDUs buffered at the STA (including the MSDUs or A-MSDUs contained in the present (A-)MPDU) in the delivery queues used for MSDUs and A-MSDUs with AC(s) that are specified in the ACI High and ACI Bitmap subfields, respectively. A queue size value of 254 is used for all sizes greater than 254 × *SF* octets. A queue size value of 255 is used to indicate an unspecified or unknown size. If a QoS Data frame is fragmented and is not carried in an A-MPDU, the queue size value can remain constant in all fragments even if the amount of queued traffic changes as successive fragments are transmitted. If a QoS Data frame is fragmented and is carried in an A-MPDU, the queue size values are set according to the rules in 10.9 (HT operation).(#824)(#93)(#1067)(#2388)

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9.2.4.6.5.1 UL power headroom

The Control Information subfield, when the Control ID subfield is 4, contains the UL power headroom used for power pre-correction (see 26.3.13.2 (Power pre-correction).

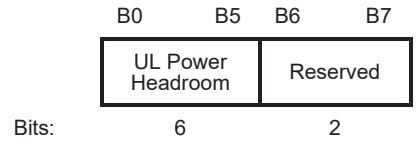

Figure 9-15g—Control Information subfield format when the Control ID subfield is 4

The 5 LSBs (B0-B4) of the UL Power Headroom subfield indicate the available power headroom in units of dB, for the current MCS. The resolution for the UL power headroom reported in UL Power Headroom subfield is 1 dB. The UL Power Headroom subfield carries a value 0 to 31 that maps to 0 dB to 31 dB. B5 of the UL Power Headroom subfield is set to 1 to indicate that the minimum transmit power for the current MCS is reached by the STA and set to 0 otherwise.(#340)

9.2.5 Duration/ID field (QoS STA)

9.2.5.2 Setting for single and multiple protection under enhanced distributed channel access (EDCA)

Change item a) of the 2nd paragraph as follows:

The Duration/ID field is determined as follows:

a) Single protection settings.

1) For an RTS frame that is not part of a dual clear-to-send (CTS) exchange and is not part of a BDT exchange(11ah), the Duration/ID field is set to the estimated time, in microseconds, required to transmit the pending frame, plus one CTS frame, plus one Ack or BlockAck frame if required, plus any NDPs required, plus explicit feedback if required, plus applicable IFSs.

1a) In an MU-RTS frame, the Duration/ID field is set to the estimated time, in microseconds, required for the pending frame, plus one CTS frame, plus the time for the solicited HE trigger-based PPDU if required, plus the time to transmit an acknowledgement frame for the solicited HE trigger-based PPDU if required, plus applicable IFSs.(#2579)

...

3 In a BlockAckReq frame, the Duration/ID field is set to the estimated time required to transmit one Ack or BlockAck frame, as applicable, plus one SIFS.

3a In a MU-BAR frame, the Duration/ID field is set to the time required for the solicited HE trigger-based PPDU plus one SIFS.(#2410)

...

6) In individually addressed QoS Data frames with the Ack Policy subfield equal to No Ack or Block Ack, for Action No Ack frames, and for group addressed frames, the Duration/ID field is set to one of the following:

i) i) If the frame is the final fragment of the TXOP, 0

ii) ii) Otherwise, the estimated time required for the transmission of the following frame and its response frame, if required (including appropriate IFSs)

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7) In a Basic Trigger frame, the Duration/ID field is set to the estimated time required to transmit the solicited HE trigger-based PPDU, plus the estimated time required to transmit multiple BlockAck frames, Ack frames or a Multi-STA BlockAck frame, plus applicable SIFSs.(#2579)

Change item b) of the 2nd paragraph as follows:(#366)

b) Multiple protection settings. The Duration/ID field is set to a value D as follows:

4) Else $T_{END-NAV} - T_{PPDU} \le D \le T_{TXOP-REMAINING} - T_{PPDU}$

where

$T_{SINGLE\text{-}MSDU}$ is the estimated time required for the transmission of the allowed frame exchange sequence defined in 10.22.2.8 (TXOP limits) (for a TXOP limit of 0), including applicable IFS durations

$T_{PENDING}$ is the estimated time required for the transmission of

—Pending MPDUs of the same AC

—Any associated immediate response frames

—Any HT NDP, VHT NDP, or Beamforming Report Poll frame transmissions and explicit feedback response frames

—Applicable IFSs

—Any RDG

—Any pending QoS Null frame exchanges by paged STAs(11ah)

—Any pending PS-Poll or NDP PS-Poll frame exchanges by paged STAs(11ah)

—Any DL MU PPDUs

—Any HE trigger-based PPDUs

—Any Trigger frames to solicit HE trigger-based PPDUs

T_{TXOP} is the duration given by dot11EDCATableTXOPLimit (dot11QAPEDCATableTXOPLimit for the AP) for that AC

$T_{TXOP\text{-}REMAINING}$ is T_{TXOP} less the time already used time within the TXOP

$T_{END\text{-}NAV}$ is the remaining duration of any NAV set by the TXOP holder, or 0 if no NAV has been established

T_{PPDU} is the time required for transmission of the current PPDU

9.2.5.7 Setting for control response frames

Change as follows:

This subclause describes how to set the Duration/ID field for CTS, Ack, and BlockAck frames transmitted by a QoS STA.

In a CTS frame that is not part of a dual CTS sequence transmitted in response to an RTS frame, the Duration/ID field is set to the value obtained from the Duration/ID field of the RTS frame that elicited the response minus the time, in microseconds, between the end of the PPDU carrying the RTS frame and the end of the PPDU carrying the CTS frame.

In a CTS frame that is transmitted in response to an MU-RTS frame, the Duration/ID field is set to the value obtained from the Duration/ID field of the MU-RTS frame that elicited the CTS frame minus the time, in microseconds, between the end of the PPDU carrying the MU-RTS frame and the end of the PPDU carrying the CTS frame.

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In an Ack frame, the Duration/ID field is set to the value obtained from the Duration/ID field of the frame that elicited the response minus the time, in microseconds between the end of the PPDU carrying the frame that elicited the response and the end of the PPDU carrying the Ack frame.

In a BlockAck frame transmitted in response to a BlockAckReq or MU-BAR frame or transmitted in response to a frame containing an implicit block ack request, the Duration/ID field is set to the value obtained from the Duration/ID field of the frame that elicited the response minus the time, in microseconds between the end of the PPDU carrying the frame that elicited the response and the end of the PPDU carrying the BlockAck frame.

In a BlockAck frame transmitted in response to a frame carried in HE trigger-based PPDU, the rule of setting Duration/ID field is described in 9.2.5.2 (Setting for single and multiple protection under enhanced distributed channel access (EDCA)).(#2411)

9.3 Format of individual frame types

9.3.1 Control frames

9.3.1.3 CTS frame format

Change the 2nd paragraph of this subclause as follows:

When the CTS frame is a response to an RTS frame, the value of the RA field of the CTS frame is set to the address from the TA field of the RTS frame with the Individual/Group bit forced to the value 0. When the CTS frame is a response to an MU-RTS frame, the value of the RA field of the CTS frame is set to the address from the TA field of the MU-RTS frame.(#2603)

9.3.1.8 BlockAckReq frame format

9.3.1.8.2 Basic BlockAckReq variant

Change Figure 9-28 as follows:

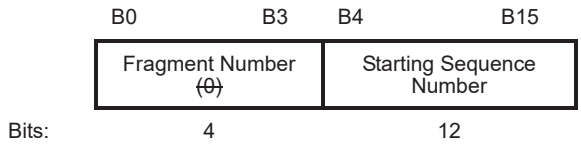

Figure 9-28—Block Ack Starting Sequence Control subfield(#515)

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9.3.1.9 BlockAck frame format

9.3.1.9.1 Overview

Change Figure 9-33 as follows:

	B0	~~B1~~	~~B2~~	~~B3~~ ~~B4~~	B1 B4	~~B5~~B6 B11	B12 B15
	BA Ack Policy	~~Multi-TID~~	~~Compressed Bitmap~~	~~GCR Mode~~	BA Type(#804)(2412)	Reserved	TID_INFO
Bits:	1	~~1~~	~~1~~	~~2~~(11ak)	4	~~8~~7	4

Figure 9-33—BA Control field

Change the 3rd paragraph of this subclause as follows:

The RA field of the BlockAck frame that is not a Multi-STA BlockAck variant(#Ed) is the address of the recipient STA that requested the Block Ack. An HE AP that transmits a Multi-STA BlockAck frame with different values of the AID subfield in Per STA Info subfields sets the RA field to the broadcast address. An HE AP that transmits a Multi-STA BlockAck frame with a single AID subfield or with the same values of the AID subfield in Per STA Info subfields sets the RA field to the address of the recipient STA that requested the Block Ack or to the broadcast address. An HE non-AP STA transmits a Multi-STA BlockAck frame with a single AID subfield or with the same values of the AID subfield in Per STA Info subfields and sets the RA field to the address of the recipient STA that requested the Block Ack frame.(#2212)

Change the 6th paragraph of this subclause as follows:

For BlockAck frames sent under Delayed and HT-delayed agreements, the BA Ack Policy subfield of the BA Control field has the meaning shown in Table 9-23 (BA Ack Policy subfield). For BlockAck frames sent under other types of agreement, the BA Ack Policy subfield is reserved. A Multi-STA BlockAck frame is not sent under Delayed and HT-delayed agreements.

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Change Table 9-24 as follows:

Table 9-24—BlockAck frame variant encoding(11ak)

~~Multi-TID subfield value~~	~~Compressed Bitmap subfield value~~	~~GCR subfield value~~	BA Type (B1 B2 B3 B4)	BlockAck frame variant
~~0~~	~~0~~	~~00~~	0000	Basic BlockAck
		~~01~~	0001	Reserved
		~~10~~	0010	Reserved
		~~11~~	0011	Reserved
~~0~~	~~1~~	~~00~~	0100	Compressed BlockAck
		~~01~~	0101	GLK-GCR BlockAck(#961)(#1137)(#212)
		~~10~~	0110	GCR BlockAck
		~~11~~	0111	Reserved
~~1~~	~~0~~	~~00~~	1000	Extended Compressed BlockAck
		~~01~~	1001	Reserved
		~~10~~	1010	Reserved
		~~11~~	1011	Reserved
~~1~~	~~1~~	~~00~~	1100	Multi-TID BlockAck
		~~01~~	1101	~~Reserved~~ Multi-STA BlockAck(#2413)
		~~10~~	1110	Reserved
		~~11~~	1111	Reserved

Change the 7th paragraph of this subclause as follows:

The ~~values of the Multi-TID, Compressed Bitmap, and GCR~~ BA Type subfield~~s~~ of the BA Control field determines which of the BlockAck frame variants is represented, as indicated in the Table 9-24 (BlockAck frame variant encoding(11ak)).

9.3.1.9.3 Compressed BlockAck variant

Change subclause 9.3.1.9.3 (including Figure 9-34) as follows:

The TID_INFO subfield of the BA Control field of the Compressed BlockAck frame contains the TID for which this BlockAck frame is sent.

The BA Information field of the Compressed BlockAck frame comprises the Block Ack Starting Sequence Control subfield and the Block Ack Bitmap subfield, as shown in Figure 9-35 (BA Information field (Compressed BlockAck)). The Starting Sequence Number subfield of the Block Ack Starting Sequence Control subfield contains the sequence number of the first MSDU or A-MSDU for which this BlockAck frame is sent. The value of this subfield is defined in 10.24.7.5 (Generation and transmission of BlockAck

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frames by an HT STA or DMG STA). ~~The Fragment Number subfield of the Block Ack Starting Sequence Control subfield is set to 0.~~

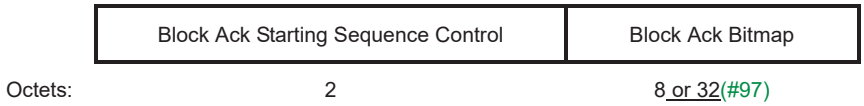

Figure 9-34—BA Information field (Compressed BlockAck)

(#97)The Fragment Number subfield is set as defined in Table 9-24a (Fragment Number subfield encoding for the Compressed BlockAck variant)

Insert the following table:

Table 9-24a—Fragment Number subfield encoding for the Compressed BlockAck variant

Fragment Number subfield			Fragmentation Level 3 (ON/ OFF)	Block Ack Bitmap subfield length (octets)	Maximum number of MSDUs/A-MSDUs that can be acknowledged
B3	B2-B1	B0			
0	0	0	OFF	8 octets	64
0	1	0		Reserved	Reserved
0	2	0		32 octets	256
0	3	0		Reserved	Reserved
0	0	1	ON	8 octets	16
0	1	1		Reserved	Reserved
0	2	1		32 octets	64
0	3	1		Reserved	Reserved
1	Any	Any		Reserved	Reserved

NOTE—A Compressed BlockAck frame with B0 of the Fragment Number subfield set to 1 can only be sent to an HE STA whose HE Fragmentation Support subfield in the HE Capabilities element it transmits is 3 (see 25.3 (Fragmentation)).

Change the remainder of 9.3.1.9.3 as follows:

(#97)When B0 of the Fragment Number subfield is 0, the Block Ack Bitmap subfield of the BA Information field of the Compressed BlockAck frame is used to indicate the receive status of up to 64 or 256 MSDUs and A-MSDUs depending upon the value of B2-B1 in the Fragment Number subfield as shown in Table 9-24a (Fragment Number subfield encoding for the Compressed BlockAck variant).~~The Block Ack Bitmap subfield of the BA Information field of the Compressed BlockAck frame is 8 octets in length and is used to indicate the received status of up to 64 MSDUs and A-MSDUs.~~ Each bit that is equal to 1 in the compressed Block Ack Bitmap subfield(#1279) acknowledges the successful reception of a single MSDU or A-MSDU in the order of sequence number, with the first bit of the Block Ack Bitmap subfield(#1280) corresponding to the MSDU or A-MSDU with the sequence number that matches the value of the Starting Sequence Number subfield of the Block Ack Starting Sequence Control subfield.

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When (#1806)B0 of the Fragment Number subfield is 1, the Block Ack Bitmap subfield of the BA Information field of the Compressed BlockAck frame is used to indicate the receive status of up to 16 or 64 MSDUs and A-MSDUs depending upon the value B2-B1 in the Fragment Number subfield as shown in Table 9-24a (Fragment Number subfield encoding for the Compressed BlockAck variant). If bit position *n* of the Block Ack Bitmap subfield(#1281) is 1, it acknowledges receipt of an MPDU with sequence number value *SN* and fragment number value *FN* with $n = 4 \times (SN - SSN) + FN$, where *SSN* is the value of the Starting Sequence Number subfield of the Block Ack Starting Sequence Control subfield and the operations on the sequence numbers are performed modulo 4096. If bit position *n* of the Block Ack Bitmap subfield(#1282) is 0, it indicates that the MPDU has not been received.(#1138)

NOTE—When (#1808)the B0 of the Fragment Number subfield is equal to 1 then the (#1139)Block Ack Bitmap subfield(#1278) is split into (#1809)(Block Ack Bitmap subfield length)/4 subbitmaps, each of which indicates receive status for (#1270)up to 4 fragments of each of the MSDUs(#2300) as indicated in Table 9-24a (Fragment Number subfield encoding for the Compressed BlockAck variant). (#1275)For an A-MSDU, only the first bit of the subbitmap is used, as fragmentation is not allowed in an A-MSDU.

Insert a new subclause after 9.3.1.9.6:

9.3.1.9.7 Multi-STA BlockAck variant

The format defined below is used for multi-STA multi-TID, and multi-STA single TID BlockAck variant. Multi-STA BlockAck(#Ed) frames shall be supported if either UL MU or multi-TID A-MPDU operation is supported.(#80)

The TID_INFO subfield of the BA Control field of the Multi-STA BlockAck frame is reserved.

The BA Information field of the Multi-STA BlockAck frame comprises one or more (#1271)Per STA Info subfields. The Per STA Info subfield is shown in Figure 9-38a (Per STA Info subfield format).

	Per AID TID Info	Block Ack Starting Sequence Control	Block Ack Bitmap
Octets: (#555)	2	0 or 2	0, 4, 8, 16 or 32

Figure 9-38a—Per STA Info subfield format

The Per AID TID Info subfield is shown in Figure 9-38b (Per AID TID Info subfield format).

	B0 B10	B11	B12 B15
	AID	Ack Type(#1408)	TID
Bits:	11	1	4

Figure 9-38b—Per AID TID Info subfield format

When Multi-STA BlockAck variant is intended for a non-AP STA, the AID subfield(#2581) carries the AID of the non-AP STA for which the Per STA Info subfield(#1272) is intended. When the Multi-STA BlockAck variant is intended for an AP, the AID subfield is set to 0.(#99)

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NOTE—One or more Per STA Info subfields with same value of the AID subfield and different values of the TID subfields can be present in the Multi-STA BlockAck frame.(#80)

The TID subfield(#2581) contains the TID for which the acknowledgment or block acknowledgment contained in the Per AID TID Info subfield applies.

NOTE—When a Multi-STA BlockAck frame is used to acknowledge a management frame, the TID value is set to 15.(#100)

If the Ack Type(#1408) subfield is (#2185)1 and the TID value of the Per AID TID Info subfield is less than 8 or equal to 15, then the Block Ack Starting Sequence Control and Block Ack Bitmap subfields(#1274) are not present and the Per STA Info subfield(#1141) acknowledges(#Ed) successful reception of a single MPDU indicated by the TID of the Per AID TID Info subfield. (#2414)(#2582)If the Ack Type subfield is 1 and the TID subfield of the Per AID TID Info field is 14, then the Block Ack Starting Sequence Control and Block Ack Bitmap are not present and the Per STA Info field acknowledges(#Ed) successful reception of all the MPDUs carried in the eliciting A-MPDU. (#2232)(#2458)The Ack Type field is not set to 1 when responding to a BlockAckReq frame or an MU-BAR frame. If the Ack Type(#1408) subfield is 0, then the Block Ack Starting Sequence Control and Block Ack Bitmap subfields(#1141) are present.

If the Ack Type field is 0, the Fragment Number subfield encoding is defined in Table 9-24b (Fragment Number subfield encoding for the Multi-STA BlockAck variant).

Table 9-24b—Fragment Number subfield encoding for the Multi-STA BlockAck variant

Fragment Number subfield			Fragmentation Level 3 (ON/ OFF)	Block Ack Bitmap subfield length (octets)	Maximum number of MSDUs/A-MSDUs that can be acknowledged
B3	B2-B1	B0			
0	0	0	OFF	8 octets	64
0	1	0		16 octets	128
0	2	0		32 octets	256
0	3	0		4 octets	32
0	0	1	ON	8 octets	16
0	1	1		16 octets	32
0	2	1		32 octets	64
0	3	1		4 octets	8
1	Any	Any		Reserved	Reserved
NOTE—A Multi-STA BlockAck frame with B0 of the Fragment Number subfield set to 1 can only be sent to an HE STA whose HE Fragmentation Support subfield in the HE Capabilities element it transmits is 3 (see 25.3 (Fragmentation)).					

When B0 of the Fragment Number subfield of the Block Ack Starting Sequence Control subfield(#1289) is 0(#515)(#1182), the Block Ack Starting Sequence Control subfield is as defined in Figure 9-28. The BA Information field of the Multi-STA BlockAck frame contains an 8-octet, 16-octet, 32-octet or 4-octet Block Ack Bitmap subfield depending on B2-B1 of(#Ed) the Fragment Number subfield as defined in the Table 9-24b (Fragment Number subfield encoding for the Multi-STA BlockAck variant). Each bit that is equal to 1 in the Block Ack Bitmap subfield acknowledges the successful reception of a single MSDU or A-MSDU in the order of sequence number with the first bit of the Block Ack Bitmap subfield corresponding to the

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MSDU or A-MSDU with the sequence number that matches the value of the Starting Sequence Number subfield of the Block Ack Starting Sequence Control subfield.

When B0 of the Fragment Number subfield of the Block Ack Starting Sequence Control subfield(#1290) is 1, the Block Ack Bitmap subfield of the BA Information field of the Multi-STA Block Ack frame is used to indicate the receive status of up to 16, 32, 64 or 8 MSDUs and A-MSDUs depending on B2-B1 of(#Ed) the Fragment Number subfield as shown in the Table 9-24b (Fragment Number subfield encoding for the Multi-STA BlockAck variant). If bit position *n* of the Block Ack Bitmap subfield(#1281) is 1, it acknowledges receipt of an MPDU with sequence number value *SN* and fragment number value *FN* with $n = 4 \times (SN - SSN) + FN$, where *SSN* is the value of the Starting Sequence Number subfield of the Block Ack Starting Sequence Control subfield and the operations on the sequence numbers are performed modulo 4096. If bit position *n* of the Block Ack Bitmap subfield(#1282) is 0, it indicates that the MPDU has not been received.(#1138)

NOTE—When B0 of the Fragment Number subfield is 1(#1142) then the Block Ack Bitmap(#1143) field is split into Block Ack Bitmap field length/4 subbitmaps, each of which indicates receive status for 4 fragments of each of the MSDUs(#2300) as indicated in Table 9-24b (Fragment Number subfield encoding for the Multi-STA BlockAck variant). (#1287)For an A-MSDU, only the first bit of the subbitmap is used, as fragmentation is not allowed in an A-MSDU.

Change the title of 9.3.1.20 as follows:

9.3.1.20 VHT/HE NDP Announcement frame format

Insert the following at the end of 9.3.1.20:

(#1222)The HE NDP Announcement uses the same Frame Control Type as the VHT NDP Announcement. The frame format of the HE NDP Announcement frame with multiple STA info field is shown in Figure 9-51a (HE NDP Announcement frame format).

	Frame Control	Duration	RA	TA	Sounding Dialog Token	STA Info 1	…	STA Info *n*	FCS
Octets:	2	2	6	6	1	4		4	4

Figure 9-51a—HE NDP Announcement frame format

Bit 1 of the Sounding Dialog Token is set to 1 to indicate an HE NDP Announcement frame.

The format of the STA Info subfield in an HE NDP Announcement Frame is defined in Figure 9-51b (STA Info subfield format in an HE NDP Announcement frame).(#Ed)

	B0 B10	B11 B24	B25 B26	B27	B28	B29 B31
	AID11	Partial BW Info	Feedback Type And Ng	Disambiguation (#Ed)	Codebook Size	Nc
Bits:	11	14	2	1	1	3

Figure 9-51b—STA Info subfield format in an HE NDP Announcement frame

The Partial BW Info subfield is defined in Figure 9-51c (Partial BW Info subfield).

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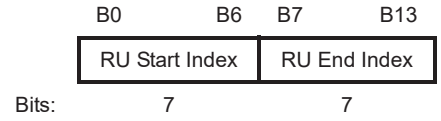

Figure 9-51c—Partial BW Info subfield

The RU Start Index subfield of the Partial BW subfield indicates the first 26-tone RU for which the HE beamformer is requesting feedback. The RU End Index subfield of the Partial BW subfield indicates the last 26-tone RU for which the HE beamformer is requesting feedback.

The Feedback Type And Ng and Codebook Size subfields are defined inTable 9-25a (Feedback Type And Ng subfield and Codebook Size subfield encoding)

Table 9-25a—Feedback Type And Ng subfield and Codebook Size subfield encoding

Feedback Type + Ng + codebook size	Description
000	SU, Ng4, quantization resolution = {2, 4}
001	SU, Ng4, quantization resolution = {4, 6}
010	SU, Ng16, quantization resolution = {2, 4}
011	SU, Ng16, quantization resolution = {4, 6}
100	MU+Ng4, quantization resolution = {5, 7}
101	MU+Ng4, quantization resolution = {7, 9}
110	CQI only feedback
111	MU+Ng16, quantization resolution = {7, 9}

The Disambiguation subfield is set to 1 to prevent a VHT STA from wrongly determining it's AID in the HE STA Info.

Insert a new subclause after 9.3.1.22:

9.3.1.23 Trigger frame format

The Trigger frame solicits and allocates resources for UL MU transmissions a SIFS(#2195) after the PPDU that carries the Trigger frame(#368). The Trigger frame also carries other information required by the responding STA to send an HE trigger-based PPDU(#718).

The frame format for the Trigger frame is as defined in Figure 9-52c (Trigger frame).

The Duration(#1297) field is set as defined in 9.2.5 (Duration/ID field (QoS STA)).

The RA field of the Trigger frame is the address of the recipient STA.(#262) If the Trigger Frame has one User Info field then the RA of the Trigger Frame is the STA's MAC Address. If the Trigger Frame has multiple User Info fields then the RA of the Trigger Frame is the broadcast address.(#102)

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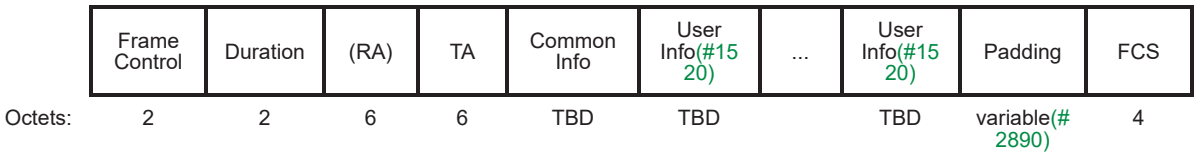

Figure 9-52c—Trigger frame

The TA field value is the address of the STA transmitting the Trigger frame.

The Common Info field is defined in Figure 9-52d (Common Info field(#2134)(#101)).

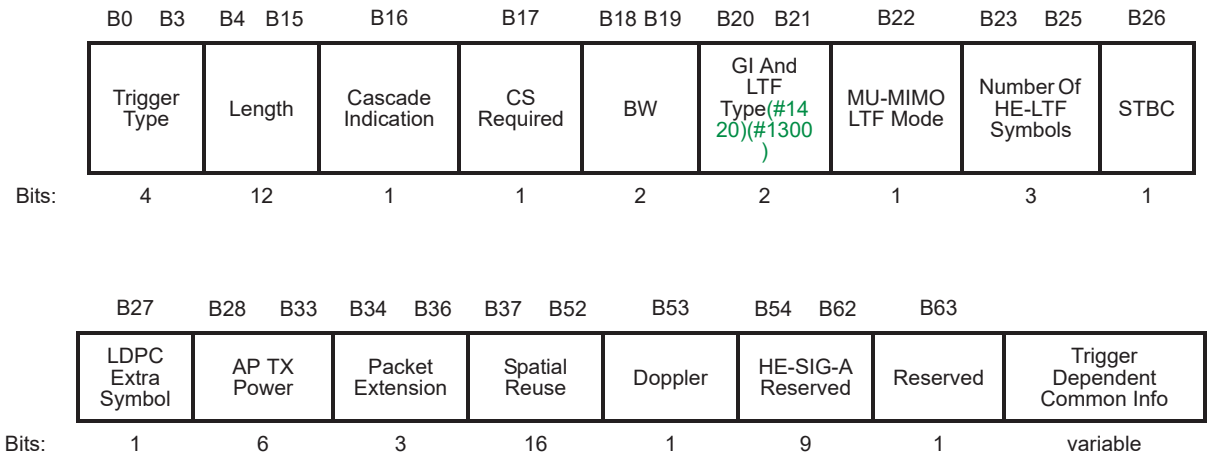

Figure 9-52d—Common Info field(#2134)(#101)

The Trigger Type subfield indicates the type of the Trigger frame. The Trigger frame can include an optional Trigger Dependent Common Info field(#613) and optional Trigger Dependent User Info field(#1520)(#613). The Trigger Type subfield encoding is defined in Table 9-25a (Trigger Type subfield encoding)(#376).

Table 9-25a—Trigger Type subfield encoding

Trigger Type field value	Description
0	Basic Trigger
1	Beamforming Report Poll(#Ed)
2	MU-BAR
3	MU-RTS
4	Buffer Status Report Poll (BSRP)(#824)
5-15(#262)	Reserved

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The Length subfield of the Common Info field indicates the value of the L-SIG Length field of the HE trigger-based PPDU that is the response to the Trigger frame.

If the Cascade Indication subfield is 1, then a subsequent Trigger frame as defined in 25.7 (TWT operation) and in 25.15.2 (Power save with UL OFDMA-based random access) follows the current Trigger frame. Otherwise the Cascade Indication subfield is 0.(#372)

The CS Required subfield is set to 1 to indicate that the STAs identified in the User Info(#1520) fields are required to use ED to sense the medium and to consider the medium state and the NAV in determining whether or not to respond(#557). The CS Required(#2689) subfield is set to 0 to indicate that the STAs identified in the User Info(#1520) fields are not required to(#234) consider the medium state or the NAV in determining whether or not to respond.

The BW subfield indicates the bandwidth in the HE-SIG-A of the HE trigger-based PPDU and is defined in Table 9-25b (BW subfield encoding).(#101)

Table 9-25b—BW subfield encoding

BW subfield value	Description
0	20 MHz
1	40 MHz
2	80 MHz
3	80+80 MHz or 160 MHz

The GI And LTF Type subfield(#1420)(#1300) of the Common Info field indicates the GI(#1420) and HE-LTF type of the HE trigger-based PPDU response. The GI And LTF Type subfield(#1420)(#1300) encoding is defined in Table 9-25c (GI And LTF Type subfield(#1420)(#1300) encoding).

Table 9-25c—GI And LTF Type subfield(#1420)(#1300) encoding

GI(#1420) And LTF field value	Description
0	1x LTF + 1.6 μs GI(#101)
1	2x LTF + 0.8 μs GI(#1420)
2	2x LTF + 1.6 μs GI(#1420)
3	4x LTF + 3.2 μs GI(#1420,#1146)

The MU-MIMO LTF Mode subfield of the Common Info field indicates the LTF mode of the UL MU-MIMO HE trigger-based PPDU response. The AP shall set the MU-MIMO LTF Mode subfield to Single Stream pilot if the triggered UL PPDU contains partial or full UL OFDMA allocation.(#227) The MU-

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MIMO LTF Mode subfield encoding is defined in Table 9-25d (MU-MIMO LTF Mode subfield encoding).(#101)

Table 9-25d—MU-MIMO LTF Mode subfield encoding

MU-MIMO LTF subfield value	Description
0	Single stream pilots
1	Mask LTF sequence of each spatial stream by a distinct orthogonal code

The Number of HE-LTFs subfield of the Common Info field indicates the number of HE-LTF symbols present in the HE trigger-based PPDU response. The number of HE-LTF symbols is a function of the total number of space-time streams. The number of HE-LTF subfield encoding is defined in Table 22-13.

The STBC subfield of the Common Info field indicates the status of STBC encoding of the HE trigger-based PPDU response. It is set to 1 if STBC encoding is used and set to 0 otherwise.

The LDPC Extra Symbol subfield of the Common Info field indicates the status of LDPC Extra Symbol. It is set to 1 when LDPC extra symbol is present and set to 0 otherwise.

The AP Tx Power subfield of the Common Info field indicates the combined average power per 20 MHz bandwidth of all transmit antennas used to transmit the trigger frame at the HE AP. The resolution for the transmit power reported in the Common Info field is 1 dB. The AP Tx Power subfield encoding is defined in Table 9-25e (AP Tx Power subfield encoding).(#101)

Table 9-25e—AP Tx Power subfield encoding

AP Tx Power subfield value	Description
0-60	Values 0 to 61 maps to –20 dBm to 40 dBm
61-63	Reserved

(#101)The Packet Extension subfield of the Common Info field indicates the packet extension duration of the trigger-based PPDU response. The first two bits indicate the pre-FEC padding factor(#2564) and the third bit indicates the PE-Disambiguity.

The Spatial Reuse subfield(#Ed) carries the value for the Spatial Reuse field in the HE-SIG-A field of the HE trigger-based PPDU transmitted as a response to the Trigger frame. For HE trigger-based PPDU, four SR fields are signaled:

— For 20 MHz one SR field corresponding to entire 20 MHz (other 3 fields indicate identical values)

— For 40 MHz two SR fields for each 20 MHz (other 2 fields indicate identical values)

— For 80 MHz four SR fields for each 20 MHz

— For 160 MHz four SR fields for each 40 MHz

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When operating 40 MHz in 2.4GHz band, two SR fields, SR field 1 and SR field 2, are set to same values. When operating 80+80 MHz, SR field 3 is set to same value as SR field 1, and SR field 4 is set to the same value as SR field 2.(SR Motion #11)

The exact location of each 20 MHz for 80 MHz BW is TBD.

The Doppler subfield indicates(#Ed) a high doppler mode of transmission.

Editor's Note: The edits in 16/780r1 change Figure 9-51c without change tracking. Presumably HE-SIG-A Info subfield is changed to HE-SIG-A Reserved subfield. However, no edits delete the next paragraph, and, in fact, a comment (#1299) modifying this paragraph is accepted in the same document.

The HE-SIG-A Info subfield of the Common Info field indicates the content of the HE-SIG-A field of the HE trigger-based PPDU response. The TBD bits in HE-SIG-A of the HE trigger-based PPDU that are(#1299) implicitly known by all responding STAs can be excluded.

The HE-SIG-A Reserved subfield indicate the values of the reserved bits in HE-SIG-A2 of the HE trigger-based PPDU transmitted as a response to the Trigger frame. Bits B54 to B62 in the Trigger frame are set to 1 and correspond to the bits B7 to B15 in the HE-SIG-A2 of the HE trigger-based PPDU with B54 in the Trigger frame corresponding to B7 in the HE-SIG-A2 of the HE trigger-based PPDU and so on.(#101)(PHY Motion #169)

The User Info(#1520) field is defined in Figure 9-52e (User Info(#1520) field(#262)(#663)).(#101)

	B0 B11	B12 B19	B20	B21 B24	B25	B26 B31	B32 B38	B39	
	AID12	RU Allocation	Coding Type	MCS	DCM	SS Allocation	Target RSSI	Reserved	Trigger Dependent User Info(#1520)
Bits:	12	8	1	4	1	6	7	1	variable

Figure 9-52e—User Info(#1520) field(#262)(#663)

The AID12 subfield of the User Info(#1520) field carries the least significant(#Ed) 12 bits of the AID of the STA for which the User Info field is intended(#511). An AID12 subfield that is 0 indicates that the User Info field identifies an RU for random access.(#558) User Info fields with AID = 0 shall be allocated only after User Info fields with AID not equals to 0, if any, and before the MAC padding field, if present.(MAC Motion #86)

The RU Allocation subfield of the User Info(#1520) field indicates the RU used by the HE trigger-based PPDU of the STA identified by the AID12(#Ed) subfield(#1302). The RU Allocation subfield is 8 bits in length. The first bit, B12, indicates the allocated RU is located in the primary or non-primary 80 MHz (zero

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for primary and one for non-primary). The mapping of the subsequent 7 bits, B19-B13, indices to the RU allocation is defined in Table 9-25f (The encoding of B19-B13 of the RU Allocation subfield(#Ed)).

Table 9-25f—The encoding of B19-B13 of the RU Allocation subfield(#Ed)

B19-B13	Description(#Ed)	Number of entries
0000000 - 0100100	Possible 26-tone RU cases in 80 MHz	37
0100101 - 0110100	Possible 52-tone RU cases in 80 MHz	16
0110101 - 0111100	Possible 106-tone RU cases in 80 MHz	8
0111101 - 1000000	Possible 242-tone RU cases in 80 MHz	4
1000001 - 1000010	Possible 484-tone RU cases in 80 MHz	2
1000011	996-tone RU cases in 80 MHz	1
1000100	2×996-tone RU case	1
Total		69

(#864)B12 is set to 0 for a 20 MHz, 40 MHz and 80 MHz PPDU. For the 2×996-tone RU case, B12 is set to 1. The mapping of subsequent 7 bits indices B19-B13 to RU index in each row depends on the BW bits in Common Info field:

— For a 20 MHz PPDU, the mapping of B19-B13 to RU allocation follows the RU index in Table 26-3 (Subcarrier indices for RUs in a 20 MHz HE PPDU) in an increasing order. B19-B13 are 0000000 indicates 26-tone RU1 [–121: –96], 0001000 indicates 26-tone RU9 [96: 121], and 0001001-0100100 are not used. B19-B13 are 0100101 indicates 52-tone RU1 [–121: –70], 0101000 indicates 52-tone RU4 [70: 121], and 0101001-0110100 are not used. B19-B13 are 0110101 indicates 106-tone RU1 [–122: –17], 0110110 indicates 106-tone RU2 [17: 122], and 0110111-0111100 are not used. B19-B13 are 0111101 indicates 242-tone RU1 [–122: –2, 2:122], and 0111110-1000000 are not used.

— For a 40 MHz PPDU, the mapping of B19-B13 to RU allocation follows the RU index in Table 26-4 (Subcarrier indices for RUs in a 40 MHz HE PPDU) in an increasing order. B19-B13 are 0000000 indicates 26-tone RU1 [–243: –218], 0010001 indicates 26-tone RU18 [218: 243], and 0010010-0100100 are not used. B19-B13 are 0100101 indicates 52-tone RU1 [–243: –192], 0101100 indicates 52-tone RU8 [192: 243], and 0101101-0110100 are not used. Similar ordering is followed for 106-tone RU, 242-tone RU and 484-tone RU.

— For an 80 MHz, 160 MHz and 80+80 MHz PPDU, the mapping of B19-B13 to RU allocation follows the RU index in Table 26-5 (Subcarrier indices for RUs in an 80 MHz HE PPDU) in an increasing order. B19-B13 are 0000000 indicates 26-tone RU1 [–499: –474], and 0100100 indicates 26-tone RU37 [474: 499]. B19-B13 are 0100101 indicates 52-tone RU1 [–499: –448], and 0110100 indicates 52-tone RU16 [448: 499]. Similar ordering is followed for 106-tone RU, 242-tone RU, 484-tone RU and 996-tone RU. For a 160 MHz and 80+80 MHz PPDU, B19-B13 are 1000100 indicates 2×996-tone RU.

The Coding Type subfield of the User Info(#1520) field indicates the code type of the HE trigger-based PPDU response of the STA identified by the AID12(#Ed) subfield(#1302). Set to 0 for BCC and set to 1 for LDPC.

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The MCS subfield of the User Info(#1520) field indicates the MCS of the HE trigger-based PPDU response of the STA identified by the AID12(#Ed) subfield(#1302). The encoding of the MCS field is as defined in Section XXX.

The DCM subfield of the User Info(#1520) field indicates dual carrier modulation of the HE trigger-based PPDU response of the STA identified by the AID12(#Ed) subfield(#1302). A value of 1 indicates that the HE trigger-based PPDU response shall use DCM as defined in section XXX. A value 0 indicates that DCM is not be used(#237).

The SS Allocation subfield of the User Info(#1520) field indicates the spatial streams of the HE trigger-based PPDU response of the STA identified by the AID12(#Ed) subfield(#1302). The format of the SS Allocation subfield is defined in Figure 9-52f (SS Allocation subfield format).(#663)

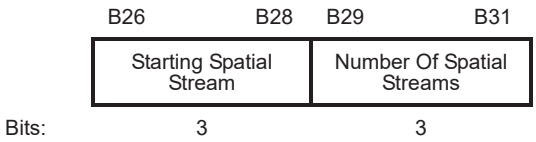

Figure 9-52f—SS Allocation subfield format

The Target RSSI subfield of the User Info field indicates the target received signal power of the HE trigger-based PPDU response. The resolution for the Target RSSI subfield in the User Info field is 1 dB. The Target RSSI subfield encoding is defined in Table 9-25g (Target RSSI subfield encoding).(#663)

Table 9-25g—Target RSSI subfield encoding

Target RSSI subfield	Description
0-90	Values 0 to 90 map to –100 dBm to –20 dBm
91-127	Reserved

The Padding field extends the frame length to give the recipient STAs more time to prepare a response. (#2890)The Padding field of the Trigger frame, if present, is an integer number of octets ≥ 2: Padding field starts with special STAID[11:0] as 0xFFF and the rest bits of the Padding field are all set to one. 0xFFF is reserved as the special value to indicate the start of the MAC padding. The length of the Padding field is in units of octets and is set as defined in the following formulas.

For a non-HT PPDU, HT PPDU and VHT PPDU the length of the Padding field is given by Equation (9-ax1).

$$L_{PAD,\,MAC} = \left\lceil \frac{N_{DBPS} m_{PAD}}{8} \right\rceil \text{ octets} \qquad \text{(9-ax1)}$$

where

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$$m_{PAD} = \begin{cases} 0, \text{ max TF MAC Padding Duration among receiving STAs} = 0\ \mu s \\ 2, \text{ max TF MAC Padding Duration among receiving STAs} = 8\ \mu s \\ 4, \text{ max TF MAC Padding Duration among receiving STAs} = 16\ \mu s \end{cases}$$

For an HE PPDU, the length of the Padding field is given by Equation (9-ax2).

$$L_{PAD,\,MAC} = \left\lceil \frac{N_{DBPS,\,SHORT} m_{PAD}}{8} \right\rceil \text{ octets} \qquad \text{(9-ax2)}$$

where

$$m_{PAD} = \begin{cases} 0, \text{ max TF MAC Padding Duration among receiving STAs} = 0\ \mu s \\ 2, \text{ max TF MAC Padding Duration among receiving STAs} = 8\ \mu s \\ 4, \text{ max TF MAC Padding Duration among receiving STAs} = 16\ \mu s \end{cases}$$

STBC is disallowed for Trigger Frame transmission.(#2890)

9.3.1.23.1 Basic Trigger variant(#2219)

If the Trigger frame is a Basic Trigger variant, the Trigger Dependent Common Info field is not present and the Trigger Dependent User Info field is defined in Figure 9-52g (Trigger Dependent User Info field for the Basic Trigger variant).(#Ed)

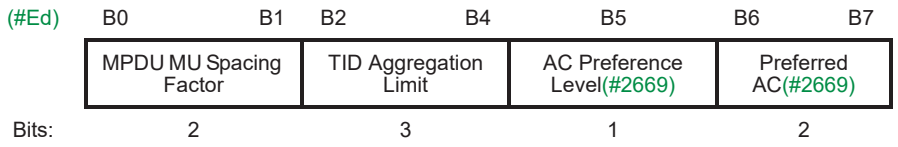

Figure 9-52g—Trigger Dependent User Info field for the Basic Trigger variant

The MPDU MU Spacing Factor subfield indicates the value by which the minimum MPDU start spacing defined in Table 8-159 is multiplied. The MPDU MU Spacing Factor subfield encoding is defined in Table 9-25h (MPDU MU Spacing Factor subfield encoding).

Table 9-25h—MPDU MU Spacing Factor subfield encoding

Value	Description
0	Multiplier = 1
1	Multiplier = 2
2	Multiplier = 4
3	Multiplier = 8

The TID Aggregation Limit subfield indicates the maximum number of TIDs(MAC Motion #92) that can be aggregated by a STA in a multi-TID A-MPDU carried in the responding HE trigger-based PPDU.

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NOTE–A value of 7 in the TID Aggregation Limit subfield indicates to the STA that it can aggregate QoS Data frames from any number of different TID values in the multi-TID A-MPDU.(MAC Motion #92)

The value in the TID Aggregation Limit subfield in Trigger frame is less than or equal to the value indicated in the Multi-TID Aggregation Support field in the HE Capabilities element (see 9.4.2.218 (HE Capabilities element)).(#2669)

The AC Preference Level subfield is set to 1 to indicate that MPDUs with TIDs that correspond to the AC indicated in the Preferred AC subfield are recommended with respect to TIDs from other ACs. The AC Preference Level subfield is set to 0 if the AP does not have a recommendation.(#Ed)(#2669)

The Preferred AC subfield indicates the AC that is recommended for aggregation of MPDUs of ACs belonging to the same AC as indicated or higher priority AC(s) within a multi-TID A-MPDU sent as a response to the Trigger frame (see 9.3.1.23 (Trigger frame format)). The encoding of the Preferred AC subfield is shown in Table 9-25i (Preferred AC subfield encoding).(#2669)

Table 9-25i—Preferred AC subfield encoding

Value	Description
0	AC_VO
1	AC_VI
2	AC_BE
3	AC_BK

9.3.1.23.2 Beamforming Report Poll variant(#9)

If the Trigger frame is a Beamforming Report Poll variant, the Trigger Dependent Common Info field is not present and the Trigger Dependent User Info field is defined in Figure 9-52h (Trigger Dependent User Info field for the Beamforming Report Poll variant).

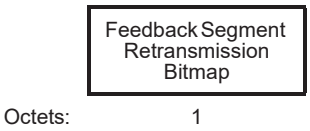

Figure 9-52h—Trigger Dependent User Info field for the Beamforming Report Poll variant

The Feedback Segment Retransmission Bitmap subfield indicates the requested feedback segments of an HE Compressed Beamforming report. If the bit in position n ($n = 0$ for LSB and $n = 7$ for MSB) is 1, then the feedback segment with the Remaining Feedback Segments subfield in the HE MIMO Control field equal to n is requested. If the bit in position n is 0, then the feedback segment with the Remaining Feedback Segments subfield in the HE MIMO Control field equal to n is not requested.

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9.3.1.23.3 MU-BAR variant

(#5)The Trigger Dependent Common Info field is not present in the MU-BAR variant Trigger frame. The Trigger Dependent User Info(#1520) field of the MU-BAR variant Trigger frame is defined(#1307) in Figure 9-52i (Trigger Dependent User Info field for the MU-BAR variant(#2700))(#2698).

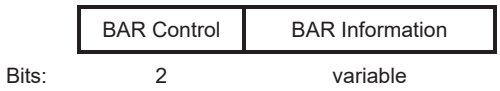

Figure 9-52i—Trigger Dependent User Info field for the MU-BAR variant(#2700)

The BAR Control subfield is defined in 9.3.1.8 (BlockAckReq frame format).

The BAR Information subfield is defined in 9.3.1.8 (BlockAckReq frame format). The Fragment number field is set accordingly to Table 9-24a (Fragment Number subfield encoding for the Compressed BlockAck variant) for a compressed BAR variant and Table 9-24b (Fragment Number subfield encoding for the Multi-STA BlockAck variant) for a Multi-TID BAR variant.(#5)

9.3.1.23.4 MU-RTS variant

The MU-RTS frame format is a variant of Trigger frame format as shown in Figure 9-52c (Trigger frame).

The RA field of the MU-RTS frame is set to the broadcast address.(#2894)

NOTE—The TA field value is the address of the STA transmitting the MU-RTS frame.(#2603)

(#2222)The Common Info field is defined in Figure 9-52d (Common Info field(#2134)(#101)).

The Trigger Type subfield is set to 3 to indicate MU-RTS variant.

The BW subfield indicates the total PPDU bandwidth, and is defined in Table 9-25b (BW subfield encoding).

The Length, GI And LTF Type, MU MIMO LTF Mode, Number of LTFs, STBC, LDPC Extra Symbol, AP TX Power, Packet Extension, Spatial Reuse and HE-SIG-A Reserved fields are reserved.

NOTE—The Trigger Dependent Common Info field is not present in the MU-RTS frame.

The User Info field is defined in Figure 9-52e (User Info(#1520) field(#262)(#663)).

The MCS,(#863) Coding Type, DCM, SS Allocation and Target RSSI fields are reserved.

(#110)The RU Allocation subfield in the User Info(#1520) field addressed to the STA follows the same definition as described in 9.3.1.23 (Trigger frame format) and(#2222) indicates whether the CTS frame is transmitted on the primary 20 MHz channel, primary 40 MHz channel, primary 80 MHz channel, 160 MHz channel, or 80+80 MHz channel.(#1763)

(#1311)(#2222)B12 of the RU Allocation subfield is set to 0 for indication of primary 20 MHz/40 MHz/80 MHz. For 160 MHz/80+80 MHz indication, B12 of the RU Allocation subfield is set to 1. The mapping of

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B19-B13 to RU Allocation subfield follows the RU index in Table 26-3 (Subcarrier indices for RUs in a 20 MHz HE PPDU) in an increasing order.

If the BW subfield indicates 20 MHz, then the 242-tone RU entry 0111101 for B19-B13 indicates primary 20 MHz channel.

If the BW subfield indicates 40 MHz, then the 242-tone RU entry for B19-B13 corresponding to the primary 20 MHz channel indicates primary 20 MHz; the 484-tone RU entry 1000001 for B19-B13 indicates the primary 40 MHz channel.

If the BW subfield indicates 80 MHz or 80+80 MHz or 160 MHz, then the 242-tone RU entry for B19-B13 corresponding to the primary 20 MHz indicates the primary 20 MHz channel, the 484-tone RU entry for B19-B13 corresponding to the primary 40 MHz indicates the primary 40 MHz channel and the 996-tone RU entry 1000011 for B19-B13 indicates the primary 80 MHz channel.

If the Bandwidth field indicates 80+80 MHz or 160 MHz, then the entry 1000100 for B19-B13 indicates primary and secondary 80 MHz.

NOTE—The Trigger Dependent User Info field is not present in the MU-RTS frame.(#2222)

9.3.1.23.5 BSRP variant(#824)

The BSRP variant Trigger frame format is as defined in Figure 9-52c (Trigger frame).

The Common Info field of the BSRP variant Trigger frame is defined in Figure 9-52d (Common Info field(#2134)(#101)) and the Trigger Dependent Common Info field is not present.

The User Info field of the BSRP variant Trigger frame is defined in Figure 9-52e (User Info(#1520) field(#262)(#663)) and the Trigger Dependent User Info field is not present.

9.3.2 Data frames

9.3.3 Management frames

9.3.3.1 Beacon frame format

Editor's Note: Order: 11ai adds 66-69, 11ah adds none, 11aq adds 70-71, 11ak adds 67 (appears to be out of date), 11aj adds none.

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Insert the following new rows (header row shown for convenience) into Table 9-27 (Beacon frame body):

Table 9-27—Beacon frame body

Order	Information	Notes
73(#Ed)	HE Capabilities	The HE Capabilities element is present when dot11HEOptionImplemented(#1313) is true; otherwise it is not present.
74	HE Operation	The HE Operation element is present when dot11HEOptionImplemented(#1313) is true; otherwise it is not present.
75	TWT	The TWT element is optionally present when dot11TWTOptionActivated(#1313) is true; otherwise it is not present.
76	RAPS	The RAPS element is optionally present when dot11OFDMARandomAccessOptionImlemented is true; otherwise it is not present.(#600)

9.3.3.5 Association Request frame format

Editor's Note: Order: 11ai adds 24-28, 11ah adds 29-38, 11ak adds 24 (appears to be out of date), 11aj adds two (numbers unassigned)

Insert the following new row (header row shown for convenience) into Table 9-29 (Association Request frame body(#198)):

Table 9-29—Association Request frame body(#198)

Order	Information	Notes
43(#2304)(#Ed)	HE Capabilities	The HE Capabilities element is present when dot11HEOptionImplemented(#1313) is true; otherwise it is not present.

9.3.3.6 Association Response frame format

Editor's Note: Order: 11ai adds 31-36, 11ah adds 37-49, 11aq adds none, 11ak adds 30-31 (appears to be out of date), 11aj adds three (numbers unassigned)

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Change Table 9-30 (Association Response frame body) as follows maintaining numeric order (only rows with changes are shown):

Table 9-30—Association Response frame body

Order	Information	Notes
29	TWT	~~The TWT element is optionally present if dot11TWTOptionActivated is true; otherwise not present.~~ The TWT element is present if dot11TWTOptionActivated is true and the TWT element is present in the Association Request frame that elicited this Association Response frame. The TWT element is optionally present if dot11TWTOptionActivated is true and the TWT Requester Supported field in the HE Capabilities in the Association Request frame that elicited this Association Response frame is one.(#1315)
54(#2304)(#Ed)	HE Capabilities	The HE Capabilities element is present when dot11HEOptionImplemented(#1313) is true; otherwise it is not present.
55	HE Operation	The HE Operation element is present when dot11HEOptionImplemented(#1313) is true; otherwise it is not present.

9.3.3.7 Reassociation Request frame format

Editor's Note: Order: 11ai adds 29-33, 11ah adds 34-43, 11aq adds none, 11ak adds 29 (appears to be out of date), 11aj adds two (numbers unassigned)

Insert the following row in Table 9-31 (Reassociation Request frame body(#198)) (header shown for convenience):

Table 9-31—Reassociation Request frame body(#198)

Order	Information	Notes
47(#2305)(#Ed)	HE Capabilities	The HE Capabilities element is present when dot11HEOptionImplemented(#1313) is true; otherwise it is not present.

9.3.3.8 Reassociation Response frame format

Editor's Note: Order: 11ai adds 35-49, 11ah adds 41-52, 11aq adds none, 11ak adds 34 and 30 (appears to be an error), 11aj adds three (numbers unassigned)

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Change Table 9-32 (Reassociation Response frame body) as follows maintaining numeric order (only rows with changes are shown):

Table 9-32—Reassociation Response frame body

Order	Information	Notes
42	TWT	~~The TWT element is optionally present if dot11TWTOptionActivated is true; otherwise not present.~~ The TWT element is present if dot11TWTOptionActivated is true and the TWT element is present in the Reassociation Request frame that elicited this Reassociation Response frame. The TWT element is optionally present if dot11TWTOptionActivated is true and the TWT Requester Supported field in the HE Capabilities in the Reassociation Request frame that elicited this Association Response frame is one.(#1315)
55(#2305)(#Ed)	HE Capabilities	The HE Capabilities element is present when dot11HEOptionImplemented(#1313) is true; otherwise it is not present.
56	HE Operation	The HE Operation element is present when dot11HEOptionImplemented(#1313) is true; otherwise it is not present.

9.3.3.10 Probe Request frame format

Editor's Note: Order: 11ai adds 20-21, 11ah adds 22-27, 11aq adds none, 11ak adds 20 (appears to be out of date), 11aj adds three (numbers unassigned)

Insert the following new row (header row shown for convenience) into Table 9-33 (Probe Request frame body(#198)):

Table 9-33—Probe Request frame body(#198)

Order	Information	Notes
32(#2306)(#Ed)	HE Capabilities	The HE Capabilities element is present when dot11HEOptionImplemented(#1313) is true; otherwise it is not present.

9.3.3.11 Probe Response frame format

Editor's Note: Order: 11ai adds 70-73, 11ah adds 74-84, 11aq adds 85-86, 11ak adds 70 (appears to be out of date), 11aj adds four (numbers unassigned)

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Insert the following new rows into Table 9-34 (Probe Response frame body) (header shown for convenience):

Table 9-34—Probe Response frame body

Order	Information	Notes
92(#2306)(#Ed)	HE Capabilities	The HE Capabilities element is present when dot11HEOptionImplemented(#1313) is true; otherwise it is not present.
93	HE Operation	The HE Operation element is present when dot11HEOptionImplemented(#1313) is true; otherwise it is not present.
94	TWT	The TWT element is optionally present when dot11TWTOptionActivated and dot11HEOptionImplemented is true; otherwise it is not present.(#1315)
95	RAPS	The RAPS element is optionally present when dot11OFDMARandomAccessOptionImlemented is true; otherwise it is not present.(#600)

9.4 Management and Extension frame body components

9.4.1 Fields that are not elements

9.4.1.11 Action field

Change Table 9-47 as follows (insert new row and updated reserved row):

Table 9-47—Category values

Code	Meaning	See subclause	Robust	Group addressed privacy
	...			
<ANA>	HE	9.6.28 (HE Action frame details)	No	No
~~21~~<ANA+1>–125	Reserved	—	—	—
	...			

Insert the following subclauses after 9.4.1.61:

9.4.1.62 HE MIMO Control field(#223)

The HE MIMO Control field is included in every HE Compressed Beamforming frame (see 9.4.1.63 (HE Compressed Beamforming Report field)). The HE MIMO Control field is defined in Figure 9-121a (HE MIMO Control field).

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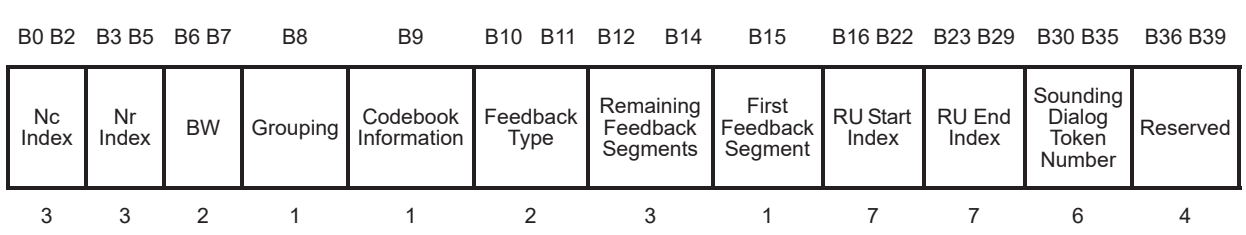

Figure 9-121a—HE MIMO Control field

The subfields for the HE MIMO Control Fields are defined in Table 9-76a (HE MIMO Control field encoding).

Table 9-76a—HE MIMO Control field encoding

Subfield	Description
Nc Index	Indicates the number of columns, *Nc*, in the compressed beamforming feedback matrix minus 1: Set to 0 for *Nc* = 1 Set to 1 for *Nc* = 2 … Set to 7 for *Nc* = 8
Nr Index	Indicates the number of rows, *Nr*, in the compressed beamforming feedback matrix minus 1: Set to 0 for *Nr* = 1 Set to 1 for *Nr* = 2 … Set to 7 for *Nr* = 8
BW	Indicates the channel width (#Ed)used to determine the starting and ending subcarrier indexes when interpreting the RU Start Index and RU End Index subfields. Set to 0 for 20 MHz Set to 1 for 40 MHz Set to 2 for 80 MHz Set to 3 for 160 MHz and 80+80 MHz
Grouping	Indicates the subcarrier grouping, *Ng*, used for the compressed beamforming feedback matrix: Set to 0 for *Ng* = 4 Set to 1 for *Ng* = 16
Codebook Information	Indicates the size of codebook entries: If Feedback Type is SU: Set to 0 for 2 bits for ψ, 4 bits for ϕ Set to 1 for 4 bits for ψ, 6 bits for ϕ If Feedback Type is MU: Set to 0 for 5 bits for ψ, 7 bits for ϕ Set to 1 for 7 bits for ψ, 9 bits for ϕ NOTE—The codebook size for MU Feedback with *Ng* = 16 is limited to {9, 7}

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Table 9-76a—HE MIMO Control field encoding *(continued)*

Feedback Type	Indicates the feedback type: Set to 0 for SU Set to 1 for MU Set to 2 for CQI feedback(#971)(#2713) 3 is reserved
Remaining Feedback Segments	Indicates the number of remaining feedback segments for the associated VHT Compressed Beamforming frame: Set to 0 for the last feedback segment of a segmented report or the only feedback segment of an unsegmented report. Set to a value between 1 and 6 for a feedback segment that is neither the first nor the last of a segmented report. Set to a value between 1 and 7 for a feedback segment that is not the last feedback segment of a segmented report. In a retransmitted feedback segment, the field is set to the same value associated with the feedback segment in the original transmission.
First Feedback Segment	Set to 1 for the first feedback segment of a segmented report or the only feedback segment of an unsegmented report. Set to 0 if not the first feedback segment or if the VHT Compressed Beamforming Report field and MU Exclusive Beamforming Report field are not present in the frame. In a retransmitted feedback segment, the field is set to the same value associated with the feedback segment in the original transmission.
RU Start Index	The starting RU index indicates the first 26-tone RU for which the HE beamformer is requesting feedback.
RU End Index	The ending RU index indicates the last 26-tone RU for which the HE beamformer is requesting feedback.
Sounding Dialog Token Number	The ending RU index indicates the last RU26 for which the HE beamformer is requesting feedback.[sic]

In an HE Compressed Beamforming frame not carrying all or part of a HE Compressed Beamforming report, the Nc Index, Nr Index, Channel Width, Grouping, Codebook Information, Feedback Type and Sounding Dialog Token Number subfields are reserved, the First Feedback Segment subfield is set to 0 and the Remaining Feedback Segments subfield is set to 7.

9.4.1.63 HE Compressed Beamforming Report field

(#112)The HE Compressed Beamforming Report field is used in the HE Compressed Beamforming And CQI frame (see 9.6.28.2 (HE Compressed Beamforming And CQI frame format)) to carry average SNR of each space-time stream and compressed beamforming feedback matrices V for use by a transmit beamformer to determine steering matrices Q, as described in 10.32.3 (Explicit feedback beamforming) and 19.3.12.3 (Explicit feedback beamforming).

The size of the HE Compressed Beamforming Report field depends on the values in the HE MIMO Control field. The HE Compressed Beamforming Report field contains HE Compressed Beamforming Report information or successive (possibly zero-length) portions thereof in the case of segmented HE Compressed Beamforming and CQI feedback (see 25.6 (HE sounding protocol)). HE Compressed Beamforming Report information is included in the HE Compressed Beamforming and CQI feedback if an SU feedback type or an MU feedback type is indicated in the Feedback Type field in the HE MIMO Control field.

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The HE Compressed Beamforming Report information contains the channel matrix elements indexed, first, by matrix angles in order shown in Table 9-67 (Order of angles in the Compressed Beamforming Feedback Matrix subfield), and second, by data and pilot subcarrier index from lowest frequency to highest frequency. The explanation on how these angles are generated from the beamforming feedback matrix *V* is given in 19.3.12.3.6 (Compressed beamforming feedback matrix) in Table 9-67 (Order of angles in the Compressed Beamforming Feedback Matrix subfield), *Nc* is the number of columns in a compressed beamforming feedback matrix determined by the Nc Index field of the HE MIMO Control field, *Nr* is the number of rows in a compressed beamforming feedback matrix determined by the Nr Index field of the HE MIMO Control field.

The beamforming feedback matrix *V* is formed by the beamformee as follows. The beamformer transmits an NDP with $N_{STS,NDP}$ space-time streams, where $N_{STS,NDP}$ may take a value between 2 and 8. Based on this NDP, the beamformee estimates the $N_{RX,BFEE} \times N_{STS,NDP}$ channel, and based on that channel it determines a $Nr \times Nc$ orthogonal matrix *V*, where *Nr* and *Nc* satisfy Equation (8-1).

Further restrictions on *Nc* are described in 26.2 (HE PHY service interface). The angles are quantized as defined in Table 9-68 (Quantization of angles).

The HE Compressed Beamforming Report information has the same structure and order as the VHT Compressed Beamforming Report information as defined in Table 9-69 (VHT Compressed Beamforming Report Information).

In Table 9-69 (VHT Compressed Beamforming Report Information), *Ns* is the number of subcarriers for which the Compressed Beamforming Feedback Matrix subfield is sent back to the beamformer. A beamformee may choose to reduce Ns by using a method referred to as grouping, in which only a single Compressed Beamforming Feedback Matrix is reported for each group of *Ng* adjacent subcarriers. For HE Compressed Beamforming Report, *Ns* is a function of the RU Start Index, RU End Index and Grouping subfields in the HE MIMO Control field (see 9.4.1.62 (HE MIMO Control field(#223))). Subcarriers *scidx(0)* and *scidx(Ns–1)* represent the S (Start)-tone corresponding to the RU Start Index and E (End)-tone corresponding to the RU End Index, respectively. For 40 MHz and 80 MHz, subcarrier $scidx(i) = scidx(i - 1) + Ng$, where $1 \le i \le Ns - 2$. The S-tone and E-tone corresponding to the possible RU indices are listed in Table 9-76b (Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for Ng = 4) for *Ng* = 4 and Table 9-76c (Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for Ng = 16) for *Ng* = 16. For 160 MHz, to determine the S-tone and E-tone, RUs 37 to 73 occupying the higher 80 MHz use the same entries in Table 9-76b (Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for Ng = 4) and Table 9-76c (Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for Ng = 16) as RUs 0 to 36 occupying the lower 80 MHz. For 20 MHz, $scidx(i)$, where $1 \le i \le Ns - 2$, includes all subcarrier indices between the S-tone and the E-tone subcarrier indices described in Table 9-76d (Feedback subcarrier indices for 20 MHz bandwidth for Ng = 4 and Ng = 16) for *Ng* = 4 and *Ng* = 16.

Table 9-76b—Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for *Ng* = 4

80 MHz 26-tone RU Index	80 MHz (S, E) FB tone	40 MHz 26-tone RU Index	40 MHz (S, E) FB tone	20 MHz 26-tone RU Index	20 MHz (S, E) FB tone

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Table 9-76b—Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for *Ng* = 4 *(continued)*

0	–500, –472	0	= (S, E) for 80 MHz + 256		
1	–476, –448	1			
2	–448, –420	2			
3	–420, –392	3			
4	–392, –364	4			
5	–368, –340	5			
6	–340, –312	6			
7	–312, –284	7			
8	–288, –260	8			
9	–260, –232				
10	–232, –204				
11	–204, –176				
12	–180, –152				
13	–152, –124				
14	–124, –96			0	–122, –96
15	–100, –72			1	= (S, E) for 80 MHz + 4
16	–72, –44			2	
17	–44, –16			3	= (S, E) for 80 MHz
18	–16, 16			4	
19	16, 44			5	
20	44, 72			6	= (S, E) for 80 MHz – 4
21	72, 100			7	
22	96, 124			8	
23	124, 152				
24	152, 180				
25	176, 204				
26	204, 232				

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Table 9-76b—Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for *Ng* = 4 *(continued)*

27	232, 260				
28	260, 288	9	= (S, E) for 80 MHz – 256		
29	284, 312	10			
30	312, 340	11			
31	340, 368	12			
32	364, 392	13			
33	392, 420	14			
34	420, 448	15			
35	448, 476	16			
36	472, 500	17			

Table 9-76c—Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for *Ng* = 16

80 MHz 26-tone RU index	80 MHz (S, E) FB tone	40 MHz 26-tone RU index	40 MHz (S, E) FB tone	20 MHz 26-tone RU index	20 MHz (S, E) FB tone
0	–500, –468	0	= (S, E) for 80 MHz + 256		
1	–484, –436	1			
2	–452, –420	2			
3	–420, –388	3			
4	–404, –356	4			
5	–372, –340	5			
6	–340, –308	6			
7	–324, –276	7			
8	–292, –260	8			
9	–260, –228				
10	–244, –196				
11	–212, –164				
12	–180, –148				

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Table 9-76c—Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for *Ng* = 16 *(continued)*

13	–164, –116				
14	–132, –84			0	–122, –96
15	–100, –68			1	= (S, E) for 80 MHz + 4
16	–84, –36			2	
17	–52, –4			3	= (S, E) for 80 MHz
18	–20, 20			4	
19	4, 52			5	
20	36, 84			6	= (S, E) for 80 MHz – 4
21	68, 100			7	
22	84, 132			8	
23	116, 164				
24	148, 180				
25	164, 212				
26	196, 244				
27	228, 260				
28	260, 292	9	= (S, E) for 80 MHz – 256		
29	276, 324	10			
30	308, 340	11			
31	340, 372	12			
32	356, 404	13			
33	388, 420	14			
34	420, 452	15			
35	436, 484	16			
36	468, 500	17			

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Table 9-76d—Feedback subcarrier indices for 20 MHz bandwidth for *Ng* = 4 and *Ng* = 16

Ng	Subcarrier indeces
4	−122, −120, −116, −112, −108, −104, −100, −96, −92, −88, −84, −80, −76, −72, −68, −64, −60, −56, −52, −48, −44, −40, −36, −32, −28, −24, −20, −16, −12, −8, −4, −2, 2, 4, 8, 12, 16, 20, 24, 28, 32, 36, 40, 44, 48, 52, 56, 60, 64, 68, 72, 76, 80, 84, 88, 92, 96, 100, 104, 108, 112, 116, 120, 122
16	−122, −116, −100, −84, −68, −52, −36, −20, −4, −2, 2, 4, 20, 36, 52, 68, 84, 100, 116, 122

The Average SNR of space-time stream *i* subfield in the Table 8-53f is an 8-bit twos complement integer whose definition is shown in Table 8-53h (Average SNR of Space-Time Stream i subfield).

The $AvgSNR_i$ in Table 9-71 (Average SNR of Space-Time Stream i subfield) is found by computing the SNR per subcarrier in decibels for the subcarriers identified in Table 9-76b (Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for Ng = 4) for *Ng* = 4 and Table 9-76c (Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for Ng = 16) for *Ng* = 16, and then computing the arithmetic mean of those values. Each SNR value per subcarrier in stream *i* (before being averaged) corresponds to the SNR associated with the column *i* of the beamforming feedback matrix *V* determined at the beamformee. Each SNR corresponds to the predicted SNR at the beamformee when the beamformer applies all columns of the matrix *V*.

(PHY Motion 160)For HE beamformee, supporting *Ng* = 16 in the HE Compressed Beamforming Report field is optional for both SU and MU feedback types(#Ed). A beamformer shall not request *Ng* = 16 in an HE NDP Announcement frame(#Ed) if the beamformee does not indicate support for *Ng* = 16 in the HE Capabilities element it transmits (see 9.4.2.218 (HE Capabilities element)).

For an HE beamformee, supporting the codebook size {4, 2} in the HE Compressed Beamforming Report field is optional for SU feedback type(#Ed). A beamformer shall not request codebook size {4, 2} in an HE NDP Announcement frame(#Ed) if the beamformee does not indicate support for the codebook size {4, 2} in the HE Capabilities element it transmits (see 9.4.2.218 (HE Capabilities element)).

For an HE beamformee, supporting codebook size {7, 5} in the HE Compressed Beamforming Report field is optional for MU feedback type(#Ed). A beamformer shall not request the codebook size {7, 5} in an HE NDP Announcement frame if the beamformee does not indicate support for the codebook size {7, 5} in the HE Capabilities element it transmits (see 9.4.2.218 (HE Capabilities element)).

9.4.1.64 HE MU Exclusive Beamforming Report field

(#112)The MU Exclusive Beamforming Report field is used by the HE Compressed Beamforming And CQI frame (see 9.6.28.2 (HE Compressed Beamforming And CQI frame format)) to carry explicit feedback in the form of delta SNRs. The information in the HE Compressed Beamforming Report field and the HE MU Exclusive Beamforming Report field can be used by the transmit MU beamformer to determine the steering matrices *Q*, as described in 26.3.3.7 (DL MU-MIMO).

The size of the HE MU Exclusive Beamforming Report field depends on the values in the HE MIMO Control field. The HE MU Exclusive Beamforming Report field contains HE MU Exclusive Beamforming Report information or successive (possibly zero-length) portions thereof in the case of segmented HE Compressed Beamforming and CQI feedback (see 25.6 (HE sounding protocol)). HE Compressed Beamforming Report information and HE MU Exclusive Beamforming Report information are included in

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the HE Compressed Beamforming and CQI feedback if the MU feedback type is indicated in the Feedback Type field in the HE MIMO Control field.

The HE MU Exclusive Beamforming Report information consists of Delta SNR subfields for each of the space-time stream (1 to *Nc*) of a subset of subcarriers typically spaced *Ng* apart, where *Ng* is signaled in the Grouping subfield of the HE MIMO Control field. Starting from the lowest frequency subcarrier and continuing to the highest frequency subcarrier. Specifically, the locations of the feedback subcarriers for delta SNR subfield shall be identical to the subcarrier locations of the compressed *V* matrices feedback.

No padding is present between $\Delta SNR_{k,i}$, in the HE MU Exclusive Beamforming Report field, even if they correspond to different subcarriers. The subset of subcarriers included is determined by the values of the RU Start Index, RU End Index, and Grouping subfield of the HE MIMO Control field. For each subcarrier included, the deviation in dB of the SNR of that subcarrier for each column of *V* relative to the average SNR of the corresponding space-time stream is computed using Equation (9-2).

The HE MU Exclusive Beamforming Report information has the same structure and order as the VHT MU Exclusive Beamforming Report information defined in Table 9-72 (MU Exclusive Beamforming Report information).

In Table 9-72 (MU Exclusive Beamforming Report information), Ns' is the number of subcarriers for which the Delta SNR subfield is sent back to the beamformer. Subcarriers $sscidx(0)$ and $sscidx(Ns' - 1)$ represent the S-tone corresponding to the RU Start Index and E-tone corresponding to the RU End Index, respectively. For 40 MHz and 80 MHz, subcarrier $sscidx(i) = sscidx(i - 1) + Ng$, where $1 \leq i \leq Ns' - 2$. The S-tone and E-tone corresponding to the possible RU indices are listed in Table 9-76b (Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for Ng = 4) for $Ng = 4$ and Table 9-76c (Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for Ng = 16) for $Ng = 16$. For 160 MHz, to determine the S-tone and E-tone, RUs 37 to 73 occupying the higher 80 MHz use the same entries in Table 9-76b (Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for Ng = 4) and Table 9-76c (Feedback subcarrier indices indicating start 26-tone RU index and end 26-tone RU index for Ng = 16) as RUs 0 to 36 occupying the lower 80 MHz. For 20 MHz, $sscidx(i)$, where $1 \leq i \leq Ns' - 2$, includes all subcarrier indices between the S-tone and the E-tone subcarrier indices described in Table 9-76d (Feedback subcarrier indices for 20 MHz bandwidth for Ng = 4 and Ng = 16) for $Ng = 4$ and $Ng = 16$.

9.4.1.65 HE CQI-only Report field

(#112)The HE CQI-only Report field is used by the HE Compressed Beamforming And CQI frame (see 9.6.28.2 (HE Compressed Beamforming And CQI frame format)) to carry the per-RU average SNRs of each space-time stream, where each per-RU average SNR is the arithmetic mean of the SNR in decibels over a 26-tone RU for which the feedback is being requested.

The size of the HE Compressed Beamforming Report field depends on the values in the HE MIMO Control field. The HE Compressed Beamforming Report field contains HE CQI-only Report information or successive (possibly zero-length) portions thereof in the case of segmented HE Compressed Beamforming and CQI feedback (see 25.6 (HE sounding protocol)). HE CQI-only Report information is included in the HE Compressed Beamforming and CQI feedback if the CQI-only feedback type is indicated in the Feedback

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Type field of the HE MIMO Control field. The structure of the HE CQI-only Report field is shown in Table 9-76e (HE CQI-only Report information).

Table 9-76e—HE CQI-only Report information

Field	Size (bits)	Meaning
Average SNR for space-time stream 1 for RU index $k = ruidx(0)$	6	SNR at the beamformee for space-time stream 1 averaged over 26-tone RU. See Table 9-76f (Average SNR of RU index k for space-time stream i subfield).
...		
Average SNR for space-time stream *Nc* for RU index $k = ruidx(0)$	6	SNR at the beamformee for space-time stream *Nc* averaged over 26-tone RU. See Table 9-76f (Average SNR of RU index k for space-time stream i subfield).
Average SNR for space-time stream 1 for RU index $k = ruidx(1)$	6	SNR at the beamformee for space-time stream 1 averaged over 26-tone RU. See Table 9-76f (Average SNR of RU index k for space-time stream i subfield).
...		
Average SNR for space-time stream *Nc* for RU index $k = ruidx(1)$	6	SNR at the beamformee for space-time stream *Nc* averaged over 26-tone RU. See Table 9-76f (Average SNR of RU index k for space-time stream i subfield).
...		
Average SNR for space-time stream 1 for RU index $k = ruidx(Ncqi - 1)$	6	SNR at the beamformee for space-time stream 1 averaged over 26-tone RU. See Table 9-76f (Average SNR of RU index k for space-time stream i subfield).
...		
Average SNR for space-time stream *Nc* for RU index $k = ruidx(Ncqi - 1)$	6	SNR at the beamformee for space-time stream *Nc* averaged over 26-tone RU. See Table 9-76f (Average SNR of RU index k for space-time stream i subfield).

Ncqi is the number of RU indices for which the CQI-only report is sent back to the beamformer. *Ncqi* is a function of the RU Start Index and RU End Index subfields in the HE MIMO Control field. The RU indices $ruidx(0)$ and $ruidx(Ncqi - 1)$ correspond to the RU Start Index and RU End Index subfields, respectively. The RU index $ruidx(i) = ruidx(i - 1) + 1$, where $1 \leq i \leq Ncqi - 2$.

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The Average SNR of space-time stream *i* for the RU index *k* subfield in the Table 9-76e (HE CQI-only Report information) is an 6-bit twos complement integer whose definition is shown in Table 9-76f (Average SNR of RU index k for space-time stream i subfield).

Table 9-76f—Average SNR of RU index *k* for space-time stream *i* subfield

Average SNR of RU index *k* for space-time stream *i*	$AvgSNR_{k,i}$ (dB)
−32	≤ −10
−31	−9
−30	−8
...	
30	52
31	≥ 53

The $AvgSNR_{k,i}$ in Table 9-76f (Average SNR of RU index k for space-time stream i subfield) is found by computing the arithmetic mean of the SNR per subcarrier in decibels for space-time stream *i* over the subcarriers in RU index *k* for which the feedback is being requested.

9.4.2 Elements

9.4.2.1 General

Insert the following new rows into Table 9-77 (Element IDs) (header row shown for convenience)::

Table 9-77—Element IDs

Element	Element ID	Element ID Extension	Extensible
HE Capabilities (see 9.4.2.213 (HE Capabilities element))	<ANA>	N/A	Yes
HE Operation (see 9.4.2.214 (HE Operation element))	<ANA>	N/A	Yes
RAPS element (see 9.4.2.220 (OFDMA-based Random Access Parameter Set (RAPS) element(#450)))	255	<ANA>	Yes

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9.4.2.27 Extended Capabilities element

(#1803)Insert the following rows into Table 9-135 (Extended Capabilities element) (header row shown for convenience):

Table 9-135—Extended Capabilities element

Bit	Information	Notes
<ANA>	TWT Requester Support	A STA sets the TWT Requester Support field to 1 when dot11TWTOptionActivated is true, and sets it to 0 otherwise. See 11.11.9.9 (TWT section).
<ANA>	TWT Responder Support	A STA sets the TWT Responder Support field to 1 when dot11TWTOptionActivated is true, and sets it to 0 otherwise. See 11.11.9.9 (TWT section).

9.4.2.196 TWT element

Change as Figure 9-586ax (Control field format) follows.

	B1	B2	B3	~~B3~~B4	B8
	NDP Paging Indicator	Responder PM Mode	Broadcast	Reserved	
Bits:	1	1	1	~~6~~5	

Figure 9-586ax—Control field format

Insert the following paragraph after Table 9-257l (TWT Setup Command field values):

The Broadcast field indicates if the TWT SP indicated by the TWT element is a broadcast TWT as defined in 10.44.3 (Broadcast TWT Operation)(#954). The Broadcast field is 1 to indicate that the TWT(s) defined by the TWT element are broadcast TWT(s). The Broadcast field is 0, otherwise.(#382)

Change Figure 9-586ay (Request Type field format) as follows (B4 from "Reserved" to "Trigger").

	B0	B1 B3	B4	B5	B6	B7 B9	B10 B14	B15
	TWT Request	TWT Setup Command	~~Reserved~~ Trigger	Implicit	Flow Type	TWT Flow Identifier	TWT Wake Interval Exponent	TWT Protection
Bits:	1	3	1	1	1	3	5	1

Figure 9-586ay—Request Type field format

Insert the following paragraph after Table 9-257l (TWT Setup Command field values):

The Trigger field indicates if the TWT SP indicated by the TWT element includes Trigger frames as defined in 10.44 (Target wake time (TWT)). The Trigger field is set to 1 to indicate that at least one Trigger frame is transmitted during the TWT SP. The Trigger field is set to 0 otherwise.

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Change the text as shown in subclause 9.4.2.196 TWT element:

The TWT Flow Identifier subfield contains a 3-bit value which identifies the specific information for this TWT request uniquely from other requests made between the same TWT requesting STA and TWT responding STA pair. For a TWT SP that is indicated in a TWT response transmission that is(#1320) a broadcast TWT SP, the TWT Flow Identifier subfield contains a value that indicates recommendations on the types of frames that are transmitted by scheduled STAs(#1320) during the broadcast TWT SP, encoded according to Table 9-257l1 (TWT Flow Identifier field for a broadcast TWT element).

Insert a new table as follows:

Table 9-257l1—TWT Flow Identifier field for a broadcast TWT element

TWT Flow Identifier field value	Description when transmitted in a broadcast TWT element
0	No constraints on the frames transmitted during a broadcast TWT SP.
1	Frames transmitted during a broadcast TWT SP by a TWT scheduled STA are recommended to be limited to: — Frames with reduced payload sizes that deliver control feedback: • PS-Poll and QoS Null frames • Feedback can be contained is the QoS Control field or in the HE variant HT Control field of the frame, whichever is present (see 25.5.1 (HE DL MU operation), 25.5.2 (UL MU operation), 25.8 (Operating mode indication), 25.14 (Link adaptation using the HE variant HT Control field), etc.) — Frames that are sent as part of a sounding feedback exchange (see 25.6 (HE sounding protocol)) — Management frames • Action, or Action No Ack frames There are no restrictions on the frames transmitted by the scheduling STA of the broadcast TWT SP. Trigger frames transmitted by the AP during the broadcast TWT SP will not contain RUs for random access (see 25.7.3.2 (Rules for TWT scheduling STA)).(#114)

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Table 9-257l1—TWT Flow Identifier field for a broadcast TWT element

2	Frames transmitted during a broadcast TWT SP by a TWT scheduled STAT are recommended to be limited to: — Frames with reduced payload sizes that deliver control feedback: • PS-Poll and QoS Null frames • Feedback can be contained is the QoS Control field or in the HE variant HT Control field of the frame, whichever is present (see 25.5.1 (HE DL MU operation), 25.5.2 (UL MU operation), 25.8 (Operating mode indication), 25.14 (Link adaptation using the HE variant HT Control field), etc.) — Frames that are sent as part of a sounding feedback exchange (see 25.6 (HE sounding protocol)) — Management frames • Action, Action No Ack frames or (Re-)Association Request frames There are no restrictions on the frames transmitted by the scheduling STA of the broadcast TWT SP. Trigger frames transmitted by the AP during the broadcast TWT SP will contain at least one RU for random access (see 25.7.3.2 (Rules for TWT scheduling STA)).(#114)
3-7	Reserved

Change the paragraph below as follows:

In a TWT element transmitted by a TWT requesting or scheduled STA(#1324), the TWT wake interval is equal to the average time that the TWT requesting STA expects to elapse between successive TWT SPs. In a TWT element transmitted by a TWT responding or scheduling STA(#1324), the TWT wake interval is equal to the average time that the TWT-responding STA expects to elapse between successive TWT SPs. In a TWT element contained in a TWT request(#1324) that is sent by the scheduled STA(#1324) to negotiate the wake intervals for Beacon frames that contain a TWT(#384) element that indicates a broadcast TWT(#1324), the TWT wake interval indicates the value of the listen interval (see 10.44.3.4 (Negotiation of TBTT and listen interval))(#616).

The TWT Wake Interval Exponent subfield is set to the value of the exponent of the TWT wake interval value in microseconds, base 2. The TWT wake interval of the requesting STA is equal to (TWT Wake Interval Mantissa) × $2^{(\text{TWT Wake Interval Exponent})}$(#1326).

Change the paragraph below as follows:

When transmitted by a TWT requesting STA or a TWT scheduled STA, the Target Wake Time field contains a positive integer which corresponds to a TSF time at which the STA requests to wake, or a value of zero when the TWT Setup Command subfield contains the value corresponding to the command "Request TWT". The Target Wake Time field is 8 octets when the Broadcast field is 0; otherwise it is 2 octets with the lowest bit of the 2 octets corresponding to bit 4 of the relevant TSF value.(#1324) When a TWT responding STA or a TWT scheduling STA with dot11TWTGroupingSupport equal to 0 transmits a TWT element to the TWT requesting STA, the TWT element contains a value in the Target Wake Time field which corresponds to a TSF time at which the TWT responding STA requests the TWT requesting STA or TWT scheduled STA to wake for the corresponding TWT SP (#1324)and it does not contain the TWT Group Assignment field.

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Change Table 9-257l (TWT Setup Command field values) by adding two new columns as shown:

Table 9-257l—TWT Setup Command field values

TWT Setup Command field value	Command name	Description when transmitted by a TWT requesting STA, Wake TBTT Negotiation subfield = 0	Description when transmitted by a TWT responding STA, Wake TBTT Negotiation subfield = 0	Description when transmitted by a TWT scheduled STA, Wake TBTT Negotiation subfield = 1	Description when transmitted by a TWT scheduling STA, Wake TBTT Negotiation subfield = 1
0	Request TWT	The Target Wake Time field of the TWT element contains 0s as the TWT responding STA specifies the target wake time value for this case, other TWT parameters* are suggested by the TWT requesting STA in the TWT request.	N/A	N/A(#682)	N/A
1	Suggest TWT	TWT requesting STA includes a set of TWT parameters such that if the requested target wake time value and/or other TWT parameters cannot be accommodated, then the TWT setup might still be accepted.	N/A	The Target Wake Time field of the TWT element contains 0s as the TWT scheduling STA specifies the target wake time value for this case, other TWT parameters are suggested by the TWT scheduled STA in the TWT request.(#682)	N/A
2	Demand TWT	TWT requesting STA includes a set of TWT parameters such that if the requested target wake time value and/or other TWT parameters cannot be accommodated, then the TWT setup will be rejected.	N/A	The Target Wake Time field of the TWT element contains 0s as the TWT scheduling STA specifies the target wake time value for this case, other TWT parameters are demanded by the TWT scheduled STA in the TWT request.(#682)	N/A

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Table 9-257l—TWT Setup Command field values *(continued)*

3	TWT Grouping	N/A	TWT responding STA suggests TWT group parameters that are different from the suggested or demanded TWT parameters of the TWT requesting STA	N/A	N/A
4	Accept TWT	N/A	TWT responding STA accepts the TWT request with the TWT parameters (See NOTE) indicated in the TWT element transmitted by the responding STA	N/A	TWT scheduling STA accepts the TWT request with the TWT parameters (see NOTE)(#1328) indicated in the TWT element transmtted by the TWT scheduled STA.
5	Alternate TWT	N/A	TWT responding STA suggests TWT parameters that are different from TWT requesting STA suggested or demanded TWT parameters	N/A	N/A
6	Dictate TWT	N/A	TWT responding STA demands TWT parameters that are different from TWT requesting STA TWT suggested or demanded parameters	N/A	N/A
7	Reject TWT	N/A	TWT responding STA rejects TWT setup	N/A	TWT scheduling STA rejects TWT setup

NOTE—TWT Parameters are: TWT, Nominal Minimum Wake Duration, TWT Wake Interval and TWT Channel subfield values indicated in the element. The Trigger subfield value indicated in the element is also a TWT parameter for an HE STA.(#682)

(#2391)Change the two paragraph in the middle of the subclause (in strikethrough below) as follows:

~~A TWT requesting STA sets the TWT Protection subfield to 1 to request the TWT responding STA to provide protection of the set of TWT SPs corresponding to the requested TWT flow identifier by allocating RAW(s) that restrict access to the medium during the TWT SP(s) for that(those) TWTs. A TWT requesting STA sets the TWT Protection subfield to 0 if TWT protection by RAW allocation is not requested for the corresponding TWT(s).~~

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A TWT requesting STA sets the TWT Protection subfield to 1 to request the TWT responding STA to provide protection of the set of TWT SPs corresponding to the requested TWT flow identifier by:

— Allocating RAW(s) that restrict access to the medium during the TWT SP(s) for that (those) TWTs that are set up within an S1G BSS

— Enabling NAV protection during the TWT SP(s) for that (those) TWTs that are set up within an HE BSS

A TWT requesting STA sets the TWT Protection subfield to 0 if TWT protection by RAW allocation is not requested for the corresponding TWT(s).

A TWT scheduled STA sets the TWT Protection subfield to 0.

~~When transmitted by a TWT responding STA that is an AP, the TWT Protection subfield indicates whether the TWT SP(s) identified in the TWT element will be protected. A TWT responding STA sets the TWT Protection subfield to 1 to indicate that the TWT SP(s) corresponding to the TWT flow identifier(s) of the TWT element will be protected by allocating RAW(s) that restrict access to the medium during the TWT SP(s) for that(those) TWT(s). A TWT responding STA sets the TWT Protection subfield to 0 to indicate that the TWT SP(s) identified in the TWT element might not be protected from TIM STAs by allocating RAW(s).~~

When transmitted by a TWT responding STA or TWT scheduling STA that is an AP, the TWT Protection subfield indicates whether the TWT SP(s) identified in the TWT element will be protected. A TWT responding STA or TWT scheduling STA sets the TWT Protection subfield to 1 to indicate that the TWT SP(s) corresponding to the TWT flow identifier(s) of the TWT element will be protected by:

— Allocating RAW(s) that restrict access to the medium during the TWT SP(s) for that (those) TWT(s) when the responding STA or scheduling STA is an S1G STA.

— Enabling NAV protection during the TWT(s) for that (those) TWTs when the responding STA or scheduling STA is not an S1G STA

A TWT responding STA or TWT scheduling STA sets the TWT Protection subfield to 0 to indicate that the TWT SP(s) identified in the TWT element might not be protected.

Insert the following new subclauses after the last subclause in 9.4.2:

9.4.2.218 HE Capabilities element

9.4.2.218.1 General

An HE STA declares that it is an HE STA by transmitting the HE Capabilities element.

The HE Capabilities element contains a number of fields that are used to advertise the HE capabilities of an HE STA. The HE Capabilities element is defined in Figure 9-589cj (HE Capabilities element format(#200))..

	Element ID	Length	HE MAC Capabilities Information	HE PHY Capabilities Information	Tx Rx HE MCS NSS Support	PPE Thresholds (optional)
Octets:	1	1	5	9	2 or more	variable

Figure 9-589cj—HE Capabilities element format(#200)

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The Element ID and Length fields are defined in 9.4.2.1 (General).

(#200)The HE MAC Capabilities Information, HE PHY Capabilities Information, Tx Rx HE MCS NSS Support, and PPE Thresholds fields are defined in the subclauses below.

9.4.2.218.2 HE MAC Capabilities Information field

(#200)The format of the HE MAC Capabilities Information field is defined in Figure 9-589ck (HE MAC Capabilities Information field format)(#617).

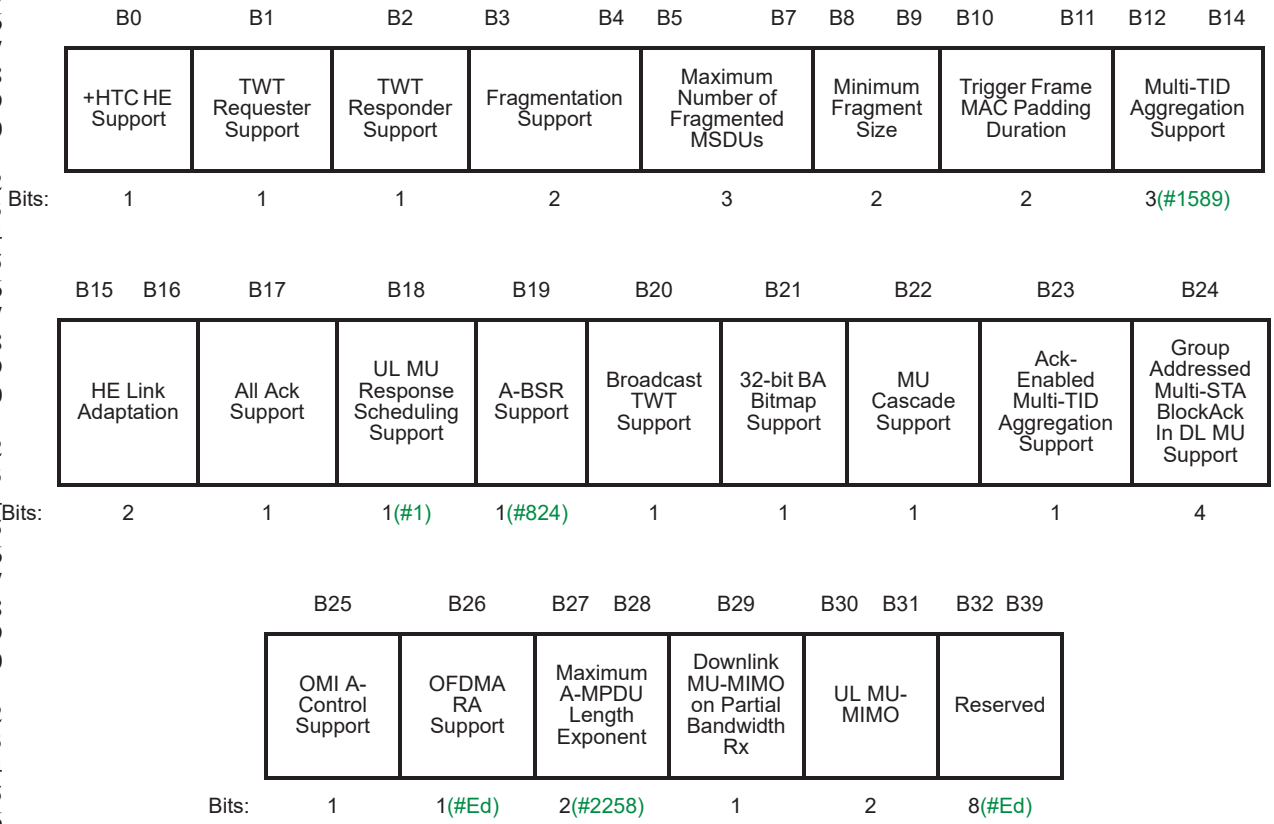

Figure 9-589ck—HE MAC Capabilities Information field format

The subfields of the HE MAC Capabilities Information field are defined in Table 9-262z (Subfields of the HE MAC Capabilities Information field).

Table 9-262z—Subfields of the HE MAC Capabilities Information field

Subfield	Definition	Encoding
+HTC-HE Support	Indicates if the STA supports the reception of an HE variant HT Control field carried in a QoS Data, QoS Null, or Management frame.	Set to 1 if the STA supports reception of an HE variant HT Control field. Set to 0 otherwise.

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Table 9-262z—Subfields of the HE MAC Capabilities Information field

TWT Requester Support	Indicates support by an HE STA for the role of TWT requesting STA as described in 10.44 (Target wake time (TWT)).	Set to 1 if dot11TWTOptionActivated is true and the STA supports TWT requester STA functionality (see 10.44 (Target wake time (TWT))). Set to 0 otherwise.
TWT Responder Support	Indicates support by an HE STA for the role of TWT responder STA as described in 10.44 (Target wake time (TWT)).	Set to 1 if dot11TWTOptionActivated is true and the STA supports TWT responder STA functionality (see 10.44 (Target wake time (TWT))). Set to 0 otherwise.
Fragmentation Support	Indicates the level of dynamic fragmentation that is supported by a STA as a recipient.	Set to 0 for no support for dynamic fragmentation. Set to 1 for support for dynamic fragments that are contained within a VHT single MPDU, no support for dynamic fragments within an A-MPDU that is not a VHT Single MPDU. Set to 2 for support for dynamic fragments that are contained within a Single MPDU(#11ah) and support for up to one dynamic fragment for each MSDU and each MMPDU within an A-MPDU or multi-TID A-MPDU that is not a Single MPDU(#11ah). Set to 3 for support for dynamic fragments that are contained within a Single MPDU(#11ah) and support for multiple dynamic fragments for each MSDU within an (#1160)A-MPDU or multi-TID AMPDU and up to one dynamic fragment for each MMPDU in a multi-TID A-MPDU that is not a Single MPDU(#11ah).
Maximum Number of Fragmented MSDUs	Indicates the maximum number of fragmented MSDUs that can be concurrently received by a STA.	The maximum number of fragmented MSDUs, N_{max}, defined by this field is $N_{max} = 2^{\text{Maximum Number Of F-MPDUs}}$, except for a value of the Maximum Number of Fragmented MSDUs equal to 7 which indicates that there is no restriction.
Minimum Fragment Size	Indicates the minimum payload size in octets of the first fragment of an MSDU that is supported by the STA.(#Ed)	Set to 0 to indicate no restriction on the minimum payload size. Set to 1 to indicate a minimum payload size of 128 octets. Set to 2 to indicate a minimum payload size of 256 octets. Set to 3 to indicate a minimum payload size of 512 octets.(#Ed)
Trigger Frame MAC Padding Duration	Indicates the number of TIDs minus 1 of QoS Data frames that an HE STA can aggregate in a multi-TID A-MPDU as described in 25.10.4 (A-MPDU with multiple TIDs).	Set to the number of TIDs minus 1 of QoS Data frames that an HE STA can aggregate in a multi-TID A-MPDU.
HE Link Adaptation Capable	Indicates whether the STA supports link adaptation using the HE variant HT Control field.	If +HTC-HE Support is 1: Set to 0 (No Feedback) if the STA does not provide HE MFB. Set to 2 (Unsolicited) if the STA provides only unsolicited HE MFB. Set to 3 (Both) if the STA can provide HE MFB in response to HE MRQ and if the STA provides unsolicited HE MFB. The value 1 is reserved. Reserved if +HTC-HE Support is 0.

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Table 9-262z—Subfields of the HE MAC Capabilities Information field

All ACK Support	Indicates whether the STA supports reception of a Multi-STA Block-Ack frame under the all ack context (see 25.4.2)	Set to 1 is the STA supports reception of a Multi-STA BlockACk frame under the all ack context. Set to 0 otherwise.
UL MU Response Scheduling Support	Indicates support for receiving an MPDU that contains an UL MU Response Scheduling A-Control field.	If +HTC-HE Support is 1: Set to 1 if the STA supports reception of the UL MU Response Scheduling A-Control field. Set to 0 otherwise. Reserved if +HTC-HE Support is 0.
A-BSR Support	Indicates support by an AP for receiving an (A-)MPDU that contains a BSR in the A-Control subfield and support by a non-AP STA for generating an (A-)MPDU that contains a BSR in the A-Control subfield.	If +HTC-HE Support is 1: Set to 1 if the STA supports the BSR A-Control field functionality. Set to 0 otherwise. Reserved if +HTC-HE Support is 0.
Broadcast TWT Supported	Indicates support by an HE non-AP STA for the role of TWT scheduled STA and by an AP for the role of TWT scheduling STA as described in 25.7.3 (Broadcast TWT operation(#1779)(#1874)(#1214)).	Set to 1 when the STA supports broadcast TWT functionality. Set to 0 otherwise.
32-bit BA Bitmap Support	Indicates whether the STA supports reception of a Multi-STA BlockAck frame that has a 32-bit BlockAck Bitmap intended to it.	Set to 1 if the STA supports reception of a Multi-STA BlockAck frame that has a 32-bit Block Ack Bitmap subfield intended to it. Set to 0 otherwise.
MU Cascading Supported	Indicates whether the STA supports participating in an MU Cascading sequence (see 25.5.3 (HE MU cascading operation)).	Set to 1 if the STA supports MU cascading operation. Set to 0 otherwise.
Ack-enabled Multi-TID Aggregation Support	Indicates support by a STA to receive a multi-TID A-MPDU that can solicit either Ack or Block-Ack, or both, as described in 25.10.4 (A-MPDU with multiple TIDs).	Set to 1 when the STA supports reception of this multi-TID A-MPDU format. Set to 0 otherwise.
Group Addressed Multi-STA Block-Ack In DL MU Support	Indicates support by a non-AP STA for the reception of a group-addressed Multi-STA BlockAck frame that is sent in a DL MU PPDU in a non-broadcast RU.	Set to 1 when the STA supports its reception. Set to 0 otherwise.
OMI A-Control Support	Indicates support for receiving an MPDU that contains an OMI A-Control field.	If +HTC-HE Support is 1: Set to 1 if the STA supports reception of the OMI A-Control field. Set to 0 otherwise. Reserved if +HTC-HE Support is 0.

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Table 9-262z—Subfields of the HE MAC Capabilities Information field

OFDMA RA Supports	Indicates support for a non-AP STA to follow the OFDMA random access procedure and for an AP to send Trigger frames that allocate random RUs (see 25.5.2.6 (UL OFDMA-based random access)).	Set to 1 if supported.(#Ed) Set to 0 otherwise.
Maximum A-MPDU Length Exponent		
Downlink MU-MIMO On Partial Bandwidth Rx	Indicates support by a non-AP STA to receive an MU-MIMO transmission on an MU in an HE MU PPDU where the RU does not span the entire PPDU bandwidth.(#1801)	Set to 1 if supported. Set to 0 otherwise.(#Ed)
UL MU-MIMO	B1 of the UL MU MIMO subfield indicates the STA supports transmission of full bandwidth UL MU-MIMO transmission. B2 of the UL MU MIMO subfield indicates the STA supports transmission of UL MU-MIMO transmission on an RU in an HE MU PPDU where the RU does not span the entire PPDU bandwidth.(#1801)	

(#2258)If the HE STA includes a VHT Capabilities element, the Maximum A-MPDU Length Exponent subfield in HE Capabilities element combined with the Maximum A-MPDU Length Exponent subfield in VHT Capabilities element indicate the maximum length of A-MPDU that the STA can Receive where EOF padding is not included in this limit. When Maximum A-MPDU Length Exponent subfield in HE Capabilities element is 0, the value in Maximum A-MPDU Length Exponent subfield in VHT Capabilities element indicates the maximum length of A-MPDU that the STA can Receive which follows the definition in 9.4.2.158.2 (VHT Capabilities Info field). When Maximum A-MPDU Length Exponent subfield in HE Capabilities element is 1 or 2, the value in Maximum A-MPDU Length Exponent subfield in VHT Capabilities element is 7 and the length defined by the field is $2^{(20+\text{Maximum A-MPDU Length Exponent subfield in HE Capabilities element})}-1$. The value 3 in Maximum A-MPDU Length Exponent subfield in HE Capabilities element is reserved.

If the HE STA does not include VHT Capabilities element, the Maximum A-MPDU Length Exponent subfield in HE Capabilities element combined with the Maximum A-MPDU Length Exponent subfield in HT Capabilities element indicate the maximum length of A-MPDU that the STA can Receive where EOF padding is not included in this limit. When Maximum A-MPDU Length Exponent subfield in HE Capabilities element is 0, the value in Maximum A-MPDU Length Exponent subfield in HT Capabilities element indicates the the maximum length of A-MPDU that the STA can Receive which follows the definition in 9.4.2.56.3 (HT Capabilities Info field). When Maximum A-MPDU Length Exponent subfield in HE Capabilities element is 1 or 2, the value in Maximum A-MPDU Length Exponent subfield in HT Capabilities element is 7 and the length defined by the field is $2^{(16+\text{Maximum A-MPDU Length Exponent subfield in}}$

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HE Capabilities element) – 1. The value 3 in Maximum A-MPDU Length Exponent subfield in HE Capabilities element is reserved.

9.4.2.218.3 HE PHY Capabilities Information field

(#2064)(PHY Motion #168)The format of the HE PHY Capabilities Information field is defined in Figure 9-589cl (HE PHY Capabilities Information field format)(#617).

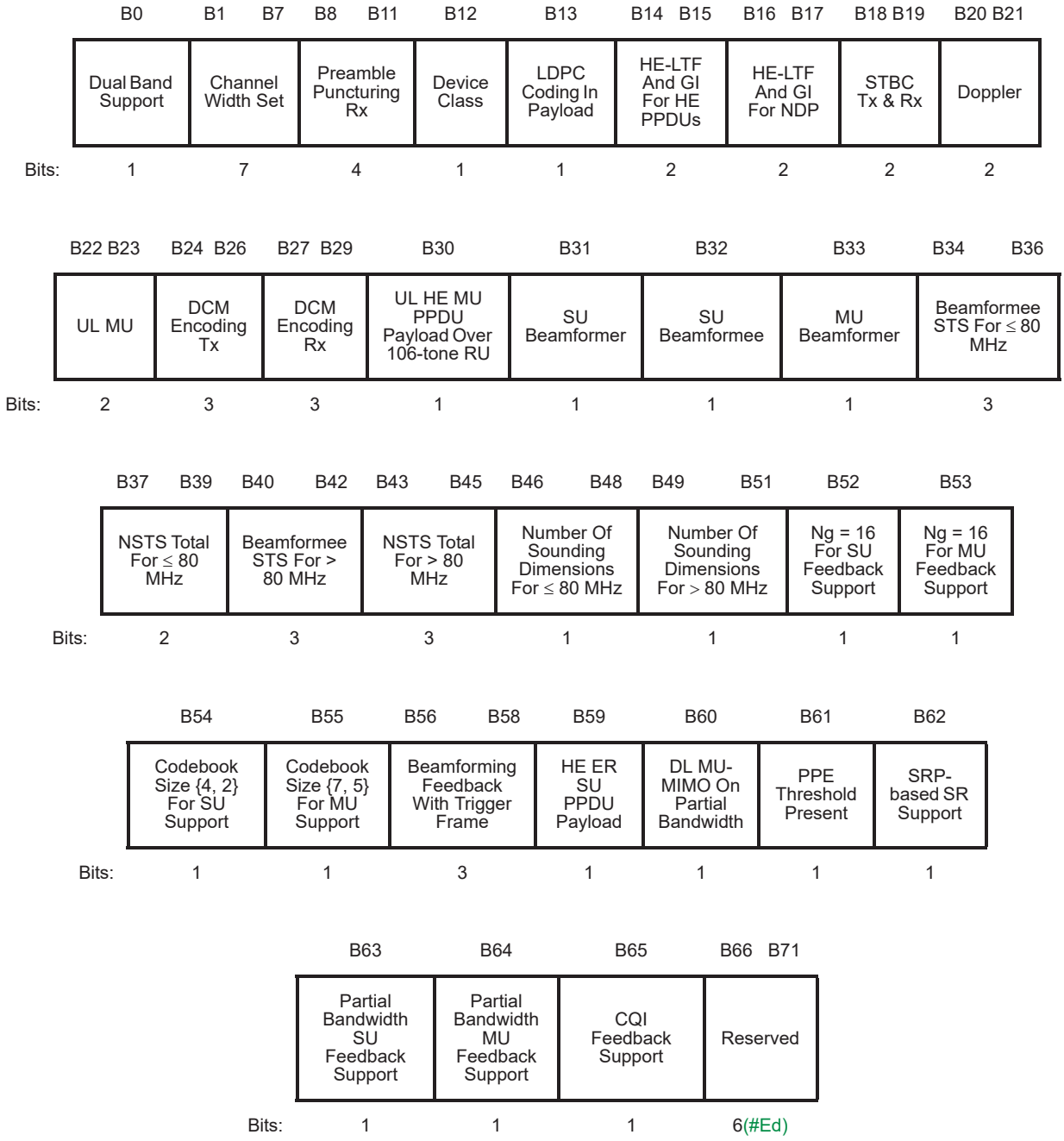

Figure 9-589cl—HE PHY Capabilities Information field format

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The subfields of the HE PHY Capabilities Information field are defined in Table 9-262aa (Subfields of the HE PHY Capabilities Information field).

Table 9-262aa—Subfields of the HE PHY Capabilities Information field

Subfield	Definition	Encoding
Dual Band Support	Indicates support of both 2.4 GHz and 5 GHz frequency bands	Set to 0 if not supported. Set to 1 if supported.
Channel Width Set	B1: Indicates STA support 40 MHz channel width in 2.4 GHz B2: Indicates STA support 40 MHz and 80 MHz channel width in 5 GHz B3: Indicates STA supports 160 MHz channel width in 5 GHz B4: Indicates STA supports 160/80+80 MHz channel width in 5 GHz B5: If B1 is set to 0, then B5 indicates support of 242/106/52/26-tone RU mapping in 40 MHz channel width in 2.4 GHz. Otherwise Reserved. B6: If B2, B3, and B4 are set to 0, then B6 indicates support of 242-tone RU mapping in 40 MHz and 80 MHz channel width in 5 GHz. Otherwise Reserved. B7: Reserved	B1 set to 0 if not supported. B1 set to 1 if supported. B2 set to 0 if not supported, i.e., it indicates 20 MHz only device in 5 GHz. B2 set to 1 if supported. Note AP always sets B2 to 1. B3 set to 0 if not supported. B3 set to 1 if supported. If B3 set to 1 then B2 is set to 1. B4 set to 0 if not supported. B4 set to 1 if supported. If B4 set to 1 then B3 is set to 1. B5 set to 0 if not supported. B5 set to 1 if supported. B6 set to 0 if not supported. B6 set to 1 if supported. NOTE: B1 and B5 are only applicable to 2.4 GHz and ignored at the receiver when HE PHY capabilities advertised on 5 GHz. B2, B3, B4, and B6 are only applicable to 5 GHz and ignored at the receiver when HE PHY capabilities advertised of 2.4 GHz.
Preamble Puncturing Rx	B8: Indicates STA supports reception of preamble puncturing in 80 MHz, where in the preamble only the secondary 20 MHz is punctured B9: Indicates STA supports reception of preamble puncturing in 80 MHz, where in the preamble only one of the two 20 MHz sub-channels in the secondary 40 MHz is punctured B10: Indicates STA supports reception of preamble puncturing in 160 MHz or 80+80 MHz, where in the primary 80 MHz of the preamble only the secondary 20 MHz is punctured B11: Indicates STA supports reception of preamble puncturing in 160 MHz or 80+80 MHz, where in the primary 80 MHz of the preamble, the primary 40 MHz is present	B8 set to 0 if not supported. B8 set to 1 if supported. B9 set to 0 if not supported. B9 set to 1 if supported. B10 set to 0 if not supported. B10 set to 1 if supported. B11 set to 0 if not supported. B11 set to 1 if supported.

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Table 9-262aa—Subfields of the HE PHY Capabilities Information field

Subfield	Definition	Encoding
Device Class	Indicates transmitting STA is a Class A or a Class B device.	Set to 1 to indicate STA is a Class A device. Set to 0 to indicate STA is a Class B device. Note: This field is reserved when transmitting STA is an AP STA.
LDPC Coding In Payload	Indicates support of transmission and reception of LDPC encoded packets	Set to 1 if supported by the STA. Set to 0 otherwise.
HE-LTF And GI For HE PPDUs	B14: Indicates support of reception of 1x LTF and 0.8 us guard interval duration for HE SU PPDUs. B15: Indicates support of reception of 1x LTF and 1.6 us guard interval duration for HE Trigger-based PPDUs.	Set to 1 if supported by the STA. Set to 0 otherwise.
HE-LTF And GI For NDP	B16: For a transmitting STA acting as beamformer, it indicates support of NDP transmission using 4x LTF and 3.2 us guard interval duration B17: For a transmitting STA acting as beamformee, it indicates support of NDP reception using 4x LTF and 3.2 us guard interval duration	If the SU Beamformer Capable field is set to 1 then B16 set to 1 if supported by the STA. Set B16 to 0 otherwise. If SU Beamformer Capable field is set to 0 then B16 is reserved. If the SU Beamformee Capable field is set to 1 the B17 set to 1 if supported by the STA.Set B17 to 0 otherwise.
STBC Tx And Rx	B18 indicates support for the transmission of HE PPDUs using STBC with one spatial stream B19 indicates support for the reception of HE PPDUs using STBC with one spatial stream	B18 set to 1 if supported by the STA. Set to 0 otherwise. B19 set to 1 if supported by the STA. Set to 0 otherwise.
Doppler	B20 indicates transmitting STA supports transmitting HE PPDUs with Doppler procedure B21 indicates transmitting STA supports receiving HE PPDUs with Doppler procedure	B20 set to 1 if supported by the STA. Set to 0 otherwise. B21 set to 1 if supported by the STA. Set to 0 otherwise.
UL MU	If the transmitting STA is an AP: B22 indicates STA supports of reception of full bandwidth UL MU-MIMO transmission. B23 indicates STA supports of reception of UL MU-MIMO transmission on an RU in an HE MU PPDU where the RU does not span the entire PPDU bandwidth. If the transmitting STA is a non-AP STA: B22 indicates STA supports of transmission of full bandwidth UL MU-MIMO transmission. B23 indicates STA supports of transmission of UL MU-MIMO transmission on an RU in an HE MU PPDU where the RU does not span the entire PPDU bandwidth.	B22 set to 1 if supported by the STA. Set to 0 otherwise. B23 set to 1 if supported by the STA. Set to 0 otherwise. NOTE: If the non-AP STA sets B23 (Uplink MU-MIMO on Partial Bandwidth) to 0, it shall support transmitting SU RU within an HE MU PPDU where some other RU is employing DL MU-MIMO

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Table 9-262aa—Subfields of the HE PHY Capabilities Information field

Subfield	Definition	Encoding
DCM encoding at Tx and Rx	B24 - B26 Signals support of Tx of (i) packet payload with dual sub-carrier modulation at a STA and (ii) DCM encoded HE-SIG-B in an HE MU PPDU at a STA. The signaling includes maximum constellation and the maximum number of spatial streams that are supported with DCM. B27 - B29 Signals support of reception of (i) packet payload with dual sub-carrier modulation at a STA and (ii) DCM encoded HE-SIG-B in an HE MU PPDU at a STA. The signaling includes maximum constellation and the maximum number of spatial streams that are supported with DCM.	B25:B24 signals Maximum Constellation 00: Does not support DCM, 01: BPSK , 10: QPSK, 11: 16-QAM B26 signals maximum number of spatial streams with DCM 0: 1 spatial stream, 1: 2 spatial streams. B28:B27 signals Maximum Constellation 00: Does not support DCM, 01: BPSK , 10: QPSK, 11: 16-QAM B29 signals maximum number of spatial streams with DCM 0: 1 spatial stream, 1: 2 spatial streams
UL HE MU PPDU Payload over 106-tone RU	It indicates STA supports of reception of HE MU PPDU payload over a 106-tone RU within 20 MHz	Set to 1 if supported by the STA. Set to 0 otherwise
SU Beamformer	Indicates support for operation as an SU beamformer.	Set to 0 if not supported. Set to 1 if supported. Set to 1 if sent by an HE AP with support for 4 or more spatial streams
SU Beamformee	Indicates support for operation as an SU beamformee.	Set to 0 if not supported. Set to 1 if supported. Set to 1 if sent by a non-AP STA.
MU Beamformer	Indicates support for operation as an MU Beamformer.	Set to 0 if not supported. Set to 0 if the SU Beamformer subfield is 0. Set to 0 if sent by a non-AP STA. Set to 1 if supported. Set to 1 if SU Beamformer subfield is set to 1. Set to 1 if sent by an AP.
Beamformee STS For ≤ 80 MHz	The maximum number of space-time streams that the STA can receive in an HE NDP	If SU beamformee capable, set to maximum number of space-time streams that the STA can receive in an HE NDP minus 1. The minimum value of this field is 3. Otherwise, reserved.
NSTS Total For ≤ 80 MHz	The maximum value for $N_{STS,total}$ that can be sent to the STA in a DL MU-MIMO transmission on full or partial bandwidth	If SU beamformee capable, set to maximum number of total space-time streams that the STA can receive minus 1. The minimum value of this field is 3. Otherwise reserved.

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Table 9-262aa—Subfields of the HE PHY Capabilities Information field

Subfield	Definition	Encoding
Beamformee STS For > 80 MHz	The maximum number of space-time streams that the STA can receive in an HE NDP	If SU beamformee capable, set to maximum number of space-time streams that the STA can receive in an HE NDP minus 1. The minimum value of this field is 3. Otherwise, reserved.
NSTS Total For > 80 MHz	The maximum value for $N_{STS,total}$ that can be sent to the STA in an DL MU-MIMO transmission on full or partial bandwidth	If SU beamformee capable, set to maximum number of total space-time streams that the STA can receive minus 1. The minimum value of this field is 3. Otherwise reserved.
Number Of Sounding Dimensions For ≤ 80 MHz	Beamformer's capability indicating the maximum value of the TXVECTOR parameter NUM_STS for an HE NDP	If SU beamformer capable, set to the maximum supported value of the TXVECTOR parameter NUM_STS minus 1. Otherwise, reserved
Number Of Sounding Dimensions For > 80 MHz	Beamformer's capability indicating the maximum value of the TXVECTOR parameter NUM_STS for an HE NDP	If SU beamformer capable, set to the maximum supported value of the TXVECTOR parameter NUM_STS minus 1. Otherwise, reserved
Ng = 16 For SU Feedback Support	Indicates if the HE beamformee is capable of feedback with tone grouping of 16 in the HE Compressed Beamforming Report field for a SU-type feedback.	Set to 1 if supported. Set to 0 otherwise.
Ng = 16 For MU Feedback Support	Indicates if the HE beamformee is capable of feedback with tone grouping of 16 in the HE Compressed Beamforming Report field for a MU-type feedback	Set to 1 if supported. Set to 0 otherwise.
Codebook Size {4, 2} For SU Support	Indicates if the HE beamformee is capable of feedback with codebook size {4, 2} in the HE Compressed Beamforming Report field for a SU-type feedback.	Set to 1 if supported. Set to 0 otherwise.
Codebook Size {7, 5} For MU Support	Indicates if HE beamformee is capable of feedback with codebook size {7, 5} in the HE Compressed Beamforming Report field for a MU-type feedback.	Set to 1 if supported. Set to 0 otherwise.
Tx Beamforming Feedback With Trigger Frame	If the transmitting STA is an AP STA: B56: indicates support of reception of SU-Type partial and full bandwidth feedback B57: indicates support of reception of MU-Type partial bandwidth feedback B58 indicates support of reception of CQI-Only partial and full bandwidth feedback If the transmitting STA is a non-AP STA: B56: indicates support of transmission of SU-Type partial and full bandwidth feedback B57: indicates support of transmission of MU-Type partial bandwidth feedback B58: indicates support of transmission of CQI-Only partial and full bandwidth feedback	Set B56 to 1 if SU-Type partial and full bandwidth feedback supported by the STA. Set to 0 otherwise. Set B57 to 1 if MU-Type partial bandwidth feedback supported by the STA. Set to 0 otherwise. Set B58 to 1 if CQI-Only partial and full bandwidth feedback supported by the STA. Set to 0 otherwise.
HE ER SU Payload	Indicates the support of transmission and reception of an HE extended range SU PPDU payload transmitted over the right 106-tone RU within primary 20 MHz channel.	Set to 1 if supported by the STA. Otherwise, set to 0.

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Table 9-262aa—Subfields of the HE PHY Capabilities Information field

Subfield	Definition	Encoding
DL MU-MIMO on Partial BW	It indicates non-AP STA supports reception of DL MU-MIMO transmission on an RU in an HE MU PPDU where the RU does not span the entire PPDU bandwidth.	Set to 1 if supported by the non-AP STA. Set to 0 if not supported by non-AP STA. This field is reserved for an AP.
PPE Threshold Present	It indicates if the PPE Threshold field is present or not.	Set to 1 if PPE Threshold field is present. Set to 0, otherwise
SRP-based SR Support	It indicates if the STA supports SRP-based SR operation	Set to 1 if supported. Set to 0 otherwise.
Partial Bandwidth SU Feedback Support	Indicates whether the beamformee is capable of SU-Type feedback over partial BW in the HE Compressed Beamforming Report field(PHY Motion #167)	Set to 1 if supported. Set to 0 otherwise.
Partial Bandwidth MU Feedback Support	Indicates whether the beamformee is capable of MU-Type feedback over partial BW in the HE Compressed Beamforming Report field and HE MU exclusive beamforming Report field(PHY Motion #167)	Set to 1 if supported. Set to 0 otherwise.
CQI Feedback Support	Indicates whether the beamformee is capable of CQI-only feedback with RU start index and RU end index in the HE CQI-only Report field(PHY Motion #167)	Set to 1 if supported. Set to 0 otherwise.

A STA that declares(#1165) support for HE trigger-based PPDUs(#1342) shall also declare whether they belong to class A or class B. Class A STAs (#575)are high capability devices and class(#1345) B STAs are low capability devices.

9.4.2.218.4 Tx Rx HE MCS Support field

(#200)The Tx Rx HE MCS Support field format is defined in Figure 9-589cm (Tx Rx HE MCS Support field format).

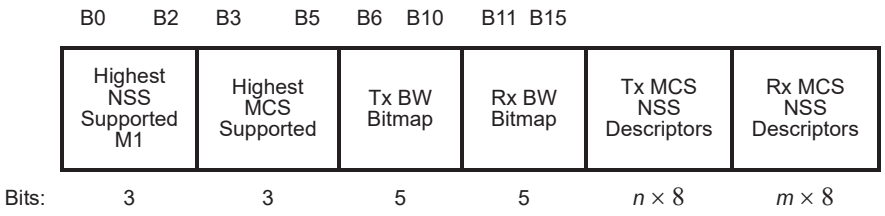

Figure 9-589cm—Tx Rx HE MCS Support field format

The Highest NSS Supported M1 subfield indicates the highest NSS value minus 1, supported by the STA that transmitted this subfield. The Highest NSS Supported M1 value is applicable to both transmissions and receptions but does not necessarily apply to all combinations of PPDU bandwidth and MCS. The PPDU bandwidth and MCS values that do not support the NSS value indicated in this subfield are described in the Tx MCS NSS Descriptors and Rx MCS NSS Descriptors subfields, if present. If no Tx MCS NSS Descriptors subfield is present, then the STA supports transmission of all combinations of PPDU bandwidth identified by the Channel Bandwidth Set field at each NSS and MCS indicated in the Highest NSS Supported M1 and Highest MCS Supported subfields. If no Rx MCS NSS Descriptors subfield is present, then the STA supports reception of all combinations of PPDU bandwidth identified by the Channel

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Bandwidth Set field at each NSS and MCS indicated in the Highest NSS Supported M1 and Highest MCS Supported subfields.

The Highest MCS Supported subfield indicates whether the STA transmitting this subfield supports the optional MCS values of MCS8, MCS9, MCS10, MCS11. The encoding of this field is defined in Table 9-262ab (Highest MCS Supported subfield encoding). The Highest MCS Supported value is applicable to both

Table 9-262ab—Highest MCS Supported subfield encoding

Highest MCS Supported subfield value	Highest supported MCS of the transmitting STA
0	MCS7
1	MCS8
2	MCS9
3	MCS10
4	MCS11
5-7	Reserved

transmissions and receptions but does not necessarily apply to all combinations of PPDU bandwidth and NSS. The PPDU bandwidth and NSS values that do not support the MCS value indicated in this subfield are described in the Tx MCS NSS Descriptors and Rx MCS NSS Descriptors subfields, if present. If no Tx MCS NSS Descriptors subfield is present, then the STA supports transmission of all combinations of PPDU bandwidth identified by the Channel Bandwidth Set field at each NSS and MCS indicated in the Highest NSS Supported M1 and Highest MCS Supported subfields. If no Rx MCS NSS Descriptors subfield is present, then the STA supports reception of all combinations of PPDU bandwidth identified by the Channel Bandwidth Set field at each NSS and MCS indicated in the Highest NSS Supported M1 and Highest MCS Supported subfields.

Each bit of the Tx BW Bitmap indicates whether a set of TX MCS NSS Descriptor field(s) are present for a specific PPDU bandwidth. The bits correspond to the ordered set of PPDU bandwidth values of 20 MHz, 40 MHz, 80 MHz, 80+80 and 160 MHz with the bit in the lowest numbered bit position corresponding to 20 MHz. A bit in the Tx BW Bitmap is set to 1 to indicate that the corresponding Tx MCS NSS Descriptor for that bandwidth is present; otherwise the bit is set to 0.

Each bit of the Rx BW Bitmap indicates whether a set of RX MCS NSS Descriptor field(s) are present for a specific bandwidth of operation. The bits correspond to the ordered set of PPDU values of 20 MHz, 40 MHz, 80 MHz, 80+80 and 160 MHz with the bit in the lowest numbered bit position corresponding to 20 MHz. A bit in the Rx BW Bitmap is set to 1 to indicate that the corresponding Rx MCS NSS Descriptor for that bandwidth is present; otherwise the bit is set to 0.

If all of the bits of the Tx BW Bitmap subfield and all of the bits of the Rx BW Bitmap subfield are zero, then none of the subfields of the Tx Rx HE MCS Support field beyond Highest MCS Supported need to be present. If either the Tx BW Bitmap subfield or the Rx BW Bitmap subfield has at least one bit set to 1, then both the Tx BW Bitmap subfield and the Rx BW Bitmap subfield are present, even if one of these subfields has the value of all zeros.

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Each Tx MCS NSS Descriptor indicates the value of the highest supported NSS for the indicated MCS for a specific bandwidth of operation and for all MCS that are higher than the indicated MCS up to but not including the next MCS in the set for this bandwidth. MCS values that are lower than the lowest specified MCS within a set of Tx MCS NSS Descriptor fields implicitly support transmission of PPDUs using the highest NSS value indicated in the Highest NSS Supported subfield.

Each Rx MCS NSS Descriptor indicates the value of the highest supported NSS for the indicated MCS for a specific bandwidth of operation and for all MCS that are higher than the indicated MCS up to but not including the next MCS in the set for this bandwidth. MCS values that are lower than the lowest specified MCS within a set of Rx MCS NSS Descriptor fields implicitly support reception of PPDUs using the highest NSS value indicated in the Highest NSS Supported subfield.

The Tx MCS NSS Descriptor and Rx MCS NSS Descriptor subfield format is defined in Figure 9-589cn (Tx MCS NSS Descriptor and Rx MCS NSS Descriptor subfield format).

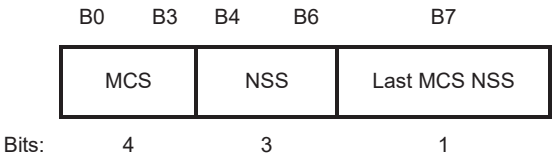

Figure 9-589cn—Tx MCS NSS Descriptor and Rx MCS NSS Descriptor subfield format

The MCS subfield of the Tx MCS NSS Descriptor and Rx MCS NSS Descriptor subfields indicates an MCS value encoded as an unsigned integer.

The NSS subfield of the Tx MCS NSS Descriptor and Rx MCS NSS Descriptor subfields indicates an NSS value encoded as an unsigned integer. The NSS indicated by the field corresponds to the MCS value in the same Tx MCS NSS Descriptor or Rx MCS NSS Descriptor subfield. The value 0 indicates that there is no support for this combination of PPDU bandwidth and this MCS and higher.

The Last MCS NSS subfield indicates the last Tx MCS NSS Descriptor or Rx MCS NSS Descriptor for a set of Tx MCS NSS Descriptors or Rx MCS NSS Descriptors corresponding to a single PPDU bandwidth value. The Last MCS NSS subfield is set to 1 to indicate that the current Tx MCS NSS Descriptor or Rx MCS NSS Descriptor is the last descriptor for the corresponding PPDU bandwidth. Otherwise the subfield is set to 0.

9.4.2.218.5 PPE Thresholds field

(#200)The format of the PPE Thresholds field is defined in Figure 9-589co (PPE Thresholds field format)(#2834).

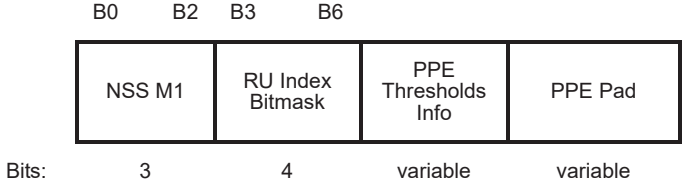

Figure 9-589co—PPE Thresholds field format

The NSS M1 subfield contains an unsigned integer that is equal to the number of NSS values minus one for which PPE threshold values are included in the PPE Thresholds Info field.(#1334)

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The RU Index Bitmask subfield contains a bitmask that indicates whether PPE threshold values are present for each of four RU allocation sizes according to their RU Allocation Index values. For example, when B3 is set to 1, PPE threshold values are present for the RU allocation corresponding to RU allocation index 0 and when B3 is set to 0, PPE threshold values are not present for the RU allocation corresponding to RU allocation index 0.

The PPE Thresholds Info field is (NSS M1 + 1) × Number of bits set to 1 in the RU Index Bitmask subfield × 6 bits(#1337) in length. The format of the PPE Thresholds Info field is defined in Figure 9-589cp (PPE Thresholds Info field format)(#2835).

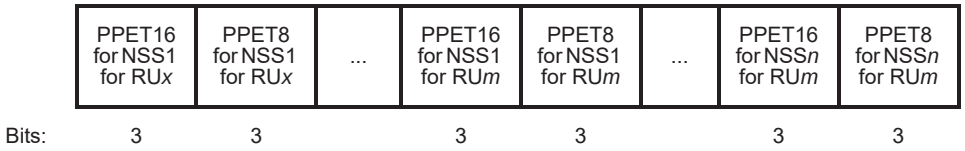

Figure 9-589cp—PPE Thresholds Info field format

PPE threshold values appear in increasing NSS value and increasing RU index value order, where lower-numbered PPE Thresholds Info field bits contain PPE threshold values corresponding to lower numbered NSS values and within a set of PPE Threshold subfields corresponding to a single value of NSS, lower-numbered PPE Thresholds Info field bits contain PPE threshold values corresponding to lower numbered RU index values. Subfields PPET16 for NSSn for RUb and PPET8 for NSSn for RUb are present for all values of n and b where:

$1 \le n \le (\text{NSS M1} + 1)$

$b = [x, \ldots, m]$

where $[x, \ldots, m]$ is the set of integers equal to the ordered list of bit positions of all bits that are set to 1 in the RU Index Bitmask subfield, with x being the lowest value.

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Each PPET8 for NSS*n* for RU*b* subfield and PPET16 for NSS*n* for RU*b* subfield contains an integer that corresponds to a constellation index value related to the transmission constellation of an HE PPDU as defined in Table 9-262ac (Constellation index).(#1349)(#619).

Table 9-262ac—Constellation index

Constellation Index	Corresponding Transmission Constellation
0	BPSK
1	QPSK
2	16-QAM
3	64-QAM
4	256-QAM
5	1024-QAM
6	Reserved
7	None

The PPET8 for NSS*n* for RU*b* subfield and PPET16 for NSS*n* for RU*b* subfield values are combined to determine the Maximum PE value for HE PPDUs that are transmitted to the STA sending this field and using NSS = *n* and an RU allocation corresponding to RU Allocation Index *b*, for each value of NSS and RU specified by the field. For all values of n and b for which PPET8 and PPET16 are not present, the Maximum PE value is 0 for HE PPDUs that are transmitted to the STA using NSS = *n* and an RU allocation corresponding to RU Allocation Index *b*. The value for each PPET8 for NSS*n* for RU*m* is always less than

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the value of PPET16 for NSS*n* for RU*m*. The encoding is described in Table 9-262ad (PPET8 and PPET16 encoding).

Table 9-262ad—PPET8 and PPET16 encoding

Result of comparison of the constellation index *x* of an HE PPDU with NSS value *n* and RU value Allocation size that corresponds to the RU Allocation index = (*b* + DCM) to the value in the PPET8 for NSS*n* for RU*m* subfield	Result of comparison of the constellation index of an HE PPDU with NSS value *n* and RU value Allocation size that corresponds to the RU Allocation index = value (*b* + DCM) to the value in the PPET16 for NSS*n* for RU*m* subfield	Maximum PE value for an HE PPDU transmitted to this STA using the constellation index = *x*, NSS = *n* and RU Allocation size that corresponds to the RU Allocation index = (*b* + DCM)
x greater than or equal to PPET8	*x* less than PPET16 or PPET16 equal to None	8 µs
x > PPET8 or PPET8 = None	*x* > PPET16	16 µs
All other combinations not otherwise listed in this table		0
NOTE—DCM = 1 when the HE PPDU uses DCM; DCM = 0 otherwise.		

The RU Allocation Index encoding is indicated in Table 9-262ae (RU Allocation Index encoding).

Table 9-262ae—RU Allocation Index encoding

RU Allocation Index value	RU allocation size
0	242
1	484
2	996
3	2×996(#1337)

The PPE Pad field contains all zeros. The number of bits in the PPE Pad field is the number of bits required to round the length of the PPE Thresholds Info field up to the next integer number(#1895) of octets.

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9.4.2.219 HE Operation element

The operation of HE STAs in an HE BSS is controlled by the HT Operation element, the VHT Operation element and the HE Operation element. The format of the HE Operation element is defined in Figure 9-589cq (HE Operation element format).

	Element ID	Length	HE Operation Parameters	Basic HE MCS And NSS Set
Octets:	1	1	4(#Ed)	2(#667)

Figure 9-589cq—HE Operation element format

The Element ID and Length fields are defined in 9.4.2.1 (General).

The format of the HE Operation Parameters field is defined in Figure 9-589cr (HE Operation Parameters(#1350) field format).

	B0 B5	B6 B8	B9	B10 B19	B20	B21 B31
	BSS Color	Default PE Duration	TWT Required	HE Duration Based RTS Threshold	Partial BSS Color	Reserved
Bits:	6(#244)	3(#1)	1(#667)	10(#576)	1	11(#Ed)

Figure 9-589cr—HE Operation Parameters(#1350) field format

The BSS Color field is an unsigned integer whose value is the BSS color(#1165) of the BSS corresponding to the AP which transmitted this element, except that a value of 0 in this field indicates that there is no BSS color(#1165) for this BSS.

The BSS Color field is an unsigned integer whose value is the BSS Color of the BSS corresponding to the AP, IBSS STA, mesh STA or TDLS STA that transmitted this element, except that a value of 0 in this field is used if one or more intended recipient STAs of an HE PPDU is not a member of a transmitting STA's BSS.(#73)

The Default PE Duration subfield indicates the PE duration in units of 4 μs, for an HE trigger-based PPDU that is solicited with UL MU Response Scheduling in the A-Control subfield. Values 5-7 of the Default PE Duration subfield are reserved.(#1)

The TWT Required subfield is set to 1 to indicate that the AP requires the non-AP HE STAs to operate in the role of either TWT requesting STA, as described 25.7.2 (Individual TWT agreements(#1214)), or TWT scheduled STA, as described in 25.7.3 (Broadcast TWT operation(#1779)(#1874)(#1214)) and set to 0 otherwise.(#1640)

(#576)The HE Duration Based RTS Threshold field allows an HE AP to manage RTS/CTS usage by the associated HE STAs. The value is specified as an unsigned integer, in units of 32 μs. The value 0 indicates that RTS/CTS must be used for all the data transmit sequences. The value 1023 indicates that this feature is disabled.

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The Partial BSS Color field indicates whether or not the BSS applies an AID assignment rule using the partial BSS color bits. If the Partial BSS Color field is set to 1, then the 4 least significant bits of BSS color are used in AID assignment. If the Partial BSS Color field is set to 0, no partial BSS color bits are used in the AID assignment.(MAC Motion #88)

(#667)The Basic HE MCS And NSS Set field indicates the HE-MCSs for each number of spatial streams in HE PPDUs that are supported by all HE STAs in the BSS (including IBSS and MBSS). The Basic HE MCS And NSS Set field is a bitmap of size 16 bits. Each 2 bit pair in the bitmap(#Ed) indicates the supported HE-MCS set for NSS from 1 to 8. The Basic HE-MCS And NSS Set field is defined in Figure 9-589cs (Basic HE-MCS And NSS Set field format).

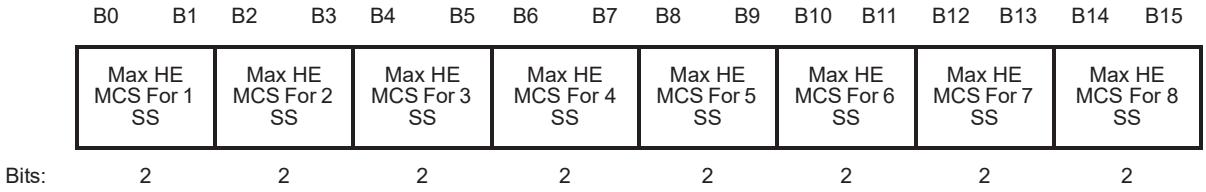

Figure 9-589cs—Basic HE-MCS And NSS Set field format

9.4.2.220 OFDMA-based Random Access Parameter Set (RAPS) element(#450)

The metrics of the OFDMA-based random access mechanism (see 25.5.2.6 (UL OFDMA-based random access)) are signaled in the RAPS element. The format of the RAPS element is defined in Figure 9-589ct (RAPS element format).

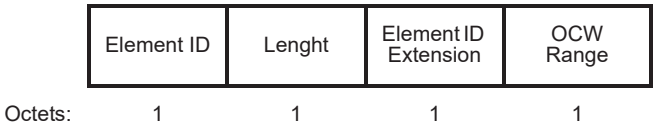

Figure 9-589ct—RAPS element format

The Element ID, Length, Element ID Extension fields are defined in 9.4.2.1 (General).

The OCW Range field indicates the minimum and maximum values of the OCW (OFDMA contention window) derived from the fields defined in Figure 9-589cu (OCW Range field format).

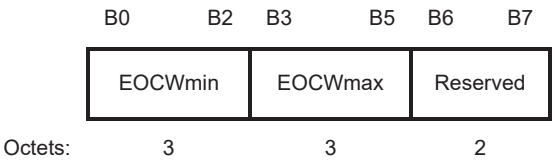

Figure 9-589cu—OCW Range field format

The EOCWmin field indicates the minimum value of OCW for the initial HE trigger-based PPDU transmission using UL OFDMA-based random access. The OCWmin parameter is used by a STA either for an initial transmission or following a successful HE trigger-based PPDU transmission and is derived from the value in the EOCWmin field as

$$OCWmin = 2^{EOCWmin} - 1$$

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The EOCW_max field indicates the maximum value of OCW for UL OFDMA-based random access. The OCW_max parameter used by a STA for its retransmission attempts of UL OFDMA-based random access is derived from the value in the EOCWmax field as

$$OCWmax = 2^{EOCWmax} - 1$$

9.4.2.221 MU EDCA Parameter Set element

(MAC Motion #91)The MU EDCA Parameter Set element provides information needed by non-AP STAs that are UL MU capable for proper operation of the QoS facility during the CP. The format of the MU EDCA Parameter Set element is defined in Figure 9-589cv (MU EDCA Parameter Set element).

	Element ID	Length	Element ID Extension	MU QoS Info	MU EDCA Timer	MU AC_BE Parameter Record	MU AC_BK Parameter Record	MU AC_VI Parameter Record	MU AC_VO Parameter Record
Octets:	1	1	1	1	1	2	2	2	2

Figure 9-589cv—MU EDCA Parameter Set element

The Element ID, Length, and Element ID Extension fields are defined in 9.4.2.1 (General).

For an infrastructure BSS, the MU EDCA Parameter Set element is used by the AP to establish policy (by changing default MIB attribute values), to change policies when accepting new STAs or new traffic, or to adapt to changes in offered load. The most recent MU EDCA Parameter Set element received by a STA is used to update the appropriate MIB values.

The format of the MU QoS Info field is the same as the field defined in 9.4.1.17 (QoS Info field). The MU QoS Info field contains the EDCA Parameter Set Update Count subfield, which is initially set to 0 and is incremented each time any of the MU AC parameters changes. This subfield is used by non-AP STAs to determine whether the MU EDCA parameter set has changed and requires updating the appropriate MIB attributes.

The MU EDCA Timer indicates the duration of time, in units of 8 TUs, for which the provided MU EDCA parameters are used by an HE STA after reception of a basic variant Trigger frame.

The formats of MU AC_BE, MU AC_BK, MU AC_VI, and MU AC_VO Parameters fields are identical and are illustrated in Figure 9-589cw (MU AC Parameter Record field format).

	ACI/AIFSN	ECWmin/ ECWmax
Octets:	1	1

Figure 9-589cw—MU AC Parameter Record field format

The format of the ACI/AIFSN field is illustrated in Figure 9-262 (ACI/AIFSN field) and the encoding of its subfields is as defined in 9.4.2.29 (EDCA Parameter Set element), except that a value 0 of the AIFSN field indicates that the AIFS is equal to the value of the MU EDCA Timer.

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The format of the ECWmin/ECWmax field is illustrated in Figure 9-263 (ECWmin and ECWmax fields) and the encoding of its subfields is as defined in 9.4.2.29 (EDCA Parameter Set element).

9.6 Action frame format details

9.6.4 DLS Action frame details

9.6.4.2 DLS Request frame format

(#1352)Insert the following new rows (header row shown for convenience) into Table 9-299 (DLS Request frame Action field format) after the row for Order 11:

Table 9-299—DLS Request frame Action field format

Order	Information	Notes
12	HE Capabilities	The HE Capabilities element is present when dot11HEOption-Implemented is true; otherwise it is not present.
13	HE Operation	The HE Operation element is present when dot11HEOptionImplemented is true; otherwise it is not present.

9.6.4.3 DLS Response frame format

(#1352)Insert the following new row (header row shown for convenience) into Table 9-300 (DLS Response frame Action field format) after the row for Order 11:

Table 9-300—DLS Response frame Action field format

Order	Information	Notes
12	HE Capabilities	The HE Capabilities element is present when dot11HEOption-Implemented is true; otherwise it is not present.

9.6.5 Block Ack Action frame details

9.6.5.1 General

(#2268)Change Table 9-302 (Block Ack Action field values) as follows:

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Table 9-302—Block Ack Action field values

Block Ack Action field values	Meaning
0	ADDBA Request
1	ADDBA Response
2	DELBA
3	L3 FRAG ADDBA Request
4	L3 FRAG ADDBA Response
5	L3 FRAG DELBA
~~3~~6–255	Reserved

9.6.8 Public Action details

9.6.8.16 TDLS Discovery Response frame format

(#1352)Insert the following new rows (header row shown for convenience) into Table 9-317 (TDLS Discovery Response Action field format) after the row for Order 17:

Table 9-317—TDLS Discovery Response Action field format

Order	Information	Notes
18	HE Capabilities	The HE Capabilities element is present when dot11HEOption-Implemented is true; otherwise it is not present, The HE Capabilities element is defined in 9.4.2.218 (HE Capabilities element)

9.6.13 TDLS Action field formats

9.6.13.2 TDLS Setup Request Action field format

(#1352)Insert the following new rows (header row shown for convenience) into Table 9-343 (Information for TDLS Setup Request Action field) after the row for Order 20:

Table 9-343—Information for TDLS Setup Request Action field

Order	Information	Notes
21	HE Capabilities	The HE Capabilities element is present when dot11HEOption-Implemented is true; otherwise it is not present. The HE Capabilities element is defined in 9.4.2.218 (HE Capabilities element)

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9.6.13.3 TDLS Setup Request Action field format

(#1352)Insert the following new row (header row shown for convenience) into Table 9-344 (Information for TDLS Setup Response Action field) after the row for Order 22:

Table 9-344—Information for TDLS Setup Response Action field

Order	Information	Notes
23	HE Capabilities	The HE Capabilities element is present when dot11HEOptionImplemented is true and the Status Code is SUCCESS; otherwise it is not present. The HE Capabilities element is defined in 9.4.2.218 (HE Capabilities element)

9.6.13.4 TDLS Setup Confirm Action field format

(#1352)Insert the following new row (header row shown for convenience) into Table 9-345 (Information for TDLS Setup Confirm Action field) after the row for Order 12:

Table 9-345—Information for TDLS Setup Confirm Action field

Order	Information	Notes
13	HE Operation	The HE Operation element is present when dot11HEOptionImplemented is true, the TDLS Setup Response frame contained an HE Capabilities element and the Status Code is SUCCESS; otherwise it is not present. The HE Operation element is defined in 9.4.2.219 (HE Operation element).

9.6.16 Self-protected Action frame details

9.6.16.2 Mesh Peering Open frame format

9.6.16.2.2 Mesh Peering Open frame details

(#1352)Insert the following new row (header row shown for convenience) into Table 9-365 (Mesh Peering Open frame Action field format) after the row for Order 21:

Table 9-365—Mesh Peering Open frame Action field format

Order	Information	Notes
22	HE Capabilities	The HE Capabilities element is present when dot11HEOptionImplemented is true; otherwise it is not present.
13	HE Operation	The HE Operation element is present when dot11HEOptionImplemented is true; otherwise it is not present.

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9.6.16.3 Mesh Peering Confirm frame format

9.6.16.3.2 Mesh Peering Confirm frame details

(#1352)Insert the following new row (header row shown for convenience) into Table 9-366 (Mesh Peering Open frame Action field format) after the row for Order 17:

Table 9-366—Mesh Peering Open frame Action field format

Order	Information	Notes
18	HE Capabilities	The HE Capabilities element is present when dot11HEOption-Implemented is true; otherwise it is not present.
19	HE Operation	The HE Operation element is present when dot11HEOptionImplemented is true; otherwise it is not present.

9.6.28 HE Action frame details

9.6.28.1 HE Action field

A HE Action field, in the octet immediately after the Category field, differentiates the HE Action frame formats. The HE Action field values associated with each frame format within the HE category are defined in Table 9-421z (HE Action field values).

Table 9-421z—HE Action field values

Value	Meaning
0	HE Compressed Beamforming And CQI
1-255	Reserved

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9.6.28.2 HE Compressed Beamforming And CQI frame format

The HE Compressed Beamforming And CQI frame is an Action No Ack frame of category HE. The Action field of a HE Compressed Beamforming And CQI frame contains the information shown in Table 9-421aa (HE Compressed Beamforming And CQI frame Action field format) .

Table 9-421aa—HE Compressed Beamforming And CQI frame Action field format

Order	Information
1	Category
2	HE Action
3	HE MIMO Control
4	HE Compressed Beamforming Report (see 9.4.1.63 (HE Compressed Beamforming Report field))
5	HE MU Exclusive Beamforming Report (see 9.4.1.64 (HE MU Exclusive Beamforming Report field))
6	HE CQI-only Report (see 9.4.1.65 (HE CQI-only Report field))

The Category field is defined in Table 9-47 (Category values).

The HE Action field is defined in Table 9-421z (HE Action field values).

The HE MIMO Control field is always present in the frame. The presence and contents of the HE Compressed Beamforming Report field, HE MU Exclusive Beamforming Report field and HE CQI-only Report field are dependent on the values of Feedback Type subfield of HE MIMO Control field.

No vendor-specific elements are present in HE Compressed Beamforming and CQI frame.

9.7 Aggregate MPDU (A-MPDU)

9.7.1 A-MPDU format

Change the 4th paragraph as follows:

The EOF Padding field is shown in Figure 9-739 (EOF Padding field format). This is present only in a VHT or HE PPDU.(#2481)

Change the 6th and subsequent paragraphs as follows:

In a VHT or HE PPDU(#2482), the following padding is present, as determined by the rules in 10.13.6 (A-MPDU padding for VHT PPDU):

— 0–3 octets in the Padding subfield of the final A-MPDU subframe (see Figure 9-740 (A-MPDU subframe format)) before any EOF padding subframes. The content of these octets is unspecified.

— Zero or more EOF padding subframes in the EOF Padding Subframes subfield.

— 0–3 octets in the EOF Padding Octets subfield. The content of these octets is unspecified.

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An A-MPDU pre-EOF padding refers to the contents of the A-MPDU up to, but not including, the EOF Padding field.

NOTE—A-MPDU pre-EOF padding includes any A-MPDU subframes with 0 in the MPDU Length field and 0 in the EOF field inserted in order to meet the minimum MPDU start spacing requirement.

The maximum length of an A-MPDU in an HT PPDU is 65 535 octets. The maximum length of an A-MPDU in a DMG PPDU is 262 143 octets. The maximum length of an A-MPDU pre-EOF padding in a VHT PPDU is 1 048 575 octets. (#2258)The maximum length of an A-MPDU pre-EOF padding in a HE PPDU is 4 194 303 octets. The length of an A-MPDU addressed to a particular STA can be further constrained as described in 10.13.2 (A-MPDU length limit rules).

Change Table 9-422 as follows:

Table 9-422— MPDU delimiter fields (non-DMG)

Field	Size (bits)	Description
EOF	1	End of frame indication. Set to 1 in an A-MPDU subframe that has 0 in the MPDU Length field and that is used to pad the A-MPDU in a VHT or HE PPDU(#2483) as described in 10.13.6 (A-MPDU padding for VHT PPDU). Set to 1 in the MPDU delimiter of a VHT single MPDU as described in 10.13.7 (Setting the EOF field of the MPDU delimiter). Set to 0 otherwise.
Reserved	1	
MPDU Length	14	Length of the MPDU in octets. Set to 0 if no MPDU is present. An A-MPDU subframe with 0 in the MPDU Length field is used as defined in 10.13.3 (Minimum MPDU Start Spacing field) to meet the minimum MPDU start spacing requirement and also to pad the A-MPDU to fill the available octets in a VHT or HE PPDU(#2484) as defined in 10.13.6 (A-MPDU padding for VHT PPDU).
CRC	8	8-bit CRC of the preceding 16 bits.
Delimiter Signature	8	Pattern that may be used to detect an MPDU delimiter when scanning for an MPDU delimiter. The unique pattern is 0x4E (see NOTE below).
NOTE—The ASCII value of the character 'N' was chosen as the unique pattern for the value in the Delimiter Signature field.		

Change the 12th and 13th paragraph as follows:

The format of the MPDU Length field when transmitted by a non-DMG STA is shown in Figure 9-743. The MPDU Length Low subfield contains the 12 low order bits of the MPDU length. In a VHT or HE PPDU, the MPDU Length High subfield contains the two high order bits of the MPDU length. In an HT PPDU, the MPDU Length High subfield is reserved.

The MPDU length value is derived from the MPDU Length field subfields as follows:

$$L_{MPDU} = \begin{cases} L_{low} + L_{high} \times 4096, & \text{VHT PPDU} \\ L_{low}, & \text{HT PPDU} \\ L, & \text{DMG PPDU} \end{cases} \quad (9\text{-}5)$$

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where

L_{low} is the value of the MPDU Length Low subfield

L_{high} is the value of the MPDU Length High subfield

L is the value of the MPDU Length field

NOTE—The format of the MPDU Length field maintains a common encoding structure for ~~both~~ HE, VHT and HT PPDUs. For HT PPDUs, only the MPDU Length Low subfield is used, while for VHT PPDUs, both subfields are used.

9.7.3 A-MPDU contents

Change the 1st paragraph of this subclause as follows:

In a non-DMG PPDU, an A-MPDU is a sequence of A-MPDU subframes carried in a single PPDU with one of the following combinations of RXVECTOR or TXVECTOR parameter values:

- The FORMAT parameter set to VHT
- The FORMAT parameter set to HT_MF or HT_GF and the AGGREGATION parameter set to 1
- The FORMAT parameter set to S1G, S1G_DUP_1M, or S1G_DUP_2M and the AGGREGATION parameter set to 1(11ah)
- The FORMAT parameter set to HE_SU, HE_MU, HE_TRIG or HE_EXT

Insert the following paragraph:

An A-MPDU carried in an(#2829) HE MU PPDU may include MPDUs with different values of the TID field. Additional rules are TBD.

(#2429)Change the 5th paragraph as follows:

The Duration/ID fields in the MAC headers of all MPDUs in an A-MPDU carry the same value. The Duration/ID fields in the MAC headers of MPDUs in A-MPDUs carried in the same VHT MU PPDU, the same HE MU PPDU or all HE trigger-based PPDUs addressed to the same AP ~~all~~ carry the same value.

NOTE 1—The reference point for the Duration/ID field is the end of the PPDU carrying the MPDU. Setting the Duration/ID field to the same value in the case of A-MPDU aggregation means that each MPDU consistently specifies the same NAV setting.

Change the 7th and 8th paragraph as follows:

(#805)An A-MPDU is transmitted in one of the contexts specified in Table 9-424 (A-MPDU contexts) as defined by the description in the "Definition of context" column~~, independently of whether the A-MPDU is contained in a VHT MU PPDU or an SU PPDU~~. The further restrictions of A-MPDU content are defined in the conditions of various contexts. Ordering of MPDUs within an A-MPDU is not constrained, except where noted in these tables. See 10.13.1 (A-MPDU contents).

(#2430)A VHT MU PPDU does not carry more than one A-MPDU that contains one or more MPDUs soliciting an immediate response. An HE MU PPDU does not carry more than one A-MPDU that contains one or more MPDUs soliciting an immediate response that is not carried in an HE trigger-based PPDU.

NOTE 2—The TIDs present in a data enabled A-MPDU context are also constrained by the channel access rules (for a TXOP holder; see 10.22.2 (HCF contention based channel access (EDCA)) and 10.22.3 (HCF controlled channel access (HCCA))) and the RD response rules (for an RD responder, see 10.28.4 (Rules for RD responder)). This is not shown in these tables.

NOTE 3—If a STA supports A-MSDUs of 7935 octets (indicated by the Maximum A-MSDU Length field in the HT Capabilities element), A-MSDUs transmitted by that STA within an A-MPDU carried in a PPDU with FORMAT HT_MF or HT_GF are constrained so that the length of the QoS Data frame carrying the A-MSDU is no more than 4095

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octets. The 4095-octet MPDU length limit does not apply to A-MPDUs carried in VHT or DMG PPDUs. The use of A-MSDU within A-MPDU might be further constrained as described in 9.4.1.14 (Block Ack Parameter Set field) through the operation of the A-MSDU Supported field.

(#805)Change Table 9-424 (A-MPDU Contexts) as follows:

Table 9-424—A-MPDU Contexts

Name of Context	Definition of Context	Table defining permitted contents
Data Enabled Immediate Response	The A-MPDU is transmitted outside a PSMP sequence by a TXOP holder, TXOP responder or an RD responder including potential immediate responses.	Table 9-425 (A-MPDU contents in the data enabled immediate response context)
Data Enabled No Immediate Response	The A-MPDU is transmitted outside a PSMP sequence by a TXOP holder, TXOP responder that does not include or solicit an immediate response. See NOTE.	Table 9-426 (A-MPDU contents in the data enabled no immediate response context)
PSMP	The A-MPDU is transmitted within a PSMP sequence.	Table 9-427 (A-MPDU contents in the PSMP context)
Control Response	The A-MPDU is transmitted by a STA that is neither a TXOP holder nor an RD responder or the A-MPDU is transmitted by AP in an HE BSS that also needs to transmit one of the following immediate response frames: Ack BlockAck frame with a TID for which an HT-immediate block ack agreement exists Multi-STA BA for acknowledging multi-TID A-MPDU	Table 9-428 (A-MPDU contents MPDUs in the control response context)
S-MPDU(11ah) context	The A-MPDU is transmitted within a VHT PPDU or a HE PPDU and contains an S-MPDU(11ah).	Table 9-429 (A-MPDU contents in the VHT single MPDU context)

NOTE—This context includes cases when no response is generated or when a response is generated later by the operation of the delayed block ack rules.

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(#805)Change Table 9-425 (A-MPDU contents in the data enabled immediate response context) as follows:

Table 9-425—A-MPDU contents in the data enabled immediate response context

MPDU Description	Conditions	
Ack	If the preceding PPDU contains an MPDU that requires an Ack frame response, a single Ack frame at the start of the A-MPDU.	In a non-DMG STA other than an HE STA: at most one of ~~these~~ Ack and HT-immediate BlockAck MPDUs is present. In an HE STA: at most one of these MPDUs is present. In a DMG STA: at most one Ack frame is present, and zero or more HT-immediate BlockAck frames are present.
HT-immediate BlockAck	In a non-DMG STA: if the preceding PPDU contains an implicit or explicit block ack request for a TID for which an HT-immediate block ack agreement exists, at most one BlockAck frame for this TID, in which case it occurs at the start of the A-MPDU. In a DMG STA: if the preceding PPDU contains an implicit or explicit block ack request for a TID for which an HT-immediate block ack agreement exists, one or more copies of the same BlockAck for this TID.	
Multi-STA BlockAck(#Ed)	In an HE STA: If the preceding PPDU that carried a multiple-TID A-MPDU contains implicit or explicit block ack requests for multiple TIDs for which HT-immediate block ack agreement exist, at most one Multi-STA BA frame, in which case it occurs at the start of the A-MPDU.	
Delayed BlockAcks	BlockAck frames with the BA Ack Policy subfield equal to No Acknowledgment with a TID for which an HT-delayed block ack agreement exists.	
Delayed block ack data	QoS Data frames with a TID that corresponds to a Delayed or HT-delayed block ack agreement. These have the Ack Policy field equal to Block Ack.	
Action No Ack	Action No Ack frames.	
Delayed BlockAckReqs	BlockAckReq frames with a TID that corresponds to an HT-delayed block ack agreement in which the BA Ack Policy subfield is equal to No Acknowledgment.	

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Table 9-425—A-MPDU contents in the data enabled immediate response context *(continued)*

MPDU Description	Conditions	
Data frames without HT-immediate block ack agreement	QoS Data frames with multiple TIDs which have no HT-immediate block ack agreement See NOTE 1.	Of these, at most one of the following is present in a non-DMG BSS except HE BSS: — One or more QoS Data frames with the Ack Policy field equal to Implicit Block Ack Request — A BlockAckReq frame Of these, at most one of the following is present in a DMG BSS: — One or more QoS Data frames with the Ack Policy field equal to Implicit Block Ack Request — QoS Null MPDU with Ack Policy set to No Ack — A BlockAckReq frame with an optional QoS Null MPDU with Ack Policy set to No Ack Of these, at most one of the following is present between two HE STAs: — One or more QoS Data frames from multiple TIDs with the Ack Policy field equal to Implicit Block Ack Request/MU Ack/ AckRequest, at most one Action, optional QoS Null with Ack Policy set to No Ack, Trigger frame only when AP transmits the A-MPDU — QoS Null MPDU with Ack Policy set to No Ack — One of BolckAckReq and Multi-TID BlockAckReq frame — Trigger frame only when AP transmits the A-MPDU
Data frames sent under an HT-immediate block ack agreement	QoS Data frames with the same TID, which corresponds to an HT-immediate block ack agreement. QoS Data frames with multiple TIDs, which correspond to multiple HT-immediate block ack agreements. See NOTE 1.	
QoS Null MPDUs with Ack Policy set to No Ack	In a DMG BSS, QoS Null MPDUs with Ack Policy set to No Ack. In a HE BSS, QoS Null MPDUs with Ack Policy set to No Ack.	
Immediate BlockAckReq	At most one BlockAckReq frame with a TID that corresponds to an HT-immediate block ack agreement. This is the last MPDU in the A-MPDU. It is not present if any QoS Data frames for that TID are present. At most one of the following cases: — Multi-TID BlockAckReq frame with TIDs that correspond to an HT-immediate block ack agreement. This is after data and management frames in the A-MPDU. — This is the last MPDU in the A-MPDU	
Action	At most one Action frame	
Trigger	One or more Trigger Type is Basic Trigger, MU-BAR, BSRP. See NOTE 2	

NOTE 1— ~~These~~ The MPDUs from the same TID all have the Ack Policy field equal to the same value, which is either Implicit Block Ack Request (Ack Request), MU Ack or Block Ack.
NOTE 2—An AP including a Trigger frame and BlockAck frame is not required to include QoS Data in that A-MPDU

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(#805)Change Table 9-426 (A-MPDU contents in the data enabled no immediate response context) as follows:

Table 9-426—A-MPDU contents in the data enabled no immediate response context

MPDU Description	Conditions
Delayed BlockAcks	BlockAck frames for a TID for which an HT-delayed block ack agreement exists with the BA Ack Policy subfield equal to No Acknowledgment.
Delayed Block Ack data	QoS Data frames with a TID that corresponds to a Delayed or HT-delayed block ack agreement. These have the Ack Policy field equal to Block Ack.
Data without a block ack agreement	QoS Data frames with a TID that does not correspond to a block ack agreement. These have the Ack Policy field equal to No Ack and the A-MSDU Present subfield equal to 0.
Action No Ack	Action No Ack frames.
Delayed BlockAckReqs	BlockAckReq frames with the BA Ack Policy subfield equal to No Acknowledgment and with a TID that corresponds to an HT-delayed block ack agreement.
Trigger	One or more Trigger frames where the Trigger Type field is Basic Trigger, MU-BAR, BSRP when AP transmits the A-MPDU. See NOTE 1.
NOTE 1—An AP including Trigger frame and BlockAck is not required to include QoS Data in that A-MPDU.	

(#805)Change Table 9-428 (A-MPDU contents MPDUs in the control response context) as follows:

Table 9-428—A-MPDU contents MPDUs in the control response context

MPDU	Conditions	
Ack	Ack frame transmitted in response to an MPDU that requires an Ack frame.	One Ack and BlockAck frame is present at the start of the A-MPDU in a BSS that is not an HE BSS. One of these is present at the start of the A-MPDU between two HE STAs.
BlockAck	BlockAck frame with a TID that corresponds to an HT-immediate block ack agreement.	
Multi-STA BlockAck	If the preceding PPDU that carried multi-TID A-MPDU contains implicit or explicit block ack requests for multiple TIDs for which HT-immediate block ack agreement exist, at most one Multi-STA BlockAck frame.	
Action No Ack	+HTC Action No Ack frames carrying a Management Action Body containing an explicit feedback response or BRP frame.	

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10. MAC sublayer functional description

10.2 MAC architecture

10.2.4 Hybrid coordination function (HCF)

10.2.4.2 HCF contention based channel access (EDCA)

Insert the following after the 4th paragraph (the 4th paragraph begins "The QoS AP shall announce the EDCA parameters..."):

(MAC Motion #91)In addition, an HE AP may temporarily change the EDCA access parameters for HE non-AP STAs that are UL MU capable, by including an MU EDCA Parameter Set element in the Beacon frame, Probe Response frame, and (Re-)Association Response frame. An HE non-AP STA that receives an MU EDCA Parameter Set element from its associated AP follows the rules defined in 25.2.3 (Obtaining an EDCA TxOP for UL MU capable STAs).

10.3 DCF

10.3.1 General

Change the 6th paragraph as follows:

The virtual CS mechanism is achieved by distributing reservation information announcing the impending use of the medium. The exchange of RTS and CTS frames prior to the actual Data frame is one means of distribution of this medium reservation information. The RTS and CTS frames contain a Duration field that defines the period of time that the medium is to be reserved to transmit the actual Data frame and the returning Ack frame. A STA receiving either the RTS frame (sent by the originating STA) or the CTS frame (sent by the destination STA) shall process the medium reservation. Thus, a STA might be unable to receive from the originating STA and yet still know about the impending use of the medium to transmit a Data frame. The exchange of MU-RTS and simultaneous CTS responses by HE STAs prior to the actual Data frames (#1389)is another(#396) means of distribution of this medium reservation information.

(#576)Change the 12th paragraph as follows:

~~The~~ When HE duration-based RTS is disabled, the use of the RTS/CTS mechanism is under control of dot11RTSThreshold. This attribute may be set on a per-STA basis. This mechanism allows STAs to be configured to initiate RTS/CTS either always, never, or only on frames longer than a specified length.

When HE duration-based RTS is enabled, the use of the RTS/CTS mechanism is under control of dot11DurationRTSThreshold. This mechanism requires STAs to initiate RTS/CTS when TXOP is longer than dot11DurationRTSThreshold.

NOTE 1—A STA configured not to initiate the RTS/CTS mechanism updates its virtual CS mechanism with the duration information contained in a received RTS or CTS frame, and responds to an RTS frame addressed to it with a CTS frame if permitted by medium access rules.

10.3.2 Procedures common to the DCF and EDCAF

10.3.2.1 CS mechanism

Change the 3rd and 4th paragraph of the subclause as follows:

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A first(11ah) virtual CS mechanism shall be provided by all MAC entities, and an additional second virtual CS mechanism shall be provided by an S1G MAC entity(11ah). The first mechanism is referred to as the NAV. The NAV maintains a prediction of future traffic on the medium based on duration information that is announced in RTS/CTS frames by non-DMG STAs, MU-RTS/CTS by HE STAs as defined in 10.3.2.8a, and RTS/DMG CTS frames by DMG STAs prior to the actual exchange of data. The duration information is also available in the MAC headers of all frames sent during the CP other than PV1 MAC frames and PS-Poll frames and during the BTI, the A-BFT, the ATI, the CBAP, and the SP. The duration information may also be available in the RXVECTOR parameter TXOP_DURATION when an HE PPDU is received(#Ed).(#2596)

The CS mechanism combines the NAV state and the STA's transmitter status with physical CS to determine the busy/idle state of the medium. The NAV may be thought of as a counter, which counts down to 0 at a uniform rate. When the counter is 0, the virtual CS indication is that the medium is idle; when the counter is nonzero, the indication is busy. The virtual CS indication of medium for HE STAs with two NAVs is described in 25.2.2 (Updating two NAVs).(#1775) If a DMG STA supports multiple NAVs as defined in 10.36.10 (Updating multiple NAV) and all counters are 0, the virtual CS indication is that the medium is idle; when at least one of the counters is nonzero, the indication is busy. The medium shall be determined to be busy when the STA is transmitting.

10.3.2.3 IFS

10.3.2.3.7 EIFS

Change the 2nd paragraph of 10.3.2.3.7 as follows:

EIFS shall not be invoked if the NAV is updated by the frame that would have caused an EIFS. EIFS shall not be invoked for an A-MPDU if one or more of its frames are received correctly. EIFS shall not be invoked if a valid TXOP_DURATION parameter is present in the RXVECTOR of a received HE PPDU.(#162)

10.3.2.4 Setting and resetting the NAV

Change the 1st four paragraph as follows (the 2nd paragraph is broken into three paragraphs):

This subclause describes the setting and resetting of the NAV for non-DMG STAs and DMG STAs that support a single NAV. DMG STAs that support multiple NAVs shall update their NAVs according to the procedures described in 10.36.10 (Updating multiple NAV). HE STAs with two NAV timers shall update their NAV timers according to the procedures described in 25.2.2 (Updating two NAVs).(#1775)

A STA that receives at least one valid frame in a PSDU can update its NAV with the information from any valid Duration field in the PSDU. ~~When the received frame's RA is equal to the STA's own MAC address, the STA shall not update its NAV.~~ When the STA is solicited for an immediate response by the PPDU carrying the received frame, the STA shall not update its NAV.(#2905) Further, when the received frame is a DMG CTS frame and its TA is equal to the STA's own MAC address, the STA shall not update its NAV. For all other received frames the STA shall update its NAV when the received Duration is greater than the STA's current NAV value. Upon receipt of a PS-Poll frame, a STA shall update its NAV settings as appropriate under the data rate selection rules using a duration value equal to the time, in microseconds, required to transmit one Ack frame plus one SIFS, but only when the new NAV value is greater than the current NAV value. If the calculated duration includes a fractional microsecond, that value is rounded up to the next higher integer.

A STA shall update the NAV with the duration information indicated by the RXVECTOR parameter TXOP_DURATION if and only if all the following conditions are met:

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- The RXVECTOR parameter TXOP_DURATION is not all 1s.
- The STA does not receive a frame with the duration information indicated by a Duration field in the PSDU of the PPDU carrying the RXVECTOR parameter TXOP_DURATION
- The duration information indicated by the RXVECTOR parameter TXOP_DURATION is greater than the STA's current NAV value
- The PPDU that carried information of the RXVECTOR parameter is not HE trigger-based PPDU triggered by the STA(#2316)

Various additional conditions may set or reset the NAV, as described in 10.4.3.3 (NAV operation during the CFP). When the NAV is reset, a PHY-CCARESET.request primitive shall be issued. The exact time of updating the NAV is described as follows. This NAV update operation is performed when the PHY-RXEND.indication primitive is received, except when the PHYRXEND.indication primitive is received before the end of the PPDU, in this case, this NAV update operation is performed at the expected end of the PPDU.(#966)

Figure 10-5 (RTS/CTS/data/Ack and NAV setting) indicates the NAV for STAs that might receive the RTS frame, while other STAs might receive only the CTS frame, resulting in the lower NAV bar as shown (with the exception of the STA to which the RTS frame was addressed).

A STA that used information from an RTS or MU-RTS(#2316) frame as the most recent basis to update its NAV setting is permitted to reset its NAV if no PHY-RXSTART.indication primitive is received from the PHY during a NAVTimeout period starting when the MAC receives a PHY-RXEND.indication primitive corresponding to the detection of the RTS or MU-RTS(#2316) frame.

Insert the following at the end of 10.3.2.4:

An HE AP may use the HE duration-based RTS threshold to configure the use of RTS/CTS initiated by non-AP HE STA.(#576)

Insert a new subclause following 10.3.2.4:

10.3.2.4a Duration-based RTS/CTS

In dense environments, managing RTS usage by an AP can help the overall interference situation since the AP may have better view of the network situation. To improve spectrum utilization, RTS usage should be duration-based, rather than length-based.(#576)

Insert a new subclause following 10.3.2.8:

10.3.2.8a MU-RTS/CTS procedure(#1432)

10.3.2.8a.1 General

The MU-RTS/CTS procedure allows an AP to protect an MU transmission(#397). An HE AP may transmit an MU-RTS frame to solicit simultaneous CTS responses from one or more HE STAs.

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Figure 10-9a (Example of MU-RTS/CTS/DL MU PPDU/Acknowledgement Response and NAV setting(#2224)) shows an example of the exchange of MU-RTS and simultaneous CTS responses to protect DL MU PPDU and acknowledgement responses..

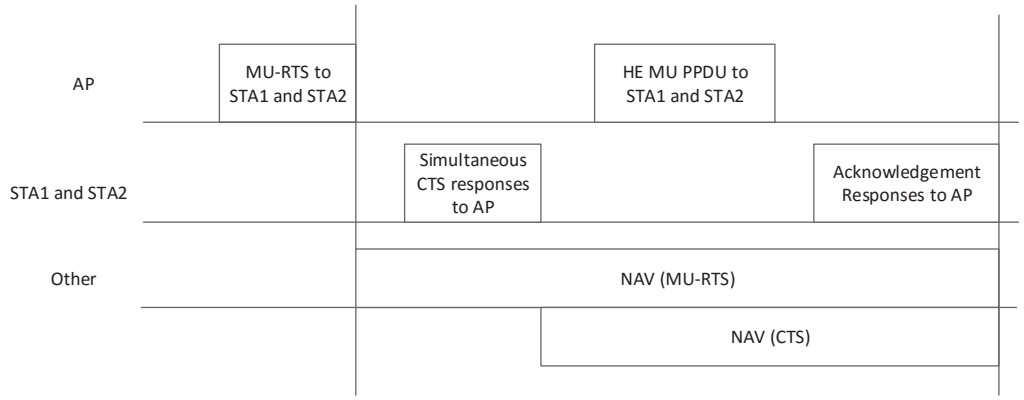

Figure 10-9a—Example of MU-RTS/CTS/DL MU PPDU/Acknowledgement Response and NAV setting(#2224)

Figure 10-9b (Example of MU-RTS/CTS/Trigger/HE trigger-based PPDU/Multi-STA BlockAck and NAV setting(#2224)) shows an example of the exchange of MU-RTS and simultaneous CTS responses to protect the scheduled HE trigger-based PPDU and Multi-STA BlockAck frame.

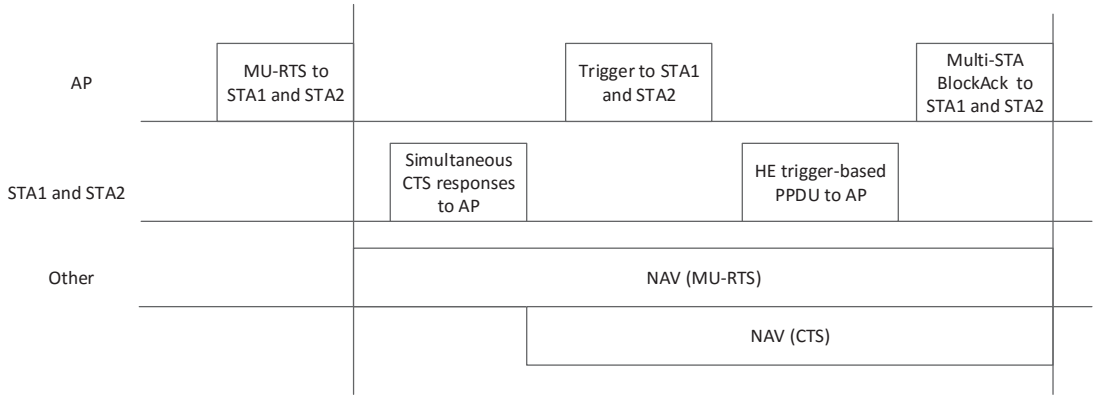

Figure 10-9b—Example of MU-RTS/CTS/Trigger/HE trigger-based PPDU/Multi-STA BlockAck and NAV setting(#2224)

10.3.2.8a.2 MU-RTS procedure

The transmitter of an MU-RTS frame shall not request a STA to send a CTS frame response in a 20 MHz channel that is not occupied by the PPDU that contains the MU-RTS frame. In each 20 MHz channel occupied by the PPDU that contains an MU-RTS frame, the transmitter of the MU-RTS frame shall request at least one STA to send a CTS frame response that occupies the 20 MHz channel.(#1644)(#Ed)

(#2428)After transmitting an MU-RTS frame, the STA shall wait for a CTSTimeout interval with a value of aSIFSTime + aSlotTime + aRxPHYStartDelay. This interval begins when the MAC receives a PHY-TXEND.confirm primitive. If a PHY-RXSTART.indication primitive does not occur during the CTSTimeout interval, the STA shall conclude that the transmission of the MU-RTS frame has failed, and this STA

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shall invoke its backoff procedure upon expiration of the CTSTimeout interval. If a PHY-RXSTART.indication primitive does occur during the CTSTimeout interval, the STA shall wait for the corresponding PHY-RXEND.indication primitive to determine whether the MU-RTS frame transmission was successful. The recognition of a valid CTS frame sent by the recipient of the MU-RTS frame, corresponding to this PHY-RXEND.indication primitive, shall be interpreted as successful response, permitting the frame exchange sequence to continue. The recognition of anything else, including any other valid frame, shall be interpreted as failure of the MU-RTS frame transmission.(#160)

An MU-RTS frame shall not be carried in an HE MU PPDU.(MU Motion #60)

10.3.2.8a.3 CTS response(#996) to MU-RTS

If an(#2829) HE STA receives an MU-RTS frame, the HE STA shall commence the transmission of a CTS frame(#1396) response at the SIFS time boundary after the end of a received PPDU when all the following conditions are met:

— The MU-RTS frame has one of the User Info(#1520) fields addressed to the STA.

— The UL MU CS condition described in 25.5.2.4 (UL MU CS mechanism) indicates the medium is idle. The ED-based CCA during the SIFS after receiving an MU-RTS frame and virtual CS functions are used to determine the state of the medium to respond to an MU-RTS frame.(#2650)

— The RU Allocation subfield in the User Info field addressed to the STA indicates either the primary 20 MHz channel, primary 40 MHz channel, primary 80 MHz channel, 160 MHz channel, or 80+80 MHz channel.(#2428)

— The MU-RTS frame is sent by the AP with which the STA is associated and the value of the regular NAV is 0.(#125)

The CTS frame sent in response to an MU-RTS frame shall be carried in a non-HT or non-HT duplicate PPDU.(#13)

An HE non-AP STA transmitting a CTS frame in response to an MU-RTS frame shall set the TXVECTOR parameter SCRAMBLER_INITIAL_STATE to the same value as the RXVECTOR parameter SCRAMBLER_INITIAL_STATE of the received MU-RTS frame.(#127) The rate selection rule for the CTS frame(#1396) is defined in 10.7.6 (Rate selection for Control frames). The data rate to be used for the non-HT PPDU response shall be 6 Mb/s (see 17.1.1 General).(#863)

(#963)A CTS frame sent in response to an MU-RTS frame(#1396) shall be transmitted on the 20 MHz channels indicated(#Ed) in the RU Allocation subfield of the User Info field of the MU-RTS frame(#1520)(#1727) when the indicated 20 MHz channels are all idle. If any 20 MHz channel indicated in the RU Allocation subfield of the User Info field is busy, the CTS frame response shall not be transmitted.(#1070)(#2651)

Figure 10-9c (An example of an MU-RTS frame soliciting CTS frame(#Ed)(#1396) responses on the primary 40 MHz channel(#2224)) shows an example of the exchange of MU-RTS and simultaneous CTS frame(#1396) responses on the(#1397) primary 40 MHz channel. In this example, MU-RTS is transmitted in a 40 MHz non-HT duplicate PPDU on the(#1397) primary 40 MHz channel. Further, the MU-RTS frame(Ed) requests STA1 to transmit a CTS frame(#1396) response in a non-HT PPDU on the(#1397) pri-

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mary 20 MHz channel and STA2 to transmit a CTS frame(#1396) response in a 40 MHz non-HT duplicate PPDU on the(#1397) primary 40 MHz channel.

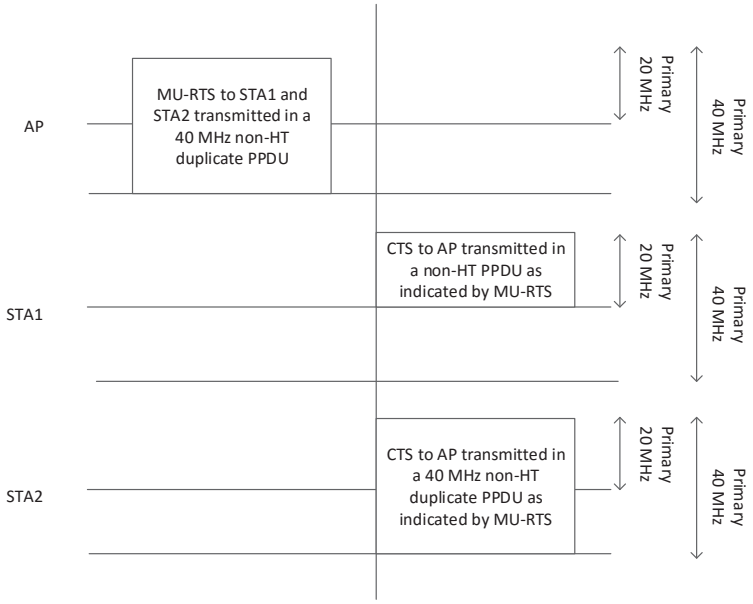

Figure 10-9c—An example of an MU-RTS frame soliciting CTS frame(#Ed)(#1396) responses on the primary 40 MHz channel(#2224)

A STA that transmits a CTS frame in response to an MU-RTS frame shall follow the synchronization requirement as defined in 17.3.9.10 (Pre-correction accuracy requirements).(#2115)

10.3.2.10 MU acknowledgement procedure

Insert a new subclause heading before the first paragraph as follows:

10.3.2.10.1 Acknowledgement procedure for DL MU PPDU in SU format

Change the subclause as follows:

The acknowledgment procedure performed by a STA that receives MPDUs that were transmitted within a VHT MU PPDU or an HE MU PPDU for DL transmission(#129)(#406) is the same as the acknowledgment procedure for MPDUs that were not transmitted within a VHT MU PPDU or an HE MU PPDU for DL transmission(#129)(#406).

NOTE—All MPDUs transmitted within a VHT MU PPDU or an HE MU PPDU for DL transmission(#129)(#406) are contained within A-MPDUs, and the rules specified in 9.7.3 (A-MPDU contents) prevent an immediate response carried in SU format to more than one of the A-MPDUs.

Responses to A-MPDUs within a VHT MU PPDU or an HE MU PPDU for DL transmission(#129)(#406) that are not immediate responses to the VHT MU PPDU or the HE MU PPDU for DL transmission(#129)(#406) are transmitted in response to explicit BlockAckReq frames by the AP. Examples of VHT MU PPDU frame exchange sequences are shown in Figure 10-11 (An example of a TXOP containing a VHT MU PPDU transmission with an immediate acknowledgment to the VHT MU PPDU) and Figure 10-12 (An example of a TXOP containing a VHT MU PPDU transmission with no immediate acknowledgment to the VHT MU PPDU).

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Recovery within the TXOP that contains a VHT MU PPDU or an HE MU PPDUfor DL transmission(#129)(#406) can be performed according to the rules of 10.22.2.7 (Multiple frame transmission in an EDCA TXOP). BlockAckRequest frames related to A-MPDUs within a VHT MU PPDU or an HE MU PPDU for DL transmission(#129)(#406) can be transmitted in a TXOP separate from the one that contained the VHT MU PPDU or the HE MU PPDU for DL transmission(#129)(#406).

NOTE 1—A BlockAck frame or an Ack frame is sent in immediate response to the BlockAckReq frame for HT-immediate or HT-delayed Block Ack, respectively. An Ack frame might be sent in immediate response carried in SU format(#405) to a Single MPDU(11ah) in the VHT MU PPDU or the HE MU PPDU for DL transmission(#129)(#406). A Multi-STA Block Ack frame is sent in immediate response to the BlockAckReq frame with multi-TID BAR variant or MU-BAR frame with multi-TID BAR variant(#131).

NOTE 2—A BlockAckRequest frame would typically not be sent to a STA in the case where the A-MPDU to the STA contained no MPDUs requiring acknowledgment. It could be sent if MPDUs in a previous A-MPDU remain unacknowledged.

Insert a new subclauses 10.3.2.11.2 and 10.3.2.11.3 as follows:

10.3.2.10.2 Acknowledgement procedure for DL(#1410) MU PPDU in MU format

A non-AP STA that is the recipient, within an(#2829) HE MU PPDU, of a QoS Data frame or QoS Null frame(#2606) that solicits an immediate response with Ack Policy equal to MU Ack in QoS Control field, or of an MMPDU that solicits an immediate response(#130), shall send the immediate response according to the scheduling information defined by the UL trigger information that is carried either in the Trigger frame(s) or in the(#1402) MAC header. If no valid Trigger frame(s) (see 9.3.1.23 (Trigger frame format))(#130)(#407) or MAC header header (see 9.2.4.6.4.2 (UL MU response scheduling))(#130)(#407) containing UL trigger information is received, then the STA shall not respond. An example of UL OFDMA acknowledgement to an HE MU PPDU is shown in Figure 10-12a (An example of an HE MU PPDU transmission with an immediate UL OFDMA acknowledgement(#1730)).

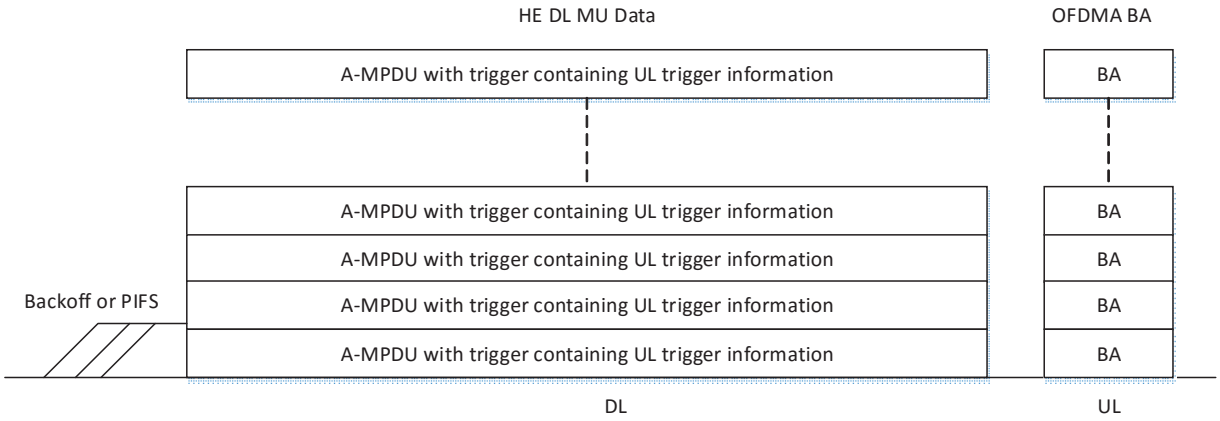

Figure 10-12a—An example of an HE MU PPDU transmission with an immediate UL OFDMA acknowledgement(#1730)

(#2607)

10.3.2.10.3 Acknowledgement(#1410) procedure for an UL MU transmission

When receiving frames(#409) from more than one STA that are part of an UL MU transmission (see(#1406) 9.42.2) and that require an immediate acknowledgement, an AP may send either multiple BlockAck frames (or Ack(#1408) frames) in an HE MU PPDU, or a Multi-STA BlockAck frame(#1407)(#1424) (see 25.4

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(Block acknowledgement)). Multi-STA BlockAck frame transmissions are allowed in a non-HT Duplicate PPDU, HT PPDU, VHT PPDU, HE SU PPDU, HE extended range SU PPDU and OFDMA HE MU PPDU.(#1427) After a successful reception of an UL frame requiring acknowledgment, transmission of the DL acknowledgement shall commence after a SIFS, without regard to the busy/idle state of the medium.(#2608) Specifically, when an AP transmits an immediate acknowledgement in HE MU PPDU in response to (A-)MPDU sent in HE trigger-based PPDU, the AP should send it within the 20 MHz channel(s) where the pre-HE modulated fields of the HE trigger-based PPDU sent by the STA are located. The immediate acknowledgement is either a BlockAck frame, Ack frame or Multi-STA Block Ack frame.(MU Motion #58)

An example of a DL OFDMA BA is(#410) shown in Figure 10-12b (An example of an UL MU transmission with an immediate DL MU transmission containing individually addressed(#1512) BlockAck frames acknowledging the frames received from the respective STAs(#1732)).(#1427)

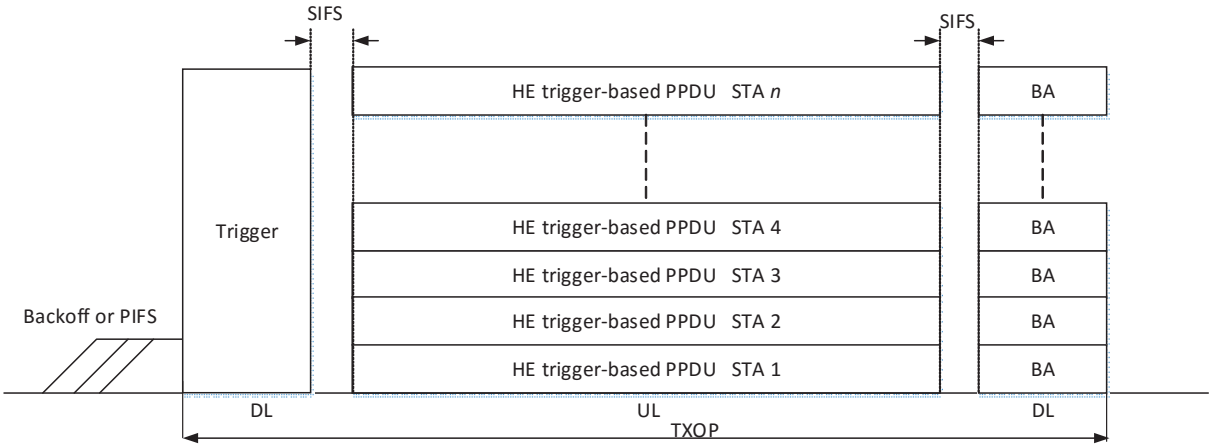

Figure 10-12b—An example of an UL MU transmission with an immediate DL MU transmission containing individually addressed(#1512) BlockAck frames acknowledging the frames received from the respective STAs(#1732)

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An example of a Multi-STA BlockAck frame acknowledgement in a non-HT, HT, VHT or HE SU PPDU is given in Figure 10-12c (An example of UL MU transmissions with an immediate Multi-STA BlockAck frame(#1407) acknowledging the MPDUs(#1732)).(#1427)

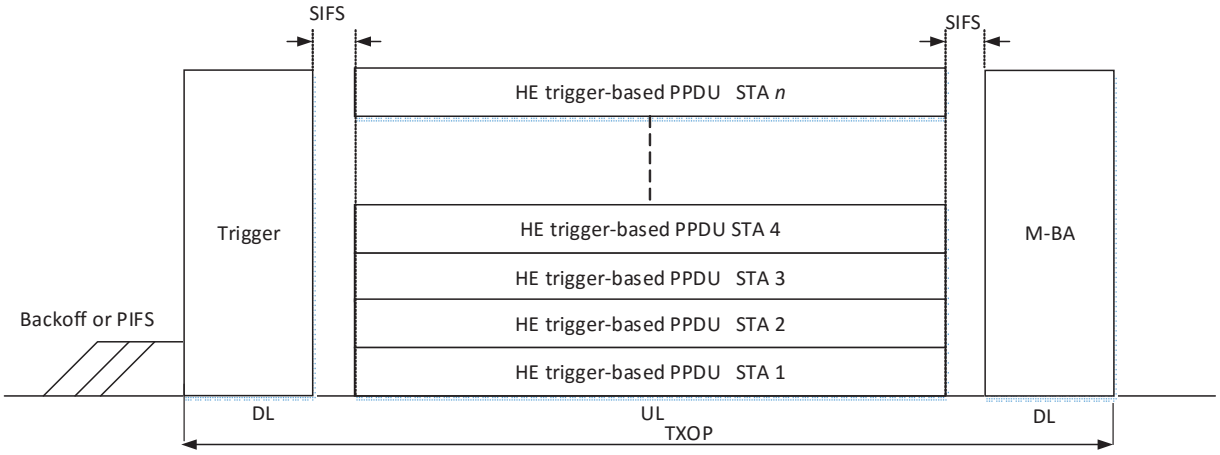

Figure 10-12c—An example of UL MU transmissions with an immediate Multi-STA BlockAck frame(#1407) acknowledging the MPDUs(#1732)

An example of a Multi-STA BlockAck frame acknowledgement in a non-HT Duplicate PPDU is given in Figure 10-12d (An example of UL MU transmissions with an immediate DL non-HT duplicate PPDU containing the Multi-STA BlockAck frame(#1732)).(#1427)

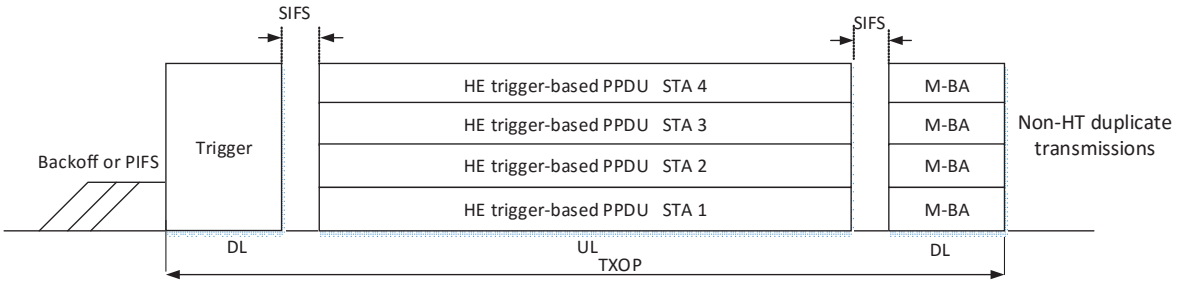

Figure 10-12d—An example of UL MU transmissions with an immediate DL non-HT duplicate PPDU containing the Multi-STA BlockAck frame(#1732)

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An example of a Multi-STA BlockAck frame acknowledgement in an OFDMA HE MU PPDU is given in Figure 10-12e (An example of UL MU transmissions with an immediate OFDMA HE MU PPDU containing Multi-STA BlockAck frames(#1732)).(#1427)

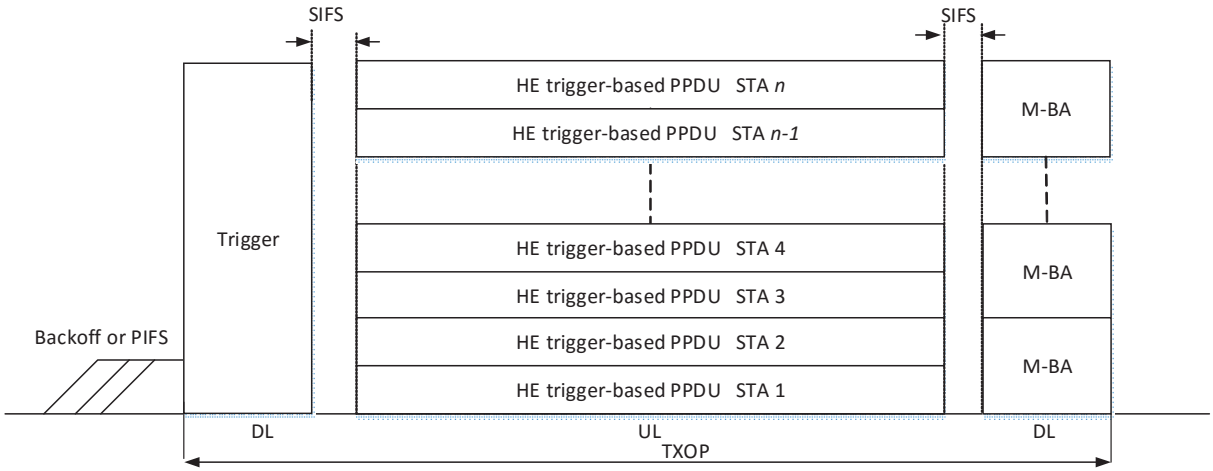

Figure 10-12e—An example of UL MU transmissions with an immediate OFDMA HE MU PPDU containing Multi-STA BlockAck frames(#1732)

10.5 Fragmentation

Change the 2nd paragraph as follows:

With static fragmentation, t~~T~~he length of each fragment shall be an equal number of octets for all fragments except the last, which may be smaller. The length of each fragment shall be an even number of octets, except for the last fragment of an MSDU or MMPDU, which may be either an even or an odd number of octets. The length of a static fragment shall never be larger than dot11FragmentationThreshold unless security encapsulation is invoked for the MPDU. If security encapsulation is active for the MPDU, then the MPDU shall be expanded by the encapsulation overhead and this may result in a fragment larger than dot11FragmentationThreshold. Unless the conditions described in 25.3.2 (Support and requirements for dynamic fragmentation) are met, static fragmentation is used.(#1484)

10.7 Multirate support

10.7.6 Rate selection for Control frames

10.7.6.5 Rate selection for control response frames

10.7.6.5.2 Selection of a rate or MCS

Insert the following at the end of the subclause:

(#863)If a Multi-STA BlockAck frame or DL OFDMA acknowledgement frame is sent as an immediate response to an HE trigger-based PPDU(#1767), the AP may ignore the <HE-MCS, NSS> tuples that are used for MPDUs in HE trigger-based PPDU(#1767) from non-AP STAs that elicits the DL acknowledgement.

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An AP that transmits a Multi-STA BlockAck frame in a non-HT PPDU, HT PPDU, VHT PPDU or HE PPDU shall use a rate, HT-MCS, <VHT-MCS, NSS> tuple or <HE-MCS, NSS> tuple, respectively, that is supported by all the recipients(#623).

10.9 HT Control field operation

Change 10.9 as follows:

If the value of dot11HTControlFieldSupported is true, a STA shall set the +HTC Support subfield of the HT Extended Capabilities field of the HT Capabilities element to 1 in HT Capabilities elements that it transmits. If the value of dot11VHTControlFieldOptionImplemented is true, a STA shall set the +HTC-VHT Support subfield of the VHT Capabilities Information field of the VHT Capabilities element to 1 in VHT Capabilities elements that it transmits. If (#1433)dot11HEControlFieldOptionImplemented(#1313) is true, a STA shall set the +HTC-HE Support subfield of the HE Capabilities(#2397) Information field of the HE Capabilities element to 1 in HE Capabilities elements that it transmits.

A STA that has a value of true for at least one of dot11RDResponderOptionImplemented, dot11MCSFeedbackOptionImplemented, and dot11AlternateEDCAActivated shall set dot11HTControlFieldSupported or dot11VHTControlFieldOptionImplemented or both to true. A STA for which at least one of dot11HEULMUResponseSchedulingOptionImplemented(#1515)(#1), dot11HEMCSFeedbackOptionImplemented or dot11HEROMIOptionImplemented is true shall set dot11HEControlFieldOptionImplemented(#1313) to true.(#1434)(#1435)

An HT variant HT Control field shall not be present in a frame addressed to a STA unless that STA declares support for +HTC-HT in the HT Extended Capabilities field of its HT Capabilities element (see 9.2.4.6 (HT Control field)).

A VHT variant HT Control field shall not be present in a frame addressed to a STA unless that STA declares support for +HTC-VHT in the VHT Capabilities Information field of its VHT Capabilities element.

NOTE–An HT STA that does not support +HTC (HT or VHT variant) that receives a +HTC frame addressed to another STA still performs the CRC on the actual length of the MPDU and uses the Duration/ID field to update the NAV, as described in <reference>.

An HE variant HT Control field shall not be present in a frame addressed to a STA unless that STA declares support for +HTC-HE in the HE Capabilities Information field of its HE Capabilities element. The HE variant HT Control field carried in the frame may contain a Control(#2495) subfield supported by the intended receiver that has:

- A value of 0 in the Control ID subfield when the transmitting STA expects an HE trigger-based PPDU(#Ed) that carries an immediate acknowledgement, as described in 25.5.2 (UL MU operation)(#2315).
- A value of 1 in the Control ID subfield when the transmitting STA changes the receive operating mode(#2209), as described in 25.8 (Operating mode indication)(#2228).
- A value of 2 in the Control ID subfield when the transmitting STA follows the HE link adaptation procedure, as described in 10.31.4 (Link adaptation using the HE variant HT Control field).
- A value of 3 in the Control ID subfield when the transmitting STA follows the corresponding buffer status report procedure, as described in 25.5.2.5 (HE buffer status feedback operation for UL MU)(#824)
- A value of 4 in the Control ID subfield when the transmitting STA follows the UL MU operation procedure, as described in 26.3.13.2 (Power pre-correction).

If the HT Control field is present in an MPDU aggregated in an A-MPDU(#1436), then all MPDUs of the same frame type (i.e., having the same value for the Type subfield of the Frame Control field) aggregated in

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the same A-MPDU(#1436) shall contain an HT Control field. The HT Control field of all MPDUs containing the HT Control field aggregated in the same A-MPDU(#1436) shall be set to the same value.

If an A-Control field is present in a frame then it shall contain at least one Control subfield, and the Control subfield shall be present in the A-Control field only if it is supported by the receiving STA; otherwise it shall not be present. At most one Control subfield with a given Control ID value shall be present in the A-Control field of QoS Data or Management frames carried in an (A-)MPDU.(#1253)(#134)

NOTE—An A-Control field that is present in a frame cannot contain only the Padding subfield.

An HE STA that receives an A-Control field shall ignore the remainder of the A-Control field that follows a Control ID subfield whose value is not recognized or is not supported by the STA.(#362)(#2206)

10.13 A-MPDU operation

10.13.1 A-MPDU contents

Change the 2nd paragraph as follows:

When an A-MPDU contains multiple QoS Control fields, bits 4 shall be identical across all MPDUs that contain the QoS Control fields and bits 8–15 of these QoS Control fields shall be identical across all MPDUs with equal value of the TID subfield.(#147)

10.13.2 A-MPDU length limit rules

(#2258)Change as follows:

A STA indicates in the Maximum A-MPDU Length Exponent field in its HT Capabilities element the maximum A-MPDU length that it can receive in an HT PPDU. A STA indicates in the Maximum A-MPDU Length Exponent field in its VHT Capabilities element the maximum length of the A-MPDU pre-EOF padding that it can receive in a VHT PPDU. A DMG STA indicates in the Maximum A-MPDU Length Exponent field in its DMG Capabilities element the maximum A-MPDU length that it can receive. A STA indicates in the Maximum A-MPDU Length Exponent field in its HE Capabilities element the maximum length of the A-MPDU pre-EOF padding that it can receive in a HE PPDU. The encoding of these fields is defined in Table 9-163 (Subfields of the A-MPDU Parameters field) for an HT PPDU, in Table 9-249 (Subfields of the VHT Capabilities Information field) for a VHT PPDU, and in Table 9-229 (Subfields of the A-MPDU Parameters subfield) for a DMG STA, and in 9.4.2.213 (HE Capabilities element).

A VHT STA that sets the Maximum A-MPDU Length Exponent field in its VHT Capabilities element to a value in the range 0 to 3 shall set the Maximum A-MPDU Length Exponent in its HT Capabilities to the same value. A VHT STA that sets the Maximum A-MPDU Length Exponent field in the VHT Capabilities element to a value larger than 3 shall set the Maximum A-MPDU Length Exponent in its HT Capabilities element to 3.

Using the Maximum A-MPDU Length Exponent fields in the HT Capabilities, and VHT Capabilities, and HE Capabilities elements, the STA establishes at association the maximum length of an A-MPDU pre-EOF padding that can be sent to it. An HT STA shall be capable of receiving A-MPDUs of length up to the value indicated by the Maximum A-MPDU Length Exponent field in its HT Capabilities element. A VHT STA shall be capable of receiving A-MPDUs where the A-MPDU pre-EOF padding length is up to the value indicated by the Maximum A-MPDU Length Exponent field in its VHT Capabilities element. An HE STA shall be capable of receiving A-MPDUs where the A-MPDU pre-EOF padding length is up to the value indicated by the Maximum A-MPDU Length Exponent field in its HE Capabilities element.

A STA shall not transmit an A-MPDU in an HT PPDU that is longer than the value indicated by the Maximum A-MPDU Length Exponent field in the HT Capabilities element received from the intended receiver. MPDUs

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in an A-MPDU carried in an HT PPDU shall be limited to a maximum length of 4095 octets. A STA shall not transmit an A-MPDU in a VHT PPDU where the A-MPDU pre-EOF padding length is longer than the value indicated by the Maximum A-MPDU Length Exponent field in the VHT Capabilities element received from the intended receiver. A DMG STA shall not transmit an A-MPDU that is longer than the value indicated by the Maximum A-MPDU Length Exponent field in the DMG Capabilities element received from the intended receiver. A STA shall not transmit an A-MPDU in a HE PPDU where the A-MPDU pre-EOF padding length is longer than the value indicated by the Maximum A-MPDU Length Exponent field in the HE Capabilities element received from the intended receiver.

10.22 HCF

10.22.2 HCF contention based channel access (EDCA)

10.22.2.2 EDCA backoff procedure

Change the 2nd paragraph as follows:

For the purposes of this subclause, transmission failure of an MPDU is defined as follows:

- After transmitting an MPDU (even if it is carried in an A-MPDU or as part of a VHT MU PPDU that is sent using TXVECTOR parameter NUM_USERS > 1) that requires ~~an~~ one or more immediate response:
  - The STA shall wait for a timeout interval of duration aSIFSTime + aSlotTime + aRxPHYStartDelay, starting when the MAC receives a PHY-TXEND.confirm primitive. If a PHY-RXSTART.indication primitive does not occur during the timeout interval, the transmission of the MPDU has failed.
  - If a PHY-RXSTART.indication primitive does occur during the timeout interval, the STA shall wait for the corresponding PHY-RXEND.indication primitive to recognize ~~a~~ one or more valid response MPDUs (see Annex G) that either does not have a TA field or is sent by ~~the~~ one or more recipients of the MPDU requiring a response. If anything else, including any other valid frame, is recognized, the transmission of the MPDU has failed.
- The nonfinal (re)transmission of an MPDU that is delivered using the GCR unsolicited retry retransmission policy (10.22.2.11.2 (Unsolicited retry procedure))) is defined to be a failure.
- In all other cases, the transmission of the MPDU has not failed.

Editor's Note: Edits to 4th paragraph from 16/929r3 not applied since quoted baseline is out of date and changes appear to be unnecessary

Insert the following at the end of subclause 10.22.2.2:

(MU Motion #57)When an HE STA successfully receives the corresponding acknowledgement frame in response to the MPDU sent in HE trigger based PPDU, the backoff for the associated EDCAF resumes the backoff counter countdown.

When an HE STA does not receive the corresponding acknowledgement frame in response to the MPDU sent in HE trigger based PPDU, the backoff for the associated EDCAF resumes the backoff counter countdown.

If an HE STA does not successfully receive the corresponding acknowledgement frame in response to the MPDU sent in an HE trigger based PPDU, the short retry counters and long retry counters for the associated EDCAF are not changed.

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10.22.2.4 Obtaining an EDCA TXOP

Change the last paragraph and insert a new paragraph as follows:

A STA shall save the TXOP holder address for the BSS in which it is associated, which is the MAC address from the Address 2 field of the frame that initiated a frame exchange sequence except when this is a CTS frame, in which case the TXOP holder address is the Address 1 field. If the TXOP holder address is obtained from a Control frame, a VHT STA or HE STA shall save the nonbandwidth signaling TA value obtained from the Address 2 field. If a non-VHT non-HE STA receives an RTS frame with the RA address matching the MAC address of the STA and the MAC address in the TA field in the RTS frame matches the saved TXOP holder address, then the STA shall send the CTS frame after SIFS, without regard for, and without resetting, its NAV. If a VHT STA or HE STA receives an RTS frame with the RA address matching the MAC address of the STA and the nonbandwidth signaling TA value obtained from the Address 2 field in the RTS frame matches the saved TXOP holder address, then the STA shall send the CTS frame after SIFS, without regard for, and without resetting, its NAV. When a STA receives a frame addressed to it that requires an immediate response, except for RTS and Trigger frames (see 25.5.2.4 (UL MU CS mechanism)), it shall transmit the response independent of its NAV. The saved TXOP holder address shall be cleared when the NAV is reset or when the NAV counts down to 0.

During an EDCA TXOP, Address 2 field excluding the Individual/Group bit of all control frames sent by a TXOP holder shall be set to the same address value.(#2448)

10.22.2.6 Sharing an EDCA TXOP

Change the 1st three paragraphs as follows:

This mode applies only to an AP that supports DL-MU-MIMO or DL-OFDMA. The AC associated with the EDCAF that gains an EDCA TXOP becomes the primary AC. TXOP sharing is allowed when primary AC traffic is transmitted in a VHT MU PPDU or an HE MU PPDU and resources permit traffic from secondary ACs to be included, targeting up to four STAs if it is transmitted in the VHT MU PPDU. The inclusion of secondary AC traffic in a VHT MU PPDU shall not increase the duration of the VHT MU PPDU beyond that required to transport the primary AC traffic. The inclusion of secondary AC traffic in an HE MU PPDU is described in 25.10.4 (A-MPDU with multiple TIDs). If a destination in a VHT MU PPDU is targeted by frames in the queues of both the primary AC and at least one secondary AC, the frames in the primary AC queue shall be transmitted to the destination first, among a series of downlink transmissions within a TXOP. The decision of which secondary ACs and destinations are selected for TXOP sharing, as well as the order of transmissions, are implementation specific and out of scope of this standard. For an HE MU PPDU, the inclusion of secondary AC traffic in the HE MU PPDU shall not cause the TXOP limit of the primary AC to be exceeded.(#809)

When sharing, the TXOP limit that applies is the TXOP limit of the primary AC.

NOTE—An AP can protect an immediate response by preceding the VHT MU PPDU or the HE MU PPDU (which might have TXVECTOR parameter NUM_USERS > 1) with an RTS/CTS exchange or an MU-RTS/CTS exchange or a CTS-to-self transmission.(#809)

10.22.2.7 Multiple frame transmission in an EDCA TXOP

Change the 1st paragraph as follows:

A frame exchange, in the context of multiple frame transmission in an EDCA TXOP, may be one of the following:

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- A frame not requiring immediate acknowledgment (such as a group addressed frame or a frame transmitted with an acknowledgment policy that does not require immediate acknowledgment) or an A-MPDU containing only such frames
- A frame requiring acknowledgment (such as an individually addressed frame transmitted with an acknowledgment policy that requires immediate acknowledgment) or an A-MPDU containing at least one such frame, followed after SIFS by a corresponding acknowledgment frame
- A Trigger frame or a frame carrying an UL MU Response Scheduling A-Control subfield followed after SIFS by the requested immediate response
- Either
  - a VHT NDP Announcement frame followed after SIFS by a VHT NDP followed after SIFS by a PPDU containing one or more VHT Compressed Beamforming frames, or
  - a Beamforming Report Poll frame followed after SIFS by a PPDU containing one or more VHT Compressed Beamforming frames

A DL MU PPDU may carry MPDUs addressed to multiple recipients, hence multiple frame exchanges are performed simultaneously. If at least one of those frame exchanges requires an immediate response (i.e. the AP includes at least one Trigger frame or UL MU Response Scheduling A-Control field) and if the AP receives an immediate response with at least one correct MPDU from at least one of the solicited STAs, the rules in this subclause apply.(#593)(#1530)(#2631)(#39)(#1531)

10.22.2.8 TXOP limits

Change the 3rd paragraph as follows:

A TXOP limit of 0 indicates that the TXOP holder may transmit or cause to be transmitted (as responses) the following within the current TXOP:

a) One of the following at any rate, subject to the rules in 10.7 (Multirate support)
   1) One or more SU PPDUs carrying fragments of a single MSDU or MMPDU
   2) An SU PPDU or a VHT MU PPDU or an HE MU PPDU or an HE trigger-based PPDU(#2450) carrying a single MSDU, a single MMPDU, a single A-MSDU, or a single A-MPDU
   3) A VHT MU PPDU or an HE MU PPDU(#2450) carrying A-MPDUs to different users (a single A-MPDU to each user)
   4) A QoS Null frame or PS-Poll frame
   5) Trigger frame(#2450)

b) Any required acknowledgments

c) Any frames required for protection, including one of the following:
   1) An RTS/CTS or MU-RTS/CTS(#2450) exchange
   2) CTS to itself
   3) Dual CTS as specified in 10.3.2.8 (Dual CTS protection)

d) Any frames required for beamforming as specified in 10.30 (Sounding PPDUs), 10.34.5 (VHT sounding protocol) and 10.38 (DMG beamforming).

e) Any frames required for link adaptation as specified in 10.31 (Link adaptation)

f) Any number of BlockAckReq or MU-BAR(#2450) frames

NOTE 1—This is a rule for the TXOP holder. A TXOP responder need not be aware of the TXOP limit nor of when the TXOP was started.

NOTE 2—This rule prevents the use of RD when the TXOP limit is 0.

Insert the following at the end of the subclause:

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When the Duration field value in the MAC header of an HE trigger-based PPDU is set to 0, the HE trigger-based PPDU shall not include any frames that solicit a control response frame from the AP.(#2451)

10.22.2.9 Truncation of TXOP

Insert the following at the end of the subclause:

An HE STA that receives a CF-End frame should not reset its NAV if any of following conditions is met, otherwise it resets its NAV(#204)(#2193)(#2613):

— The received CF-End frame is an inter-BSS frame and the most recent NAV update was due to an intra-BSS frame (see 25.2.1 (Intra-BSS and inter-BSS frame detection))(#18)(#673)(#1440)(#1660).

— The received CF-End frame is an intra-BSS frame and the most recent NAV update was due to an inter-BSS frame (see 25.2.1 (Intra-BSS and inter-BSS frame detection)).

NOTE 1—For HE STAs with two NAVs, the TXOP truncation rule applies to each NAV separately.(#737)(#2283)(#2447)(#2614)(#992)

10.22.4 Admission Control at the HC

10.22.4.2 Contention based admission control procedures

10.22.4.2.3 Procedure at non-AP STAs

Change the 8th paragraph as follows:

The MPDUExchangeTime equals the time required to transmit the MPDU sequence. For the case of an MPDU transmitted with Normal Ack policy and without RTS/CTS protection, this equals the time required to transmit the MPDU plus the time required to transmit the expected response frame plus one SIFS. Frame exchange sequences for Management frames and the HE trigger-based PPDU(#2470) are excluded from the used_time update. If the used_time value reaches or exceeds the admitted_time value, the corresponding EDCAF shall no longer transmit QoS Data frames or QoS Null MPDUs using the EDCA parameters for that AC as specified in the QoS Parameter Set element. However, a STA may choose to temporarily replace the EDCA parameters for that EDCAF with those specified for an AC of lower priority, if no admission control is required for those ACs.

10.24 Block acknowledgement (block ack)

10.24.10 GCR block ack

10.24.10.3 GCR block ack BlockAckReq and BlockAck frame exchanges

Change the following 2nd and 3rd paragraphs as follows:

When the retransmission policy for a group address is GCR Block Ack, an originator shall not transmit more than the GCR buffer size number of A-MSDUs with RA set to the GCR concealment address and the DA field of the A-MSDU subframe set to the GCR group address before sending a BlockAckReq frame to one of the STAs that has a GCR block ack agreement for this group address. The RA field of the BlockAckReq frame shall be set to the MAC address of the destination STA. Upon reception of the BlockAck frame, an originator may send a BlockAckReq frame to another STA that has a block ack agreement for this group address, and this process may be repeated multiple times. If the originator has a GCR block ack agreement with one or more of the HE STAs for this group address, the originator may send an(#2817) MU-BAR frame (MU-BAR variant Trigger frame(#1532)) to one or more of the HE STAs(#1213). Upon reception of the BlockAck frame from one or more HE STAs, the(#2818) originator may send an(#2817) MU-BAR frame to

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one or more other(#413) HE STAs that have a GCR block ack agreement(#21), and this process may be repeated multiple times.(#136)

NOTE 1—If the originator sends a BlockAckReq frame to a STA with a MAC address that matches the SA in any of the A-MSDUs transmitted during the GCR TXOP, the Block Ack Bitmap subfield does not indicate the MSDUs sourced from this STA. This is because the STA will have discarded all group addressed MPDUs transmitted by the AP that have the source address equal to their MAC address (see 10.3.6 (Group addressed MPDU transfer procedure)).

When a recipient receives a BlockAckReq frame with the GCR Group Address subfield equal to a GCR group address, the recipient shall transmit a BlockAck frame at a delay of SIFS after the BlockAckReq frame. The BlockAck frame acknowledges the STA's reception status of the block of group addressed frames requested by the BlockAckReq frame. When an(#2819) HE STA receives an(#2817) MU-BAR frame with User Identifier subfield(#1444)(#2843) set to the AID of the HE STA, the HE STA shall transmit BlockAck frame in the indicated resource unit SIFS after the Trigger frame. The BlockAck frames report(#414) the HE STA's reception status of the block of group addressed frames requested by the MU-BAR frame.

Figure 10-36 (Example of a frame exchange with GCR block ack retransmission policy) shows an example of a frame exchange when the GCR block ack retransmission policy is used. The AP sends several A-MSDUs using the GCR block ack retransmission policy. The AP then sends a BlockAckReq frame to group member 1 of the GCR group, waits for the BlockAck frame, and then sends a BlockAckReq frame to group member 2. After receiving the BlockAck frame from GCR group member 2, the AP determines whether any A-MSDUs need to be retransmitted and sends additional A-MSDUs (some of which might be retransmissions of previous A-MSDUs) using the GCR block ack retransmission policy.

Insert the following paragraph and associated figure:

Figure 10-36a (Example of a frame exchange with GCR block ack retransmission policy(#22)(#415)(#1442)) shows another example of a frame exchange when the GCR block ack retransmission policy is used. The HE AP sends several A-MSDUs using the GCR block ack retransmission policy. The HE AP then sends an(#2817) MU-BAR to group members 1 and 2 of the GCR group, waits for the BlockAck frames, and then sends an(#2817) MU-BAR to group members 3 and 4 and then waits for the BlockAck frame. The HE AP then sends a BAR frame to group member 5, which is a non-HE STA, and waits for the BlockAck frame(#22)(#1442). After receiving the BlockAck frames(#22)(#1442), the HE AP

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determines whether any A-MSDUs need to be retransmitted and sends additional A-MSDUs (some of which might be retransmissions of previous A-MSDUs) using the GCR block ack retransmission policy.

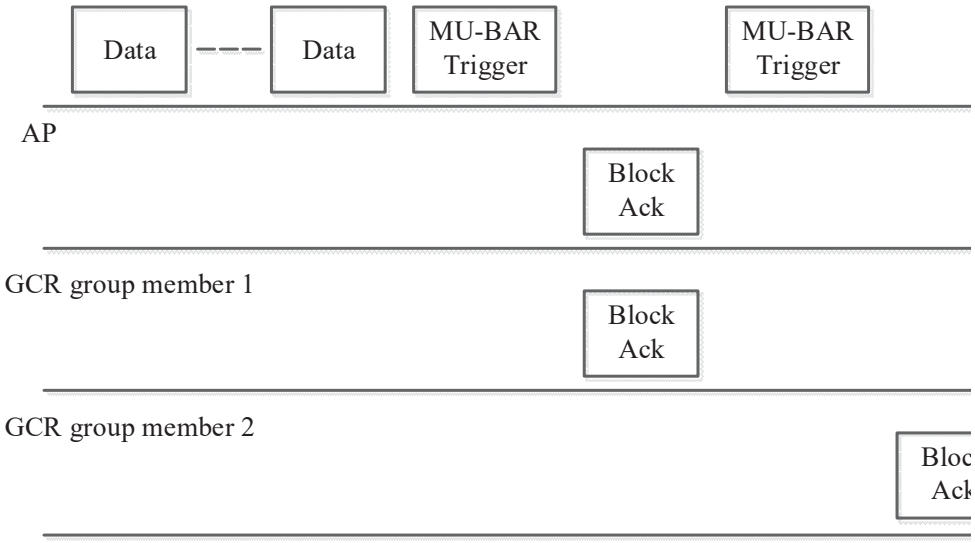

Figure 10-36a—Example of a frame exchange with GCR block ack retransmission policy(#22)(#415)(#1442)

Change the 6th,7th and 8th paragraph as follows:

After completing the BlockAckReq or MU-BAR and BlockAck frame exchanges(#23), the originator determines from the information provided in the BlockAck bitmap and from the missing BlockAck frames which, if any, A-MSDUs need to be retransmitted.

An originator adopting the GCR block ack retransmission policy for a GCR group address chooses a lifetime limit for the group address. The originator may vary the lifetime limit for the group address at any time and may use different lifetime limits for different GCR group addresses. The originator transmits and retries each A-MSDU until the appropriate lifetime limit is reached or until each one has been received by all group members to which a BlockAckReq frame or an MU-BAR frame has been sent, whichever occurs first.

For GCR streams with retransmission policy equal to GCR Block Ack, an originator may regularly send a BlockAckReq frame with the GCR Group Address subfield in the BAR Information field set to the GCR group address and the Block Ack Starting Sequence Control subfield set to the Sequence Number field of the earliest A-MSDU of the GCR stream that has not been acknowledged by all group members and has not expired due to lifetime limits, in order to minimize buffering latency at receivers in the GCR group. An originator may also (#1443)send an MU-BAR frame with AID12 fields(#1444) set to AIDs of HE STAs that transmit the BlockAck frames and the Block Ack Starting Sequence Control subfield set to the Sequence Number field of the earliest A-MSDU of the GCR stream that has not been acknowledged by all group members and has not expired due to lifetime limits, in order to minimize buffering latency at receivers in the GCR group.

NOTE 2—This is because an originator might transmit Management frames, QoS Data frames with a group address in the Address 1 field (including different GCR streams), and non-QoS Data frames intermingled. Since these are transmitted using a single sequence counter, missing frames or frames sent to group addresses absent from a receiving STA's dot11GroupAddresses table complicate receiver processing for GCR streams with a GCR block ack retransmission policy since the cause of a hole in a receiver's block ack bitmap is ambiguous: it is due either to an MPDU being lost from the GCR stream or to transmissions of MPDUs not related to the GCR service using the same sequence number counter.

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Change the last paragraph as follows:

If the beginning of such reception does not occur during the first slot time following a SIFS(#24)(#587)(#694)(#1756)(#1769)(#2615)(#2231), then the originator may perform error recovery by retransmitting a BlockAckReq frame or an MU-BAR frame(Ed) PIFS after the previous BlockAckReq frame or an MU-BAR frame when both of the following conditions are met:

— The carrier sense mechanism (see 10.3.2.1 (CS mechanism)) indicates that the medium is idle at the TxPIFS slot boundary (defined in 10.3.7 (DCF timing relations)) after the expected start of a Block-Ack frame, and

— The remaining duration of the GCR TXOP is longer than the total time required to retransmit the GCR BlockAckReq frame or an MU-BAR frame plus one slot time.

NOTE 3—If an originator fails to receive a BlockAck frame in response to a BlockAckReq frame and there is insufficient time to transmit a recovery frame, the AP retransmits the BlockAckReq frame in a new TXOP.

10.45 Target wake time (TWT)

10.45.1 TWT overview

Change the 2nd paragraph of 9.44.1 as follows:

A TWT requesting STA communicates wake scheduling information to its TWT responding STA and the TWT responding STA devises a schedule and delivers TWT values to the TWT requesting STA when a TWT agreement has been established between them(#1381). When explicit TWT is employed, a TWT requesting STA wakes and performs a frame exchange and receives the next TWT information in a response from the TWT responding STA as described in 10.45.2.2 (Explicit TWT operation). When implicit TWT is used, the TWT requesting STA calculates the Next TWT by adding a fixed value to the current TWT value as described in 10.45.3 (Implicit TWT operation).

(#1655)Insert a new paragraph and table after the 9th paragraph:

The result of an exchange of TWT Setup frames is defined in Table 10-19a (TWT Setup exchange Command interpretation). In general, the meaning of Request TWT is that the transmitting STA will negotiate the TWT parameters for a TWT agreement, Suggest TWT indicates that the transmitting STA offers a set of preferred TWT parameters for a TWT agreement but will accept whatever the responding STA indicates and Demand TWT indicates tha the transmitting STA will accept only the indicated TWT parameters for a TWT agreeement. For a responding STA, accept TWT indicates that the responding STA has initiated a TWT agreement with the given parameters, alternate TWT indicates a counter-offer of TWT parameters without the creation of a TWT agreement and dictate TWT indicates that no TWT agreement is created, but one can be created using the indicated TWT parameters.

Table 10-19a—TWT Setup exchange Command interpretation

Initiating frame	Response frame	
TWT Setup Command field value within a TWT Setup frame transmitted from first STA to second STA	TWT Setup Command field value within a TWT Setup frame transmitted from second STA to first STA	TWT condition after the completion of the exchange

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Table 10-19a—TWT Setup exchange Command interpretation

Request TWT or Suggest TWT or Demand TWT with Wake TBTT Negotiation subfield = don't care	No frame transmitted	No new active individual TWT agreement exists with the TWT Flow ID corresponding to the Flow ID in the initiating frame. No new active Broadcast individual TWT agreement exists.
Request TWT or Demand TWT with Wake TBTT Negotiation subfield = 0	Accept TWT with Broadcast subfield = 0	An individual TWT agreement is now active and is using the TWT parameters identified in the initiating frame. The TWT parameters in the response frame match the TWT parameters of the initiating frame.
Suggest TWT with Wake TBTT Negotiation subfield = 0	Accept TWT with Broadcast subfield = 0	An individual TWT agreement is now active and is using the TWT parameters identified in the responding frame.
Request TWT or Suggest TWT or Demand TWT with Wake TBTT Negotiation subfield = 0	Accept TWT with Broadcast subfield = 1	This response is not allowed.
Suggest TWT or Demand TWT with Wake TBTT Negotiation subfield = 0	Alternate TWT or Dictate TWT with Broadcast subfield = 0	This response is not allowed.
Request TWT with Wake TBTT Negotiation subfield = 0	Alternate TWT with Broadcast subfield = 0	No active individual TWT agreement exists with the associated TWT Flow ID. The responder is offering an alternative set of parameters vs. those indicated in the initiating frame, as a means of negotiating TWT parameters with the requester. The requesting STA can send a new request with any set of TWT parameters and the responder might entertain the creation of an individual TWT agreement using those parameters.
Request TWT with Wake TBTT Negotiation subfield = 0	Dictate TWT with Broadcast subfield = 0	No active individual TWT agreement exists with the associated TWT Flow ID. The responder offers an alternative set of parameters vs. those indicated in the TWT request. By selecting "Dictate TWT", the responder indicates that it is not willing to accept any other TWT parameters for the requesting STA at this time. The requesting STA can send a new request, but will only receive an Accept TWT if it uses the dictated TWT parameters.
Request TWT with Wake TBTT Negotiation subfield = 0	Dictate TWT with Broadcast subfield = 1	No active individual TWT agreement exists with the associated TWT Flow ID. A broadcast TWT agreement is now active and is using the TWT parameters identified in the responding frame. The broadcast TWT agreement is not necessarily a newly created TWT agreement. The responding STA will not create any new individual TWT agreement with the requester at this time.
Request TWT or Suggest TWT or Demand TWT with Wake TBTT Negotiation subfield = 0	Reject TWT with Broadcast subfield = 0	No active individual TWT agreement exists with the associated TWT Flow ID. The responding STA will not create any new individual TWT agreement with the requester at this time.
Suggest TWT or Demand TWT with Wake TBTT Negotiation subfield = 1	Accept TWT or Alternate TWT or Dictate TWT or Reject TWT with Broadcast subfield = 0	This response is not allowed.

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Table 10-19a—TWT Setup exchange Command interpretation

Demand TWT with Wake TBTT Negotiation subfield = 1	Accept TWT with Broadcast subfield = 1	An active broadcast TWT agreement exists or has been created with the TWT parameters indicated in the initiating frame.
Suggest TWT with Wake TBTT Negotiation subfield = 1	Accept TWT with Broadcast subfield = 1	An active broadcast TWT agreement exists or has been created with the TWT parameters indicated in the responding frame.
Request TWT with Wake TBTT Negotiation subfield = 1	Alternate TWT with Broadcast subfield = 1	No active broadcast TWT agreement has been created with the TWT parameters indicated in the initiating frame. The responder is offering an alternative set of parameters vs. those indicated in the initiating frame, as a means of negotiating TWT parameters with the requester. The requesting STA can send a new request with any set of TWT parameters and the responder might entertain the creation of a new broadcast TWT agreement using those parameters.
Suggest TWT or Demand TWT with Wake TBTT Negotiation subfield = 1	Alternate TWT with Broadcast subfield = 1	This response is not allowed.
Suggest TWT or Demand TWT with Wake TBTT Negotiation subfield = 1	Dictate TWT with Broadcast subfield = 1	An active broadcast TWT agreement is either created or already exists and is using the TWT parameters identified in the responding frame. The responding STA will not create any new broadcast TWT agreement with the requester at this time
Suggest TWT or Demand TWT with Wake TBTT Negotiation subfield = 1	Reject TWT with Broadcast subfield = 1	No new active broadcast TWT agreement is created and the responding STA will not create any new broadcast TWT agreement at this time.
Accept TWT or Alternate TWT or Dictate TWT or Reject TWT with Wake TBTT Negotiation subfield = 0	No frame transmitted	This exchange is not allowed.
Accept TWT with Wake TBTT Negotiation subfield = 1	No frame transmitted	A broadcast TWT agreement exists and is using the TWT parameters identified in the initiating frame.
Alternate TWT or Dictate TWT with Wake TBTT Negotiation subfield = 1	No frame transmitted	The TWT parameters of the existing broadcast TWT agreement identified by the TWT Flow ID and the TA of the initiating frame have been updated to the values of the TWT parameters of the initiating frame.
Reject TWT with Wake TBTT Negotiation subfield = 1	No frame transmitted	The broadcast TWT agreement identified by the TWT Flow ID and the TA of the initiating frame frame is terminated.
Reject TWT with Wake TBTT Negotiation subfield = 0	No frame transmitted	The individual TWT agreement identified by the TA, RA pair of the transmitted frame and with the corresponding TWT Flow ID is terminated.
NOTE 1—Initiating frames are all required to have Broadcast subfield value of 0. NOTE 2—Request frame settings not listed in the table are not allowed.		

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11. MLME

11.2 Power management

11.2.2 Power management in a non-DMG infrastructure network

11.2.2.17 TIM Broadcast

(#152)Change the 11th paragraph as follows:

The AP shall increase the value (modulo 256) of the Check Beacon field in the next transmitted TIM frame(s) when a critical update occurs to any of the elements inside the Beacon frame. The following events shall classify as a critical update:

a) Inclusion of a Channel Switch Announcement element
b) Inclusion of an Extended Channel Switch Announcement element
c) Modification of the EDCA parameters element
d) Inclusion of a Quiet element
e) Modification of the DSSS Parameter Set
f) Modification of the CF Parameter Set element
g) Modification of the HT Operation element
h) Inclusion of a Wide Bandwidth Channel Switch element
i) Inclusion of a Channel Switch Wrapper element
j) Inclusion of an Operating Mode Notification element
k) Inclusion of a Quiet Channel element
l) Modification of the VHT Operation element
m) Modification of an HE Operation element
n) Inclusion of a Broadcast TWT element

11.23 Tunneled direct-link setup

11.23.1 General

Change as follows:

The VHT Operation element shall be present in a TDLS Setup Confirm frame when both STAs are VHT capable and the TDLS direct link is not established in the 2.4 GHz band. When the TDLS Setup Confirm frame includes a VHT Operation element, the Basic VHT-MCS And NSS Set field is reserved.

The HE Operation element shall be present in a TDLS Setup Confirm frame when both STAs are HE capable.(#1352)

11.24 Wireless network management procedures

11.24.6 Fine timing measurement procedure

11.24.6.4 Measurement exchange

Change the 10th paragraph as follows:

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For the Fine Timing Measurement frames transmitted during the FTM session:

- The responding STA shall not use a bandwidth wider than that indicated by the STA in the initial Fine Timing Measurement frame.
- The responding STA shall not use an HE format if the STA indicated VHT or HT-mixed or non-HT format in the initial Fine Timing Measurement frame.(#1352)
- The responding STA shall not use a VHT format if the STA indicated HT-mixed or non-HT format in the initial Fine Timing Measurement frame.
- The responding STA shall not use an HT format if the STA indicated non-HT format in the initial Fine Timing Measurement frame.

Insert a new subclause 11.49 at the end of Clause 11:

11.49 HE BSS operation

11.49.1 AID assign rule

If the value of Partial BSS Color field is set to 1, then the HE AP shall allocate AIDs according to the formula for AID (5: 8)

$$AID(5:8) = bin[(BCB(0:3) - (BSSID(44:47) \oplus BSSID(40:43))) \bmod 2^4, 4]$$

where *BCB*(0:3) stands for the least significant 4 BSS color bits and *bin*[x, 4] is the operator that casts decimal value *x* into 4 bits binary vector.(MAC Motion #88)

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17. Orthogonal frequency division multiplexing (OFDM) PHY specification

17.2 OFDM PHY specific service parameter list

17.2.2 TXVECTOR parameters

17.2.2.1 General

(#2115)Insert a new last row into Table 17-1 (TXVECTOR parameters) as follows:

Table 17-1—TXVECTOR parameters

Parameter	Associated primitive	Value
TRIGGER_RESPONDING	PHY-TXSTART.request (TXVECTOR)	If present, false or true. When true, the MAC entity requests that the PHY entity does synchronization as defined in 17.3.9.10 (Pre-correction accuracy requirements). When false, the MAC entity requests that the PHY entity does not have to do synchronization as defined in 17.3.9.10 (Pre-correction accuracy requirements).

(#2115)Insert a new subclause at the end of 17.2.2 as follows:

17.2.2.6 TRIGGER_RESPONDING

If present, the allowed values are false or true. A parameter value of true indicates that the MAC sublayer is requesting that the PHY entity does synchronization as defined in 17.3.9.10 (Pre-correction accuracy requirements). A parameter value of false indicates that the MAC sublayer is requesting that the PHY entity does not do synchronization as defined in 17.3.9.10 (Pre-correction accuracy requirements).

17.3 OFDM PHY

17.3.9 PHY transmit specifications

(#2115)Insert a new subclause at the end of 17.3.9 as follows:

17.3.9.10 Pre-correction accuracy requirements

A STA that transmits a PPDU where the TXVECTOR parameter TRIGGER_RESPONDING is true shall pre-compensate for carrier frequency offset (CFO) error and symbol clock error. After compensation, the absolute value of residual CFO error with respect to the PPDU carrying the soliciting MU-RTS frame shall not exceed 2 kHz when measured as the 10% point of CCDF of CFO errors in AWGN at a received power of –60 dBm in the primary 20 MHz. The residual CFO error measurement shall be made on the non-HT PPDU or non-HT duplicate PPDU following the L-STF field. The symbol clock error shall be pre-compensated by the same ppm amount as CFO error.

A STA that transmits an non-HT or non-HT duplicate PPDU where the TXVECTOR parameter TRIGGER_RESPONDING is true shall have timing accuracy of ±0.4 μs relative to the PPDU carrying the MU-RTS frame. This requirement does not include round trip delay. This requirement is the same as the timing requirement for HE trigger based PPDU.

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Insert new Clauses 25 and 26 following Clause 24 as follows:

25. High Efficiency (HE) MAC specification

25.1 Introduction

The use of HCCA and TSPEC are banned at HE STAs.(#2414)

25.2 Channel Access

25.2.1 Intra-BSS and inter-BSS frame detection

An HE STA(#2331) determines whether a received(#1577) frame is an inter-BSS or an intra-BSS frame by using the RXVECTOR parameters (e.g., BSS_COLOR in HE PPDUs or GROUP_ID and PARTIAL_AID in VHT PPDUs)(#186)(#2434) or MAC address(#1575).

A frame received(#1577) by the STA is an intra-BSS frame if one of the following conditions is true:

— The RXVECTOR parameter BSS_COLOR(#2435) in the received PPDU carrying the frame(#1577) is the same as the BSS color announced by the AP to which the STA is associated

— The RA field, TA field or BSSID field(#2438)(#2662) of the received(#1577) frame with the Individual/Group bit forced to the value 0(#447) is the same as the BSSID of AP to which the STA is associated(#608)

— The AP to which the STA is associated is a member of a Multiple BSSID Set with two or more members(#703)(#257)(#2332) and the RA field, TA field or BSSID field(#2438, #2662) of the received(#1577) frame with the Individual/Group bit forced to the value 0(#447) is same as the BSSID of any member of the Multiple BSSID Set

— The RXVECTOR parameter PARTIAL_AID in the received VHT PPDU with the RXVECTOR parameter GROUP_ID equal to 0 is the same as the BSSID[39:47] of the AP to which the STA is associated(#2437)

— The value of RXVECTOR parameter PARTIAL_AID [5:8] in the received VHT PPDU with the RXVECTOR parameter GROUP_ID equal to 63 is the same as the partial BSS color announced by the AP to which the STA is associated when the Partial BSS Color field in the most recently received HE Operation element is 1.(#705)(#2436)(MAC Motion #88)

A frame received by the STA is an inter-BSS frame if one of the following conditions is true(#62)(#2718):

— The RXVECTOR parameter BSS_COLOR of the PPDU carrying the frame is not 0 and does not match the BSS color announced by the AP to which the STA is associated

— When the RXVECTOR parameter BSS_COLOR of the PPDU carrying the frame is not present:

  • The BSSID field of the received frame with Individual/Group bit forced to the value 0, if available, does not match the BSSID of AP to which the STA is associated
  • If the BSSID field is not available, both the RA and TA fields exist, and none of the address fields of the received frame with Individual/Group bit forced to the value 0 match the BSSID of AP to which the STA is associated(#Ed)

— The AP to which the STA is associated is a member of a Multiple BSSID Set with two or more members and the BSSID field of the received frame with Individual/Group bit forced to the value 0, if available, does not match the BSSID of any member of the Multiple BSSID Set

— If the AP to which the STA is associated is a member of a Multiple BSSID Set with two or more members, the BSSID field is not available, both the RA and TA fields exist, and none of the address

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fields of the received frame with the Individual/Group bit forced to the value 0 match the BSSID of any member of the Multiple BSSID Set(#Ed)

— The RXVECTOR parameter PARTIAL_AID of the received VHT PPDU frame with the RXVECTOR parameter GROUP_ID equal to 0 is different from the BSSID[39:47] of the AP to which the STA is associated(#2439)

— The value of RXVECTOR parameter PARTIAL_AID [5:8] in the received VHT PPDU with the RXVECTOR parameter GROUP_ID equal to 63 is different from the partial BSS color announced by the AP to which the STA is associated when the Partial BSS Color field in the most recently received HE Operation element is 1.(#705)(#2439)(MAC Motion #88)

— An HE AP receives either a VHT MU PPDU or an HE MU PPDU.(#2440)

If the received frame satisfies both intra-BSS and inter-BSS conditions, the decision made by using the MAC address takes precedence over the decision made by using the RXVECTOR parameter BSS_COLOR (#640)(#2661)(#776).

If the received frame does not satisfy any of the intra-BSS and inter-BSS conditions, then the frame cannot be determined as intra-BSS or inter-BSS frame(#62).

25.2.2 Updating two NAVs

An HE non-AP STA shall maintain two NAV timers. An HE AP STA may maintain two NAV timers.(#2316)

The requirements in 10.3.2.1 (CS mechanism) applies to an HE STA maintaining two NAVs with the exception of virtual CS indication of medium. For an HE STA maintaining two NAVs, if both the NAV timers are 0, the virtual CS indication is that the medium is idle; if one of the two NAV timers is nonzero, the virtual CS indication is that the medium is busy.(#1775)

For the two NAVs maintained by an(#2829) HE STA, one is identified as intra-BSS(#1465) NAV, and the second one is identified as regular NAV. Intra-BSS NAV is used to store NAV value, if needed, from a PPDU identified as intra-BSS. Regular NAV is used to store NAV value, if needed, from a PPDU identified as inter-BSS or cannot be identified as intra-BSS or inter-BSS.(#1742) Note that the method of identifying a PPDU as intra-BSS or inter-BSS is described in 25.2.1 (Intra-BSS and inter-BSS frame detection).(#1466)

(#164)The duration information is indicated by a frame in a PSDU as follows:

— If there is a Duration field in the frame, then the duration information is indicated by the Duration field(#164)

— If the frame is PS-Poll, then the duration information is equal to the time, in microseconds, required to transmit one Ack frame plus one SIFS under the data rate selection rules. If the calculated duration information includes a fractional microsecond, that duration information is rounded up to the next higher integer.(#1759)

A STA shall update the intra-BSS NAV with the duration information indicated by the received frame in a PSDU if and only if all the following conditions are met:(#164)

— The frame is identified as intra-BSS according to the rule described in 25.2.1 (Intra-BSS and inter-BSS frame detection)(#164)(#1466)

— The indicated duration information is greater than the STA's current intra-BSS NAV value(#164)

— The STA is not solicited an immediate response by the PPDU carrying the frame.(#2905)

A STA shall update the regular NAV with the duration information indicated by the received frame in a PSDU if and only if all the following conditions are met:(#164)

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- The frame is identified as inter-BSS or cannot be identified as intra-BSS or inter-BSS according to the rule described in 25.2.1 (Intra-BSS and inter-BSS frame detection)(#164)(#1466)
- The indicated duration information is greater than the STA's current regular NAV value(#164)
- The STA is not solicited an immediate response by the PPDU carrying the frame.(#2905)

A STA shall update the intra-BSS NAV with the duration information indicated by the RXVECTOR parameter TXOP_DURATION if and only if all the following conditions are met:(#164)

- The RXVECTOR parameter TXOP_DURATION is not set to all 1s(#164)
- The PPDU that carried information of the RXVECTOR parameter is identified as intra-BSS or cannot be identified as intra-BSS or inter-BSS(#632) according to the rule described in 25.2.1 (Intra-BSS and inter-BSS frame detection)(#164)(#1466)
- The STA does not receive a frame with the duration information indicated by a Duration field in the PSDU of the PPDU carrying the RXVECTOR parameter TXOP_DURATION(#164)
- The duration information indicated by the RXVECTOR parameter TXOP_DURATION is greater than the STA's current intra-BSS NAV(#164)
- The PPDU that carried information of the RXVECTOR parameter is not an HE trigger-based PPDU triggered by the STA(#2473)

A STA shall update the regular NAV with the duration information indicated by the RXVECTOR parameter TXOP_DURATION if and only if all the following conditions are met:(#164)

- The RXVECTOR parameter TXOP_DURATION is not set to all 1s(#164)
- The PPDU that carried information for the RXVECTOR parameter is identified as inter-BSS according to the rule described in 25.2.1 (Intra-BSS and inter-BSS frame detection)(#164)(#1466)
- The STA does not receive a frame with the duration information indicated by a Duration field in the PSDU of the PPDU carrying the RXVECTOR parameter TXOP_DURATION(#164)
- The duration information indicated by the RXVECTOR parameter TXOP_DURATION is greater than the STA's current regular NAV(#164)

NOTE 1—If a PS-Poll is received carried in a received HE SU PPDU, HE extended range SU PPDU, or HE MU PPDU, then the RXVECTOR parameter TXOP_DURATION does not indicate duration information (see 25.12 (TXVECTOR parameter TXOP_DURATION for an HE PPDU(#2596)).(#1759)

NOTE 2—Based on the setting rule, if a STA receives a frame with the duration information indicated by both a Duration field in the PSDU and the RXVECTOR parameter TXOP_DURATION, then the duration information indicated by the RXVECTOR parameter TXOP_DURATION is ignored.(#164)(#1744)

NOTE 3—The additional rules of NAV consideration for a STA that is solicited for an immediate response are described in 10.3.2.7 (CTS and DMG CTS procedure), 10.3.2.9 (Acknowledgment procedure), and 25.5.2.4 (UL MU CS mechanism).(#2905)

Various additional conditions may set or reset the intra-BSS NAV or regular NAV, as described in 10.4.3.3 (NAV operation during the CFP). When one NAV is reset, if the other NAV timer is 0, a PHY-CCARESET.request primitive shall be issued. The exact time of updating the NAVs uses the same rule as defined in 10.3.2.4 (Setting and resetting the NAV).(#1775)(#966)

A STA that maintains two NAVs has the capability to maintain NAV set by intra-BSS PPDU and inter-BSS PPDU separately. Maintaining two NAV is beneficial in dense deployment scenarios where a STA requires protection from frames transmitted by STAs within its BSS, i.e., intra-BSS, and avoid interference from frames transmitted by STAs in neighboring BSS, i.e., inter-BSS. For example, in a TXOP initiated by the associated AP for UL MU transmission, the intra-BSS NAV of the STA can be set by the AP to prevent the STA from contending the channel, and the regular NAV will not be updated by the associated AP so that NAV set by inter-BSS PPDU can be considered in UL MU CS as described in 25.5.2.4 (UL MU CS mechanism).(#1743)

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An HE STA that used information from an RTS or MU-RTS frame as the most recent basis to update its NAV setting is permitted to reset the NAV which is updated by the RTS or MU-RTS if no PHY-RXSTART.indication primitive is received from the PHY during a period with a duration of 2 × aSIFSTime + CTS_Time + aRxPHYStartDelay + 2 × aSlotTime starting when the MAC receives a PHY-RXEND.indication primitive corresponding to the detection of the RTS or MU-RTS frame.(MAC Motion #89)

25.2.3 Obtaining an EDCA TxOP for UL MU capable STAs

(MAC Motion #91)An UL MU capable non-AP HE STA that receives a Basic Trigger frame that contains a Per User Info field with the AID of the STA, and that receives an immediate response from the AP for the transmitted Trigger-based PPDU, shall:

— Update its CWmin[AC], CWmax[AC] and AIFSN[AC] state variables to the values contained in the most recently received MU EDCA Parameter Set element sent by the AP to which the STA is associated, for all the ACs from which QoS Data frames were transmitted in the HE trigger-based PPDU.

— Update its HEMUEDCATimer state variable to the values contained in the most recently received MU EDCA Parameter Set element sent by the AP to which the STA is associated.

The HEMUEDCATimer shall uniformly count down to 0 when its value is nonzero.

NOTE—A non-AP STA that sends a frame to the AP with an OMI A-Control field containing a value of 1 in the UL MU Disable field does not participate in UL MU operation, as such it is exempt from updating its EDCA access parameters to the values contained in the MU EDCA Parameter Set element.

An UL MU capable non-AP HE STA may update its CWmin[AC], CWmax[AC] and AIFSN[AC] state variables for all ACs to the values contained in the most recently received EDCA Parameter Set element sent by the AP to which the STA is associated or to the default dot11EDCATable when an EDCA Parameter Set element has not been received when the HEMUEDCATimer reaches 0.

25.3 Fragmentation

25.3.1 General

An HE STA supports the static fragmentation procedure defined in 10.2.7 (Fragmentation/defragmentation overview), 10.5 (Fragmentation), and 10.6 (Defragmentation). In addition, an HE STA can support the dynamic fragmentation procedure defined in this subclause.(#1484)

An HE STA can dynamically fragment individually addressed MSDUs or MMPDUs and defragment received MPDUs as defined in this subclause, and using the fragmentation/defragmentation processes defined in 10.2.7 (Fragmentation/defragmentation overview) without being subject to the rules defined in that subclause. Dynamic fragmentation provides further flexibility in aggregating the data so that padding can be minimized (see 25.5 (MU operation))(#30).

25.3.2 Support and requirements for dynamic fragmentation

A dynamic fragment is an MPDU, the payload of which carries a portion of an MSDU or MMPDU. The generation of dynamic fragments follows the rules defined in 10.2.7 (Fragmentation/defragmentation overview) and 10.5 (Fragmentation), except for:

— Generation of dynamic fragments and their transmission within an MPDU or A-MPDU under HT-immediate block ack agreements is allowed for an HE STA under the conditions defined in 25.3.4 (Procedure at the recipient).(#2627)(#2626)

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— Reception of dynamic fragments is not mandatory. An HE STA declares its dynamic fragments reception capability in the HE Fragmentation Support field of the HE Capabilities element(#1471).

— The length of each fragment is not required to be equal for all fragments of the MSDU or MMPDU. The length of each fragment may be of any nonzero value, except that the length of the first fragment of an MSDU shall be greater than or equal to the minimum fragment size specified by the receiver STA in the Minimum Fragment Size subfield of the HE Capabilities element it transmits. An MSDU with a size that is less than the minimum fragment size shall not be fragmented.(#30)(#697)(#696)(#1470)(#165)

25.3.3 Procedure at the originator(#1484)

25.3.3.1 General(#Ed)

An originator STA transmitting an MPDU or A-MPDU that contains one or more dynamic fragments shall solicit an immediate response from the recipient STA for each of the fragments contained in the MPDU or A-MPDU, except when the fragments are sent under level 3 dynamic fragmentation (see 25.3.3.4 (Level 3 dynamic fragmentation(#1484))).(#2629)(#1794).

NOTE—The originator STA sends the fragments in order as defined in 10.5 (Fragmentation), except for level 3 dynamic fragmentation.

If the originator STA received explicit indications in response frames that none of the transmissions of previously transmitted fragment(s) of an MSDU or MMPDU have been successfully received then the STA may retransmit the full MSDU or MMPDU instead of retransmitting all the failed fragments. Otherwise, the originator STA may retransmit the failed fragment, in which case the frame body length and contents of the retransmitted fragment shall be the same as the first transmitted fragment and shall remain fixed for the lifetime of the MSDU or MMPDU at that STA.(#1225)

NOTE—An explicit indication is the absence of a valid Ack frame, BlockAck frame or Multi-STA BlockAck frame that is expected to be present in the first MPDU of the immediately received A-MPDU, or the absence of a BA Information field in the immediately received Multi-STA BlockAck frame for the TID of the transmitted fragment(s).(#1225)

An originator STA shall not transmit to a recipient STA an MPDU or A-MPDU containing dynamic fragments that do not satisfy the conditions in the subclauses below.(#1480)(#1479)(#1478)(#750)

25.3.3.2 Level 1 dynamic fragmentation(#1484)

An originator STA may transmit to a recipient STA an MPDU(#1472) or VHT single MPDU(#1473) that contains one dynamic fragment of an MSDU or MMPDU if the recipient STA has indicated a value 1 in the HE Fragmentation Support field of its HE Capabilities element. The originator STA shall follow the rules defined in 10.13.8 (Transport of VHT single MPDUs) for generating the VHT single MPDU.(#Ed)

25.3.3.3 Level 2 dynamic fragmentation(#1484)

An originator STA may transmit to a recipient STA, which has indicated a value 2 in the HE Fragmentation Support field of its HE Capabilities element, an MPDU, VHT single MPDU, or A-MPDU(#1473) that contains:

— One dynamic fragment of an MSDU or MMPDU in an MPDU or VHT single MPDU(#1474)
  - The originator STA shall follow the rules defined in 10.13.8 (Transport of VHT single MPDUs) for generating the VHT single MPDU

— Up to one dynamic fragment of an MSDU or MMPDU for each MSDU and for the MMPDU in an A-MPDU format(#1474)(#2464)

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- The originator STA shall follow the rules defined in 10.24.7.7 (Originator's behavior) for generating the A-MPDU and the rules defined in 25.10.4 (A-MPDU with multiple TIDs) for generating the multi-TID A-MPDU (that can contain the fragment of the MMPDU)(#1476)

25.3.3.4 Level 3 dynamic fragmentation(#1484)

An HE STA may transmit an L3 Frag BA Request frame to a receiver STA that has indicated a value of 3 in the HE Fragmentation Support field of the HE Capabilities element it transmits. The receiver STA that accepts the HT-Immediate block ack session shall respond with an L3 Frag BA Response if it has allocated resources for operating in a block ack session with level 3 fragmentation enabled. Otherwise, it shall respond with a BA Response frame to indicate that it has not allocated resources for operating in a block ack session where level 3 fragmentation is enabled.(#2268)(#2198)(#1800)(#1796)(#1663)

NOTE—A block ack session with level 3 fragmentation enabled requires a block acknowledgment record that maintains up to 4 bits per MSDU (one bit for each fragment of the MSDU).(#2268)(#2198)(#1800)(#1796)(#1663)

An originator STA may transmit to a recipient STA, which has indicated a value 3 in the HE Fragmentation Support field of its HE Capabilities element, an MPDU, VHT single MPDU, or A-MPDU(#1473) that contains:

— One dynamic fragment of an MSDU or MMPDU in an MPDU or VHT single MPDU(#1474)
  - The originator STA shall follow the rules defined in 10.13.8 (Transport of VHT single MPDUs) for generating the VHT single MPDU

— Up to four dynamic fragments of an MSDU(#1475) for each MSDU and up to one dynamic fragment of an MMPDU(#1476)(#1475)(#2465) in an A-MPDU
  - The originator STA shall set the Fragment Number subfield of each MPDU to a value less than 4
  - The originator STA shall follow the rules defined in 10.24.7.7 (Originator's behavior) for generating the A-MPDU with the exception that the A-MPDU shall contain MPDUs whose range of the Sequence Number subfields does not exceed $B_L/4$, where B_L is the length of the Block Ack Bitmap field of the BlockAck or Multi-STA BlockAck(#Ed) frame that corresponds to a TID of a transmitted fragment (see 10.24.7 (HT-immediate block ack extensions) and 25.4 (Block acknowledgement).(#697)(#Ed)(#166)(#1818)

25.3.4 Procedure at the recipient

25.3.4.1 General(#Ed)

An HE STA shall set the HE Fragmentation Support subfield of the HE Capabilities element it transmits to 0 if its dot11HEDynamicFragmentationImplemented is false. Otherwise the HE STA shall set the HE Fragmentation Support subfield as follows:

— Set to 1 if the STA supports reception of dynamic fragments following the procedure defined in 25.3.3.2 (Level 1 dynamic fragmentation(#1484))

— Set to 2 if the STA supports reception of dynamic fragments following the procedure defined in 25.3.3.3 (Level 2 dynamic fragmentation(#1484))

— Set to 3 if the STA supports reception of dynamic fragments following the procedure defined in 225.3.3.4 (Level 3 dynamic fragmentation(#1484))

(#1481)(#424)Defragmentation of dynamic fragments shall follow the rules defined in 10.6 (Defragmentation) with the following exceptions:(#Ed)

— The recipient STA shall support the concurrent reception of dynamic fragments of a number of *outstanding* MSDUs or MMPDUs from a transmitting STA that is equal to N_{max}, where N_{max} for MSDUs is indicated in the Maximum Number of Fragmented MSDUs subfield of the HE Capabilities element transmitted by the STA, and N_{max} is equal to 1 for MMPDUs. The term

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outstanding refers to an MPDU containing all or part of an MSDU or MMPDU for which transmission has been started, and for which delivery of the MSDU or MMPDU has not yet been completed (i.e., an acknowledgment of the final fragment has not been received and the MSDU or MMPDU has not been discarded due to retries, lifetime, or for some other reason). (#1482)(#697)(#167)(#1484)

— The recipient STA is not subject to the receive timer rules(#1483) for each of the MSDUs/MMPDUs defined in 10.6 (Defragmentation)(#2318).

25.3.4.2 Level 1 dynamic defragmentation

Upon reception of an MPDU or VHT single MPDU that carries one or more dynamic fragments, the recipient STA responds with an Ack frame when the received fragment is contained in an MPDU or VHT single MPDU that solicits the immediate response. The receiver STA shall follow the rules defined in 10.3.2.9 (Ack procedure) for generating the Ack frame and the rules defined in 25.4 (Block acknowledgement) for generating the Multi-STA BlockAck frame that contains the acknowledgement for the soliciting VHT single MPDU carried in a Trigger-based PPDU(#1793)(#2628).

25.3.4.3 Level 2 dynamic fragmentation(#1484)

Upon reception of an MPDU or A-MPDU that carries one or more dynamic fragments, the recipient STA responds with one of the following frames:

— An Ack frame when the received fragment is contained in an MPDU or VHT single MPDU that solicits the immediate response. The recipient STA shall follow the rules defined in 10.3.2.9 (Ack procedure) for generating the Ack frame and the rules defined in 25.4 (Block acknowledgement) for generating the Multi-STA BlockAck frame that contains the acknowledgement for the soliciting VHT single MPDU carried in a HE trigger-based PPDU(#1793)(#2628).

— A BlockAck frame when the received fragments, up to one fragment for each MSDU, are contained in an A-MPDU that solicits an immediate response(#1820)(#1485). The recipient STA shall follow the rules defined in 10.24.7.5 (Generation and transmission of BlockAck frames by an HT STA or DMG STA) for generating the BlockAck frame and the rules in 25.4 (Block acknowledgement) for generating the Multi-STA BlockAck frame(#1793), except that the STA shall:

- Set to 0 the LSB of the Fragment Number subfield in the Block Ack Starting Sequence Control subfield of the BlockAck frame or Multi-STA BlockAck(#Ed) frame that corresponds to a TID of a received fragment(#967)
- Set to 1 each bit of the Block Ack Bitmap field that corresponds to a Sequence Number subfield and TID subfield of a successfully received fragment contained in the soliciting A-MPDU or multi-TID A-MPDU
- Update the corresponding block ack record(#1486)(#Ed) only when an MSDU that is received in fragments is successfully reconstructed (see 10.6 (Defragmentation)) otherwise it shall not update the block ack record(#Ed) for that MSDU.(#1793)(#1217)

A recipient STA shall discard any fragments that have been received during an HT-immediate BA session for a TID if it receives a BlockAckReq(#Ed) frame from the originator STA for that TID when the fragments have a Sequence Number field value that is less than the value of the Starting Sequence Number field of the BlockAckReq(#Ed) frame (where the comparison of the two values is performed modulo 4096)(#1662)(#2197)(#1217).

25.3.4.4 Level 3 dynamic fragmentation(#1484)

Upon reception of an MPDU or A-MPDU that carries one or more dynamic fragments, the recipient STA responds with one of the following frames:

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— An Ack frame when the received fragment is contained in an MPDU or VHT single MPDU that solicits the immediate response. The recipient STA shall follow the rules defined in 10.3.2.9 (Ack procedure) for generating the Ack frame and the rules defined in 25.4 (Block acknowledgement) for generating the Multi-STA BlockAck frame that contains the acknowledgement for the soliciting VHT single MPDU carried in a Trigger-based PPDU(#1793)(#2628).

— A BlockAck frame when the received fragments, one or more fragments for each MSDU, are contained in an A-MPDU where at least one MPDU's Fragment Number field is of non-zero value(#2268) that solicits the immediate response and is sent during a BA session that was setup with an L3 FRAG ADDBA Response frame(#2268). The recipient STA shall follow the rules in 10.24.7.5 (Generation and transmission of BlockAck frames by an HT STA or DMG STA) for generating the BlockAck frame, except that the STA shall:

  - Set to 1 the LSB of the Fragment Number subfield in the Block Ack Starting Sequence Control subfield of the BlockAck frame or Multi-STA BlockAck frame that corresponds to a TID of a received fragment
  - Set to 1 each bit in position(#1488) *B*(#633) of the Block Ack Bitmap field that corresponds to a successfully received fragment and shall set it to 0 otherwise, with *B*(#633) calculated as:
    $B = 4 \times (SN - SSN) + FN$, where the operations on the sequence numbers are performed module 4096(#675)(#2270)(#2254)(#1624)(#1491)(#1489)
    SN is the value of the Sequence Number subfield of an MPDU containing the fragment for which the receive status is indicated
    SSN is the value of the Starting Sequence Number subfield of the Block Ack Starting Sequence Control subfield of the BlockAck frame
  - Update the corresponding block ack record(#1486) only when an MSDU that is received in fragments is successfully reconstructed (see 10.6 (Defragmentation)). Otherwise it shall not update the block ack record for that MSDU.(#1793)(#1217)

The(#Ed) recipient STA shall discard any fragments that have been received during an HT-immediate BA session for a TID if it receives a BlockAckReq(#Ed) frame from the originator STA for that TID when the fragments have a Sequence Number field value that is less than the value of the Starting Sequence Number field of the BlockAckReq(#Ed) frame (where the comparison of the two values is performed modulo 4096)(#1662)(#2197)(#1217).

25.4 Block acknowledgement

25.4.1 Overview

(#168)An HE STA can use Compressed BlockAck frame or Multi-STA BlockAck frame after setting up a block ack agreement(#Ed). An HE STA shall support generation of Compressed BlockAck frames if HT-immediate BA is supported in the role of recipient (see 10.24.7.1 (Introduction). An HE STA shall support generation of Multi-STA BlockAck frame if either UL MU operation (see 25.5.2 (UL MU operation)) or multi-TID A-MPDU operation (25.10.4 (A-MPDU with multiple TIDs)) is supported in the role of recipient(#1495).

A HE AP should only transmit a group addressed Multi-STA BlockAck frame in a DL MU PPDU to a non-AP HE STA *n* on the (broadcast RU) RU (26/52/106/242/484/996) that includes the RU used for receiving the immediate preceding HE trigger-based PPDU from STA *n*. There shall be no more than one Multi-STA BlockAck frame that is addressed to multiple recipients carried in a broadcast RU of the DL MU PPDU.(MU Motion #59)

An HE non-AP STA that sends a Multi-STA BlockAck frame shall set the AID subfield in the Per STA Info field of the Multi-STA BlockAck frame to 0 and the RA field to the BSSID when the intended receiver of the frame is the AP.(#1664)

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When sending Multi-STA BlockAck frame, the HE STA shall transmit the Multi-STA BlockAck using one of rate, MCS, NSS that all of the acknowledgement receivers support.

An HE STA may send a Multi-STA BlockAck frame in response to an HE trigger-based PPDU. A Multi-STA BlockAck frame contains one or more BA Information fields with one or more AIDs and one or more different TIDs. An HE AP that transmits a Multi-STA BlockAck frame with different AID subfield values shall set the RA field to the broadcast address. An HE AP that transmits a Multi-STA BlockAck frame with a single AID subfield or with the same values of the AID subfield in Per STA Info subfields shall set the RA field to the address of the recipient STA that requested the Block Ack or to the broadcast address. An HE non-AP STA shall transmit a Multi-STA BlockAck frame with a single AID subfield or with the same values of the AID subfield in Per STA Info subfields and shall set the RA field to the address of the recipient STA that requested the Block Ack frame.(#1493)(#2212)

An HE STA that supports Multi-STA BlockAck shall examine each received Multi-STA sent by an STA with which it has a BA agreement. On receiving such a Multi-STA BlockAck frame a STA performs the following for each BA Information field with its AID:

— If the Ack Type(#1408) field is 0 then the Block Ack Starting Sequence Control(#1490), TID and Block Ack Bitmap fields(#Ed) of the STA Info field are processed according to 10.24.7 (HT-immediate block ack extensions) and 25.3 (Fragmentation).(MAC Motion #87)

— If the Ack Type(#1408) field is 1, then the STA Info field indicates either the acknowledgement of a single MPDU identified by the value of the TID or of all MPDUs carried in the eliciting PPDU, when the TID field is set to 14.(MAC Motion #87)

Editor's Note: Instruction in 16/1241r2 is "Insert the following at the end of subclause 25.4.5". No such subclause.

(#567)An HE STA that receives a BlockAckReq(#Ed) frame or a MU-BAR(#Ed) variant Trigger frame that contains a Compressed BlockAckReq variant in the User Info field addressed to the STA shall respond with a BlockAck frame as defined in 10.24.7 (HT-immediate block ack extensions) or a Multi-STA BlockAck frame as defined in 25.4 (Block acknowledgement).

An HE STA that receives a Multi-TID BlockAckReq(#Ed) frame or a MU-BAR(#Ed) variant Trigger frame that contains a Multi-TID BlockAckReq variant in the User Info field addressed to the STA shall respond with a Multi-STA BlockAck frame that contains a STA Info subfield with a Block Ack Bitmap subfield for each of the TIDs (with values less than 8) contained in the BlockAckReq frame and the length of each Block Ack Bitmap subfields shall be equal to the solicited Bitmap length (i.e., FN subfields in solicited Block Ack Request Starting Sequence Control and responding Block Ack Starting Sequence Control for the same TID are equal).

25.4.2 Acknowledgement, block acknowledgment or all acknowledgement selection in a Multi-STA BlockAck frame

A recipient sets the Ack Type and TID subfields in a Per AID TID Info field of the Multi-STA BlockAck frame sent as a response depending on the acknowledgement context.

a) All Ack context: if the originator had set the All Ack Supported subfield to 1 in the HE Capabilities element, then the recipient may set the Ack Type field to 1 and the TID subfield to 14 to indicate the successful reception of all the MPDUs intended to it carried in the eliciting A-MPDU or multi-TID A-MPDU only. Otherwise the recipient shall not set the Ack Type field to 1 and the TID subfield to 14. The Multi-STA BlockAck frame shall contain only one Per STA Info field addressed to an originator in the Multi-STA BlockAck frame.

b) Ack context: A recipient receiving a single MPDU, that requires an acknowledgment, shall set the Ack Type field to 1 and the TID field to the TID value of that MPDUs to indicate the successful reception of that MPDU.

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If multiple single MPDUs in a Multi-TID A-MPDUs are received by a recipient that supports its reception, the Multi-STA BlockAck frame may contain multiple occurrences of these Per STA Info fields that are intended to an originator, one for each successfully received single MPDU requesting an acknowledgment.

The allowed values for the TID field in this context are 0 to 7 (for indicating acknowledgement of QoS Data or QoS Null frames) or 15 (for indicating acknowledgement of an Action frame).

c) BlockAck context: The recipient shall set the Ack Type field to 0 and the TID field of a Per STA Info field to the TID value of MPDUs requesting block acknowledgement that are carried in the eliciting A-MPDU or multi-TID A-MPDU.

The Multi-STA BlockAck frame may contain multiple occurrences of these Per STA Info fields addressed(#Ed) to an originator, one for each MPDU that is requesting block acknowledgement, in which case the Block Ack Starting Sequence Control and Block Ack Bitmap fields shall be set according to 10.24.7 (HT-immediate block ack extensions) for each block ack session, and according to 25.3 (Fragmentation) for each block ack session with dynamic fragmentation.

The allowed values for the TID field in this context are 0 to 7 (for indicating block acknowledgement of QoS Data frames).

Variable bitmap lengths can be included in the Per STA Info field when the originator and recipient negotiate their use as defined in 25.4.3 (Negotiation of block ack bitmap lengths).

An originator(#168) shall examine each received Multi-STA BlockAck frame(#Ed)(#1900)(#2319) sent by an STA as a response to a soliciting PPDU.

Upon reception of the Multi-STA BlockAck frame the originator performs the following operations for each(#31) Per STA Info field that has an AID field addressed(#Ed) to the originator (i.e., the AID subfield is an AID if the originator is a non-AP STA and is 0 when the originator is an AP):

— If the ACK Type field is 0(#2185) then the BlockAck Starting Sequence Control, TID and BA Bitmap fields of the Per STA Info field are processed according to 10.24.7 (HT-immediate block ack mechanism), (#1498)25.3 (Fragmentation), and as defined below.

— If the ACK Type field is 1(#2185) then the Per STA Info field indicates either the acknowledgement of a single MPDU identified by the value of the TID or of all MPDUs(#1500) carried in the eliciting PPDU as defined by the acknowledgement context.

25.4.3 Negotiation of block ack bitmap lengths

Both the Compressed BlockAck frame and Multi-STA BlockAck frame allow different Block Ack Bitmap subfield lengths. The length of the Block Ack Bitmap subfield is indicated in the Fragment Number subfield of the Block Ack Starting Sequence Control field as defined in 9.3.1.9 (BlockAck frame format). The Block Ack Bitmap subfield length of a BlockAck frame used during a BA session depends on the negotiated buffer size between the originator and the recipient as indicated below:

— When a Compressed BlockAck frame is used:
  - If the negotiated buffer size is within [1, 64] then a BlockAck Bitmap length of 64 shall be used during the BA session
  - If the negotiated buffer size is within [1, 256] then a BlockAck Bitmap length of either 64 or 256 shall be used during the BA session

— When a Multi-STA BlockAck frame is used:
  - If the negotiated buffer size is within [1, 64] then a BlockAck Bitmap length of either 32 or 64 shall be used during the BA session

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- If the negotiated buffer size is within [1, 128] then a BlockAck Bitmap length of 32, 64 or 128 shall be used during the BA session
- If the negotiated buffer size is within [1, 256] then a BlockAck Bitmap length of 32, 64, 128 or 256 shall be used during the BA session

The recipient shall not include in the Buffer Size field of an ADDBA Response frame a value that would cause the BlockAck Bitmap length of its block ack responses to exceed the BlockAck Bitmap length that is derived by the Buffer Size field of the ADDBA Request frame sent by the originator.

A recipient shall not include in a transmitted Multi-STA BlockAck frame a BlockAck Bitmap field of size 32 bits that is intended to a STA that has not declared support of its reception in the HE Capabilities element it transmits.

NOTE—The recipient can include in the Multi-STA BlockAck frame BlockAck Bitmap fields of 32 bits for other intended recipients that declare reception support and the nonsupporting recipient needs to parse these fields to be able to locate the block ack information that is intended to it.

A recipient that is the intended receiver of an (multi-TID) A-MPDU, (multi-TID) BlockAckReq frame or MU-BAR variant Trigger frame that solicits an immediate BlockAck frame response for each TID shall follow the rules defined in 10.24.7 (HT-immediate block ack extensions) except that:

— *WinSizeR* is set to the smaller of *BitmapLength* and the value of the Buffer Size field of the associated ADDBA Response frame that established the block ack agreement, where the *BitmapLength* is the largest value for the BlockAckBitmap that can be used by the recipient

— The Starting Sequence Number subfield of the Block Ack Starting Sequence Control subfield shall be set to any value in the range from (*WinEndR* − *BitmapLength* + 1) to *WinStartR*

— The values in the recipient's record of status of MPDUs beginning with the MPDU for which the Sequence Number subfield value is equal to *WinStartR* and ending with the MPDU for which the Sequence Number subfield value is equal to *WinEndR*, wherein the length of the BlockAck Bitmap field shall be greater than or equal to the smallest *BitmapLength* that is greater than *WinEndR* − *WinStartR*

NOTE 1—An HE STA follows the rules in 10.24.7 (HT-immediate block ack extensions) where the value 64 is replaced with *BitmapLength*, and the value 63 is replaced with *BitmapLength* minus 1.

NOTE 2—An HE STA can generate a Block Ack frame with variable length Block Ack Bitmap field in which case the STA ensures that the Block Ack frame response fits within the remaining duration of the TXOP.(#Ed)

(#1498)If the HE Fragmentation Support subfield in the HE Capabilities element it transmits is 3, then the LSB of the Fragment Number subfield of the BA frame may be set to 1. If the LSB of the Fragment Number subfield of the BA frame is set to 1, then the BA Bitmap fields are re-mapped as defined in 25.3 (Fragmentation).

25.4.4 Per-PPDU acknowledgment selection rules

25.4.4.1 General

A STA that sends a PPDU to an intended recipient can solicit different immediate responses by using the Ack Policy field of QoS Data or QoS Null frames, the type of the frame (e.g., Action, (multi-TID) BAR, MU-BAR variant Trigger frame, etc.) and the EOF field setting when these frames are carried in an A-MPDU or multi-TID A-MPDU.

An HE AP may solicit BlockAck frame(#Ed) responses from multiple HE STAs using a MU-BAR variant Trigger frame. If an MU-BAR variant Trigger frame is aggregated in an A-MPDU then no other BlockAckReq frames shall be present in the same A-MPDU. The MU-BAR variant Trigger frame shall contain either Compressed BlockAckReq(#Ed) variant or Multi-TID BlockAckReq(#Ed) variant in each of

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the Per User Info fields. An HE AP shall not send a Multi-TID BlockAckReq(#Ed) (neither as part of a Per User Info field intended to the STA in an MU-BAR variant Trigger frame nor as a BAR frame) to a STA that has not indicated support for multi-TID A-MPDU. (Multi-TID) BlockAckReq, BlockAckReq, and MU-BAR variant Trigger frames indicate the length of the soliciting block ack responses according to the FN settings defined in 9.3.1.9 (BlockAck frame format).

25.4.4.2 DL MU PPDU soliciting an SU PPDU response

An AP that sends a DL MU PPDU that intends to solicit an immediate response carried in an SU PPDU shall set the Ack Policy to Normal Ack (or Implicit BAR) for at most one of the (A-)MPDUs contained in the soliciting DL MU PPDU (see 10.3.2.11.2 (MU acknowledgement procedure for DL MU PPDU in SU format) for an example of this sequence). The AP shall not solicit an immediate response for any of the other (A-) MPDUs carried in the DL MU PPDU. The A-MPDUs carried in the soliciting DL MU PPDU shall not contain an Action frame or a MMPDU that solicits a response. A non-AP STA that receives a DL MU PPDU that solicits an immediate response shall follow the following acknowledgment procedure:

1) If the DL MU PPDU carries a VHT Single MPDU intended to it with the Ack Policy equal to Normal Ack, then the STA shall respond with an Ack frame carried in an SU PPDU
2) If the DL MU PPDU carries an A-MPDU intended to it with the Ack Policy equal to Implicit BAR, then the STA shall respond with an Compressed BlockAck frame carried in an SU PPDU
3) If the DL MU PPDU carries a multi-TID A-MPDU intended to it with the Ack Policy equal to Implicit BAR, then the STA shall respond with a Multi-STA BlockAck frame carried in an SU PPDU

NOTE—The control response frame carried in SU PPDU format follows the rules defined in 10.7.6.5 (Rate selection for control response frames).

25.4.4.3 DL MU PPDU soliciting an HE trigger-based PPDU response(#Ed)

An AP that sends a DL MU PPDU that intends to solicit an immediate response carried in an HE trigger-based PPDU shall set the Ack Policy to MU Ack ('01') for each of the (A-)MPDUs for which it intends to solicit an immediate response (see 10.3.2.11.3 (MU acknowledgement procedure for HE MU PPDU in MU format) for an example of this sequence). An Action frame in the DL MU PPDU is always responded with an HE trigger-based PPDU. A non-AP STA that receives a DL MU PPDU that solicits an immediate response shall follow the following acknowledgment procedure:

1) If the DL MU PPDU carries a VHT Single MPDU intended to it that solicits an immediate response, and either an UL MU Response Scheduling A-Control field or a Trigger frame is present, then the STA shall respond with an Ack frame carried in the HE trigger-based PPDU sent as a response.
2) If the DL MU PPDU carries an A-MPDU intended to it that solicits an immediate response, and either a Trigger frame or UL MU Response Scheduling A-Control field is present, then the STA shall respond with a Compressed BlockAck frame carried in the HE trigger-based PPDU(#Ed) sent as a response.
3) If the DL MU PPDU carries a multi-TID A-MPDU intended to it that solicits an immediate response, and either a Trigger frame or an UL MU Response Scheduling A-Control field is present, then the STA shall respond with a Multi-STA BlockAck frame carried in the Trigger-based PPDU sent as a response.

25.4.4.4 HE trigger-based PPDU soliciting a DL SU PPDU response

A non-AP STA that sends an HE trigger-based PPDU as a response to a Basic variant Trigger frame that intends to solicit an immediate response shall set the Ack Policy to Normal Ack/Implicit BAR (see 10.3.2.11.4 (MU acknowledgement procedure for an UL MU transmission) for an example of this sequence). If the HE AP intends to send the response in a DL SU PPDU format, then the HE AP shall follow the following acknowledgment procedure:

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1) If the HE trigger-based PPDU carries a Single MPDU(11ah) from a single STA that solicits an immediate response, then the HE AP shall respond with an Ack frame or a Multi-STA BlockAck frame with ACK Type set to 1 carried in a DL SU PPDU format.
2) If the HE trigger-based PPDU carries an A-MPDU from a single STA that solicits an immediate response, then the HE AP shall respond with Compressed BlockAck frame or a Multi-STA Block Ack frame with Ack Type set to 0 carried in a DL SU PPDU format.
3) If the HE trigger-based PPDU carries a Multi-TID A-MPDU that solicits an immediate response from a single STA then the HE AP shall send a Multi-STA BlockAck frame carried in a DL SU PPDU format.

If the HE trigger-based PPDU carries Single MPDUs(11ah), A-MPDUs, or multi-TID A-MPDUs from more than one STA, or a combination of Single MPDUs(11ah) from a subset of STAs, A-MPDUs from another subset of STAs, or multi-TID A-MPDUs from another subset of STAs then the AP shall respond with a Multi-STA BlockAck frame carried in a DL SU PPDU format that contains the appropriate settings in each Per STA Info field intended to each STA as defined in the previous subclauses.

25.4.4.5 HE trigger-based PPDU soliciting a DL MU PPDU response

A non-AP STA that sends a HE trigger-based PPDU as a response to a Basic variant Trigger frame that intends to solicit an immediate response shall set the Ack Policy to Normal Ack/Implicit BAR (see 10.3.2.11.4 (MU acknowledgement procedure for an UL MU transmission) for an example of this sequence). If the HE AP intends to send the response in a HE MU PPDU format, then the HE AP shall follow the following acknowledgment procedure:

a) If the HE trigger-based PPDU carries Single MPDU(11ah) from more than one STAs, or (multi-TID) A-MPDU from more than one STAs, or a combination of Single MPDU(11ah) from some STAs and (multi-TID) A-MPDU from other STAs, then the HE-AP shall do one of the following:
   - The AP shall respond with Ack frame or an individually addressed Multi-STA BlockAck frame to each of the STAs from which a Single MPDU(11ah) that solicited an immediate response was received, and with a Compressed BlockAck frame or a Multi-STA BlockAck frame to each of the STAs from which an A-MPDU that solicited an immediate response was received, or a Multi-STA BlockAck frame to each of the STA from which a multi-TID A-MPDU that solicited an immediate response was received. The control response frames for each STA shall be sent in the allocated RU that is identified by the AID of each STA.
   - The AP may respond with group addressed Multi-STA BlockAck frame(s) using TBD mechanism in an HE MU PPDU if the receivers of group-addressed Multi-STA BlockAck frame announce the support the reception of MU Multi-STA BlockAck frame. The Ack Type field shall be set according to the acknowledgement context.(#1218).

25.5 MU operation

25.5.1 HE DL MU operation

25.5.1.1 General

HE DL MU operation allows an AP to transmit simultaneously to one or more non-AP STAs in DL OFDMA, DL MU-MIMO or both.

(#221)(#250)(#1502)(#1505)(#1901)An AP shall not transmit to a STA an(#2829) HE MU PPDU with the HE-SIG-B allocating spatial streams to more than one recipient STA, unless the STA sets the Downlink MU-MIMO On Partial Bandwidth Rx(#1507) subfield of the HE Capabilities element to 1.

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The transmission of each RU in an HE MU PPDU(#1507)(#1508) shall be padded to end at the same time, indicated by the L-SIG field as described in 26.3.10.5 (L-SIG).(#1903)

The padding procedure for each A-MPDU in an HE MU PPDU is defined in 25.10.3 (A-MPDU padding for an HE trigger-based PPDU(#1585)).

(#667)A STA shall not transmit a DL OFDMA With MIMO PPDU that contains a unicast RA that corresponds to a STA from which it has not received an HE Capabilities element with the DL OFDMA With MIMO Support field set to 1.

25.5.1.2 HE MU PPDU payload

(#427)The Type and Subtype subfields in the Frame Control field(#753)(#Ed) and address type (individually addressed or group addressed(#1509)) of MPDUs may be different across A-MPDUs in different RUs within a same HE MU PPDU(#598).

An AP shall not set more than one STA-ID field in the HE-SIG-B field to indicate the same value. If an AP sets one of the STA-ID field in the HE-SIG-B field to match the AID of a non-AP STA, then the non-AP STA may disregard any broadcast RU in(#Ed) the same HE MU PPDU.(#2633)

An MPDU sent in a broadcast RU of an HE MU PPDU(#33)(#754)(#755)(#756) shall not include information intended for a STA that is identified as the recipient of another RU in the same HE MU PPDU.

25.5.2 UL MU operation

25.5.2.1 General

The UL MU operation allows an AP to solicit simultaneous immediate response frames(#1513) from one or more non-AP STAs. Non-AP STAs transmit their response frames using(#1514) HE trigger-based PPDU format, in either UL OFDMA(#1515),(#431) UL MU-MIMO, or both, except when the Trigger frame is of type MU-RTS, in which case the response (CTS) is sent in a non-HT PPDU format (see 10.3.2.8a (MU-RTS/CTS procedure(#1432))).(#1184)

(#34)An HE STA with dot11ULMUMIMOOptionImplemented set to true shall set the UL MU-MIMO(#1507) subfield of the HE Capabilities element it transmits to 1. Otherwise, the HE STA shall set the UL MU-MIMO subfield of the HE Capabilities element it transmits to 0(#417).

A non-AP STA with (#34)dot11ULMUMIMOOptionImplemented equal to true is referred to as an UL MU capable STA.

An HE STA shall set the UL MU Response Scheduling Support subfield of the HE Capabilities element it transmits to 1 if its dot11HEULMUResponseSchedulingOptionImplemented is true; otherwise the STA shall set it to 0.(#1)

(#1343)A STA shall not transmit a Trigger frame soliciting a UL OFDMA With MIMO PPDU from a STA from which it has not received an HE Capabilities element with the UL OFDMA With MIMO Support bit set to 1.

A STA shall not transmit a Trigger frame soliciting a Full BW UL MU MIMO PPDU from a STA from which it has not received from which it has not received an HE Capabilities element with the Full BW UL MU MIMO Support bit set to 1.

A STA transmitting an UL OFDMA PPDU shall operate as either a class A or class B device as defined in 26.3.14 (Transmit requirements for an HE trigger-based PPDU(#340)). A STA that is a class A device shall

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set the Class A subfield in HE Capabilities elements that it transmits to 1. A STA that is a class B device shall set the Class A subfield in HE Capabilities elements that it transmits to 0.

25.5.2.2 Rules for soliciting UL MU frames

25.5.2.2.1 General

(#34)An AP shall not send to a STA an MPDU that contains an UL MU Response Scheduling A-Control subfield, unless the STA has set the UL MU Response Scheduling Support subfield to 1 in the HE Capabilities element it transmits.(#1)

An AP may transmit a PPDU that elicits an HE trigger-based PPDU from one or more STAs by including in the PPDU:(#34)

— One or more Trigger frames that includes one or more User Info fields(#1520) addressed to one or more of the recipient STAs. For recipient STAs that are associated with the AP, the User Info field(#1520) is addressed to a recipient STA if the value of the AID12(#Ed) subfield(#2683) of the User Info(#1520) field is equal to the AID of the STA or to 0 (indicating a random access allocation).(#34)(#170)(#1078). A value of 0 also indicates that non-associated STAs can transmit on the allocated resource using the random access procedure as described in 25.5.2.6 (UL OFDMA-based random access).

— An UL MU Response Scheduling A-Control subfield of individually addressed MPDUs contained in the HE MU PPDU that:(#1)

  • Are carried in a VHT single MPDU format that solicits an immediate Ack frame (see 10.13.8 (Transport of VHT single MPDUs))
  • Are carried in an A-MPDU format that solicits an immediate BlockAck frame (see 10.24.7.7 (Originator's behavior))
  • Are carried in a multi-TID A-MPDU format that solicits an immediate Multi-STA BA frame (see 25.10.4 (A-MPDU with multiple TIDs))

NOTE—The AP additionally follows the rules defined in 25.3.3 (Procedure at the originator(#1484)) when fragments are present in the generated MPDU(s).

The following two frames shall not be present in the same A-MPDU:(#595)

— A Trigger frame with a User Info field(#1520) addressed to a STA

— An(#1525) MPDU that contains an UL MU Response Scheduling A-Control subfield and that is addressed to a STA(#1)

(#2640)When one or more Trigger Frames are aggregated with other frames in an A-MPDU, the following ordering rules apply:

— When an Ack, BlockAck or Multi-STA BlockAck frame is not present in the A-MPDU, a Trigger frame shall be the first MPDU in the A-MPDU

— When an Ack, BlockAck or Multi-STA BlockAck frame is present in the A-MPDU, the Ack, BlockAck or Multi-STA BlockAck frame shall be the first MPDU in the A-MPDU and a Trigger frame shall follow the Ack, BlockAck or Multi-STA BlockAck frame

A non-AP STA shall not send a Trigger frame or an MPDU carrying an UL MU Response Scheduling A-Control field.(#1906)(#Ed)

(#1634)A transmitted Trigger frame that contains a User Info field with the AID of a non-AP STA may contain a Padding field, whose length shall ensure that at least *MinTrigProcTime*, in microseconds, passes from the end of the User Info field that contains that AID and the end of the PPDU that contains the Trigger frame, where the *MinTrigProcTime* is equal to the value specified by the non-AP STA in the Trigger Frame MAC Padding subfield of the HE Capabilities element it transmits. AP shall apply the Trigger Frame MAC

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Padding field with duration corresponding to the longest value among all STAs that have requested extra *MinTrigProcTime* through Trigger Frame MAC Padding Duration capability.

The AP shall ensure that the duration of the symbols that follow the symbol in the Trigger Frame that contains the last bit of the STA's User info field is larger than or equal to the *MinTrigProcTime* value specified by the STA.

NOTE 1—The start of the Padding subfield is identified by a User Info field that has a value of the AID equal to 2047, and the remaining subfields of the Padding field are set to 1.

NOTE 2—This rule applies to all variants of the Trigger frame (Basic, MU-BAR, MU-RTS, etc).

25.5.2.2.2 Allowed settings of the Trigger frame fields

If dot11MultiBSSIDActivated is false, then the TA field of a Trigger frame shall be set to TBD. If dot11MultiBSSIDActivated is true and at least two of the Trigger frame recipient STAs are associated with two different BSSIDs, then the TA field shall be set to TBD.(#2176)

The RA field of the MPDUs sent in response to a Trigger frame shall be set to TBD.(#171)

An AP shall not set any subfields of the Common Info field(#1529) of a Trigger frame(#36) to a value that is not supported by all the recipient STAs of the Trigger frame.

An AP shall not set any subfields of the User Info field of a Trigger frame to a value that is not supported by the recipient STAs of the User Info field. An AP shall not set any subfields of an UL MU Response Scheduling A-Control subfield in an HE variant HT Control field to a value that is not supported by the recipient STAs of the User Info field.(#36)

If a Trigger frame is transmitted in an RU of an(#2829) HE MU PPDU and the RU is addressed to multiple STAs(#252), then the Trigger frame shall not include any User Info fields addressed to a STA that is identified as recipient of another RU or spatial stream of the same HE MU PPDU.

An HE variant HT Control field with an UL MU Response Scheduling A-Control subfield shall not be included in an MPDU that is group addressed(#Ed).(#38)(#677)

If an AP includes one or more Trigger Frames or HE variant HT Control fields with an UL MU Response Scheduling A-Control subfield, then they shall collectively elicit HE trigger-based PPDU responses such that at least one RU is allocated for each 20 MHz channel occupied by the eliciting PPDU. An AP shall not allocate UL subchannel in any 20 MHz channel that is not occupied by the immediately preceding DL PPDU.(#2642)

Editor's Note: Incomplete sentence from 16/929r3 not included here

The responding STA shall not aggregate QoS Data frames in the multi-TID A-MPDU with a number of TIDs that exceeds the value indicated by the TID Aggregation Limit subfield in the Trigger Dependent User Info field of a Basic Trigger variant Trigger frame (see 9.3.1.23.1 (Basic Trigger variant(#2219))) intended to it.(#2219)

The AP shall set the value in the TID Aggregation Limit subfield in the Type dependent Per User Information field to 0 or 1 for an HE STA with STA that has indicated a zero value in the Multi-TID Support field of the HE Capabilities element it transmits and is identified by the AID12 subfield of the User Info field of a Basic Trigger variant Trigger frame (see 9.3.1.23 (Trigger frame format)).(#2669) A value 0 indicates to the STA that it shall not solicit any immediate response for the MPDUs that the STA aggregates in the HE trigger-based PPDU.(MAC Motion #92)

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The AP may assign any value between 0 and 7 in the TID Aggregation Limit subfield in the Trigger Dependent User Info field to 1 for an HE STA with STA that has indicated a nonzero value in the Multi-TID Support field of the HE Capabilities element it transmits and is identified by the AID12 subfield of the User Info field of a Basic Trigger variant Trigger frame.(#Ed)(#2669)

The AP may assign any value in the AC Preference Level subfield in the Trigger Dependent User Info field for an HE STA identified by the AID12 subfield of the User Info field of a Basic Trigger variant Trigger frame.(#2669)

The AP may assign any value defined in Table 9-25i (Preferred AC subfield encoding) in the AC Preference Level subfield in the Trigger Dependent User Info field to 1 for an HE STA and identified by the AID12 subfield of the User Info field of a Basic Trigger variant Trigger frame.(#2669)

NOTE—A STA follows the rules in 25.10.4 (A-MPDU with multiple TIDs) for aggregating the QoS Data frames with multiple TIDs in HE trigger-based PPDUs.(#2669)

25.5.2.2.3 AP access procedures for UL MU operation

(#172)(#173)When an AP receives an immediate response with at least one MPDU from at least one STA solicited by a Trigger frame(#1535), the procedures described in 9.22.2.7 (Multiple frame transmission in an EDCA TXOP) apply.(#39)(#1531)

When an AP does not receive an immediate response with at least one MPDU from at least one STA solicited by a Trigger frame, i.e., transmission failure, the backoff procedure described in 9.22.2.2 (EDCA backoff procedure) applies.(#593)

An AP may use any AC for sending a PPDU that contains only Trigger frames. If the PPDU contains frames that are not Trigger frames in addition to a Trigger frame, then the AP shall follow the rules defined in 10.22.2.6 (Sharing an EDCA TXOP).(#593)

An AP may send the Trigger frame using any access category and follows the rules defined in 10.22.2 (HCF contention based channel access (EDCA)) for obtaining and sharing the TXOP.(MAC Motion #90)

25.5.2.3 STA behavior

A STA shall not send an HE trigger-based PPDU unless it is(#2824) explicitly triggered by an AP in one of the operation modes described in this subclause(#1304).

The inter-frame space between a PPDU that contains a Trigger frame or contains an HE variant HT Control field that solicits an immediate response and the triggered HE trigger-based PPDU is SIFS.(#40)

A STA shall commence the transmission of an HE trigger-based PPDU at the SIFS time boundary after the end of a received PPDU, when all the following conditions are met

— The received PPDU contains either a Trigger frame(#1532) (that is not an MU-RTS variant(#Ed)) with a User Info(#1520) field addressed to the STA, or an MPDU addressed to the STA that contains an UL MU Response Scheduling A-Control subfield(#1). The User Info(#1520) field is addressed to a STA if the AID12(#Ed) subfield(#2685) is equal to the AID of the STA and(#766) the STA is associated with the AP. If the STA is not associated with the AP, TBD.

— The CS Required subfield in the Trigger frame is 1 and the(#977) UL MU CS condition described in 25.5.2.4 (UL MU CS mechanism) indicates the medium is idle, or the CS Required subfield in a Trigger frame is 0.

— Otherwise, a STA shall not send an HE trigger-based PPDU

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A STA transmitting an HE trigger-based PPDU in response to a Trigger frame sets the TXVECTOR parameter as follows:(#175)

— The FORMAT parameter shall be set to HE_TRIG

— The PE_DURATION parameter shall be set according to the value of the Packet Extension field in the soliciting Trigger frame

— The TXOP_DURATION parameter shall be set according the rules defined in 25.2.2 (Updating two NAVs)

— The BSS_COLOR parameter shall be set as follows:

- If the preceding Trigger frame was received in a HE PPDU, then set to the value of the RXVECTOR parameter BSS_COLOR of the HE PPDU
- If the Trigger frame was received in a non-HE PPDU, then set to the value of the BSS Color subfield of the most recently received HE Operation element for that BSS

— The L_LENGTH parameter shall be set to the value indicated by the Length subfield(#253) of the eliciting Trigger frame(#1)

— The HE_LTF_TYPE(#Ed) parameter shall be set to the value indicated by the GI and LTF Type subfield of the Common Info field of the eliciting Trigger frame

— The NUM_STS parameter shall be set to the number of space time streams indicated by the Number Of Spatial Streams subfield of the SS Allocation field of the User Info field and STBC field in the Common Info field of the Trigger frame

— The CH_BANDWIDTHW parameter shall be set to the value of the BW field in the Common Info field of the eliciting Trigger frame

— The HE_LTF_MODE parameter shall be set to the value indicated by the MU-MIMO LTF Mode subfield of the Common Info field of the eliciting Trigger frame

— The [??] parameter shall be set to the value indicated by the Number Of HE-LTF Symbols(#Ed) subfield of the Common Info field of the eliciting Trigger frame

— The STBC(#Ed) parameter shall be set to the value indicated by the STBC subfield of the Common Info field of the eliciting Trigger frame

— The [??] parameter shall be set to the value indicated by the LDPC Extra Symbol subfield of the Common Info field of the eliciting Trigger frame

— The SPATIAL_REUSE parameter shall be set to the value of the Spatial Reuse field in the Common Info field of the eliciting Trigger frame

— The [??] parameter shall be set to the value of the HE-SIG-A Reserved field in the Common Info field of the eliciting Trigger frame

— The MCS parameter shall be set to shall be set to the value of the MCS field in the Common Info field of the eliciting Trigger frame

— The DCM parameter shall be set to the value indicated by the DCM subfield of the User Info field(#1520) of the eliciting Trigger frame

— The STARTING_STS_NUM parameter shall be set to shall be set to the value of the Starting Spatial Stream subfield of the SS Allocation field in the Common Info field of the eliciting Trigger frame

— The FEC_CODING parameter shall be set to the value indicated by the Coding Type subfield of the User Info(#1520) field of the eliciting Trigger frame

— The RU_ALLOCATION parameter shall be set to the value indicated by the RU Allocation field of the User Info subfield of the eliciting Trigger frame(#1535)

— The TXPWR_LEVEL_INDEX parameter shall be set to the value based on the Transmit Power Control for HE trigger-based PPDU and based on the value of the AP Tx Power subfield in the Common Info field and the Target RSSI subfield in the User Info field of the eliciting Trigger frame (26.3.14.2 (Power pre-correction)).

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(#1)A STA transmitting an HE trigger-based PPDU in response to soliciting MPDU(s), containing an UL MU Response Scheduling A-Control subfield, shall set the TXVECTOR parameters as follows:

- N_{SYM} shall be set to the F_{VAL} + 1, where F_{VAL} is the value of the UL PPDU Length subfield of the UL MU Response Scheduling subfield
- UL_TARGET_RSSI, DL_TX_POWER, RU_ALLOCATION, and MCS parameters shall be set to the values of UL Target RSSI, DL TX Power, RU Allocation, and UL MCS subfields of the UL MU Response Scheduling subfield, respectively.
- BW shall be equal to the bandwidth of the soliciting DL MU PPDU
- BSS_COLOR, and DCM shall be set to the values of the RXVECTOR parameters BSS_COLOR, and DCM of the soliciting DL MU PPDU, respectively
- MU_MIMO_LTF_MODE, LDPC_EXTRA, NSTS, STBC, CODING TYPE, SS_ALLOCATION shall all be set to 0
- SPATIAL_REUSE shall be set to the value indicating SR_Disallowed
- PE_DURATION shall be set to the default PE duration value for UL MU response scheduling, which is indicated by the AP in the Default_PE Duration subfield of the HE Operation element it transmits, and the pre-FEC padding factor(#2564) shall be set to 4 (see 26.3.12 (Packet extension(#1781)))
- TXOP_DURATION parameter shall be set according the rules defined in 25.2.1 (Updating two NAVs)
- CP_LTF_TYPE parameter shall be set to indicate 4x LTF + 3.2 μs CP if the RXVECTOR parameter CP_LTF_TYPE is 4x LTF + 3.2 μs CP or 2x LTF + 1.6 μs CP ; otherwise shall be set to indicate 2x LTF + 1.6 μs CP

NOTE 1—The HE trigger-based PPDU in this case is only sent in UL OFDMA format and CS is not required prior to its transmission (see 25.5.2.4 (UL MU CS mechanism)).

NOTE 2—The use of BCC limits the available RU sizes as defined in 26.3.11.8 (BCC interleavers).

The STA that responds to a DL MU PPDU containing MPDU(s) addressed to it that include UL MU Response Scheduling A-Control subfield(s) follows the rules defined in 10.3.2.9 (Ack procedure) for generating the Ack frame, the rules defined in 10.24.7.5 (Generation and transmission of BlockAck frames by an HT STA or DMG STA) for generating the BlockAck frame, and the rules defined in 25.4 (Block acknowledgement) for generating the Multi-STA BlockAck frame.

NOTE—The STA additionally follows the rules defined in 25.3.3 (Procedure at the originator(#1484)) when fragments are present in the soliciting (A-)MPDU(s).

The MAC padding procedure is described in 10.42.2.1.2.(#1536)

The content of each A-MPDU(#1537) in an HE MU PPDU is based on the rules specified in 9.7.3 (A-MPDU contents)(#2172) with the following additional rules.

If the Trigger Type field(#1539) of a Trigger frame is not Basic Trigger, then the STA shall include in the response A-MPDU at least one MPDU of the required type. The MPDUs included in the response shall not solicit a response.(#176)

If the Trigger Type field of the soliciting trigger frame is Basic Trigger and the STA does not have a frame of the required type, the STA shall either not transmit a response or transmit one or more QoS Null frames.(#1541)(#42)

A STA may include MPDUs with any TID in an HE trigger-based PPDU sent in response to a Trigger frame subject the rules of 25.10.4 (A-MPDU with multiple TIDs).(#2644)

NOTE—The frame type of MPDUs may be different across A-MPDUs within a same HE trigger-based PPDU.(#598).

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25.5.2.4 UL MU CS mechanism

The ED-based CCA and virtual CS functions are used to determine the state of the medium if CS is required before responding to a received Trigger frame. ED-based CCA for UL MU CS follows the same procedure as defined in VHT receiver specification(#978)(#2647). ED-based CCA is described in 21.3.18.5.2 (CCA sensitivity for operating classes requiring CCA-ED)(#978)(#2647) and virtual CS is defined in 10.3.2.1 (CS mechanism).

A NAV is considered in virtual CS for a STA that is solicited by a Trigger frame for transmission(#1544) unless one of the following conditions is met:(#1220)(#2648)(#437)

— The response generated by the STA contains an Ack frame or a BlockAck frame and the Length subfield in the Common Info field of the Trigger frame is less than or equal to 418(#700)

— The NAV was set by an intra-BSS frame(#1467)

NOTE 1—The details of how a STA is solicited by the Trigger frame for transmission are described in 25.5.2.2.2 (Allowed settings of the Trigger frame fields).(#1544)

(#2316)If one or both of the NAVs are considered and the considered NAV's counter is nonzero, then the virtual CS indicates busy. Otherwise, the virtual CS is idle.

If the CS Required subfield in a Trigger frame is set to 1, the STA shall consider the status of the CCA (using Energy Detect defined in 21.3.18.5.2 CCA sensitivity for operating classes requiring CCA-ED(#768)) and the virtual carrier sense (NAV) before UL MU transmission in response to the Trigger frame(#1532). In this case, the STA shall sense the medium using energy-detect (ED) after receiving the PPDU that contains the Trigger frame (i.e. during the SIFS time), and it shall perform the energy-detect (ED) at least in the subchannel that contains the STA's UL allocation, where the sensed subchannel consists of either a single 20 MHz channel or multiple of 20 MHz channels. The STA may transmit an HE trigger-based PPDU when the 20 MHz channels containing the allocated RUs(#1295) in the Trigger frame are considered idle; if the STA detects that the 20 MHz channels containing the allocated RUs(#1295) are not all idle, then the STA shall not transmit anything in the allocated RUs(#1295).

If the CS Required subfield in a Trigger frame is set to 0 or an UL MU response scheduling A-Control field is included in the received (A-)MPDU that solicits a response, the STA may respond with an HE trigger-based PPDU without regard to the busy/idle state of the medium.(#979)

The CS Required subfield in the MU-RTS variant of the Trigger frame shall be set to 1.(#2226)

The AP shall set the CS Required subfield to 1 except when all solicited HE trigger-based PPDUs contain(#Ed) an Ack or BlockAck frame(#1547)(#1546) and the Length subfield in the Common Info field of the Trigger frame is less than or equal to 418(#206).

NOTE—The threshold value 418 of the Length subfield in the Common Info field of the Trigger frame is obtained from the maximum HE trigger-based PPDU duration, 584 μs, that can be solicited by the UL MU Response Scheduling A-Control subfield based on Equation (26-17). This duration is the sum of 20 μs for the L-STF, L-LTF and L-SIG fields, 20 μs for the RL-SIG, HE-SIG-A and HE-STF fields, 16 μs for the 4x HE-LTF field with 3.2 μs GI, 512 μs for 32 OFDM symbols in the Data field with 3.2 μs GI, and 16 μs PE field (see 9.2.4.6.4.2 (UL MU response scheduling), 25.5.2.3 (STA behavior), and 26.3.4 (HE PPDU formats)).(#206)

25.5.2.5 HE buffer status feedback operation for UL MU

(#1550)(#254)(#769)(#2711)(#1062)(#45)(#770)(#438)(#1065)A non-AP STA delivers buffer status reports (BSRs) to assist its AP in allocating UL MU resources in an efficient way. The non-AP STA can either implicitly deliver BSRs in the QoS Control field or BSR A-Control field of any frame transmitted to the AP (unsolicited BSR) or explicitly deliver BSRs in any frame sent to the AP in response to a BSRP variant Trigger frame (solicited BSR).(#178)(#2189)

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A non-AP STA reports its buffer status (unsolicited BSR) to the AP to which it is associated using either the QoS Control field or the BSR A-Control field of frames it transmits as defined below:

— The HE STA shall report the buffer status for a given TID in the Queue Size subfield of the QoS Control field in QoS Data or QoS Null frames it transmits; except that the STA may set the Queue Size subfield to 255 to indicate an unknown/unspecified BSR for that TID.

  • The HE STA may aggregate multiple QoS Data frames or QoS Null frames in an A-MPDU to report the buffer status for different TIDs. The HE STA shall follow the A-MPDU aggregation rules defined in 25.10.4 (A-MPDU with multiple TIDs) for aggregating QoS Data frames with multiple TIDs. The HE STA does not follow the rules defined in 25.10.3 (A-MPDU with multiple TIDs) for QoS Null frames whose Ack Policy subfield is No Ack.(#771)(#1066)(#2190)(#2191)

— The HE STA may report the buffer status in the BSR A-Control subfield of frames it transmits if the AP has indicated its support in the A-BSR Support subfield of its HE Capabilities element; otherwise the STA shall not report the buffer status in the BSR A-Control subfield.

  • The HE STA shall report the buffer status for its preferred AC, indicated by the ACI High subfield, in the Queue Size High subfield of the BSR A-Control field; except that the STA may set the Queue Size High subfield to 255 to indicate an unknown/unspecified BSR for that AC
  • The HE STA shall report the buffer status for all ACs, indicated by the ACI Bitmap subfield, in the Queue Size All subfield of the BSR A-Control field; except that the STA may set the Queue Size All subfield to 255 to indicate an unknown/unspecified BSR for those ACs(#2190, 2191)
  • The HE STA shall set the Delta TID subfield according to Table 9-XX (Delta TID subfield encoding), and the Scaling Factor subfield as defined in 9.2.4.6.4.5 (Buffer Status Report (BSR)).(#45)(#178)(#770)(#817)(#1066)

NOTE 1—The STA can send an unsolicited BSR in response to Basic variant Trigger frames (with or without random RUs, as defined in 25.5.2.3 (STA behavior) and in 25.5.2.6 (UL OFDMA-based random access)) or it can send the unsolicited BSR after accessing the WM using EDCA.(#254)(#769)(#2189)

NOTE 2—The STA can include both the QoS Control and the BSR A-Control field in the same frame and it can set the Queue Size subfield of either of them to a value of 255.

An AP can also solicit one or more non-AP STAs for their BSR(s) by sending a BSRP variant Trigger frame (see 9.3.1.23 (Trigger frame format)).(#1062) The non-AP STA responds (solicited BSR) as defined below:

— The STA that receives a BSRP variant Trigger frame shall follow the rules defined in 25.5.2.3 (STA behavior) to generate the trigger-based PPDU when the Trigger frame contains the STA's AID in any of the Per User Info fields; otherwise the STA shall follow the rules defined in 25.5.2.6 (UL OFDMA-based random access) to gain access to a random RU and generate the Trigger-based PPDU when the Trigger frame contains one or more random RU(s).(#254)(#769)(#1065)

— The STA shall include in the HE trigger-based PPDU one or more QoS Null or QoS Data frames containing one of the following:

  • The QoS Control field(s) with Queue Size subfields for each of the TIDs for which the STA has buffer status to report to the AP.(#771)(#1066)(#2190)(#2191)
  • The BSR A-Control field with the Queue Size All subfield indicating the queue size for all the ACs, indicated by the ACI Bitmap subfield, for which the STA has buffer status to report to the AP when the AP has indicated its support in the A-BSR Support subfield of its HE Capabilities element. The STA shall set Delta TID, SF, ACI High and Queue Size High subfields of the BSR A-Control field as defined in 9.2.4.6.5 (Buffer Status Report (BSR)(#824))).(#45)(#770)(#817)(#1066)(#2190)(#2191)

— The HE STA shall not solicit an immediate response for the frames carried in the trigger-based PPDU (e.g., by setting the Ack Policy subfield of the frame to Normal Ack or Implicit BAR).(#438)

NOTE—Similar to unsolicited BSR, the STA can set Queue Sizes in either QoS Control or BSR A-Control field to 255 to indicate unknown/unspecified BSR for a TID, AC or all AC.

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25.5.2.6 UL OFDMA-based random access

25.5.2.6.1 General

A STA shall set the UL OFDMA RA Support subfield in the HE Capabilities element to 1 if it supports UL OFDMA-based random access and set it 0, otherwise.

UL OFDMA-based random access is a mechanism for HE STAs to randomly select resource units (RUs) assigned by an AP in a soliciting Trigger frame that contains RUs for random access.(#2383) An RU for random access shall be identified by an AID12 subfield equal to 0 contained in a User Info field of a Trigger frame. An HE AP may transmit a Basic Trigger frame or a BSRP Trigger frame that contains one or more RUs for random access.

The HE AP may include the RAPS element (see 9.4.2.220 (OFDMA-based Random Access Parameter Set (RAPS) element(#450)) in Beacon and Probe Response frames it transmits. The AP shall indicate the range of OFDMA contention window (OCW)(#179) in the RAPS element for HE STAs to initiate random access following the Trigger frame transmission.

An HE STA shall use the OCWmin and OCWmax values indicated in the RAPS element within the most recently received Beacon or Probe Response.

NOTE—If the STA does not receive the RAPS element, the STA does not transmit any HE trigger-based PPDU using random access RUs.

The non-AP STA with dot11ULOFDMARandomAccessOptionImlemented set to true shall maintain an internal OFDMA backoff (OBO) counter(#2712). The HE STA shall follow the random access procedure defined in 25.5.2.6.2 (Random access procedure) to contend for an RU assigned for random access.(#450)

25.5.2.6.2 Random access procedure

In this subclause(#1304), the random access procedure is described with respect to UL OFDMA contention parameters. The procedure is also illustrated in Figure 25-1 (Illustration of the UL OFDMA-based random access procedure). The OFDMA contention window (OCW) is an integer with an initial value of OCWmin.

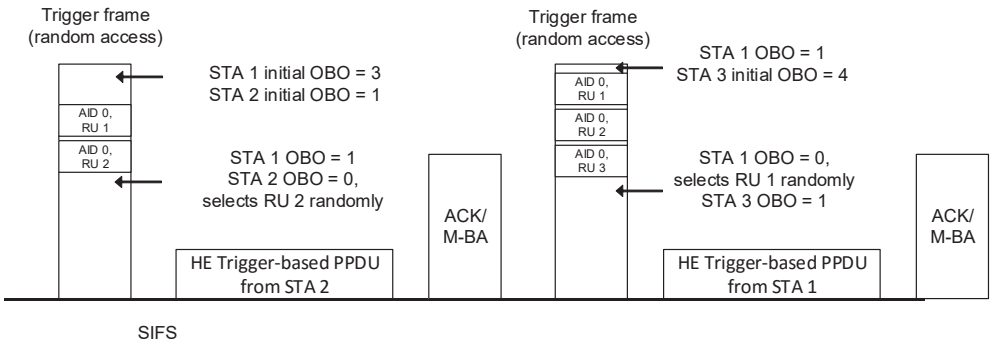

Figure 25-1—Illustration of the UL OFDMA-based random access procedure

An HE AP indicates the values of OCWmin and OCWmax in the RAPS element in a Beacon or Probe Response frame for the random access operation. OCWmax is the upper limit of OCW.

For an initial HE trigger-based PPDU transmission or following a successful HE trigger-based PPDU transmission(#48), when an HE STA obtains the value of OCWmin from the HE AP indicated in the RAPS

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element, it shall set the value of OCW to the OCWmin and shall initialize its OBO counter to a random value in the range of 0 and OCWmin.

For an HE STA, if the OBO counter is smaller than the number of RUs assigned to AID value 0 in a Trigger frame, then the HE STA shall decrement its OBO counter to zero. Otherwise, the HE STA decrements its OBO counter by a value equal to the number of RUs assigned to AID value 0 in a Trigger frame. For instance, as shown in Figure 25-1 (Illustration of the UL OFDMA-based random access procedure), HE STA 1 and HE STA 2 decrement their nonzero OBO counters by 1 in every RU assigned to AID value 0 for random access within the Trigger frame.

For an HE STA, if the OBO counter is 0 or if the OBO counter decrements to 0, then the STA(#1551) randomly selects one of the RUs assigned to AID value 0. If the selected RU is idle as a result of both physical and virtual carrier sensing as defined in subclause 25.5.2.4 (UL MU CS mechanism), the HE STA transmits its HE trigger-based PPDU in the randomly selected RU. If the selected RU is considered busy as a result of either physical or virtual carrier sensing, then the HE STA shall not transmit its HE trigger-based PPDU in the randomly selected RU and it randomly selects any one of the RUs that are assigned to AID value 0 in the subsequent Trigger frame. If the OBO counter is not zero and does not decrements to 0, the STA resumes with its OBO counter in the next Trigger frame with RUs assigned for random access.(#787)

If the HE trigger-based PPDU is successfully transmitted in the randomly selected RU, then the STA shall set its OCW to OCWmin(#Ed).(#51)

NOTE—If the transmitted HE trigger-based PPDU does not solicit an immediate response, then the STA follows the OCW reset rule that applies to successful transmission.(#51)

The MU acknowledgment procedure for random access follows the procedure as defined in 10.3.2.10.3 (Acknowledgement(#1410) procedure for an UL MU transmission).

If a STA transmits an HE trigger-based PPDU that solicits an immediate response in a random access RU and the expected response is not received, the transmission is considered unsuccessful and the STA invokes the UL OFDMA-based random access retransmission procedure as defined in 25.5.2.6.3 (Retransmission procedure for random access).(#450)

25.5.2.6.3 Retransmission procedure for random access

If an HE trigger-based PPDU soliciting an immediate response that is sent by a STA in its randomly selected RU (see 25.5.2.6.2 (Random access procedure)) fails, then the STA may attempt to retransmit the HE trigger-based PPDU using random access. This subclause defines the retransmission procedure that a STA may follow using random access.

If the HE trigger-based PPDU is not successfully transmitted in the randomly selected RU, the STA shall update its OCW to $2 \times \text{OCW} + 1$ for every retransmission, until the OCW reaches the value of OCWmax(#Ed). Once the OCW reaches OCWmax for successive retransmission attempts, the OCW shall remain at the value of OCWmax until the OCW is reset.(#51)

25.5.3 HE MU cascading operation

A TXOP can include both DL MU and UL MU transmissions.

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An(#603) HE AP can initiate a cascading sequence of MU PPDUs in a TXOP, allowing alternating HE MU PPDUs and HE trigger-based PPDUs starting with a DL MU PPDU in the same TXOP, as illustrated in Figure 25-2 (An example of cascading sequence of MU PPDUs).

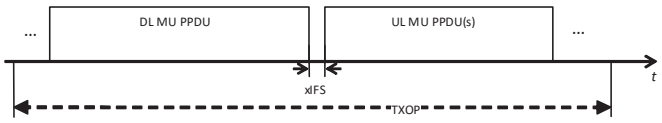

Figure 25-2—An example of cascading sequence of MU PPDUs

The cascading sequence has only one DL transmitter. The cascading sequence may have different UL transmitters within each HE trigger-based PPDU(#1556). The cascading sequence may have a different set of transmitters in HE trigger-based PPDUs as compared to the DL HE MU PPDU that follows the HE trigger-based PPDUs within the same TXOP.

25.6 HE sounding protocol

Editor's Note: Editing instructions in 16/773r2 do not mention the existing text in this subclause. I'll leave it here until the group decides what they want to do with it (delete, modify, move).

The HE sounding protocol is initiated by an AP sending an NDP Announcement frame (TBD) followed by an HE NDP transmitted a SIFS after the end of the PPDU carrying the NDP Announcement (TBD).

An HE AP may use the Trigger frame to solicit HE beamforming feedback from a STA provided that the UL MU Capable field of the most recently received HE Capabilities element from that STA is 1 (see 25.5.2 (UL MU operation)).

An HE AP may solicit beamforming feedback from multiple STAs sequentially through SU transmission.

An example of the HE sounding protocol using MU operation to solicit feedback is shown in Figure 25-3 (An example of the HE sounding protocol using MU operation).

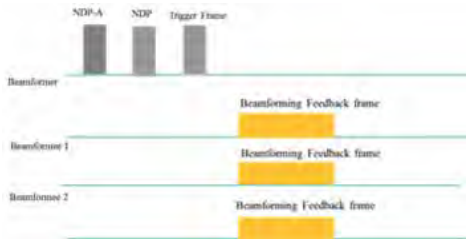

Figure 25-3—An example of the HE sounding protocol using MU operation

(#802)(#2234)(#55)(#1221)(#1915)(#1695)(#1000)

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25.6.1 General

Transmit beamforming and DL-MU-MIMO require knowledge of the channel state to compute a steering matrix that is applied to the transmit signal to optimize reception at one or more receivers. HE STAs use HE sounding protocol to determine the channel state information. Similar to VHT, HE uses explicit feedback mechanism where the HE beamformee measures the channel from the training signal transmitted by the HE beamformer and sends back a transformed estimate of the channel state. The HE beamformer uses this estimate to derive the steering matrix.

25.6.2 Rules for HE sounding protocol sequences

The HE beamformer shall initiate a sounding sequence by transmitting a HE NDP Announcement frame followed by a HE NDP after SIFS.

If the HE NDP Announcement frame includes more than one STA Info field, the RA of the HE NDP Announcement frame shall be set to a broadcast address, else it shall be set to the MAC address of the STA whose AID is included in the STA Info field. The HE NDP Announcement frame shall indicate the *Ng*, codebook and *Nc* to be used by the intended receiver STAs for the generation of CBF except when the HE NDP Announcement frame contains only one STA Info element with the Feedback Type subfield in the STA Info field is equal to SU. When the HE NDP Announcement frame contains only one STA Info element with the Feedback Type subfield in the STA Info field set to SU, then the *Ng*, codebook and *Nc* to be used for the generation of the Compressed Beamforming Report(#Ed) shall be determined by the recipient of the NDP Announcement frame.

A HE beamformer that transmits a HE NDP Announcement frame with more than one STA info field should transmit a Beamforming Report Poll Trigger frame SIFS after the HE NDP to retrieve HE Compressed Beamforming feedback from the intended HE beamformees in the same TXOP. The HE beamformer may subsequently send additional Beamforming Report Poll Trigger frames SIFS after receiving the HE Compressed Beamforming feedback to retrieve subsequent feedbacks in the same TXOP.

A HE beamformer that sets the Feedback Type subfield of a STA Info field to MU shall set the Nc Index field(#Ed) to a value less than or equal to the minimum of:

— The maximum number of supported spatial streams according to the corresponding HE beamformee's Rx HE-MCS Map subfield in the supported HE-MCS and NSS set field

— The maximum number of supported spatial streams according to the Rx NSS subfield value in the operating mode field of the most recently received Operating Mode Notification frame or the Operating Mode Notification element with the Rx NSS Type subfield equal to 0 for the corresponding HE beamformee

— The maximum number of supported spatial streams according to the Rx NSS subfield value in the most recently received frame that carried a Received Operating Mode Indication subfield (see 25.8 (Operating mode indication)).

The HE beamformee shall indicate the maximum number of space-time streams it can receive in a HE NDP as well as the total number of space-time streams (summed across all users) it can receive in a DL MU-MIMO packet through the Beamformee STS Capability field. For an HE beamformee, the value of this capability field shall be greater than or equal to 4.

A HE beamformer that sets the Feedback Type subfield of the STA Info field to MU shall set the Ng field(#Ed) value in the STA Info field of the HE NDP Announcement frame to either 0 (for $Ng = 4$) or 1 (for $Ng = 16$).

A HE beamformer shall set the RU Start Index and RU End Index in the STA Info field to indicate the starting 26-tone RU(#Ed) and the ending 26-tone RU(#Ed) of the requested HE compressed beamforming

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report. The RU Start Index is 7 bits and indicates the lowest 26-tone RU(#Ed) for which the HE beamformer is requesting feedback. The RU End Index is 7 bits and indicates the highest 26-tone RU(#Ed) for which the HE beamformer is requesting feedback. The 26-tone RU(#Ed) location is based on the RXVECTOR parameter(#Ed) CH_BANDWIDTH of the HE NDP Announcement when received in a HE PPDU or the RXVECTOR parameter(#Ed) CH_BANDWIDTH_IN_NON_HT when the HE NDP Announcement is received in a non-HT PPDU.

The HE beamformer shall set the starting RU index to a value equal to the maximum of:

— The minimum 26-tone RU(#Ed) located within the channel width in the VHT Operation Information field

— The minimum 26-tone RU(#Ed) located within the channel width in the Receive Operating Mode Notification Indication (see 25.8 (Operating mode indication))

The HE beamformer shall set the ending RU index to a value equal to the minimum of:

— The maximum 26-tone RU(#Ed) located within the channel width in the VHT Operation Information field

— The maximum 26-tone RU(#Ed) located within the channel width in the Receive Operating Mode Notification Indication

A HE beamformer that transmits a HE NDP Announcement frame that has only one STA Info field with the Feedback Type subfield equal to SU shall set the Nc Index field to 0 and the Ng field to 0.

An example of HE sounding protocol with a single HE beamformee is shown in Figure 25-4 (An example of the sounding protocol with a single HE beamformee).

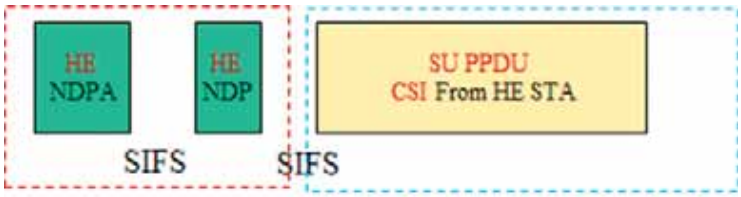

Figure 25-4—An example of the sounding protocol with a single HE beamformee

A non-AP HE beamformee that receives a HE NDP Announcement frame for a HE beamformer with which it is associated and that contains the HE beamformee's AID in the AID subfield of STA Info field, and there is only one STA Info field, shall transmit its HE Compressed beamforming feedback SIFS after receiving the HE NDP. The TXVECTOR parameter CH_BANDWIDTH for(#Ed) the PPDU containing the HE compressed beamforming feedback shall be set to indicate a bandwidth not wider than that indicated by the RXVECTOR parameter(#Ed) CH_BANDWIDTH of the HE NDP Frame.

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An example of HE sounding protocol with more than one HE beamformee is shown in Figure 25-5 (An example of the sounding protocol with a single HE beamformee).

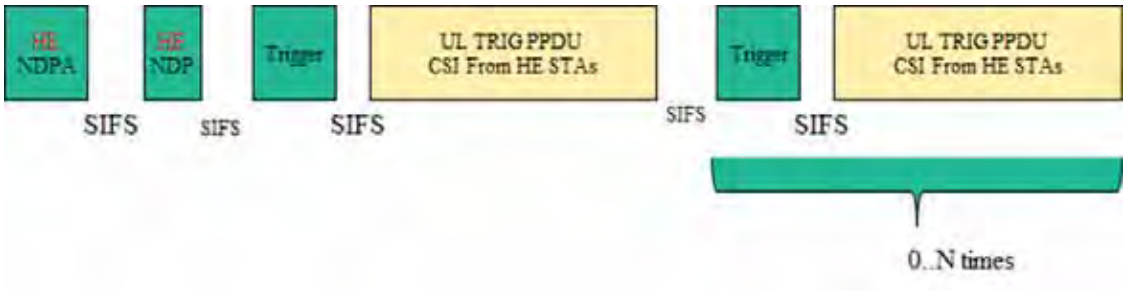

Figure 25-5—An example of the sounding protocol with a single HE beamformee

A non-AP HE beamformee that receives a HE NDP Announcement frame from a HE beamformer with which it is associated and that contains the HE beamformee's AID in any of the STA Info field, and there are multiple STA Info fields in the HE NDP Announcement, shall compute the HE Compressed beamforming feedback after receiving the HE NDP. The STA shall transmit the HE compressed beamforming feedback as a response to a Beamforming Report Poll(#Ed) variant Trigger frame that contains the AID of the STA in any of the User Info(#Ed) fields following the rules defined in 25.5.2.3 (STA behavior).

The value of the Sounding Dialog Token Number in the HE MIMO Control field shall be set to the same value as the Sounding Dialog Token Number field in the corresponding HE NDP Announcement frame.

The HE Compressed Beamforming feedback is comprised of the HE Compressed Beamforming Report information and the MU Exclusive Beamforming Report information.

(PHY Motion #167)Supporting SU-type feedback over full BW is mandatory for an HE beamformee participating in the HE sounding protocol with a single beamformee.

The beamformer initiating HE sounding protocol with one beamformee, shall not request MU-type feedback, CQI feedback, and SU-type partial bandwidth feedback, i.e., RU start index and RU end index do not cover full bandwidth, in NDP announcement.

Supporting MU-type feedback over full BW is mandatory for HE beamformees participating in HE sounding protocol with more than one beamformee.

Supporting SU-type feedback over partial BW is optional for HE beamformees participating in HE sounding protocol with more than one beamformee. The beamformer shall not request partial BW SU-type feedback in NDP announcement if the beamformee does not claim support for parital BW SU-type feedback in the HE capabilities field as in 9.4.2.218 (HE Capabilities element).

Supporting MU-type feedback over partial BW is optional for HE beamformees participating in HE sounding protocol with more than one beamformee. The beamformer shall not request partial BW MU-type feedback in NDP announcement if the beamformee does not claim support for parital BW MU-type feedback in the HE capabilities field as in 9.4.2.218 (HE Capabilities element).

Supporting CQI-only feedback with any RU start index and RU end index is optional for HE beamformees participating in HE sounding protocol with more than one beamformee.The beamformer shall not request CQI-only feedback with any RU start index and RU end index in NDP announcement if the beamformee does not claim support CQI-only feedback in the HE capabilities field as in 9.4.2.213 (HE Capabilities Element).

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25.6.3 Rules for segmented feedback in HE sounding protocol sequences(#1222)

HE Compressed beamforming feedback shall be transmitted in a single PPDU unless the size of the feedback is greater than 11 454 octets. The HE beamformer shall support maximum MPDU length for HE Compressed beamforming feedback of size which is the minimum of:

— 11 454 octets

— The size of the HE compressed beamforming feedback requested

25.7 TWT operation

25.7.1 General(#1779)

Target wake times (TWTs) allow STAs to manage activity in the BSS by scheduling STAs to operate at different times in order to minimize contention between STAs and to reduce the required amount of time that a STA in PS mode needs to be awake.

An HE STA can negotiate individual TWT values, as defined in 10.45 (Target wake time (TWT)), subject to the additional rules and restrictions that are defined in 25.7.2 (Individual TWT agreements(#1214)). An HE AP can deliver broadcast TWT values to HE non-AP STAs, without requiring that an individual TWT agreement has been established between them, as described in 25.7.3 (Broadcast TWT operation(#1779)(#1874)(#1214)).(#1779)

STAs need not be made aware of the TWT values of other STAs or that a TWT service period (SP) can be used to exchange frames with multiple STAs. Frames transmitted during a TWT SP can be carried in any PPDU format supported by the STAs, including HE MU PPDU, HE trigger-based PPDU, etc.(#1737)

An HE STA with dot11TWTOptionActivated equal to true shall set:

— The TWT Requester Support subfield to 1 in the HE Capabilities element that it transmits if it supports operating in the role of a TWT requester STA; otherwise set to 0.

— The TWT Responder Support subfield to 1 in the HE Capabilities elements that it transmits if it supports operating in the role of a TWT responding STA; otherwise set to 0.

— The Broadcast TWT Support subfield to 1 in the HE Capabilities element that it transmits if it supports operating in the role of a TWT scheduled STA or in the role of a TWT scheduling STA; otherwise set to 0.(#1651)(#1649)(#141)(#26)

An HE AP shall set the TWT Responder Support subfields of the Extended Capabilities element and HE Capabilities element to 1.(#1803)

An AP may set the TWT Required subfield to 1 in the HE Operation element it transmits to request TWT participation by all STAs that are associated to it and that have declared support for TWT. A STA that supports TWT and is associated with an AP from which it receives an HE Operation element whose TWT Required subfield is 1 shall either negotiate individual TWT agreements, as defined in 25.7.2 (Individual TWT agreements(#1214)), or participate in broadcast TWT operation, as defined in 25.7.3 (Broadcast TWT operation(#1779)(#1874)(#1214)).(#1640)

25.7.2 Individual TWT agreements(#1214)

An HE STA may negotiate individual TWT agreements with another HE STA as defined in 10.45.1 (TWT overview), except that the STA:

— May set the Responder PM Mode subfield to 1 if it is a TWT responding STA that intends to go to doze state outside of TWT SPs.

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- If the TWT responding STA is an AP then it may set the Responder PM Mode subfield to 1 only if all non-AP STAs, which are associated to it, indicate support of TWT in the role of a TWT requester; otherwise it shall set it to 0.
- An AP that sets the Responder PM Mode subfield to 1 follows the rules defined in 10.45.7 (TWT Sleep Setup).(#156)

— Shall set the Implicit subfield to 1 and the NDP Paging Indicator subfield to 0 in the TWT element it transmits during the TWT setup

— May set the Trigger subfield to 1 in the TWT element it transmits during the TWT setup to negotiate a trigger-enabled TWT

- A successful TWT agreement whose Trigger subfield in the TWT response sent by the AP is 1 is a trigger-enabled TWT; otherwise it is an implicit TWT(#1214)
- A successful TWT agreement whose Flow Type subfield is 1 is an unannounced TWT; otherwise it is an announced TWT(#2616)(#1214)

— May set the TWT Channel subfield in the TWT element it transmits to a value that corresponds to the primary channel of the BSS to indicate a 20 MHz operation; otherwise it shall set it to 0.(#139)(#2399)(#1652)

— May set the TWT Protection field to 1 to indicate that TXOPs within the TWT SPs shall be initiated with a NAV protection mechanism, such as (MU) RTS/CTS, or CTS-to-self frame; otherwise it shall set it to 0.(#2391)

An HE STA that successfully sets up a TWT agreement with another HE STA shall follow the rules defined in 10.45.1 (TWT overview) and 10.45.4 (Implicit TWT operation), except that the additional rules defined in this subclause supercede the respective rules defined in 10.45.1 (TWT overview) and 10.45.4 (Implicit TWT operation). A TWT or TWT SP that is setup under an implicit TWT agreement is an implicit TWT or implicit TWT SP, respectively (see 10.45.1 (TWT overview). A TWT or TWT SP that is setup under a trigger-enabled TWT agreement is a trigger-enabled TWT or trigger-enabled TWT SP, respectively.(#1736)(#1214)(#1318)

An HE STA that successfully sets up an individual TWT agreement and operates in PS mode shall not be required to listen to Beacon frames, as defined in 11.2.2.1 (General).(#1650)

An HE AP may send an unsolicited TWT response frame with the Trigger subfield equal to 1 to an HE non-AP STA that has set the TWT Requester Support subfield to 1 in the HE Capabilities elements that it transmits to the AP.(#1639)(#155)

An HE STA shall not transmit BAT, TACK, or STACK frames.

A TWT requesting STA should not initiate transmission of frames to the TWT responding STA outside of negotiated TWT SPs (for both implicit TWT and trigger-enabled TWT) for that TWT agreement and should not initiate transmission of frames to the TWT responding STA within trigger-enabled TWT SPs for that TWT agreement.(#1658)(#1646)(#959)(#138)

NOTE—The STA decides what frames to transmit within or outside TWT SPs.

(#1651)(#1651)(#1736)The TWT responding STA of a trigger-enabled TWT agreement shall schedule for transmission a Trigger frame for the TWT requesting STA, as described in 25.5.2 (UL MU operation), within each TWT SP for that TWT agreement. The TWT responding STA that intends to transmit additional Trigger frames during a trigger-enabled TWT SP shall set the Cascade Indication field of the Trigger frame to 1 to indicate that it will transmit another Trigger frame within the same TWT SP. The TWT responding STA shall set the Cascade Indication field to 0 when the Trigger frame is the last Trigger frame of the TWT SP or when the Trigger frame is sent outside of a TWT SP.(#137)(#452)

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NOTE 1—The TWT responding STA is not required to schedule for transmission a Trigger frame for the TWT requesting STA when the TWT agreement is not a trigger-enabled TWT agreement or when the TWT requesting STA has sent an OMI A-Control field that has the UL MU disable bit equal to 1 (see 25.8 (Receive operating mode).

NOTE 2— The Trigger frame can also be an UL MU Response Scheduling A-Control field contained in an MPDU carried in a DL MU PPDU.

(#1779)A TWT requesting STA transmits a trigger-based PPDU as a response to a Trigger frame that is intended for it and is sent during a trigger-enabled TWT SP (see 25.5.2 (UL MU operation))(#1738). A TWT requesting STA that is in PS mode and is awake shall include a PS-Poll frame or an APSD trigger frame in the trigger-based PPDU if the TWT is an announced TWT unless the STA has already transmitted the PS-Poll or APSD trigger frame within that TWT SP. The STA may include other frames in the trigger-based PPDU.(#2398)

NOTE–A Trigger frame is intended for a TWT requesting STA if it is sent by the AP to which the STA is associated and the frame contains the STA's AID in any of its Per User Info fields. The Trigger frame can have multiple recipients, each of which is identified by the presence of the recipient's AID in any of its Per User Info fields (see 25.5.2 (UL MU operation)).(#1738)

A TWT responding STA that receives a PS-Poll frame or an APSD trigger frame from a TWT requesting STA during an announced TWT SP shall follow the rules defined in 11.2.2.2.6 (AP operation during the CP) to deliver buffered BUs to the STA. A TWT responding STA may deliver multiple buffered BUs to the TWT requesting STAs during:

— An announced TWT SP, without following the rules in 11.2.2.2.6 (AP operation during the CP) as long as the BU delivery does not exceed the duration of the TWT SP and the PS STA sending the QoS Null frame does not follow APSD.(#2845)(#153)

— An unannounced TWT SP, without following the rules in 11.2.2.2.6 (AP operation during the CP) as long as the BU delivery does not exceed the duration of the TWT SP.(#2845)(#153)

NOTE—The TWT responding STA can deliver the buffered BUs in an A-MPDU under a block ack agreement if the TWT is an announced TWT and the PS mode of the STA allows it, or if the TWT is an unannounced TWT.

(#2616)(#139)(#2399)(#1652)A TWT requesting STA in PS mode that is awake for a TWT SP may transition to the doze state after AdjustedMinimumTWTWakeDuration time has elapsed from the TWT SP start time as identified by the TWT requesting STA if there is no frame exchange with the STA during the AdjustedMinimumTWTWakeDuration or after an early TWT SP termination event if there is at least one frame exchange with the STA during AdjustedMinimumTWTWakeDuration. The TWT requesting STA may classify any of the following events as an early TWT SP termination event:

1) The reception of a Trigger frame with the Cascade Indication field equal to 0 that is not intended to the STA and does not allocate any random RU during an unannounced TWT
2) The transmission of an acknowledgement in response to a soliciting frame sent by the TWT responding STA that had either the EOSP subfield equal to 1 or the More Data field equal to 0 when the frame does not contain an EOSP subfield(#2617)(#137)(#742)(#744)
3) The reception of a frame sent by the TWT responding STA that had either the EOSP subfield equal to 1 or the More Data field equal to 0 when the frame does not contain an EOSP subfield(#2617)(#137)(#742)(#744)

(#2617)(#137)(#25)(#1653)

25.7.3 Broadcast TWT operation(#1779)(#1874)(#1214)

25.7.3.1 General

A TWT scheduling STA is an HE AP with dot11TWTOptionActivated equal to true that includes a broadcast TWT element in the Beacon frame, and follows the rules described in 25.7.3.2 (Rules for TWT

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scheduling STA). The TWT scheduling STA may also include the broadcast TWT element in broadcast Probe Response frames.(#2618)(#2619)

A TWT scheduled STA is an non-AP HE STA that:

— Sets the Broadcast TWT Support field of the HE Capabilities element it transmits to 1(#1649)(#141)(#26)

— Receives a broadcast TWT element transmitted by an HE AP that is a TWT scheduling STA and,

— Has not negotiated any implicit TWT agreement with the HE AP as described in 25.7.2 (Individual TWT agreements(#1214)).

A TWT scheduled STA follows the schedule provided by the TWT scheduling STA as described in 25.7.3.3 (Rules for TWT scheduled STA(#1657)(#958)(#2400)(#142)(#957))(#1657)(#958)(#2400)(#142)(#957). A TWT scheduled STA can negotiate the wake(#1654)(#420) TBTT and listen interval for Beacon frames it intends to receive as described in 25.7.3.3 (Rules for TWT scheduled STA(#1657)(#958)(#2400)(#142)(#957)).

An example of broadcast TWT operation is shown in Figure 25-6 (Example of broadcast TWT operation), where the AP is the TWT scheduling STA and STA 1 and STA 2 are the TWT scheduled STAs.

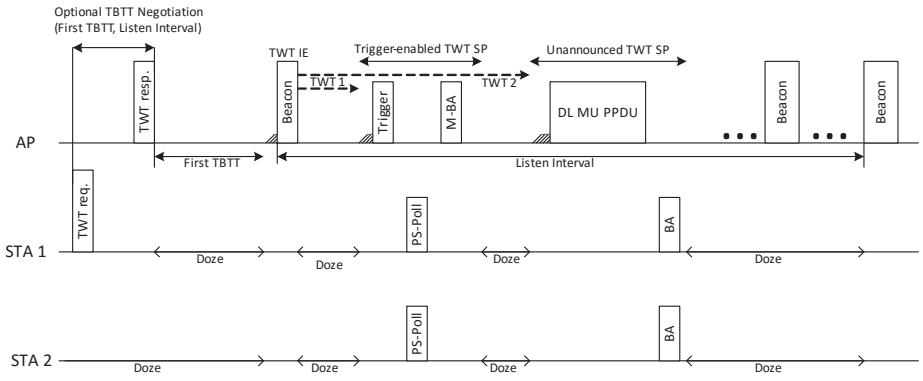

Figure 25-6—Example of broadcast TWT operation

25.7.3.2 Rules for TWT scheduling STA

TWT scheduling STA may include a broadcast TWT element in a Beacon frame that is scheduled at a TBTT (see 11.1.3.2 (Beacon generation in non-DMG infrastructure networks)). The TWT scheduling STA shall include one or more TWT parameter sets in the TWT element, and each TWT parameter set may indicate a periodic occurrence of TWTs. The TWT scheduling STA shall set the NDP Paging Indicator subfield to 0, the Broadcast subfield to 1, the Implicit subfield to 1, and the Responder PM Mode subfield to 0 in the TWT element (see 10.45.7 (TWT Sleep Setup)). Each TWT parameter set specifies the TWT parameters of a broadcast TWT that are valid within a broadcast TWT SP.

The TWT scheduling STA sets the TWT parameters of each TWT parameter set as described below.

The TWT scheduling STA shall set the TWT Request subfield to 0 and the TWT Setup Command subfield to Accept TWT, except that it may set the TWT Setup Command subfield to:

— Reject TWT when the periodic TWT is being terminated or,

— Alternate TWT when the periodic TWT is being modified(#1642)(#2621)(#1643)(#143)(#2899)

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The TWT scheduling STA shall set the Trigger field to 1 to indicate a trigger-enabled TWT. Otherwise, it shall set the Trigger field to 0 to indicate an implicit TWT(#1214).

The TWT scheduling STA shall schedule for transmission a Trigger frame addressed to(#2620) one or more TWT scheduled STAs during a trigger-enabled TWT SP. The TWT scheduling STA that intends to transmit additional Trigger frames during a trigger-enabled TWT SP shall set the Cascade Indication field of the Trigger frame to 1 to indicate that it will transmit another Trigger frame within the same TWT SP. The TWT scheduling STA shall set the Cascade Indication field to 0 when the Trigger frame is the last Trigger frame of the TWT SP or when the Trigger frame is sent outside of a TWT SP.(#137)(#452)

NOTE 1—The TWT scheduling STA is not required to schedule for transmission a Trigger frame for the TWT scheduled STA when the broadcast TWT is not a trigger-enabled TWT or when the TWT scheduled STA has sent an OMI A-Control field that has the UL MU disable bit equal to 1 (see 25.8 (Operating mode indication)).

NOTE 2—The Trigger frame can also be an UL MU Response Scheduling A-Control field contained in an MPDU carried in a DL MU PPDU.

The TWT scheduling STA shall set the Flow Type field to 1 to indicate an unannounced TWT. Otherwise, it shall set the Flow Type field to 0 to indicate an announced TWT(#1214)(#2616).

The TWT scheduling STA should schedule delivery of DL BUs during unannounced TWT SPs.

The TWT scheduling STA shall set the TWT Flow Identifier field according to Table 9.248l1 (TWT Flow Identifier field for a broadcast TWT element)(#1641).

The TWT scheduling STA should only send frames that satisfy the TWT flow identifier recommendations listed in Table 9.248l1 (TWT Flow Identifier field for a broadcast TWT element)(#1641) during the TWT SP(s). A Trigger frame transmitted during a broadcast TWT SP whose TWT parameter set has the TWT Flow Identifier subfield equal to 0 may contain zero or more random RU (see 25.5.2.6 (UL OFDMA-based random access)). A Trigger frame transmitted during a broadcast TWT SP whose TWT parameter set has the TWT Flow Identifier subfield equal to 1 shall contain no random RU (see 25.5.2.6 (UL OFDMA-based random access)). A Trigger frame transmitted during a broadcast TWT SP whose TWT parameter set has the TWT Flow Identifier subfield equal to 2 shall contain at least one random RU (see 25.5.2.6 (UL OFDMA-based random access)).(#1322)

The TWT scheduling STA shall set the TWT field to the TSF timer [4: 19](#144) at which the first TWT is scheduled for this TWT parameter set(#1741).

The TWT scheduling STA shall include a nonzero value for the TWT wake interval in the TWT Wake Interval Exponent and TWT Wake Interval Mantissa fields for a periodic TWT and a zero value for an aperiodic TWT(#145).

The TWT parameters are valid for each successive TWT of the periodic TWT or for the only TWT of the aperiodic TWT(#145).

The TWT scheduling STA may set the TWT Protection field to 1 to indicate that TXOPs within the TWT SP shall be initiated with a NAV protection mechanism defined in 10.3.2.4 (Setting and resetting the NAV), 10.3.2.8a (MU-RTS/CTS procedure(#1432)), or CTS-to-self as described in 10.3.2.13 (NAV distribution); otherwise it shall set it to 0.(#2391)

(#1077)(#695)(#139)(#2399)(#1652)(#146)A TWT scheduling STA that receives a PS-Poll or an APSD trigger frame from a TWT scheduled STA during an announced TWT SP shall follow the rules defined in 11.2.2.2.6 (AP operation during the CP) to deliver buffered BUs to the STA. A TWT scheduling STA may deliver multiple buffered BUs to the TWT scheduled STA during:

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— An announced TWT SP, without following the rules in 11.2.2.2.6 (AP operation during the CP) as long as the BU delivery does not exceed the duration of the TWT SP and the PS STA sending the QoS Null frame does not follow APSD.(#2845)(#153)

— An unannounced TWT SP, without following the rules in 11.2.2.2..6 (AP operation during the CP) as long as the BU delivery does not exceed the duration of the TWT SP and the STA has switched to AM.(#2845)

NOTE—The TWT scheduling STA can deliver the buffered BUs in an A-MPDU under a BlockAck agreement.

A TWT scheduling STA should indicate Alternate TWT or Reject TWT in the TWT Command Setup field of the broadcast TWT element for as many DTIM periods as needed to exceed the longest interval any STA is expected to not receive Beacon frames either when:

— The TWT parameters of a periodic TWT have changed, or

— The periodic TWT specified by that TWT parameter set is terminated.

A change in the TWT parameter set occurs in a subsequent DTIM Beacon frame. (#1642)(#2621)(#1643)(#143)(#2899)

25.7.3.3 Rules for TWT scheduled STA(#1657)(#958)(#2400)(#142)(#957)

A TWT scheduled STA that receives a broadcast TWT element in a Beacon frame shall follow the rules defined in this subclause to interact with the TWT scheduling STA.

A TWT scheduled STA should not initiate transmission of frames to the TWT scheduling STA outside of broadcast TWT SPs and within trigger-enabled TWT SPs.(#1658)(#1646)(#959)(#138)

A TWT scheduled STA that is in PS mode may go to doze state after receiving the Beacon frame and shall be in the awake state at a broadcast TWT start time during which the STA intends to exchange frames with the TWT scheduling STA. The TWT scheduled STA shall be in the awake state for AdjustedMinimumTWTWakeDuration time that corresponds to that TWT parameter set, except that the STA may go to doze state when a TWT SP termination event occurs.(#151) The TWT SP termination event occurs when the AdjustedMinimumWakeDuration time has elapsed from the TWT SP start time as identified by the TWT scheduled STA if there is no frame exchange with the STA during the AdjustedMinimumTWTWakeDuration or after an early TWT SP termination event if there is at least one frame exchange with the STA during AdjustedMinimumTWTWakeDuration. The early TWT SP termination events are as defined below:

1) The reception from the TWT scheduling STA of a Trigger frame with a Cascade Indication field equal to 0 that is not intended to the STA and does not allocate any random RU.(#25)

2) The transmission of an acknowledgement in response to a soliciting frame sent by the TWT responding STA that has either the EOSP subfield equal to 1 or the More Data field equal to 0 when the frame does not contain an EOSP subfield.(#2617)(#137)(#742)(#744)

The reception of a frame sent by the TWT responding STA that has either the EOSP subfield equal to 1 or the More Data field equal to 0 when the frame does not contain an EOSP subfield.(#2617)(#137)(#742)(#744)

NOTE—A Trigger frame, sent by the TWT scheduling STA, is defined as intended for the TWT scheduled STA when the Trigger frame contains the AID of the STA in one of its Per User Info fields (see 25.5.2 (UL MU operation)). Otherwise, the Trigger frame is not intended for the STA. If the Trigger frame contains one or more random RU(s) for which the STA can gain access according to 25.5.2.6 (UL OFDMA-based random access) then the STA can follow the rules defined in 25.15.2 (Power save with UL OFDMA-based random access) to determine an early TWT SP termination event.(#1653)

A TWT scheduled STA transmits a trigger-based PPDU as a response to a Trigger frame that is intended for it and is sent during a trigger-enabled TWT SP (see 25.5.2 (UL MU operation)). The TWT scheduled STA

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that is in PS mode and is awake shall include a PS-Poll frame or an APSD trigger frame in the trigger-based PPDU if it intends to solicit buffered BUs from the TWT scheduling STA (see 11.2.2.8 (Receive operation for STAs in PS mode during the CP)) unless the STA has already transmitted the PS-Poll or APSD trigger frame within that TWT SP. The STA may include other frames in the HE trigger-based PPDU.(#2845)(#745)(#2398)

NOTE—A TWT scheduling STA sets the bit in the TIM element of the Beacon frame that corresponds to the AID of the TWT scheduled STA to 1 to indicate that it expects the TWT scheduled STA to solicit available buffered BUs (see 11.2.2.8 (Receive operation for STAs in PS mode during the CP)).

A TWT scheduled STA should only send frames that satisfy the TWT flow identifier recommendations defined in Table 9.248l1 (TWT Flow Identifier field for a broadcast TWT element) during the corresponding TWT SP(s). Frames sent as a response to a Trigger frame are subject to further restrictions as defined in 25.5.2 (UL MU operation).

25.7.3.4 Negotiation of wake(#1654)(#420) TBTT and listen interval

A TWT scheduled STA that intends to operate in power save mode (see 11.2.2.2 (STA Power Management modes)) may transmit a TWT request frame to the TWT scheduling STA that identifies the wake(#420) TBTT of the first Beacon frame and the wake(#420) interval between subsequent Beacon frames it intends to receive. The TWT request frame shall contain:

— The value of the Wake TBTT Negotiation subfield equal to 1 and the TWT Command field to Suggest TWT or Demand TWT, and (#1656)(#2622)(#682)

— The value of the requested listen interval between consecutive TBTTs in the TWT Wake Interval Mantissa and TWT Wake Interval Exponent fields.

— All other fields in the TWT element are reserved.

A TWT scheduling STA that receives a TWT request frame from a STA whose value of the Wake TBTT Negotiation subfield is 1(#1656)(#2820) shall respond with a TWT response frame that contains either Accept TWT or Reject TWT in the TWT Command field and, in the case of an Accept TWT, it shall also contain:

— The value of the Wake TBTT Negotiation subfield equal to 1, and(#1656)(#2622)(#682)

— The value of the allocated first wake TBTT(#1654)(#420) in the Target Wake Time field, and

— The value of the listen interval between consecutive TBTTs in the TWT Wake Interval Mantissa and TWT Wake Interval Exponent fields.

— All other fields in the TWT element are reserved.

After successfully completing the negotiation, the TWT scheduled STA may go to doze state until its TSF matches the next negotiated wake TBTT(#1654)(#420) provided that the STA is in power save mode, and no other condition requires the STA to remain awake. The TWT scheduled STA shall be in the awake state to listen to Beacon frames transmitted at negotiated wake TBTTs and shall operate as described in in 25.7.3.3 (Rules for TWT scheduled STA(#1657)(#958)(#2400)(#142)(#957))(#1657).

Either STA can tear down an established negotiation following the tear down procedure described in 10.44.8 (TWT Teardown).

25.8 Operating mode indication

25.8.1 General

An HE STA can change its operating mode setting either using the procedure described in 11.42 (Notification of operating mode changes)(#2327), or the procedure described(#1561) in this subclause.

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Operating mode indication (OMI) is a procedure used between an OMI initiator and an OMI responder. An HE STA that transmits a frame including an OMI A-Control field is defined as an OMI initiator. An HE STA that receives a frame including an OMI A-Control field is defined as an OMI responder.(#445)(#1565)(#1569)(#1573)(#2238)(#856)

If dot11OMIOptionImplemented is true, an HE STA may send a QoS Data or QoS Null frame that contains the OMI A-Control field to indicate a change in its receive and/or transmit operating parameters. An HE AP shall set dot11OMIOptionImplemented to true and the HE AP shall implement the reception of the OMI A-Control field.(#1565)(#2238)

The OMI initiator shall indicate a change in its receive operating mode by including the OMI A-Control field in a QoS Data or QoS Null frame(#1563) that solicits an immediate acknowledgement and is addressed(#Ed) to the OMI responder.(#207)(#1562)(#2236) The OMI A-Control field indicates that the OMI initiator supports(#444) receiving PPDUs with a bandwidth up to the value indicated by the Rx Channel Width subfield and with a number of spatial streams up to the value indicated by the Rx NSS subfield as defined in 25.8.2 (Receive operating mode (ROM) indication).

The OMI initiator shall indicate a change in its transmit operating mode by including the OMI A-Control field in a QoS Data or QoS Null frame(#1563) that solicits an acknowledgement frame immediate response immediate acknowledgement and is addressed to the OMI responder as defined in 25.8.3.(#2236)

(#2657)

25.8.2 Receive operating mode (ROM) indication

The ROM indication allows the OMI initiator to adapt the maximum operating channel width and/or the maximum number of spatial streams it can receive from the OMI responder.

(#685)(#1223)(#2330)An OMI initiator that sent the frame including the OMI A-Control field should change its OMI parameters, Rx NSS and Rx Channel Width, as follows:(#685)(#446)(#2239)(#1223)(#1224)(#1572)

— When the OMI initiator changes an OMI parameter from higher to lower, it should make the change for that parameter only after receiving the immediate acknowledgement from the OMI responder.

— When the OMI initiator changes an OMI parameter from lower to higher, it should make the change for that parameter either after ACK Timeout has expired or after receiving the immediate acknowledgement from the OMI responder.

NOTE—In the event of transmission failure of the frame containing the OMI A-Control field(#1570), the OMI initiator attempts the recovery procedure defined in 10.22.2.7 (Multiple frame transmission in an EDCA TXOP)(#1571).(#1572)

If an OMI mode change is reported during a TXOP then the change should occur at least after that TXOP.(#2)(#61)(#185)

The OMI responder shall use the values indicated by the Rx Channel Width and Rx NSS subfields of the most recently received OMI A-Control field sent by the OMI initiator to send PPDUs to the OMI initiator in subsequent TXOP.(#2)(#61)(#185)

After transmitting the acknowledgement frame immediate response immediate acknowledgement for the frame containing the OMI A-Control field, the OMI responder may transmit subsequent SU PPDUs or MU PPDUs that are addressed to the OMI initiator.(#1574)(#184)

NOTE—A subsequent PPDU is a PPDU that is intended for the ROM Initiator and needs not be the immediately following PPDU.(#2463)(#2469)

(#1574)

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25.8.3 Rules for transmit operation mode (TOM) indication(#95)

An OMI initiator that is a non-AP STA may indicate changes in its transmit parameters by sending a frame that contains the OMI A-Control field to the OMI responder. The OMI initiator shall set:

— The UL MU Disable subfield to 1 to indicate suspension of the UL MU operation (see 25.5.2 (UL MU operation); otherwise it shall set the UL MU Disable subfield to 0 to indicate resumption or continuation of participation in UL MU operation.

  • An AP that is an OMI initiator shall set the UL MU Disable subfield to 0.

— The Tx NSS subfield to the maximum number of Nss that the STA will use in response to Trigger frames.(#2463)(#2659)

NOTE—The Channel Width subfield indicates the maximum channel width that the STA will use in response to Trigger frames

An OMI responder that successfully receives a frame containing an OMI A-Control field from an OMI initiator:

— Shall consider the OMI initiator as not participating in UL MU operation for subsequent TXOPs (see 25.5.2 (UL MU operation)) when the UL MU Disable subfield is 1 in the received OMI A-Control field

NOTE—The STA sets the UL MU Disable subfield to 1 to indicate that it will not respond to all variants of the Trigger frame.

— Shall consider the OMI initiator as participating in UL MU operation for subsequent TXOPs when the UL MU Disable subfield is 0 in the received OMI A-Control field in which case:

  • The maximum number of spatial streams that the OMI initiator can transmit in response to Trigger frames is indicated in the Tx NSS subfield of the OMI A-Control field(#2463)
  • The maximum channel width over which the OMI initiator can transmit in response to Trigger frames is indicated in the Channel Width subfield of the OMI A-Control field(#2469)(#2658)

— Shall indicate a number of spatial streams in the Per User Info field of a Trigger frame, which contains the AID of the OMI initiator, that is less than or equal to the number of spatial streams that is calculated from the Tx NSS subfield of the OMI A-Control field received by the OMI initiator(#2463)(#2659)

— Shall indicate a channel width in the RU Allocation subfield of the Per User Info field of a Trigger frame, containing the AID of the OMI initiator, that is less than or equal to the value specified in the Channel Width subfield of the OMI A-Control field received by the OMI initiator(#2469)(#2658)

25.9 Spatial reuse operation

25.9.1 General

The objective of the HE spatial reuse operation is to improve the system level performance, the utilization of medium resources and power saving(#2714) in dense deployment scenarios by early identification of signals from overlapping basic service sets (OBSSs) and interference management.

25.9.2 OBSS_PD-based spatial reuse operation

25.9.2.1 General

(#2386)If the PHY of a STA issues a PHY-CCA.indication with a value equal to BUSY followed by an RXSTART.indication due to a PPDU reception then the STA's MAC sublayer may a) issue a PHY-CCARESET.request primitive and b) not update its NAV timers based on frames carried in the PPDU if all the following conditions are met:

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— The received PPDU is an Inter-BSS PPDU (see 25.2.1 (Intra-BSS and inter-BSS frame detection))

— The received power level measured from the legacy portion of the PPDU is below the OBSS_PD level (defined in 25.9.2.2 (Adjustment of OBSS_PD and transmit power))

— The PPDU is not one of the following:

  • A non-HT PPDU that carries an individually addressed Public Action frame where the RA field is equal to the STA MAC address(#Ed)
  • A non-HT PPDU that carries a group addressed Public Action frame(#Ed)

(#2664)If the inter-BSS frame is carried in an HE extended range SU PPDU (where power of the L-STF/L-LTF symbols is boosted 3 dB), the received power measured based on the legacy preamble shall be decreased by 3 dB to compensate for the power boost factor when compared to the OBSS PD level.

25.9.2.2 Adjustment of OBSS_PD and transmit power

(#2386)Adjusting the OBSS_PD level and transmit power can improve the system level performance and the utilization of the spectrum. When using OBSS_PD-based spatial reuse, an HE STA is allowed to adjust the OBSS_PD level in conjunction with its transmit power based on the following adjustment rule:

Allowable $OBSS_PD_{level} \leq max(OBSSPD_{min}, min(OBSSPD_{max}, OBSSPD_{min} + (TXPWR_{ref} - TXPWR)))$

The adjustment rule is illustrated in Figure 25-7 (Illustration of the adjustment rules for OBSS_PD and TX_PWR).

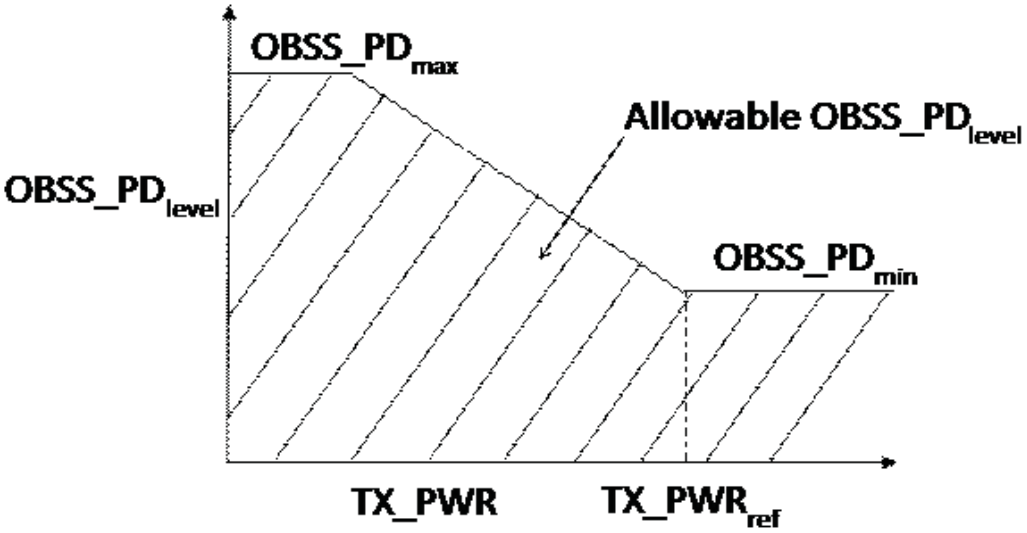

Figure 25-7—Illustration of the adjustment rules for OBSS_PD and TX_PWR

The $OBSS_PD_{level}$ is applicable to the start of a 20 MHz PPDU received on the primary 20 MHz channel(#Ed). The $OBSS_PD_{level}$(40 MHz) which is applicable to the start of a 40 MHz PPDU received on the primary 40 MHz channel(#Ed), the $OBSS_PD_{level}$(80 MHz) which is applicable to the start of a 80 MHz PPDU received on the primary 80 MHz channel(#Ed) and the $OBSS_PD_{level}$(160 MHz or 80+80 MHz) which is applicable to the start of a 160 MHz or 80+80 MHz PPDU(#Ed), can be derived by the following equations:

— $OBSS_PD_{level}$(40 MHz)= $OBSS_PD_{level}$ + 3 dB

— $OBSS_PD_{level}$(80 MHz)= $OBSS_PD_{level}$ + 6 dB

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— $OBSS_PD_{level}$(160 MHz or 80+80 MHz) = $OBSS_PD_{level}$ + 9 dB

$TXPWR_{ref}$ = 21 dBm for non-AP STAs or for AP STAs with 1 and 2 spatial streams and $TXPWR_{ref}$ = 25 dBm for AP STAs of 3 spatial streams or more.

$OBSS_PD_{min_default}$ = −82 dBm and $OBSS_PD_{max_default}$ = −62 dBm.

TXPWR is the STA transmission power in dBm at the antenna connector.

NOTE—considering the antenna connector definition section 3.1.

A STA can select an $OBSS_PD_{level}$ during its operation under SR mode. This level can be dynamically adjusted or can be static.

If a STA chooses a specific $OBSS_PD_{level}$ during its operation under SR mode, the maximum transmit power is defined in Equation (25-1).

$$TXPWR_{max} = \begin{cases} \text{unconstrained, if } OBSS_PD_{level} = OBSS_PD_{min} \\ TXPWR_{ref} - (OBSS_PD_{level} - OBSS_PD_{min}), \text{ if } OBSS_PD_{max} \geq OBSS_PD_{level} > OBSS_PD_{min} \end{cases} \quad (25\text{-}1)$$

If a STA regards an inter-BSS PPDU as not having been received at all using a specific $OBSS_PD_{level}$, the STA's power as measured at the output of the antenna connector, shall be equal or lower than the $TXPWR_{max}$, calculated with this specific $OBSS_PD_{level}$ with Equation (25-1), for the transmissions of any PPDU (including UL TB PPDU) until the end of the TXOP that the STA gains once its backoff reaches zero. The STA may increase the $OBSS_PD_{level}$ during the backoff procedure, its maximum transmit power being adjusted as defined above. The minimum $OBSS_PD_{level}$ used by the STA shall be above the received signal strength of the inter-BSS PPDU, which means that the maximum $TXPWR_{max}$ shall be calculated with $OBSS_PD_{level}$ equal to the received signal strength of the inter-BSS PPDU, with Equation (25-1).

25.10 A-MPDU operation

25.10.1 General

A-MPDU operation for an HE PPDU follows the procedures defined in 10.13 (A-MPDU operation) and, additionally, the procedures defined in this subclause.(#681)

25.10.2 A-MPDU padding for an HE SU PPDU, HE extended range SU PPDU and HE MU PPDU

An HE STA that transmits an DL(#2258) HE MU PPDU that contains one or more PSDUs, each of which carries an A-MPDU, shall construct the A-MPDU(s) as described in 10.13.6 (A-MPDU padding for VHT PPDU).(#1585) An HE STA that transmits an HE SU PPDU, HE extended range SU PPDU or UL HE MU PPDU that contains one A-MPDU, shall construct the A-MPDU(s) as described in 10.13.6 (A-MPDU padding for VHT PPDU).(#2258)

25.10.3 A-MPDU padding for an HE trigger-based PPDU(#1585)

A non-AP STA that transmits an HE trigger-based PPDU shall construct the PSDU carried in the HE trigger-based PPDU as described in this subclause(#1585).

The STA computes the PSDU_LENGTH based on the TXVECTOR parameters.

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The STA may add A-MPDU subframes to the A-MPDU contained in the PSDU provided that the following constraints are fulfilled:

— The A-MPDU content constraints (see 10.13.1 (A-MPDU contents) and 25.10.4 (A-MPDU with multiple TIDs)(#2446)) for the intended recipient

— The Length limit constraints (see 9.7.1 (A-MPDU format) and 10.13.2 (A-MPDU length limit rules)) for the intended recipient

— The MPDU start spacing constraints (see 10.13.3 (Minimum MPDU Start Spacing field)) for the intended recipient

provided that the following conditions are met:(#1586)

— The A-MPDU subframes have a value greater than 0 in the MPDU Length field, or have a value 0 in the MPDU Length field and a value 0 in the EOF field.

— After incrementing the A-MPDU_Length with the length of each such added A-MPDU subframe, the relationship A-MPDU_Length ≤ PSDU_LENGTH is true.

Padding is then(#1586) added such that the resulting A-MPDU contains exactly PSDU_LENGTH octets as follows:

— First, while A-MPDU_Length < PSDU_LENGTH and A-MPDU_Length mod 4 ≠ 0(#1587), add an octet to the final A-MPDU subframe's Padding subfield and increment A-MPDU_Length by 1.

— Then, while A-MPDU_Length + 4 < PSDU_LENGTH, add an EOF padding subframe to the EOF Padding Subframes field and increment A-MPDU_Length by 4.

— Finally, while A-MPDU_Length < PSDU_LENGTH, add an octet to the EOF Padding Octets subfield and increment A-MPDU_Length by 1.

The STA shall not add an A-MPDU subframe with EOF equal to 0 after any A-MPDU subframe with EOF set to 1. The STA shall not add an(#1774) A-MPDU subframe with EOF equal to 1 and with MPDU Length field equal to 0 before an A-MPDU subframe that contains a Single MPDU(11ah) (see 10.13.7 (Setting the EOF field of the MPDU delimiter)).

(#2446)An A-MPDU pre-EOF padding is constructed from each user from any of the following:

— A-MPDU subframes constructed from the MPDUs available for transmission from any AC that is selected by the STA

— A-MPDU subframes with 0 in the MPDU Length field and 0 in the EOF field

25.10.4 A-MPDU with multiple TIDs

(#71)(#190)A multi-TID A-MPDU is an A-MPDU that contains QoS Data frames with two or more different TID values.

(#70)An HE STA with dot11MPDUAskedforAckInMultiTIDAMPDU set to true shall set dot11AMPDUwithMultipleTIDOptionImplemented to true. An HE STA with dot11MPDUAskedforAckInMultipleTIDAMPDU set to true shall set the Ack Enabled Multi-TID A-MPDU Support subfield of the HE Capabilities element it transmits to 1; otherwise, the HE STA shall set it to 0. A HE transmitter shall not aggregate MPDU that asks for Ack in a multiple-TID A-MPDU to the HE recipient unless the recipient sets Ack Enabled Multi-TID A-MPDU Support subfield to 1 in its announced HE Capabilities element.

An HE STA shall construct a multi-TID A-MPDU as defined in 9.7 (Aggregate MPDU (A-MPDU)) and 10.13 (A-MPDU operation) except that the EOF subfield shall be set to 1 in a nonzero length MPDU delimiter that precedes a QoS Data frame, or Action frame if the QoS Data frame or Action frame solicits an immediate Ack frame.

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A multi-TID A-MPDU may contain multiple noncontiguous nonzero length MPDU delimiters with EOF subfield equal to 1, one for each TID that solicits Ack and/or multiple noncontiguous nonzero length MPDU delimiters with EOF subfield equal to 0, one for each TID that solicits BlockAck.

An HE STA that receives a multi-TID A-MPDU shall respond with a Multi-STA BlockAck frame that contains (see 25.4 (Block acknowledgement)):

— One Per STA Info field indicating an Ack for each successfully received MPDU that solicits a response that is preceded by a nonzero length MPDU delimiter whose EOF is 1 (TID value equals that of the QoS Data/QoS Null frame or 15 for the Action frame),

— One Per STA Info field indicating a BlockAck for each TID of a successfully received MPDU that solicits a response that is preceded by a nonzero length MPDU delimiter whose EOF is 0 (TID value equals that of the QoS Data frame).

An HE STA with dot11MultiTIDAMPDUImplemented set to true shall set the Multi-TID Aggregation Support subfield of the HE Capabilities element it transmits to a nonzero value. Otherwise, the HE STA shall set it to 0.

An HE STA shall not send a multi-TID A-MPDU to an HE STA that has the Multi-TID Aggregation Support subfield in the HE Capabilities element equal to 0.

An HE STA may aggregate in a multi-TID A-MPDU QoS Data frames with multiple TIDs as defined in Table 9-425 (A-MPDU contents in the data enabled immediate response context) or Table 9-426 (A-MPDU contents in the data enabled no immediate response context).

If the multi-TID A-MPDU is transmitted in a PPDU that is not an HE trigger-based PPDU, then the number of different TID values in the multi-TID A-MPDU shall not exceed the number specified by the intended recipient in the Multi-TID Aggregation Support field of the HE Capabilities element.

If the multi-TID A-MPDU is transmitted in an HE trigger-based PPDU, then the number of different TID values in the multi-TID A-MPDU shall not exceed the value specified in the Multi-TID Aggregation Limit subfield in the Trigger Dependent User Info subfield of the User Info field in the Basic Trigger variant Trigger frame that allocated resources for the HE trigger-based PPDU.

A multi-TID A-MPDU shall not be transmitted in an HE SU PPDU or HE extended range SU PPDU except when TXOP limit is not zero for the AC that is used to gain access to the medium. This AC is defined as the primary AC. When TXOP limit is not zero then the STA may aggregate QoS Data frames from one or more TIDs in the A-MPDU under the following conditions:

— The A-MPDU shall be carried in an HE SU PPDU or an HE ER SU PPDU transmitted within the obtained TXOP

— The A-MPDU shall contain one or more MPDUs with any of the TIDs that correspond to the primary AC

— When any of the buffers is empty or when no more MPDUs can be aggregated in the A-MPDU from any of the TIDs that correspond to the primary AC then the A-MPDU may additionally contain one or more MPDUs with TIDs that do not correspond to the primary AC if the TIDs correspond to any AC that has a higher priority with respect to the primary AC and the addition of these MPDUs does not cause the STA to exceed the current TXOP duration

The Multi-STA BlockAck frame shall be used to acknowledge the MPDUs in a multi-TID A-MPDU. The rules for Multi-STA BlockAck are defined in subclause 25.4 (Block acknowledgement)(#70).(#1292)

(#2669)The responding HE STA with dot11AMPDUwithMultipleTIDOptionImplemented set to true shall not aggregate QoS Data frames in the multi-TID A-MPDU with a number of TIDs that exceeds the value

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indicated in the TID Aggregation Limit subfield in the Trigger Dependent User Info field(#Ed) of a Basic Trigger variant Trigger frame (9.3.1.23.1 Basic Trigger) intended for it.

For an HE STA with dot11AMPDUwithMultipleTIDOptionImplemented set to true and having a single A-MPDU containing MPDUs with different value of TIDs, the MPDUs with the same TID value may be aggregated in non-contiguous A-MPDU subframes.

When the AP specifies a value defined in Table 9-25i (Preferred AC subfield encoding) in the Preferred AC subfield and a value of 1 in the AC Preference Level subfield in the Trigger Dependent User Info field(#Ed) of a Basic Trigger variant Trigger frame, then an HE STA with dot11AMPDUwithMultipleTIDOptionImplemented set to true and with buffered traffic in the indicated preferred AC should aggregate MPDUs from any one of the TIDs from the same AC or higher AC as indicated in the Preferred AC subfield of the Trigger Dependent User Info field(#Ed) in the Trigger frame.

When the AP specifies a value defined in Table 9-25i (Preferred AC subfield encoding) in the Preferred AC subfield and a value of 1 in the AC Preference Level subfield in the Trigger Dependent User Info(#Ed) field of a Basic Trigger variant Trigger frame, then an HE STA with dot11AMPDUwithMultipleTIDOptionImplemented set to true may aggregate MPDUs from any other TID.

The STA may aggregate MPDUs from TIDs in other ACs within the remaining time to the UL PPDU duration value indicated in the Length subfield in the Common Info field of the Trigger frame.

The total number of TIDs from which QoS Data MPDUs are aggregated by the STA shall not exceed the limit indicated in the TID Aggregation Limit subfield of its User Info(#Ed) field in the Trigger frame.

When the AP specifies a value of 0 in the AC Preference Level subfield in the Trigger Dependent User Info(#Ed) field of a Basic Trigger(#Ed) variant Trigger frame, then an HE STA with dot11AMPDUwithMultipleTIDOptionImplemented set to true may aggregate MPDUs from any AC/TID or combination of TIDs, up to the limit indicated in the TID Aggregation Limit subfield in Trigger Dependent User Info(#Ed) field of the Trigger frame.

An HE STA with dot11AMPDUwithMultipleTIDOptionImplemented set to false should select any one of the TID value within the AC value indicated in the Preferred AC subfield and AC Preference Level subfield is 1 in the Trigger Dependent User Info(#Ed) field of a Basic Trigger variant Trigger frame.

An HE STA with dot11AMPDUwithMultipleTIDOptionImplemented set to false may select a TID from any AC when the AC Preference Level subfield is 0 in the Trigger Dependent User Info(#Ed) field of a Basic Trigger variant Trigger frame.

NOTE—A multi-TID A-MPDU allows the aggregation of an Action Ack frame as well.

(#2670)An HE AP may aggregate MPDUs from any TIDs in multi-TID A-MPDU for DL HE MU PPDU transmission and the number of TIDs in multi-TID A-MPDU shall not be more than the Multi-TID Aggregation Support announced by the recipient.

25.11 TXVECTOR parameters STA_ID_LIST, UPLINK_FLAG, BEAM_CHANGE and BSS_COLOR for an HE PPDU(#2517)

Each element of the TXVECTOR parameter STA_ID_LIST identifies the STA or group of STAs that is the recipient of an RU in the HE MU PPDU. If an RU is intended for a single STA, then the STA_ID_LIST element for that RU is set to the AID of the STA receiving the PSDU contained in that RU. If an RU is intended for an AP, then the STA_ID_LIST contains only one element that is set to the AID of the non-AP STA transmitting the PPDU. If an RU is intended for a group of STAs then the STA_ID_LIST element is set as follows:

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- For an AP with dot11MultiBSSIDActivated equal to false, if the RU is intended for all STAs in the BSS, the STA_ID_LIST element is set to 0
- For an AP with dot11MultiBSSIDActivated equal to true, if the RU is intended for all STAs in any of its BSSs, the STA_ID_LIST element is set to partial virtual bitmap value assigned for the group addressed frame (see 9.4.2.6 (TIM element))
- For an AP with dot11MultiBSSIDActivated equal to true, if the RU is intended for all STAs on all its BSSs, the STA_ID_LIST element is set to 2047

The Uplink Flag is carried in the TXVECTOR parameter UPLINK_FLAG of an HE SU PPDU, HE extended range SU PPDU, and HE MU PPDU and is set as follows:

- A STA transmitting an HE PPDU that is addressed to an AP shall set the TXVECTOR parameter UPLINK_FLAG to 1
- An AP transmitting an HE PPDU that is addressed to a non-AP STA shall set the TXVECTOR parameter UPLINK_FLAG to 0
- A STA transmitting an HE PPDU in a direct path to a (T)DLS peer STA, or to a member of an IBSS, or to a mesh STA, shall set the TXVECTOR parameter UPLINK_FLAG to 0

NOTE—A (T)DLS(#1592) peer STA or the member of an IBSS can identify that the HE PPDU is sent in a direct path from the To DS and From DS fields of the MAC header of its MPDU(s)

The TXVECTOR parameter UPLINK_FLAG is not present for HE trigger-based PPDUs.

The TXVECTOR parameter BEAM_CHANGE of an HE SU PPDU, HE extended range SU PPDU shall be set to 1 if the number of spatial streams is greater(#Ed) than 2 or the PPDU is the first PPDU in a TXOP.(#2517)

The BSS Color is an identifier of the BSS and is used to assist a receiving STA in identifying the BSS from which a PPDU originates so that the STA can use the channel access rules as described in 25.9 (Spatial reuse operation)(#2338) or reduce power consumption as described in 25.15.1 (Intra-PPDU power save for HE non-AP STAs).

An HE STA transmitting an HE Operation element shall select a value in the range 1 to 63 to include in the BSS Color subfield of the HE Operation element that it transmits and shall maintain that single value of the BSS Color subfield for the lifetime(#1594) of the BSS. An HE STA that transmitted an HE Operation element shall set the TXVECTOR parameter BSS_COLOR of an HE PPDU to the value indicated in the BSS Color subfield of its HE Operation element.

An HE STA receiving an HE Operation element shall set the TXVECTOR parameter BSS_COLOR of an HE PPDU to the value indicated in the BSS Color subfield of the HE Operation element received from the HE STA with which it is associated or intends to transmit.(#643)(#2259)(#2260)

An HE STA that received an HE PPDU with RXVECTOR parameter BSS_COLOR with(#Ed) a value between 1 and 63 may ignore the HE PPDU subject to the rules as described in 25.9 (Spatial reuse operation).

An HE STA transmitting an HE SU PPDU or an HE extended range SU PPDU for which one or more intended recipient STAs is not a member of a transmitting STA's BSS shall set the TXVECTOR parameter BSS_COLOR of the HE PPDU to 0.

An HE STA that received an HE SU PPDU or an HE extended range SU PPDU with RXVECTOR parameter BSS_COLOR equal to 0 shall not discard the HE PPDU.

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A HE STA associated with an HE AP that is transmitting an HE PPDU in a direct path to a DLS or TDLS peer STA shall set the TXVECTOR parameter BSS_COLOR to the value of the value indicated in the BSS Color subfield of the HE Operation element received from the HE AP.

All APs that are members of a Multiple BSSID Set element shall use the same BSS Color.(#73)(#210)

25.12 TXVECTOR parameter TXOP_DURATION for an HE PPDU(#2596)

TXOP Duration field is carried in the TXVECTOR parameter TXOP_DURATION of an HE PPDU and indicates duration information for NAV setting and protection of TXOP.

A STA that transmits an HE SU PPDU, HE extended range SU PPDU, or HE MU PPDU may indicate no duration information for NAV setting by setting the TXVECTOR parameter TXOP_DURATION to all 1s.

If a STA transmits an HE SU PPDU, HE extended range PPDU, or HE MU PPDU that carries a PS-Poll frame, the STA shall set the TXVECTOR parameter TXOP_DURATION to all 1s.

A TXOP responder that transmits an HE trigger-based PPDU shall set the TXVECTOR parameter TXOP_DURATION to all 1s if the RXVECTOR parameter TXOP_DURATION of the soliciting PPDU is set to all 1s.

A TXOP responder that transmits an HE trigger-based PPDU shall not set the TXVECTOR parameter TXOP_DURATION to all 1s if any one of the following condition is met:

— The RXVECTOR parameter TXOP_DURATION of the soliciting PPDU is not set to all 1s

— The RXVECTOR parameter FORMAT of the soliciting PPDU is not equal to HE_SU, HE_MU, or HE_EXT_SU

If the TXVECTOR parameter TXOP_DURATION of an HE PPDU is not set to all 1s, and there exists Duration field in the MAC header of the HE PPDU, the duration information indicated by the TXVECTOR parameter TXOP_DURATION is determined based on the duration information indicated by the Duration field in the MAC header and shall indicate the largest feasible duration information that is smaller than or equal to the duration information indicated by the Duration field.

NOTE 1—Except for a PS-Poll frame, the Duration/ID field in a data frame, management frame and control frame indicates duration information.

NOTE 2—For a TXOP responder, the Duration field in the MAC header of the response PPDU is set based on the Duration field in the MAC header of the soliciting PPDU as described in 9.2.5.7 (Setting for control response frames) or 9.2.5.8 (Setting for other response frames).

For a TXOP responder that transmits an HE trigger-based PPDU carrying a PS-Poll frame, if the TXOP responder does not set the TXVECTOR parameter TXOP_DURATION of the HE trigger-based PPDU to all 1s, the TXOP responder first calculates potential duration information equal to the duration information indicated by the Duration field of the frame that solicits the response minus the time, in microseconds, between the end of the PPDU carrying the frame that soliciting the HE trigger-based PPDU and the end of the HE trigger-based PPDU. If the calculated potential duration information includes a fractional microsecond, the potential duration information is rounded up to the next higher integer. Then the duration information indicated by the TXVECTOR parameter TXOP_DURATION is determined based on the calculated potential duration information and shall indicate the largest feasible duration information that is smaller than or equal to the calculated potential duration information.

The encoding of TXVECTOR/RXVECTOR parameter TXOP_DURATION for indicating duration information is defined in Table 26-1 (TXVECTOR and RXVECTOR parameters(#1780)).

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25.13 HE PPDU post FEC padding and packet extension

An HE STA with dot11PPEThresholdsRequired set to false may set the PPE Thresholds Present subfield in HE Capabilities elements that it transmits to 0.

An HE STA with dot11PPEThresholdsRequired set to true shall set the PPE Thresholds Present subfield in HE Capabilities elements that it transmits to 1.

A STA that sets the PPE Thresholds Present subfield in HE Capabilities elements that it transmits to 1 shall indicate its minimum post-FEC padding and packet extension duration value per constellation, NSS and RU allocation by setting the subfields of the PPE Thresholds field according to 9.4.2.218 (HE Capabilities element) and using the corresponding values from dot11PPEThresholdsMappingTable.

A STA transmitting an HE PPDU to a receiving STA shall include a minimum post-FEC padding as determined(#1597) by the post-FEC padding pre-FEC padding factor(#2564) (see 26.3.11 (Data field) and after including the post-FEC padding, the transmitting STA shall include a packet extension that yields a total post-FEC padding plus packet extension that corresponds to at least the value indicated in the HE Capabilities element received from the receiving STA.

25.14 Link adaptation using the HE variant HT Control field

This subclause applies to frame exchange sequences that include PPDUs containing an HE variant HT Control field.

The HE-MCS subfield of the MFB subfield of HE link adaptation field should be set to the highest data-rate, for given transmission properties, that results in frame error rate of 10% or lower for a MPDU length of 3895 octets. The transmission properties, RU_ALLOCATION, DCM, NUM_STS, FEC_CODING, BEAMFORMED, BEAM_CHANGE, and STBC, are determined by the RXVECTOR of the PPDU used to estimate recommended MFB.(#4)(#2740)

25.15 Power management

25.15.1 Intra-PPDU power save for HE non-AP STAs

An HE non-AP STA (#1598)has dot11IntraPPDUPowerSaveOptionActivated equal to true operates in intra-PPDU power save mode.

An HE non-AP STA that is in intra-PPDU power save mode may enter the doze state until the end of a PPDU currently being received(#2848) when one of the following conditions is met:

— The PPDU is an HE MU PPDU where the RXVECTOR parameter BSS_COLOR is the BSS color of the BSS with which the STA is associated, the RXVECTOR parameter UL_FLAG is 0 and the RXVECTOR parameter STA_ID_LIST does not include the identifier of the STA or the broadcast identifier(s) intended for the STA.(#Ed)

— The PPDU is an HE MU PPDU, HE SU PPDU or HE extended range SU PPDU and one of the following conditions are true:(#Ed)

- The RXVECTOR parameter BSS_COLOR is the BSS color of the BSS with which the STA is associated and the RXVECTOR parameter UL_FLAG is 1
- The RXVECTOR parameter BSS_COLOR is the BSS color of the BSS with which the STA is associated, the RXVECTOR parameter UL_FLAG is 0 and a PHY-RXEND.indication(UnsupportedRate) primitive was received(#194)

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— The PPDU is an HE trigger-based PPDU where the RXVECTOR parameter BSS_COLOR is the BSS color of the BSS with which the STA is associated(#1599)

— The PPDU is a VHT PPDU where(#782) the RXVECTOR parameter PARTIAL_AID is the BSSID[39:47] of the BSS with which the STA is associated and the RXVECTOR parameter GROUP_ID is 0.(#Ed)

— The PPDU is a PPDU with(#782):

- An A-MPDU including TA or RA equal to either the BSSID of the BSS with which the STA is associated or the BSSID of any BSS of a multiple BSSID set that the STA's associated BSS belongs to and,(MAC Motion #93)
- The RA is not the(#Ed) MAC address of the STA

An HE STA that is in intra-PPDU power save mode and has entered doze state shall continue to operate its NAV timers(#2850) and consider the medium busy during doze state and shall transition into awake state at the end of the PPDU.

NOTE—The STA can contend for access to the medium immediately on the expiry of the NAV timers(#2851).(#1600)

25.15.2 Power save with UL OFDMA-based random access

This subclause(#1304) illustrates the power save mechanisms for HE STAs using the(#1601) random access procedure (see 25.5.2.6.2 (Random access procedure)).

An HE AP may indicate values of one or multiple Trigger frame start time(s) for random access in the broadcast TWT element that is included in the Beacon frame as described in 25.7.3.2 (Rules for TWT scheduling STA)(#723). The power save operation with the indication of one value of Trigger frame start time in a Beacon for random access is shown in Figure 25-8 (Trigger frame (TF) start time in the Beacon frame for power save operation with random access operation(#2852)).

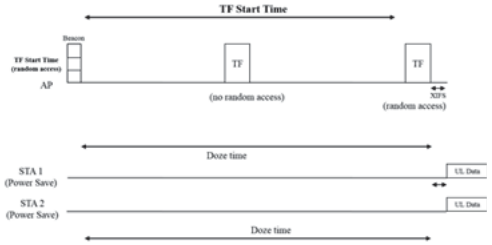

Figure 25-8—Trigger frame (TF) start time in the Beacon frame for power save operation with random access operation(#2852)

An HE STA that receives a Beacon frame containing a TWT element that has a value of 1 in the Broadcast subfield a value of 2 in the TWT Flow Identifier subfield may enter the doze state until(#1602) the start of that TWT SP as described in 25.7.3.3 (Rules for TWT scheduled STA(#1657)(#958)(#2400)(#142)(#957)).(#723)

If random access(#646) is enabled by a sequence of Trigger frames, then all the Trigger frames in the sequence shall have the Cascade Indication field set to 1, except for the last Trigger frame in the sequence, which(#1603) shall have the Cascade Indication field set to 0.

An HE STA may use the value indicated in the Cascade Indication field in a Trigger frame to enter the doze state. If the OBO counter decrements to a non-zero value with the random access procedure in a Trigger frame with Cascade Indication field set to 0, it may enter the doze state immediately. If the OBO counter

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decrements to a non-zero value with the random access procedure in a Trigger frame with Cascade Indication field set to 1, it may remain awake for random access in the cascaded Trigger frame.

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26. High Efficiency (HE) PHY specification

26.1 Introduction

26.1.1 Introduction to the HE PHY

Clause 26 specifies the PHY entity for a high efficiency (HE) orthogonal frequency division multiplexing (OFDM) system. In addition to the requirements in Clause 26, an HE STA shall be capable of transmitting and receiving PPDUs that are compliant with the mandatory requirements of the following PHY specifications:(#348)

— Clause 19 (High Throughput (HT) PHY specification) and Clause 21 (Very High Throughput (VHT) PHY specification)(#1021) when the HE STA with greater than or equal to 80 MHz capability is operating in the 5 GHz band(PHY Motion #163)

— Clause 19 (High Throughput (HT) PHY specification) when the 20 MHz only non-AP HE STA is operating in the 5 GHz band(PHY Motion #163)

— Clause 19 (High Throughput (HT) PHY specification) when the HE STA is operating in the 2.4 GHz band

The HE PHY with greater than or equal to 80 MHz capability is based on the VHT PHY defined in Clause 21 (Very High Throughput (VHT) PHY specification)(#1021), which in turn is based on the HT PHY defined in Clause 19 (High Throughput (HT) PHY specification)(#1021), which in turn is further based on the OFDM PHY defined in Clause 17 (Orthogonal frequency division multiplexing (OFDM) PHY specification)(#1021). The HE PHY with 20 MHz only capability (see 26.3.9 (Mathematical description of signals)) is based on the HT PHY defined in Clause 19, which in turn is based on the OFDM PHY defined in Clause 17.(PHY Motion #163) The HE PHY extends the maximum number of users supported for downlink multi-user MIMO (MU-MIMO) transmissions to eight and provides support for downlink and uplink orthogonal frequency division(#1185) multiple access (OFDMA) as well as for uplink MU-MIMO. Both downlink and uplink MU-MIMO transmissions are supported on portions of the PPDU bandwidth (on resource units greater than or equal to 106 tones) and in an MU-MIMO resource unit, there is support for up to eight users with up to four space-time streams per user with the total number of space-time streams not exceeding eight.

The HE PHY provides support for 20 MHz, 40 MHz, 80 MHz and 160 MHz contiguous channel widths and support for 80+80 MHz non-contiguous channel width, depending on the frequency band and capability(PHY Motion #163). For channel widths greater than or equal to 80 MHz, the HE PHY supports channel puncturing(PHY Motion #161) transmissions where one or more of the non-primary 20 MHz channels in an HE MU PPDU with more than one RU is zeroed out.(#879)

The HE PHY provides support for 0.8 µs, 1.6 µs and 3.2 µs(#1922) guard interval durations.

The HE PHY provides support for 3.2 µs (1x LTF), 6.4 µs (2x LTF), and 12.8 µs (4x LTF) LTF symbol durations (symbol duration not including the guard interval). The HE PHY supports a single Data field OFDM symbol duration of 12.8 µs (excluding guard interval).(#269)

The HE PHY data subcarrier frequency spacing is a quarter of VHT PHY and HT PHY subcarrier frequency spacing defined in Clause 21 (Very High Throughput (VHT) PHY specification) and Clause 19 (High Throughput (HT) PHY specification), respectively.(#1605) The HE PHY data subcarriers are modulated using binary phase shift keying (BPSK), quadrature phase shift keying (QPSK), 16-quadrature amplitude modulation (16-QAM), 64-QAM, 256-QAM and 1024-QAM. Forward error correction (FEC) coding (convolutional or LDPC coding) is used with coding rates of 1/2, 2/3, 3/4 and 5/6.

An HE STA shall support the following Clause 26 features:(#351)

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- Binary convolutional coding for 26-, 52-, 106- and 242-tone RUs (transmit and receive) when the number of spatial streams is less than or equal to 4
- Binary convolution coding for a 20 MHz HE SU PPDU (transmit and receive) when the number of spatial streams is less than or equal to 4
- LDPC as the only coding scheme for 484-, 996- and 2×996-tone RUs (transmit and receive)
- LDPC coding for 40 MHz, 80 MHz, 160 MHz and 80+80 MHz HE SU PPDUs
- LDPC when declaring support for more than 4 spatial streams
- LDPC when declaring support for MCS10 and MCS11(PHY Motion #158)
- A combination of 2x LTF with 0.8 μs GI duration on both LTF and data
- A combination of 2x LTF with 1.6 μs GI duration on both LTF and data
- A combination of 4x LTF with 3.2 μs GI duration on both LTF and data

An HE STA may support the following Clause 26 features:(#351)

- Other combinations of LTF durations and GI durations
- LDPC coding for 26-, 52-, 106- and 242-tone RUs (transmit and receive) when the number of spatial streams is less than or equal to 4
- LDPC coding for a 20 MHz HE SU PPDU (transmit and receive) when the number of spatial streams is less than or equal to 4
- LDPC (transmit and receive) when declaring support for less than or equal to 4 spatial streams and when declaring not supporting MCS10 and MCS11(PHY Motion #158)
- Dual carrier modulation (transmit and receive)

Editor's Note: Once mandatory and optional TBDs are decided, the above text will be revised.(#1461)(#2352)

26.1.2 Scope

The services provided to the MAC by the HE PHY consist of the following protocol functions:

a) A function that maps the PSDU received from the MAC into a PPDU for transmission to one or more receiving STAs.(#2354)

b) A function that defines the characteristics and method of transmitting and receiving data through a wireless medium between two or more STAs. Depending on the PPDU format, these STAs support a mixture of HE, Clause 21 (Very High Throughput (VHT) PHY specification), Clause 19 (High Throughput (HT) PHY specification) and Clause 17 (Orthogonal frequency division multiplexing (OFDM) PHY specification) PHYs.(#1021) A non-AP STA with 20 MHz only capability supports a mixture of HE, Clause 19 and Clause 17 PHYs.(PHY Motion #163)

26.1.3 HE PHY functions

26.1.3.1 General

The HE PHY contains two functional entities: the PHY function, and the physical layer management function (i.e., the PLME). Both of these functions are described in detail in 26.3 (HE PHY) and 26.4 (HE PLME). The HE PHY service is provided to the MAC through the PHY service primitives defined in Clause 7 (PHY service specification). The HE PHY service interface is described in 26.2 (HE PHY service interface).

26.1.3.2 PHY management entity (PLME)

The PLME performs management of the local PHY functions in conjunction with the MLME.

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26.1.3.3 Service specification method

The models represented by figures and state diagrams are intended to be illustrations of the functions provided. It is important to distinguish between a model and a real implementation. The models are optimized for simplicity and clarity of presentation; the actual method of implementation is left to the discretion of the HE-PHY-compliant developer.

The service of a layer is the set of capabilities that it offers to a user in the next higher layer. Abstract services are specified here by describing the service primitives and parameters that characterize each service. This definition is independent of any particular implementation.

26.1.4 PPDU formats

The structure of the PPDU transmitted by an HE STA is determined by the TXVECTOR parameters as defined in Table 26-1 (TXVECTOR and RXVECTOR parameters(#1780)).

The FORMAT parameter determines the overall structure of the PPDU and can take on one of the following values:

- Non-HT format (NON_HT), based on Clause 17 (Orthogonal frequency division multiplexing (OFDM) PHY specification) and including non-HT duplicate format.
- HT-mixed format (HT_MF) as specified in Clause 19 (High Throughput (HT) PHY specification).
- HT-greenfield format (HT_GF) as specified in Clause 19 (High Throughput (HT) PHY specification).
- VHT format (VHT) as defined in Clause 21 (Very High Throughput (VHT) PHY specification).(#468)
- HE SU PPDU format (HE_SU) carries a single PSDU. With this format the HE-SIG-A field is not repeated. Support for the HE SU PPDU format is mandatory.
- HE extended range SU PPDU format (HE_EXT_SU) carries a single PSDU. It is similar to the SU format, except that the HE-SIG-A field is repeated. Support for the HE extended range SU PPDU format is mandatory(#834).
- HE MU PPDU format (HE_MU) carries one or more PSDUs to one or more users. Support for the HE MU PPDU format is mandatory.
- HE trigger-based PPDU format (HE_TRIG) carries a single PSDU and is sent in response to a PPDU that carries a Trigger frame. The preamble format prior to the HE-STF field is identical to the HE SU PPDU. Support for the HE trigger-based PPDU format is mandatory(#834).

26.2 HE PHY service interface

26.2.1 Introduction

(#Ed)The PHY provides an interface to the MAC through an extension of the generic PHY service interface defined in 8.3.4 (Basic service and options). The interface includes TXVECTOR, RXVECTOR, and PHYCONFIG_VECTOR.

Using the TXVECTOR, the MAC supplies the PHY with per-PPDU transmit parameters. Using the RXVECTOR, the PHY informs the MAC of the received PPDU parameters. Using the PHYCONFIG_VECTOR, the MAC configures the PHY for operation, independent of frame transmission or reception.

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26.2.2 TXVECTOR and RXVECTOR parameters

The parameters in Table 26-1 (TXVECTOR and RXVECTOR parameters(#1780)) are defined as part of the TXVECTOR parameter list in the PHY-TXSTART.request primitive and/or as part of the RXVECTOR parameter list in the PHY-RXSTART.indication primitive.

Table 26-1—TXVECTOR and RXVECTOR parameters(#1780)

Parameter	Condition	Value	TXVECTOR	RXVECTOR
FORMAT		Determines the format of the PPDU. Enumerated type: NON_HT indicates Clause 17 (Orthogonal frequency division multiplexing (OFDM) PHY specification) or non-HT duplicate PPDU format. In this case, the modulation is determined by the NON_HT_MODULATION parameter. HT_MF indicates HT-mixed format. HT_GF indicates HT-greenfield format. VHT indicates VHT format. HE_SU indicates HE SU PPDU format. HE_MU indicates HE MU PPDU format. HE_EXT_SU indicates HE extended range SU PPDU format. HE_TRIG indicates HE trigger-based PPDU format(#1029).	Y	Y
NON_HT_MODULATION	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).			
L_LENGTH	FORMAT is HE_SU or HE_MU or HE_EXT_SU	Not present. NOTE—The Length field of the L-SIG for HE PPDU is defined in Equation (26-12) using the TXTIME value defined in 26.4.2 (TXTIME and PSDU_LENGTH calculation), which in turn depend on other parameters including the TXVECTOR parameter APEP_LENGTH.	N	N
	FORMAT is HE_TRIG	Indicates the value in the Length field of the L-SIG in the range of 1 to 4095. The value comes from the trigger frame which triggers the HE trigger-based PPDU.	Y	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		

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Table 26-1—TXVECTOR and RXVECTOR parameters(#1780) *(continued)*

L_DATARATE	FORMAT is HE_SU or HE_MU or HE_EXT_SU or HE_TRIG	Not present NOTE—The RATE field in the L-SIG field in HE PPDU is set to the value representing 6 Mb/s in the 20 MHz channel spacing column of Table 17-6 (Contents of the SIGNAL field).	N	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
LSIGVALID	FORMAT is HE_SU or HE_MU or HE_EXT_SU or HE_TRIG	Not present	N	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
SERVICE	FORMAT is HE_SU or HE_MU or HE_EXT_SU or HE_TRIG	Not present	N	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
SMOOTHING	FORMAT is HE_SU or HE_MU or HE_EXT_SU or HE_TRIG	Not present	N	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
AGGREGATION	FORMAT is HE_SU or HE_MU or HE_EXT_SU or HE_TRIG	Not present	N	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
NUM_EXTEN_SS	FORMAT is HE_SU or HE_MU or HE_EXT_SU or HE_TRIG	Not present	N	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
ANTENNA_SET	FORMAT is HE_SU or HE_MU or HE_EXT_SU or HE_TRIG	Not present	N	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
N_TX	FORMAT is HE_SU or HE_MU or HE_EXT_SU or HE_TRIG	Not present	N	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		

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Table 26-1—TXVECTOR and RXVECTOR parameters(#1780) *(continued)*

EXPANSION_MAT_TYPE	FORMAT is HE_SU or HE_MU or HE_EXT_SU or HE_TRIG	Set to COMPRESSED_SV.	Y	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
EXPANSION_MAT	FORMAT is HE_SU or HE_EXT_SU or HE_TRIG	Contains a vector in the number of selected subcarriers containing feedback matrices as defined in 26.3.15.2 (Beamforming feedback matrix V) based on the channel measured during the training symbols of previous HE NDP PPDUs or VHT NDP PPDUs.	Y	N
	FORMAT is HE_MU	For each user, contains a vector in the number of all the subcarriers within the RU which is assigned to this user. The vector for each subcarrier contains feedback matrices as defined in in 26.3.15.2 (Beamforming feedback matrix V) based on the channel measured during the training symbols of previous HE NDP PPDUs or VHT NDP PPDUs.	M U	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
CHAN_MAT_TYPE	FORMAT is HE_SU or HE_MU or HE_EXT_SU or HE_TRIG	Set to COMPRESSED_SV.	N	Y
	FORMAT is HE_MU or HE_EXT_SU or HE_TRIG or (FORMAT is HE_SU and PSDU_LENGTH is greater than 0)	Not present.	N	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
CHAN_MAT	FORMAT is HE_SU and PSDU_LENGTH equals 0	Contains a vector in the number of selected subcarriers containing feedback matrices as defined in 26.3.12.3.2 (Beamforming Feedback) based on the channel measured during the training symbols of previous HE NDP PPDU.	N	Y
	FORMAT is HE_MU or HE_EXT_SU or HE_TRIG or (FORMAT is HE_SU and PSDU_LENGTH is greater than 0)	Not present.	N	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		

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Table 26-1—TXVECTOR and RXVECTOR parameters(#1780) *(continued)*

DELTA_SNR	FORMAT is HE_SU or HE_MU or HE_EXT_SU or HE_TRIG	Contains an array of delta SNR values as defined in 9.4.1.64 (HE MU Exclusive Beamforming Report field) based on the channel measured during the training symbols of the received VHT NDP PPDU or HE NDP PPDU. NOTE—In the RXVECTOR this parameter is present only for HE NDP PPDUs for MU sounding.	M U	Y
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
RCPI	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).			
SNR	FORMAT is HE_SU or or HE_EXT_SU	Contains an array of received SNR measurements for each spatial stream. SNR indications of 8 bits are supported. SNR shall be the sum of the decibel values of SNR per tone divided by the number of tones represented in each stream as described in 9.4.1.63 (HE Compressed Beamforming Report field)	N	Y
	FORMAT is HE_MU	Contains an array of received SNR measurements for each spatial stream of the receiver. SNR indications of 8 bits are supported. SNR shall be the sum of the decibel values of SNR per tone divided by the number of tones which are assigned to the receiver in each stream as described in 9.4.1.63 (HE Compressed Beamforming Report field)	N	Y
	FORMAT is HE_TRIG	Contains an array of received SNR measurements for each spatial stream per user. SNR indications of 8 bits are supported. SNR shall be the sum of the decibel values of SNR per tone divided by the number of tones which are assigned to the user in each stream as described in 9.4.1.63 (HE Compressed Beamforming Report field)	N	Y
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
CQI	FORMAT is HE_SU and PSDU_LENGTH equals 0	Contains an array of received SNR measurements for each spatial stream per 26-tone RU. Each SNR is an absolute number represented by 6 bits, with 1 dB granularity and a range of -10 dB to 53 dB	N	Y
	FORMAT is HE_MU or HE_EXT_SU or HE_TRIG or (FORMAT is HE_SU and PSDU_LENGTH is greater than 0)	Not present.	N	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
NO_SIG_EXTN	FORMAT is HE_SU or HE_MU or HE_EXT_SU or HE_TRIG	Not present.	N	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		

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Table 26-1—TXVECTOR and RXVECTOR parameters(#1780) *(continued)*

FEC_CODING	FORMAT is HE_SU or HE_MU or HE_EXT_SU or HE_TRIG	Indicates which FEC encoding is used. Enumerated type: BCC_CODING indicates binary convolutional code. LDPC_CODING indicates low-density parity check code.	M U	M U
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
STBC	FORMAT is HE_SU or HE_MU or HE_EXT_SU or HE_TRIG	Indicates if STBC is used. In an HE MU PPDU where each RU includes no more than 1 user: Set to 1 to indicate all RUs are STBC encoded in the payload Set to 0 to indicate all RUs are not STBC encoded in the payload In HE SU PPDU, HE extended range SU PPDU or HE trigger-based PPDU: Set to 1 to that indicate STBC is used in the payload Set to 0 to indicate that STBC is not used in the payload STBC is not applied in MU-MIMO RUs, in case of HE MU PPDU if any RU is assigned to more than 1 user, STBC is set to 0 to indicate all RUs are not STBC encoded in the payload.	Y	Y
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
GI_TYPE	FORMAT is HE_SU or HE_MU or HE_EXT_SU or HE_TRIG	Indicates the length of the GI for the HE-LTF and HE-Data fields. Enumerated type: 0.8 µs 1.6 µs 3.2 µs NOTE—the length of GI for pre-HE modulated fields is 0.8 µs.	Y	Y
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
TXPWR_LEVEL_INDEX	FORMAT is HE_SU or HE_MU or HE_EXT_SU or HE_TRIG	The allowed values for the TXPWR_LEVEL_INDEX parameter are in the range from 1 to numberOfOctets (dot11TxPowerLevelExtended)/2. This parameter is used to indicate which of the available transmit output power levels defined in dot11TxPowerLevelExtended shall be used for the current transmission.	Y	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		

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Table 26-1—TXVECTOR and RXVECTOR parameters(#1780) *(continued)*

RSSI	FORMAT is HE_SU or or HE_EXT_SU	The allowed values for the RSSI parameter are in the range 0 to 255 inclusive. This parameter is a measure by the PHY of the power observed at the antennas used to receive the current PPDU measured during the reception of the HE-LTF field. RSSI is intended to be used in a relative manner, and it is a monotonically increasing function of the received power.	N	Y
	FORMAT is HE_MU	The allowed values for the RSSI parameter are in the range 0 to 255 inclusive. This parameter is a measure by the PHY of the power observed at the antennas used to receive the current PPDU measured during the reception of PHY legacy preamble. RSSI is intended to be used in a relative manner, and it is a monotonically increasing function of the received power.	N	Y
	FORMAT is HE_TRIG	Not present	N	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
MCS	FORMAT is HE_SU or HE_MU or HE_EXT_SU or HE_TRIG	Indicates the modulation and coding scheme used in the transmission of the PPDU. Integer: range 0 to 11	M U	M U
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
DCM	FORMAT is HE_SU or HE_MU or or HE_EXT_SU or HE_TRIG	Set to 1 to indicate that dual carrier modulation is used for the HE-Data field. Set to 0 to indicate that dual carrier modulation is not used for the HE-Data field. NOTE—DCM is only applied to MCS0, MCS1, MCS3 and MCS4. DCM is only applied to 1 and 2 spatial streams. DCM is only applied to HE SU PPDU, HE extend range SU PPDU, and SU RUs in HE MU PPDU. DCM is not applied to MU-MIMO. DCM is not applied to STBC.	M U	M U
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
MCS_SIG_B	FORMAT is HE_MU	Indicates the modulation and coding scheme used for HE-SIG-B field. Integer in the range 0 to 5	Y	Y
	Otherwise	Not present.	N	N
DCM_SIG_B	FORMAT is HE_ MU	Set to 1 to indicate that dual carrier modulation is used for the HE-SIG-B field. Set to 0 to indicate that dual carrier modulation is not used for the HE-SIG-B field.	Y	Y
	Otherwise	Not present.	N	N

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Table 26-1—TXVECTOR and RXVECTOR parameters(#1780) *(continued)*

SIG_B_COMPRESSION_MODE	FORMAT is HE_MU	Used to differentiate full bandwidth MU-MIMO from OFDMA MU PPDU. In case of full bandwidth MU-MIMO set to 1, otherwise set to 0.	Y	N
	Otherwise	Not present.	N	N
REC_MCS	FORMAT is HE_SU or HE_MU or HE_EXT_SU	Indicates the MCS that the receiver recommends	N	O
	FORMAT is HE_TRIG	Not present.	N	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
CH_BANDWIDTH	FORMAT is HE_SU or HE_EXT_SU or HE_TRIG	Indicates the channel width of the transmitted PPDU. Enumerated type: CBW20 for 20 MHz CBW40 for 40 MHz CBW80 for 80 MHz CBW160 for 160 MHz CBW80+80 for 80+80 MHz	Y	Y
	FORMAT is HE_MU	Indicates the channel occupied by the transmitted PPDU, supporting channel bonding. See the field of Bandwidth in Table 26-16 (Fields in the HE-SIG-A for an HE MU PPDU)	Y	Y
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
DYN_BANDWIDTH_IN_NON_HT	FORMAT is HE_SU or HE_MU or HE_EXT_SU or HE_TRIG	Not present.	N	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
CH_BANDWIDTH_IN_NON_HT	FORMAT is HE_SU or HE_MU or HE_EXT_SU or HE_TRIG	Not present.	N	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		

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Table 26-1—TXVECTOR and RXVECTOR parameters(#1780) *(continued)*

LENGTH	FORMAT is HE_SU or HE_MU or HE_EXT_SU or HE_TRIG	Not present.	N	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
APEP_LENGTH	FORMAT is HE_SU or HE_MU or HE_EXT_SU or HE_TRIG	If equal to 0, indicates an HE NDP PPDU. If greater than 0, indicates the number of octets in the range 1 to 1048575 in the A-MPDU pre-EOF padding (see 10.13.2 (A-MPDU length limit rules)) carried in the PSDU.	M U	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
PSDU_LENGTH	FORMAT is HE_SU or HE_MU or HE_EXT_SU or HE_TRIG	Indicates the number of octets in the HE PSDU in the range of 0 to aPSDUMaxLength octets (see Table 26-43 (HE PHY characteristics)). A value of 0 indicates an HE NDP PPDU.	N	Y
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
USER_POSITION	FORMAT is HE_SU or HE_MU or HE_EXT_SU or HE_TRIG	Not present.	N	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).(#1780)		
NUM_STS	FORMAT is HE_SU	Indicates the number of space-time streams. Integer in the range 1-8.	Y	Y
	FORMAT is HE_EXT_SU	Indicates the number of space-time streams. Integer in the range 1-2.	Y	Y
	FORMAT is HE_MU	Indicates the number of space-time streams. Integer in the range: 1-4 in the TXVECTOR per user 0-4 in the RXVECTOR per MU-MIMO RU 1-8 per non MU-MIMO RU in the TXVECTOR 0-8 per non MU-MIMO RU in the RXVECTOR NUM_STS summed over all users per RU is not greater than 8.	M U	M U
	FORMAT is HE_TRIG	Indicates the number of space-time streams. Integer in the range: 1-4 in the TXVECTOR for MU-MIMO RU 0-4 per user in the RXVECTOR per MU-MIMO RU 1-8 in the TXVECTOR for non MU-MIMO RU 0-8 per non MU-MIMO RU in the RXVECTOR NUM_STS summed over all users per RU is not greater than 8.	M U	M U
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		

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Table 26-1—TXVECTOR and RXVECTOR parameters(#1780) *(continued)*

GROUP_ID	FORMAT is HE_SU or HE_MU or HE_EXT_SU or HE_TRIG	Not present	N	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
PARTIAL_AID	FORMAT is HE_SU or HE_MU or HE_EXT_SU or HE_TRIG	Not present	N	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
TXOP_DURATION	FORMAT is HE_SU or HE_MU or HE_EXT_SU or HE_TRIG	Indicates a duration of time that is used to update the NAV for this TXOP (see 25.2.2 (Updating two NAVs)), except for a value of 127 (i.e., all 1s) which indicates an invalid value of TXOP duration in the HE-SIG-A field (see 25.12 (TXVECTOR parameter TXOP_DURATION for an HE PPDU(#2596))). B0 indicates whether the granularity is 8 µs or 128 µs. When B0 is 0, then B1 to B6 indicate a duration, in units of 8 µs, starting from 0 to 504 us (i.e, duration = (8 µs × value of (B1-B6)) µs). When B0 is 1, then B1 to B6 indicate a duration, in units of 128 µs, starting from 512 µs until 8448 µs (i.e, duration = (512 + 128 × value of (B1-B6)) µs). See 25.12 (TXVECTOR parameter TXOP_DURATION for an HE PPDU(#2596)) for more details.(#783)	Y	Y
	Otherwise	Not present.	N	N
SPATIAL_REUSE	FORMAT is HE_SU or HE_MU or HE_EXT_SU or HE_TRIG	Indicates the spatial reuse parameter. There is only one value for an HE SU PPDU, HE extended range SU PPDU and HE MU PPDU. There might be one to four values for an HE trigger-based PPDU depending on the bandwidth of the PPDU. See the Spatial Reuse field definition in 26.3.10.7.2 (Content)	Y	Y
	Otherwise	Not present	N	N
DOPPLER	FORMAT is HE_SU or HE_MU or HE_EXT_SU or HE_TRIG	Indicates whether the doppler effect should be considered for the PPDU. The value is 0 or 1	Y	N
	Otherwise	Not present	N	N
NUM_USERS	FORMAT is HE_SU or HE_MU or HE_EXT_SU or HE_TRIG	Not present. NOTE—number of users for an HE SU PPDU, HE extended range SU PPDU and HE trigger-based PPDU is always 1. The number of users for an HE MU PPDU is determined by RU_ALLOCATION.	N	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		

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Table 26-1—TXVECTOR and RXVECTOR parameters(#1780) *(continued)*

RU_ALLOCATION	FORMAT is HE_MU	Each 8 bit per 20 MHz PPDU BW for signaling: The RU arrangement in frequency domain Number of MU-MIMO allocations See 26.3.10.8.4 (HE-SIG-B common content) for details.	Y	Y
	FORMAT is HE_TRIG	8 bit for RU allocation in the whole bandwidth. See 9.3.1.23 (Trigger frame format) for details	Y	Y
	Otherwise	Not present	N	N
BEAMFORMED	FORMAT is HE_SU or HE_EXT_SU	Set to 1 if a beamforming steering matrix is applied to the waveform in an SU transmission. Set to 0 otherwise.	Y	Y
	FORMAT is HE_MU or HE_TRIG	For a single user allocation in an RU, set to 1 if a beamforming steering matrix is applied, and set to 0 otherwise. For each user in a multi-user allocation in an RU, always set to 0.	M U	O
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
HE_LTF_TYPE	FORMAT is HE_SU or HE_MU or HE_EXT_SU or HE_TRIG	Indicates the type of HE-LTF. Enumerated type: 1x HE-LTF 2x HE-LTF 4x HE-LTF See 26.3.10.10 (HE-LTF) for details.	Y	Y
	Otherwise	Not present.	N	N
HE_LTF_MODE	FORMAT is HE_TRIG	Indicates whether the UL MU MIMO transmission uses single stream pilots or a mask on each spatial stream of the LTF sequence by a distinct orthogonal code. It is only present for full bandwidth MU-MIMO.	Y	N
	Otherwise	Not present.	N	N
STARTING_STS_NUM	FORMAT is HE_TRIG	Indicates the starting STS number in the global space-time streams for the UL MU MIMO.	Y	N
	Otherwise	Not present.	N	N

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Table 26-1—TXVECTOR and RXVECTOR parameters(#1780) *(continued)*

TXOP_PS_NOT_ALLOWED	FORMAT is HE_SU or HE_MU or HE_EXT_SU or HE_TRIG	Not present	N	N
	Otherwise	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).		
TIME_OF_DEPARTURE_REQUE	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).			
RX_START_OF_FRAME_OFFSET	See corresponding entry in Table 21-1 (TXVECTOR and RXVECTOR parameters).			
PREAMBLE_TYPE	FORMAT is NON_HT and NON_HT_MODULATION is one of ERP-DSSS ERP-CCK	Enumerated type: SHORTPREAMBLE LONGPREAMBLE	Y	Y
	Otherwise	Not present	N	N
PE_DURATION	FORMAT is HE_SU or HE_MU or HE_EXT_SU or HE_TRIG.	Determines the duration of PE field in an HE PPDU. Possible values are 0 µs, 4 µs, 8 µs, 12 µs and 16 µs.	Y	Y
BEAM_CHANGE	FORMAT is HE_SU or HE_EXT_SU(#2675)	Boolean value: true indicates that the pre-HE-STF portion of the PPDU is spatially mapped differently from HE-LTF1. false indicates that the pre-HE-STF portion of the PPDU is spatially mapped the same way as HE-LTF1 on each tone.(#481)	Y (#2153)	Y (#2153)
	Otherwise	Not present(#2675)		
BSS_COLOR	FORMAT is HE_SU or HE_MU or HE_EXT_SU or HE_TRIG	Set to a value of the AP's choosing within the range 0 to 63(#835) (see 25.11 (TXVECTOR parameters STA_ID_LIST, UPLINK_FLAG, BEAM_CHANGE and BSS_COLOR for an HE PPDU(#2517))).	Y	Y
	Otherwise	Not present	N	N

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Table 26-1—TXVECTOR and RXVECTOR parameters(#1780) *(continued)*

UPLINK_FLAG	FORMAT is HE_SU or HE_MU or HE_EXT_SU	Set to 1 if the HE PPDU is addressed to an AP.(#1611) Set to 0 otherwise (see 25.11 (STA ID, Uplink Flag and BSS Color in HE PPDUs)).	Y	Y
	Otherwise	Not present	N	N
STA_ID_LIST	FORMAT is HE_MU	Indicates the list of STA IDs for an HE MU PPDU (see 25.11 (TXVECTOR parameters STA_ID_LIST, UPLINK_FLAG, BEAM_CHANGE and BSS_COLOR for an HE PPDU(#2517))).	MU	Y
	Otherwise	Not present	N	N
SCRAMBLER_INTIAL_STATE	FORMAT is NON_HT	In TXVECTOR, if present, indicates the initial state of the scrambler of the transmitted PPDU. In RXVECTOR, indicates the Scrambler Initialization value in the Service field, prior to descrambling.(#127)	O	Y
	FORMAT is HE_MU or HE_TRIG	Not present.	N	N
	Otherwise	Indicates the Scrambler Initialization value in the Service field, prior to descrambling.	N	Y

NOTE—In the "TXVECTOR" and "RXVECTOR" columns, the following apply:
Y = Present;
N = Not present;
O = Optional;
MU indicates that the parameter is present once for an HE SU PPDU and HE extended range SU PPDU and present per user for an HE MU PPDU. For an HE trigger-based PPDU, MU in the TXVECTOR column indicates that the parameter is present once and MU in the RXVECTOR column indicates the parameter is present per user.(#2676) Parameters specified to be present per user are conceptually supplied as an array of values indexed by *u*, where *u*(#2356) takes values 0 to NUM_USERS–1.

26.3 HE PHY

26.3.1 Introduction

26.3.2 MU transmission(#507)

26.3.2.1 Introduction

The MU transmissions include DL MU transmissions and UL MU transmissions.

The DL MU transmission allows an AP to simultaneously transmit frames to more than one non-AP STAs. For the DL MU transmission, the AP uses the HE MU PPDU format, and employs either DL OFDMA, DL MU-MIMO, or a mixture of both. The UL MU transmission allows an AP to receive simultaneous frames from more than one non-AP STAs. Non-AP STAs transmit their frames using HE trigger-based PPDU format and employ either UL OFDMA, UL MU-MIMO, or a mixture of both.

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The HE PHY supports OFDMA transmissions, both in the DL and the UL where different users can occupy different RUs in a PPDU (see 26.3.9 (Mathematical description of signals)). On an RU in a PPDU, it is allowed to have single stream transmissions to one user or spatial multiplexing to one user (SU-MIMO) or spatial multiplexing to multiple users (MU-MIMO). Note that the VHT PHY supports only full bandwidth DL MU-MIMO as described in 21.3.11 (SU-MIMO and DL-MU-MIMO Beamforming). The HE PHY defines DL MU-MIMO and UL MU-MIMO, for the full bandwidth case as well as for the case where they are being used on only certain RUs in the PPDU. The combination of SU transmissions and MU-MIMO transmissions on different RUs in one PPDU is also supported.

26.3.3 OFDMA and SU tone allocation

Orthogonal Frequency Division Multiple Access (OFDMA) is an OFDM-based multiple access scheme where different subsets of subcarriers are allocated to different users(#1946), allowing simultaneous data transmission to or from(#2524) several users. In OFDMA, in general, users are allocated different subsets of subcarriers which can change from one PPDU(#Ed) to the next(#2525). In HE, the time region covers the entire data portion of an HE PPDU, and the frequency region includes a number of contiguous subcarriers with the exception of the RUs which straddle DC where nulls are placed in the middle of the band. The difference between OFDM and OFDMA is illustrated in Table 26-15 (CH_BANDWIDTH and for pre-HE modulated fields). Similar to OFDM, OFDMA employs multiple subcarriers, but the subcarriers are divided into several groups of subcarriers where each group is denoted as a resource unit (RU). The grouping of subcarriers into groups of resource units is referred to as subchannelization. In HE, the subcarriers that form an RU(#1948) are physically adjacent (contiguous except at the middle of the band where nulls are placed at DC).

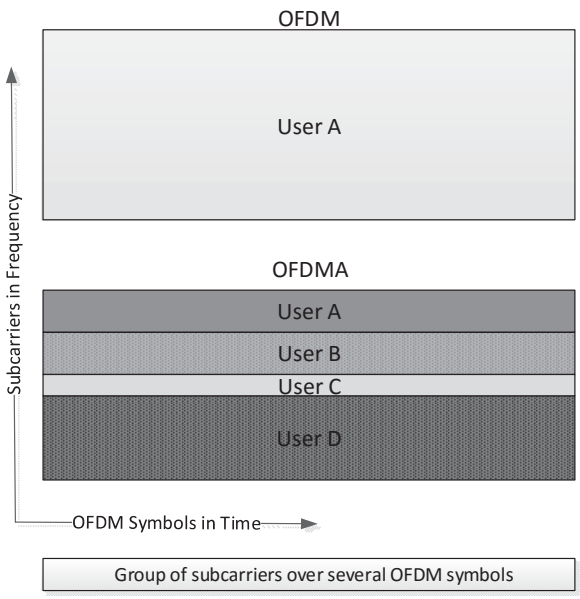

Figure 26-1—Illustration of OFDM and OFDMA concepts

Subchannelization defines subchannels that can be allocated to stations depending on their channel conditions and service requirements. An OFDMA system may allocate different transmit powers to different subchannels.(#1949)

(#2365)(#2526)In OFDMA, an OFDM symbol is constructed of subcarriers, the number of which is a function of the DFT(#2366) size. There are several subcarrier types: 1) Data subcarriers which are used for

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data transmission; defined in 26.3.3.1 (Resource unit, guard and DC subcarriers(#1951)), 2) Pilot subcarriers which are utilized for phase information and parameter tracking; defined in 26.3.3.3 (Pilot tones), and 3) unused subcarriers which are not used for data/pilot transmission. The unused subcarriers are the DC subcarrier (defined in 26.3.3.1 (Resource unit, guard and DC subcarriers(#1951))), the Guard band subcarriers at the band edges (defined in 26.3.3.1 (Resource unit, guard and DC subcarriers(#1951))), and the Null subcarriers (defined in 26.3.3.2 (Null subcarriers)).

26.3.3.1 Resource unit, guard and DC subcarriers(#1951)

The following resource units (RUs) are defined for DL and UL transmission: a 26-tone RU, 52-tone RU, 106-tone RU, 242-tone RU, 484-tone RU and 996-tone RU and 2×996-tone RU(#838)(#1337)(#353).

The 26-tone RU, 52-tone RU, 106-tone RU and 242-tone RU(PHY Motion #172) are used in the 20 MHz, 40 MHz, 80 MHz, 160 MHz and 80+80 MHz HE MU PPDU formats or HE trigger-based PPDU formats using OFDMA transmission. The 484-tone RU(#838) is used in the 40 MHz, 80 MHz, 160 MHz and 80+80 MHz HE MU PPDU formats or HE trigger-based PPDU formats using OFDMA transmission. The 996-tone RU(#838) is used in the 80 MHz, 160 MHz and 80+80 MHz HE MU PPDU formats or HE trigger-based PPDU formats using OFDMA transmission. The 2×996-tone RU is used in the 160 MHz and 80+80 MHz HE MU PPDU formats or HE trigger-based PPDU formats using OFDMA transmission.(#888)

The 242-tone and larger RUs are used in the HE SU PPDU formats. The 242-tone RU(#838) is used in the 20 MHz HE SU PPDU format. The 484-tone RU(#838) is used in the 40 MHz HE SU PPDU format. The 996-tone RU(#838) is used in the 80 MHz HE SU PPDU format. The 2×996-tone RU(#838)(#1337) is used in the 160 MHz and 80+80 MHz HE SU PPDU formats.(#888)

The maximum number(#Ed) of RUs in the 20 MHz, 40 MHz, 80 MHz, 160 MHZ and 80+80 MHz HE PPDU formats are defined in Table 26-2 (Maximum number of RUs for each channel width(#1850)).(#285).

Table 26-2—Maximum number of RUs for each channel width(#1850)

RU type	CBW20	CBW40	CBW80	CBW80+80 and CBW160
26-tone RU(#838)	9	18	37	74
52-tone RU	4	8	16	32
106-tone RU	2	4	8	16
242-tone RU	1-SU/MU-MIMO	2	4	8
484-tone RU	N/A	1-SU/MU-MIMO	2	4
996-tone RU	N/A	N/A	1-SU/MU-MIMO	2
2×996 tone RU(#1337)	N/A	N/A	N/A	1-SU/MU-MIMO

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An HE MU PPDU using OFDMA transmission can carry a mixture of 26-, 52- and 106-tone RUs within any of the 242-tone RU(#838) boundaries(#888).

Table 26-3—Subcarrier indices for RUs in a 20 MHz HE PPDU

RU type					
26-tone RU(#838)	RU 1 [−121: −96](#1111)	RU 2 [−95: −70]	RU 3 [−68: −43]	RU 4 [−42: −17]	RU 5 [−16: −4, 4: 16](#1111)
	RU 6 [17: 42]	RU 7 [43: 68]	RU 8 [70: 95]	RU 9 [96: 121]	
52-tone RU	RU 1 [−121: −70]	RU 2 [−68: −17]	RU 3 [17: 68]	RU 4 [70: 121]	
106-tone RU	RU 1 [−122: −17]		RU 2 [17: 122]		
242-tone RU	RU 1 [−122: −2, 2:122]				

Table 26-4—Subcarrier indices for RUs in a 40 MHz HE PPDU

RU type					
26-tone RU(#838)	RU 1 [−243: −218]	RU 2 [−217: −192]	RU 3 [−189: −164]	RU 4 [−163: −138]	RU 5 [−136: −111]
	RU 6 [−109: −84]	RU 7 [−83: −58]	RU 8 [−55: −30]	RU 9 [−29: −4]	
	RU 10 [4: 29]	RU 11 [30: 55]	RU 12 [58: 83]	RU 13 [84: 109]	RU 14 [111: 136]
	RU 15 [138: 163]	RU 16 [164: 189]	RU 17 [192: 217]	RU 18 [218: 243]	
52-tone RU	RU 1 [−243: −192]	RU 2 [−189: −138]	RU 3 [−109: −58]	RU 4 [−55: −4]	
	RU 5 [4: 55]	RU 6 [58: 109]	RU 7 [138: 189]	RU 8 [192: 243]	
106-tone RU	RU 1 [−243: −138]	RU 2 [−109: −4]	RU 3 [4: 109]	RU 4 [138: 243]	
242-tone RU	RU 1 [−244: −3]		RU2 [3: 244]		
484-tone RU	RU 1 [−244: −3, 3: 244]				

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Table 26-5—Subcarrier indices for RUs in an 80 MHz HE PPDU

RU type					
26-tone RU	RU 1 [−499: −474]	RU 2 [−473: −448]	RU 3 [−445: −420]	RU 4 [−419: −394]	RU 5 [−392: −367]
	RU 6 [−365: −340]	RU 7 [−339: −314]	RU 8 [−311: −286]	RU 9 [−285: −260]	
	RU 10 [−257: −232]	RU 11 [−231: −206]	RU 12 [−203: −178]	RU 13 [−177: −152]	RU 14 [−150: −125]
	RU 15 [−123: −98]	RU 16 [−97: −72]	RU 17 [−69: −44]	RU 18 [−43: −18]	RU 19 [−16: −4, 4: 16]
	RU 20 [18: 43]	RU 21 [44: 69]	RU 22 [72: 97]	RU 23 [98: 123]	RU 24 [125: 150]
	RU 25 [152: 177]	RU 26 [178: 203]	RU 27 [206: 231]	RU28 [232: 257]	
	RU 29 [260: 285]	RU 30 [286: 311]	RU 31 [314: 339]	RU 32 [340: 365]	RU 33 [367: 392]
	RU 34 [394: 419]	RU 35 [420: 445]	RU 36 [448: 473]	RU37 [474: 499]	
52-tone RU	RU 1 [−499: −448]	RU 2 [−445: −394]	RU 3 [−365: −314]	RU 4 [−311: −260]	
	RU 5 [−257: −206]	RU 6 [−203: −152]	RU 7 [−123: −72]	RU 8 [−69: −18]	
	RU 9 [18: 69]	RU 10 [72: 123]	RU 11 [152: 203]	RU 12 [206: 257]	
	RU 13 [260: 311]	RU 14 [314: 365]	RU 15 [394: 445]	RU 16 [448: 499]	
106-tone RU	RU 1 [−499: −394]	RU 2 [−365: −260]	RU 3 [−257: −152]	RU 4 [−123: −18]	
	RU 5 [18: 123]	RU 6 [152: 257]	RU 7 [260: 365]	RU 8 [394: 499]	
242-tone RU	RU 1 [−500: −259]	RU 2 [−258: −17]	RU 3 [17: 258]	RU 4 [259: 500]	
484-tone RU	RU 1 [−500: −17]		RU 2 [17: 500](#2758)		
996-tone RU	RU 1 [−500: −3, 3: 500]				

A 26-tone RU(#838) consists of 24 data subcarriers and 2 pilot subcarriers. The positions of the pilots for the 26-tone RU(#838) are(#1957) defined in 26.3.3.3 (Pilot tones). The location of the 26-tone RUs(#838) are fixed as defined in Table 26-3 (Subcarrier indices for RUs in a 20 MHz HE PPDU), Table 26-4 (Subcarrier indices for RUs in a 40 MHz HE PPDU) and Table 26-5 (Subcarrier indices for RUs in an 80 MHz HE PPDU)(#1958) and shown in Figure 26-2 (RU locations in a 20 MHz HE PPDU), Figure 26-3 (RU locations in a 40 MHz HE PPDU) and Figure 26-4 (RU locations in an 80 MHz HE PPDU)(#2759) for the 20 MHz, 40 MHz and 80 MHz HE MU PPDU formats or HE trigger-based PPDU formats using OFDMA transmission, respectively. The same structure as used for the 80 MHz HE MU PPDU formats or HE

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trigger-based PPDU formats using OFDMA transmission is used for each 80 MHz frequency segment of the 160 MHz and 80+80 MHz HE MU PPDU or HE trigger-based PPDU formats using OFDMA transmission. The center 26-tone RU(#838) in the 20 MHz and 80 MHz HE MU PPDU or HE trigger-based PPDU formats using OFDMA transmission (Figure 26-2 (RU locations in a 20 MHz HE PPDU) and Figure 26-4 (RU locations in an 80 MHz HE PPDU)) is located on subcarriers [−16: −4, 4: 16].(#888)

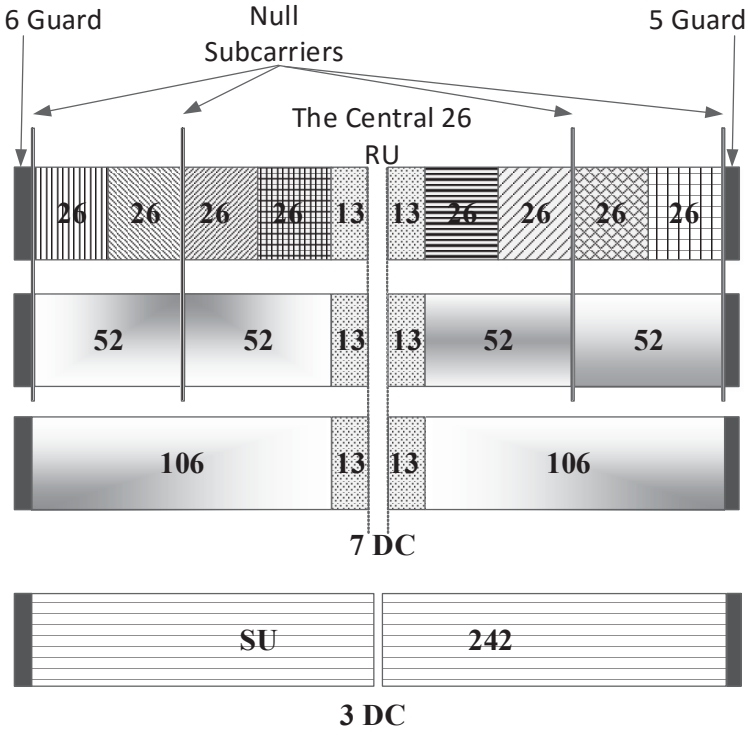

Figure 26-2—RU locations in a 20 MHz HE PPDU

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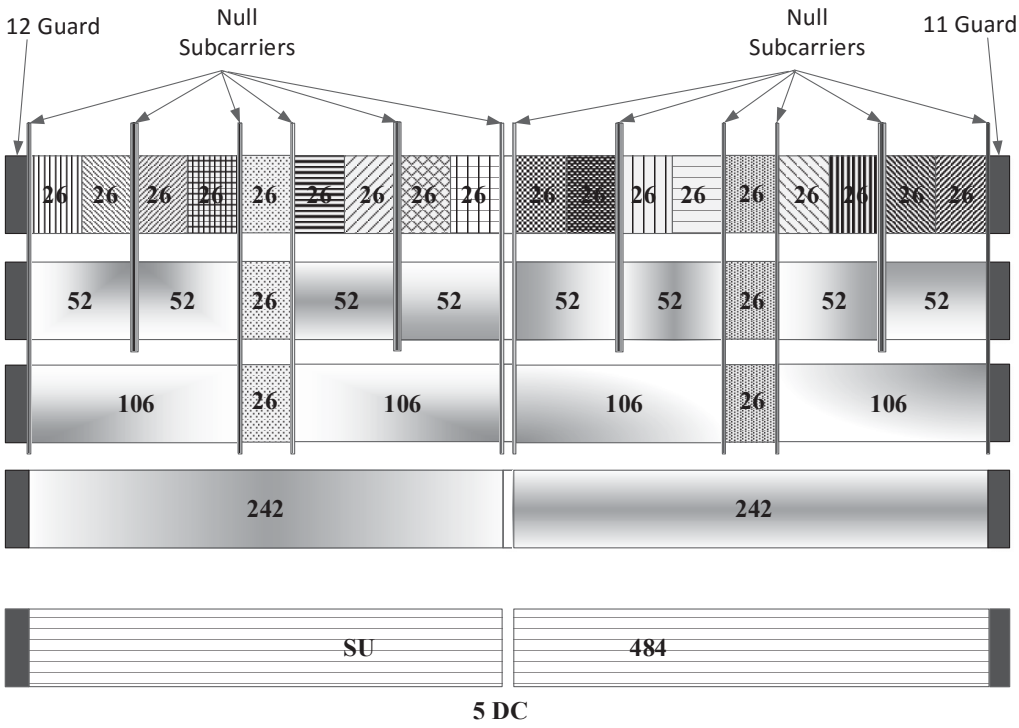

Figure 26-3—RU locations in a 40 MHz HE PPDU

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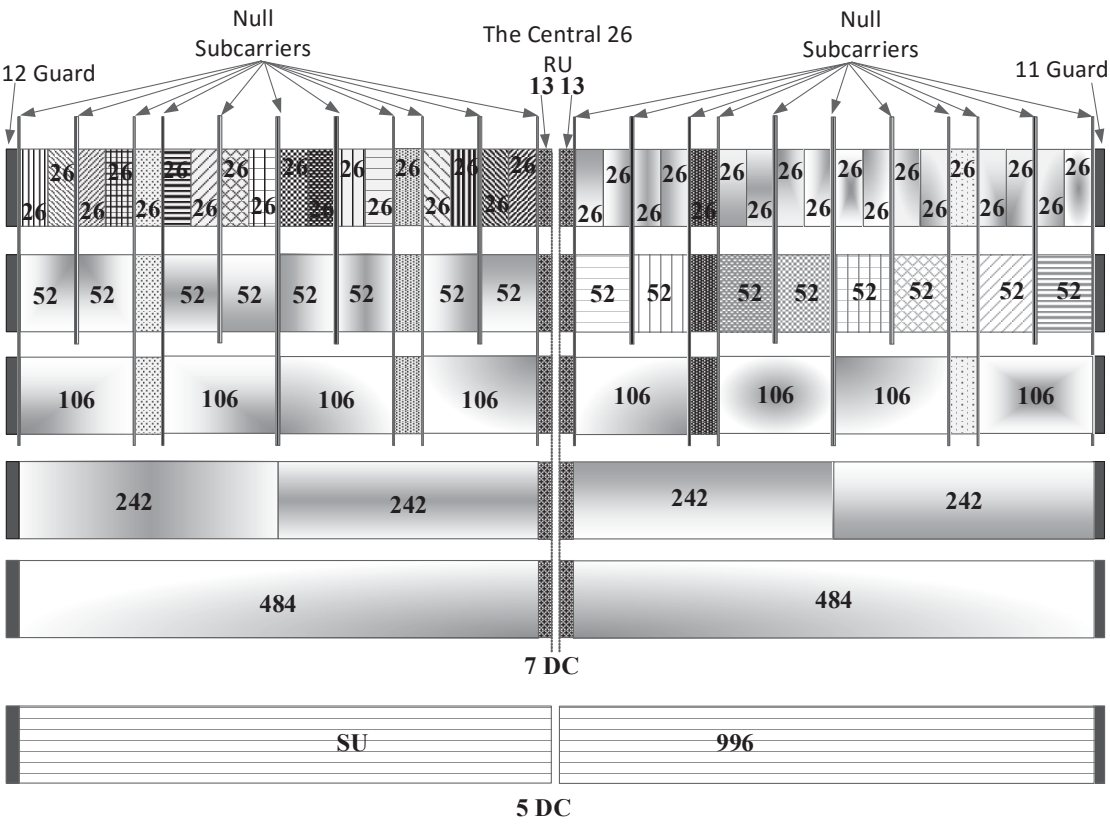

Figure 26-4—RU locations in an 80 MHz HE PPDU

A 52-tone RU(#838) consists of 48 data subcarriers and 4 pilot subcarriers. The positions of the pilots for the 52-tone RU(#838) are(#1960) defined in 26.3.3.3 (Pilot tones). The locations of the 52-tone RUs(#838) are fixed as defined in Table 26-3 (Subcarrier indices for RUs in a 20 MHz HE PPDU), Table 26-4 (Subcarrier indices for RUs in a 40 MHz HE PPDU) and Table 26-5 (Subcarrier indices for RUs in an 80 MHz HE PPDU) and illustrated in Figure 26-2 (RU locations in a 20 MHz HE PPDU), Figure 26-3 (RU locations in a 40 MHz HE PPDU) and Figure 26-4 (RU locations in an 80 MHz HE PPDU) for the 20 MHz, 40 MHz and 80 MHz HE MU PPDU formats or HE trigger-based PPDU formats using OFDMA transmission, respectively. The same structure as used in the 80 MHz HE MU PPDU format or HE trigger-based PPDU formats using OFDMA transmission is used for each 80 MHz frequency segment of the 160 MHz and 80+80 MHz HE MU PPDU formats or HE trigger-based PPDU formats using OFDMA transmission.(#888)

A 106-tone RU(#838) consists of 102 data subcarriers and 4 pilot subcarriers. The positions of the pilots for the 106-tone RU(#838) are(#1961) defined in 26.3.3.3 (Pilot tones). The locations of the 106-tone RUs(#838) are fixed as defined in Table 26-3 (Subcarrier indices for RUs in a 20 MHz HE PPDU), Table 26-4 (Subcarrier indices for RUs in a 40 MHz HE PPDU) and Table 26-5 (Subcarrier indices for RUs in an 80 MHz HE PPDU) and illustrated in Figure 26-2 (RU locations in a 20 MHz HE PPDU), Figure 26-3 (RU locations in a 40 MHz HE PPDU) and Figure 26-4 (RU locations in an 80 MHz HE PPDU) for the 20 MHz, 40 MHz and 80 MHz HE MU PPDU formats or HE trigger-based PPDU formats using OFDMA transmission, respectively. The same structure as used in the 80 MHz HE MU PPDU formats or HE trigger-based PPDU formats using OFDMA transmission is used for each 80 MHz frequency segment of the 160 MHz and 80+80 MHz HE MU PPDU formats or HE trigger-based PPDU formats using OFDMA transmission.

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A 242-tone RU(#838) consists of 234 data subcarriers and 8 pilot subcarriers. The positions of pilots for the 242-tone RU(#838) are(#1962) defined in 26.3.3.3 (Pilot tones). The locations of the 242-tone RUs(#838) are fixed as defined in Table 26-3 (Subcarrier indices for RUs in a 20 MHz HE PPDU),(#1669) Table 26-4 (Subcarrier indices for RUs in a 40 MHz HE PPDU) and Table 26-5 (Subcarrier indices for RUs in an 80 MHz HE PPDU) and illustrated in Figure 26-2 (RU locations in a 20 MHz HE PPDU), Figure 26-3 (RU locations in a 40 MHz HE PPDU) and Figure 26-4 (RU locations in an 80 MHz HE PPDU) for the 20 MHz, 40 MHz and 80 MHz HE PPDU formats, respectively. The same structure as used in the 80 MHz HE PPDU formats is used for each 80 MHz frequency segment of the 160 MHz and 80+80 MHz HE PPDU formats.(#888)

A 484-tone RU(#838) consists of 468 data subcarriers and 16 pilot subcarriers. The position of the pilots for the 484-tone RU(#838) is defined in 26.3.3.3 (Pilot tones). The locations of the 484-tone RUs(#838) are fixed as defined in Table 26-4 (Subcarrier indices for RUs in a 40 MHz HE PPDU) and Table 26-5 (Subcarrier indices for RUs in an 80 MHz HE PPDU) and illustrated in Figure 26-3 (RU locations in a 40 MHz HE PPDU) and Figure 26-4 (RU locations in an 80 MHz HE PPDU) for the 40 MHz and 80 MHz HE PPDU formats. The same structure as used for the 80 MHz HE PPDU formats is used for each 80 MHz frequency segment of the 160 MHz and 80+80 MHz HE PPDU formats.(#888)

A 996-tone RU(#838) consists of 980 data subcarriers and 16 pilot subcarriers. The position of the pilots for the 996-tone RU(#838) is defined in 26.3.3.3 (Pilot tones). The locations of the 996-tone RUs(#838) are fixed and located on subcarrier [−1012: −515, −509: −12] and [12: 509, 515: 1012] for each half of the BW, respectively, for 160 MHz and 80+80 MHz(#Ed) HE PPDU formats.(#888)

The 20 MHz HE MU PPDU and HE trigger-based PPDU with more than one RU has 7 DC subcarriers located at [−3: 3]. The 20 MHz HE SU PPDU with a 242-tone RU(#838) has 3 DC subcarriers located at [−1: 1]. The 40 MHz HE PPDU with a 484-tone RU has 5 DC subcarriers located at [−2: 2]. An 80 MHz HE MU PPDU and HE trigger-based PPDU with more than one RU has 7 DC subcarriers located at [−3: 3]. The 80 MHz HE SU PPDU with a 996-tone RU has 5 DC subcarriers located at [−2: 2]. The same structure as used in the 80 MHz HE PPDU is used for each 80 MHz frequency segment of the 160 MHz and 80+80 MHz HE PPDU. The DC tones are located on subcarriers [−11: 11].(#1963)(#888)

The 20 MHz HE PPDU format has 11 guard subcarriers (6, 5) located at [−128: −123] and [123: 127] as shown in Figure 26-2 (RU locations in a 20 MHz HE PPDU). The 40 MHz HE PPDU has 23 guard subcarriers (12, 11) located at [−256: −245] and [245: 255] as shown in Figure 26-3 (RU locations in a 40 MHz HE PPDU). The 80 MHz HE PPDU has 23 guard subcarriers (12, 11) located at [−512: −501] and [501: 511] as shown in Figure 26-4 (RU locations in an 80 MHz HE PPDU). For 160 MHz and 80+80 MHz HE PPDUs, the same number of leftmost and rightmost guard subcarriers as 80 MHz are defined at each edge of the 160 MHz.

(PHY Motion #165)In an HE MU PPDU, at least *N*x4x26 subcarriers (contiguous or non-contiguous), where *N* is the number of 20 MHz channels' legacy preambles present, shall be occupied throughout the signaled BW.

26.3.3.2 Null subcarriers

There are null subcarriers between the 26-, 52- and 106-tone RU(#838) locations as illustrated in Figure 26-2 (RU locations in a 20 MHz HE PPDU), Figure 26-3 (RU locations in a 40 MHz HE PPDU) and

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Figure 26-4 (RU locations in an 80 MHz HE PPDU). The null subcarriers have zero energy. The indices of the null subcarrier are enumerated in Table 26-6 (Null subcarrier indices).

Table 26-6— Null subcarrier indices

Channel Width	RU Size	Null Subcarrier Indices
20 MHz	26, 52	±69, ±122
	106	none
	242	none
40 MHz	26, 52	±3, ±56, ±57, ±110, ±137, ±190, ±191, ±244
	106	±3, ±110, ±137, ±244
	242, 484	none
80 MHz	26, 52	±17, ±70, ±71, ±124, ±151, ±204, ±205, ±258, ±259, ±312, ±313, ±366, ±393, ±446, ±447, ±500
	106	±17, ±124, ±151, ±258, ±259, ±366, ±393, ±500
	242, 484	none
	996	none

26.3.3.3 Pilot tones

If pilot tones are present in the HE-LTF field, the pilot tone locations in the HE-LTF field and Data field shall be the same. All pilot tones are at the even indices enumerated in Table 26-7 (Pilot tone indices).(#1789)

Table 26-7— Pilot tone indices

Channel Width	RU Size	Pilot Tone Indices
20 MHz	26, 52	±10, ±22, ±36, ±48, ±62, ±76, ±90, ±102, ±116
	106, 242	±22, ±48, ±90, ±116
40 MHz	26, 52	±10, ±24, ±36, ±50, ±64, ±78, ±90, ±104, ±116, ±130, ±144, ±158, ±170, ±184, ±198, ±212, ±224, ±238
	106, 242, 484	±10, ±36, ±78, ±104, ±144, ±170, ±212, ±238
80 MHz	26, 52	±10, ±24, ±38, ±50, ±64, ±78, ±92, ±104, ±118, ±130, ±144, ±158, ±172, ±184, ±198, ±212, ±226, ±238, ±252, ±266, ±280, ±292, ±306, ±320, ±334, ±346, ±360, ±372, ±386, ±400, ±414, ±426, ±440, ±454, ±468, ±480, ±494
	106, 242, 484	±24, ±50, ±92, ±118, ±158, ±184, ±226, ±252, ±266, ±292, ±334, ±360, ±400, ±426, ±468, ±494
	996	±24, ±92, ±158, ±226, ±266, ±334, ±400, ±468

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Table 26-7— Pilot tone indices *(continued)*

160 MHz	26, 52, 106, 242, 484	{pilot tone indices in 80 MHz –512, pilot tone indices in 80 MHz +512}
	996	{for the first 80 MHz, pilot tone indices in 80 MHz –512, for the second 80 MHz, pilot tone indices in 80 MHz +512}(#841)

The pilot tones locations for 160 MHz or 80+80 MHz shall use the same 80 MHz locations for both 80 MHz.

26.3.3.4 RU restriction rules when operating 20 MHz(#854)

A non-AP STA can operate with 20 MHz, because either it is a 20 MHz-only HE device (see 26.3.9 (Mathematical description of signals)), or it reduces operating channel width to 20 MHz by ROM (see 25.8 (Operating mode indication)). When a 20 MHz operating non-AP STA is either a recipient of 40, 80, 80+80 or 160 MHz DL-OFDMA, or one of transmitters of 40, 80, 80+80 or 160 MHz UL-OFDMA, RU tone mapping in 20 MHz is not aligned with 40, 80, 80+80 or 160 MHz RU tone mapping (see 26.3.3.1 (Resource unit, guard and DC subcarriers(#1951))). Due to misalignment of these RU locations, some of these RUs may cause significant performance penalty or interference to neighbor RUs. To improve the throughput and interoperability, some RUs in 20 MHz operating STAs are restricted to be used in 40, 80, 80+80 or 160 MHz OFDMA operation.

An AP shall not assign the following RUs to 20 MHz operating STAs

— For 26-tone RUs, [Table 26-4 (Subcarrier indices for RUs in a 40 MHz HE PPDU) and Table 26-5 (Subcarrier indices for RUs in an 80 MHz HE PPDU)]
  - RU 5 and 14 in 40 MHz DL/UL OFDMA (2 26-tone RUs are restricted)
  - RU 5, 10, 14, 19, 24, 28, 33 in 80 MHz DL/UL OFDMA (7 26-tone RUs are restricted)
  - RU 5, 10, 14, 19, 24, 28, 33 in lower 80 MHz and upper 80 MHz, in 80+80 or 160 MHz DL/UL OFDMA (14 26-tone RUs are restricted)

— For 52-tone RUs, [Table 26-4 (Subcarrier indices for RUs in a 40 MHz HE PPDU) and Table 26-5 (Subcarrier indices for RUs in an 80 MHz HE PPDU)]
  - RU 5, 12 in 80 MHz DL/UL OFDMA (2 of 52-tone RUs are restricted)
  - RU 5, 12 in lower 80 MHz and upper 80 MHz, in 80+80 or 160 MHz DL/UL OFDMA (4 of 52-tone RUs are restricted)

— For 106-tone RUs, [Table 26-4 (Subcarrier indices for RUs in a 40 MHz HE PPDU) and Table 26-5 (Subcarrier indices for RUs in an 80 MHz HE PPDU)]
  - RU 3, 6 in 80MHz DL/UL OFDMA (2 of 106-tone RUs are restricted)
  - RU 3, 6 in lower 80 MHz and upper 80 MHz, in 80+80 or 160 MHz DL/UL OFDMA (4 of 106-tone RUs are restricted)

Center 26-tone RU in primary 20 channel shall not be assigned to any STAs where 20 MHz operating STAs are recipients of 40/80/160/80+80 OFDMA.

It is optional whether all 242-tone RUs of 20 MHz operating STAs to be supported in 40/80/160/80+80 MHz DL-OFDMA. If supported, there is no restriction on 242-tone RUs. A 242-tone RU shall not be allocated to 20 MHz operating STAs in 40/80/160/80+80 for UL-OFDMA.

26.3.3.5 20 MHz only HE STAs

(PHY Motion #163)A 20 MHz only HE STA operates with 20 MHz channel width only, in frequency bands between 1 GHz and 6 GHz. A 20 MHz only HE STA operates in the primary 20 MHz channel as a

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mandatory mode. It is indicated in the capability field, whether an HE STA is 20 MHz only, 80 MHz, 160 MHz or 80+80MHz capable. Only a non-AP HE STA can be a 20 MHz-only STA.

An HE AP in 5 GHz shall be 80 MHz capable and operate for both 80 MHz capable non-AP HE STAs and 20 MHz only non-AP HE STAs.

A 20 MHz only non-AP HE STA supports tone mapping of 26-tone RU, 52-tone RU, 106-tone RU and 242-tone RU, for 20 MHz and 40 MHz OFDMA in 2.4 GHz and 5 GHz frequency band, and for 80 MHz, 80+80 MHz and 160 MHz OFDMA in 5 GHz frequency band, where some of RUs are restricted to operate (see 26.3.3.4 (RU restriction rules when operating 20 MHz(#854))).

26.3.3.6 DL MU transmission

DL MU transmission allows an AP to simultaneously transmit to more than one non-AP STA. The AP uses the HE MU PPDU for DL MU transmission.

26.3.3.7 DL MU-MIMO

26.3.3.7.1 Minimum RU size in DL MU-MIMO

A STA capable of receiving DL MU-MIMO transmission on an RU that does not span the entire PPDU bandwidth in an HE MU PPDU shall support reception of DL MU-MIMO transmissions for all RU sizes greater than or equal to 106-tones.

26.3.3.7.2 Maximum number of spatial streams in an HE MU PPDU

An HE STA shall support reception of DL MU-MIMO transmissions on full bandwidth with maximum number of space-time streams (per user) equal to minimum of 4 and the maximum number of space-time streams supported for reception of HE SU PPDUs. The maximum number of space-time streams supported for reception of HE SU PPDUs is indicated for various bandwidths in 'HE-MCS and Nss Map' field in the HE Capabilities element.

An HE STA shall support reception of DL MU-MIMO transmissions on full bandwidth with the total number of space-time streams (across NUM_USERS) less than or equal to a maximum value indicated by the Beamformee STS Capability in the HE Capabilities element(#1785).

All of the aforementioned restrictions on the per-user and total number of space-time-streams are also applicable to an MU-MIMO transmission on an RU in an HE MU PPDU where the RU does not span the entire PPDU bandwidth.

26.3.3.7.3 Maximum number of total spatial streams in an HE MU PPDU(#1863)

A DL MU-MIMO capable STA shall support reception of DL MU PPDUs with the total number of space-time streams across the N_{user} users being less than or equal to its DL MU-MIMO STS Capability in the HE Capabilities.

26.3.3.7.4 Resource indication in an HE MU PPDU(#Ed)

An AP that transmits an HE MU PPDU shall set the UL/DL field in the HE-SIG-A field to 0.(#1862) A full bandwidth MU MIMO transmission using HE MU PPDU format has a value of 1 for the SIGB Compression field in HE-SIG-A and the SIGB Common field is not present.(#2126) If the value of SIGB Compression field in HE-SIG-A is 0, the RU allocation signaling in the HE-SIG-B common field indicates the combination of RUs in current PPDU bandwidth and the number of STAs on each RU for SU/

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MU-MIMO(#1507) transmission. The number of users in RU *r* for MU-MIMO transmission, $N_{user,r}$ is indicated together with the RU allocation as defined in Table 26-21 (RU allocation signaling: arrangement and number of MU-MIMO allocations(#2032)). If the value of the SIGB Compression field in HE-SIG-A is 1, there is no RU allocation signaling in HE-SIG-B Common field and HE-SIG-B contains only User specific fields. The number of STAs in the MU-MIMO(#1507) group is indicated in the Number Of HE-SIG-B Symbols Or MU-MIMO Users field(#853) in HE-SIG-A. For bandwidths larger than 20 MHz, the User block fields are split equitably between two SIG-B channels, i.e., for a *k* user MU-MIMO PPDU, 1, …., ceil(k/2) User fblock fields are carried in HE-SIG-B content channel 1 and ceil(*k*/2) + 1, …, *k* User block fields in HE-SIG-B content channel 2.(#1005) The number of spatial streams, $N_{SS,r,u}$, is indicated by the NSTS field in user specific block as defined in Table 26-22 (Fields of the HE-SIG-B user field for an(#916) non-MU-MIMO(#1101) allocation(#2037)) and Table 26-23 (Fields of the HE-SIG-B user field for an(#2817) MU-MIMO allocation(#2037)).(#946) The allocated spatial streams for a designated MU-MIMO(#1507) user and the total number of spatial streams on the RU are indicated in spatial configuration field of user specific block containing the STA ID of designated MU-MIMO(#1507) STA as defined in Table 26-24 (Spatial Configuration subfield encoding).

When processing the HE-SIG-B, a STA will look at information of each RU to find out its membership status, i.e., if it belongs to a beamformee group in a certain RU. If $N_{user,r}$ STAs are scheduled in RU *r*, there are $N_{user,r}$ user specific blocks for RU *r*. Each user specific block has an 11-bit field indicating the STA ID. A STA identifies itself as a member in the beamformee group in the RU, if its STA ID matches one of the STA IDs. The user position is indicated by the block index. From a multiplexing information lookup table for $N_{user,r}$, the ordered number of spatial streams for all members in the beamformee group in RU *r*, $N_{SS,r,u}$, $u = 1, \ldots, N_{user,r}$ is obtained. The spatial streams of different users are ordered in accordance to user position values, i.e., the spatial streams for the user in user position 0 come first, followed by the spatial streams for the user in position 1, followed by the spatial streams for the user in position 2, and followed by the spatial streams for the user in position 3, and so on.

A STA is also able to identify the space-time streams intended for other STAs that act as interference. HE-LTF symbols in the DL HE MU PPDU are used to measure the channel for the space-time streams intended for the STA and can also be used to measure the channel for the interfering space-time streams. To successfully demodulate the space-time streams intended for the STA, it is recommended that the STA uses the channel knowledge for all space-time streams to reduce the effect of interfering space-time streams.

If a STA finds that it is a member of the beamformee group in RU r, its corresponding $N_{STS,r,u}$ interpreted from the HE-SIG-B user specific blocks shall not be zero for the STA in the PPDU. If a STA finds that it is not a member of the beamformee group in RU *r*, then the STA may elect not to process RU *r* in the remainder of the PPDU.

26.3.3.8 UL MU transmission

26.3.3.8.1 Introduction

UL MU transmissions allow an AP to receive simultaneous frames from more than one non-AP STA. UL MU transmissions are preceded by a Trigger frame from the AP. The non-AP STA uses the HE trigger-based PPDU for UL MU transmission.

26.3.3.9 UL MU-MIMO

26.3.3.9.1 Introduction

UL MU-MIMO is a technique to allow multiple STAs to transmit simultaneously over the same frequency resource to the receiver. The concept is very similar to SU-MIMO where multiple space-time streams are transmitted simultaneously over the same frequency resource utilizing spatial multiplexing through multiple

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antennas at the transmitter and receiver. The key difference from SU-MIMO is that in UL MU-MIMO, the transmitted streams originate from multiple STAs.

26.3.3.9.2 Minimum RU size in UL MU-MIMO

A STA capable of an UL MU-MIMO transmission on an RU that does not span the entire PPDU bandwidth in an HE trigger-based PPDU shall support UL MU-MIMO transmission for all RU sizes greater than or equal to 106 subcarriers.(#1862)

26.3.3.9.3 MU-MIMO LTF Mode

A STA capable of UL MU-MIMO transmission on full bandwidth shall support single stream pilot and masking LTF sequence of each spatial stream by a distinct orthogonal code.

A STA capable of UL OFDMA with MU-MIMO transmission on an RU in an HE trigger-based PPDU shall support single stream pilot for any UL OFDMA transmission, including UL OFDMA with MU-MIMO transmission on an RU in an HE trigger-based PPDU.

26.3.3.9.4 Maximum number of spatial streams in an HE trigger-based PPDU

A STA capable of UL MU-MIMO transmission shall support UL MU-MIMO transmissions on full bandwidth with maximum number of space-time streams (per user) equal to minimum of 4 and the maximum number of space-time streams supported for transmission of HE SU PPDUs. The maximum number of space-time streams supported for transmission of HE SU PPDUs is indicated for various bandwidths in 'HE-MCS and Nss Map' field in the HE Capabilities element(#1785).

A STA capable of UL MU-MIMO transmission on the full bandwidth shall support a total of up to 8 space-time streams in the UL MU-MIMO transmission.

All of the aforementioned restrictions on the per-user and total number of space-time-streams are also applicable to an MU-MIMO transmission on an RU in an HE MU PPDU where the RU does not span the entire PPDU bandwidth.

26.3.3.9.5 Resource allocation for an HE trigger-based PPDU

UL MU transmissions are preceded by a Trigger frame from the AP. The Trigger frame indicates the transmitting STAs in the Common Info field(#948) about when to transmit the UL MU-MIMO PPDUs, the duration of the payload, and packet-extension. The GI duration(#1420) for UL OFDMA/MU-MIMO transmissions shall also be explicitly indicated by AP in the Trigger frame. The value of GI duration(#1420) for all users addressed by the Trigger frame shall be the same. The Trigger frame indicates whether the UL MU transmission following it uses single stream pilots or a mask on each spatial stream of the LTF sequence by a distinct orthogonal code. When single stream pilot is used, no masking is applied to the HE-LTF. Single stream pilot is used for any UL OFDMA transmission, including UL OFDMA with MU-MIMO transmissions. The appropriate MU-MIMO LTF mode indicated by the Trigger frame is used for full bandwidth UL MU-MIMO transmission.(#1862) The allocated RU and spatial streams are carried in the fields of RU allocation info and SS allocation of User Info(#1520) field, where Address field is set as the AID of designated MU-MIMO(#1507) STA.(PHY Motion #169)

If a STA finds that there is no User Info(#1520) field in Trigger frame carrying the STA's AID in the Address field, then the STA will not transmit in the following HE trigger-based PPDU.

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26.3.4 HE PPDU formats

Four HE PPDU formats are defined: HE SU PPDU, HE MU PPDU, HE extended range SU PPDU and HE trigger-based PPDU.

The format of the HE SU PPDU is defined as in Figure 26-5 (HE SU PPDU format). This PPDU format is used for SU transmission and, in this format, the HE-SIG-A field is not repeated(#1838).

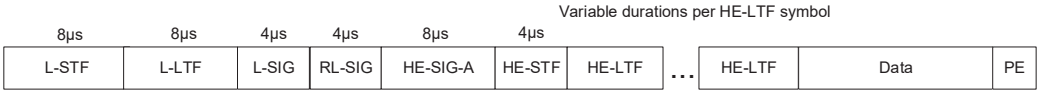

Figure 26-5—HE SU PPDU format

The format of the HE MU PPDU is defined as in Figure 26-6 (HE MU PPDU format). This format is used for transmission to one or more users that is not a response of a Trigger frame.(#271) The HE-SIG-B field is present in this format.(#1839)

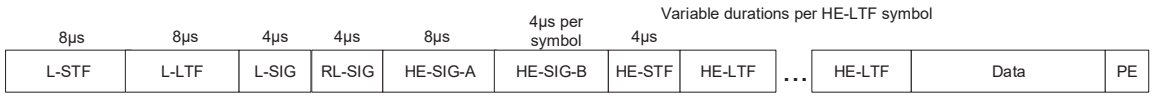

Figure 26-6—HE MU PPDU format

The format of the HE extended range SU PPDU is defined as in Figure 26-7 (HE extended range SU PPDU format). This format is used for SU transmission and, in this format,(#1840) the HE-SIG-A field is repeated.

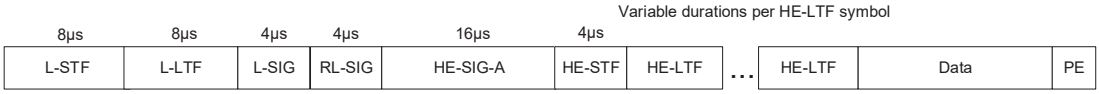

Figure 26-7—HE extended range SU PPDU format

The format of the HE trigger-based PPDU is defined as in Figure 26-8 (HE trigger-based PPDU format). This format is used for a transmission that is a response to a Trigger frame.(#1032) The HE trigger-based PPDU format is identical to the HE SU PPDU format for the L-STF, L-LTF, L-SIG, RL-SIG, HE-SIG-A fields. The duration of the HE-STF field is 8 μs.(#881)

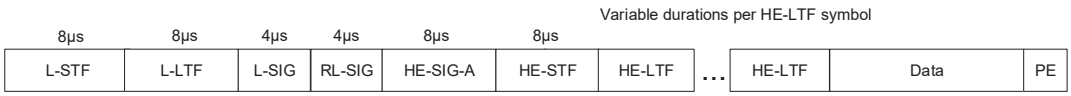

Figure 26-8—HE trigger-based PPDU format

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The fields of the HE PPDU formats are summarized in Figure 26-8 (HE PPDU fields(#2343)).

Table 26-8—HE PPDU fields(#2343)

Field	Description
L-STF	Non-HT Short Training field
L-LTF	Non-HT Long Training field
L-SIG	Non-HT SIGNAL field
RL-SIG	Repeated Non-HT SIGNAL field
HE-SIG-A	HE Signal A field
HE-SIG-B	HE Signal B field
HE-STF	HE Short Training field
HE-LTF	HE Long Training field
Data	The Data field carrying the PSDU(s)
PE	Packet Extension field

The RL-SIG, HE-SIG-A, HE-SIG-B, HE-STF, HE-LTF, and PE fields exist only in HE PPDUs. (#1612)The HE-SIG-B field is present only in the HE MU PPDU. The duration of the PE field is determined by the TXVECTOR parameter PE_DURATION.

(#2061)The HE NDP PPDU has the following properties:

— Uses the HE SU PPDU format but without the Data field

— Has a Packet Extension field that is 4 μs in duration

NOTE—The number of HE-LTF OFDM symbols, $N_{HE\text{-}LTF}$, (#1612)is a function of the total number of space-time streams N_{STS} as shown in Table 26-12 (Frequently used parameters(#282)).

(#883)The L-STF, L-LTF, L-SIG, RL-SIG, HE-SIG-A, HE-SIG-A-R, and HE-SIG-B fields are referred to as the Pre-HE modulated fields, while the HE-STF, HE-LTF and Data fields are referred to as the HE modulated fields.(#472)

26.3.5 Transmitter block diagram

The generation of each field in an(#2829) HE PPDU uses many of the following blocks:

a) pre-FEC PHY padding
b) Scrambler
c) FEC (BCC or LDPC) encoders
d) post-FEC PHY padding
e) Stream parser
f) Segment parser (for contiguous 160 MHz and noncontiguous 80+80 MHz transmissions)
g) BCC interleaver
h) Constellation mapper

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i) DCM tone mapper
j) Pilot insertion
k) Replicate over multiple 20 MHz (if BW > 20 MHz)
l) Multiply by 1st column of $P_{HE\text{-}LTF}$(#1090)
m) LDPC tone mapper
n) Segment deparser
o) Space time block code (STBC) encoder
p) Cyclic shift diversity (CSD) per STS insertion
q) Spatial mapper
r) Spatial and frequency mapping(PHY Motion #172)
s) Inverse discrete Fourier transform (IDFT)
t) Cyclic shift diversity (CSD) per chain insertion
u) Guard interval (GI) insertion
v) Windowing

Figure 26-9 (Transmitter block diagram for the L-SIG, RL-SIG and HE-SIG-A fields for an HE SU PPDU and HE extended range SU PPDU when the Beam Change field is 1 and the HE MU PPDU(#1659)) to Figure 26-17 (Transmitter block diagram for the Data field of an HE SU PPDU in 80+80 MHz with LDPC encoding) show example transmitter block diagrams. The actual structure of the transmitter is implementation dependent.

In particular, Figure 26-9 (Transmitter block diagram for the L-SIG, RL-SIG and HE-SIG-A fields for an HE SU PPDU and HE extended range SU PPDU when the Beam Change field is 1 and the HE MU PPDU(#1659)) shows the transmit process for the L-SIG, RL-SIG, and HE-SIG-A fields of an(#2829) HE PPDU using one frequency segment, when the Beam Change subfield in HE-SIG-A field is set to 1. These transmit blocks are also used to generate the L-STF and L-LTF fields(#470) of the HE PPDU when the Beam Change subfield in HE-SIG-A field is set to 1, with the following exceptions(#Ed):

— The BCC encoder and interleaver are not used when generating the L-STF and L-LTF fields.
— The BCC interleaver is not applied in the repeated HE-SIG-A symbols (i.e. the 2nd and the 4th OFDM symbols of HE-SIG-A field) in the HE extended range SU PPDU.

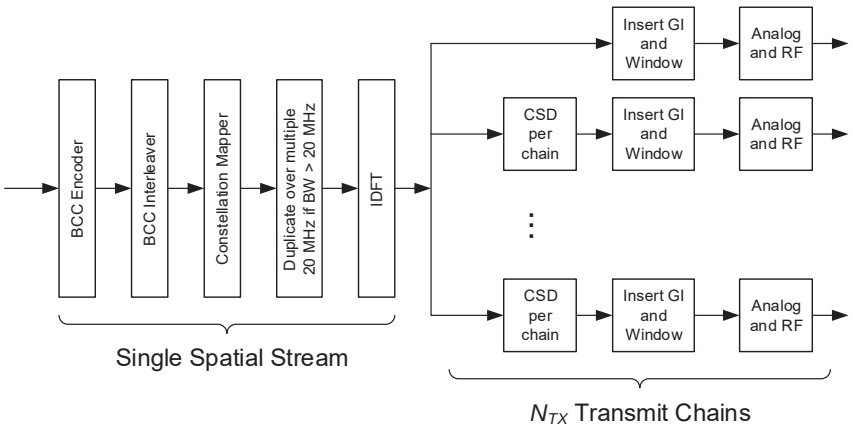

Figure 26-9—Transmitter block diagram for the L-SIG, RL-SIG and HE-SIG-A fields for an HE SU PPDU and HE extended range SU PPDU when the Beam Change field is 1 and the HE MU PPDU(#1659)

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Figure 26-10 (Transmitter block diagram for the L-SIG, RL-SIG and HE-SIG-A fields for an HE SU PPDU and HE extended range SU PPDU when the Beam Change field is 0(#2360)(#1659)) shows the transmit process for the L-SIG, RL-SIG, and HE-SIG-A fields of an(#2829) HE PPDU using one frequency segment, when the Beam Change subfield in HE-SIG-A field is set to 0. These transmit blocks are also used to generate the L-STF and L-LTF fields(#471) of the HE PPDU when the Beam Change subfield in HE-SIG-A field is set to 0, with the following exceptions:

— The BCC encoder and interleaver are not used when generating the L-STF and L-LTF fields.

— The BCC interleaver is not applied in the repeated HE-SIG-A field OFDM symbols (i.e., the 2nd and the 4th OFDM symbols of HE-SIG-A field) in the HE extended range SU PPDU.

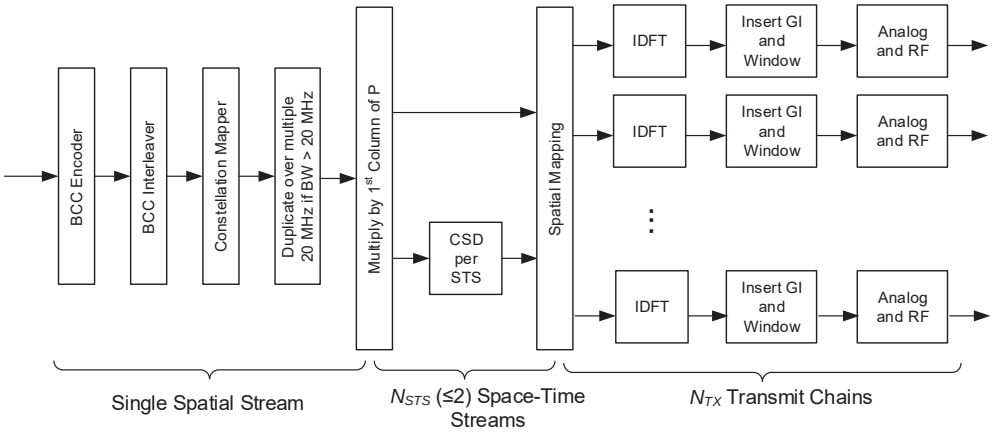

Figure 26-10—Transmitter block diagram for the L-SIG, RL-SIG and HE-SIG-A fields for an HE SU PPDU and HE extended range SU PPDU when the Beam Change field is 0(#2360)(#1659)

Figure 26-11 (Transmitter block diagram for the L-SIG, RL-SIG and HE-SIG-A fields of an HE trigger-based PPDU(#1659)) shows the transmit process for the L-SIG, RL-SIG and HE-SIG-A fields of an HE trigger-based PPDU using one frequency segment. In the HE trigger-based PPDU, the pre-HE-STF preamble, which includes legacy preamble, RL-SIG and HE-SIG-A fields, is sent only on the 20 MHz channels where the HE modulated fields are located. When the HE modulated fields are located in more than

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one 20 MHz channel, the pre-HE-STF preamble is duplicated over the multiple 20 MHz channels. The BCC encoder and interleaver are not used when generating the L-STF and L-LTF fields.(#1659)

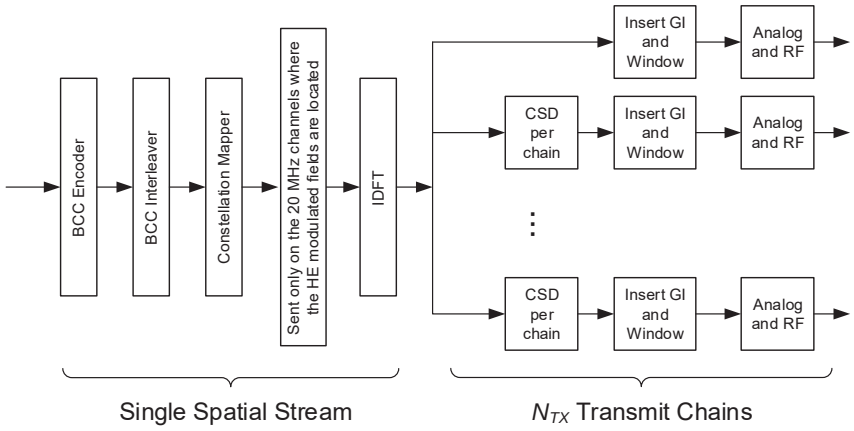

Figure 26-11—Transmitter block diagram for the L-SIG, RL-SIG and HE-SIG-A fields of an HE trigger-based PPDU(#1659)

Figure 26-12 (Transmitter block diagram for the HE-SIG-B field) shows the transmit process for the HE-SIG-B field of an HE MU PPDU using one frequency segment. This block diagram is for transmitting HE-SIG-B in one 20 MHz subchannel. Refer to 26.3.10.8.1 (Encoding and modulation) for the methods of transmitting HE-SIG-B in 40 MHz, 80 MHz and 160 MHz. The DCM tone mapper is applied only if the DCM indication in HE-SIG-A field is set to 1.(#519)

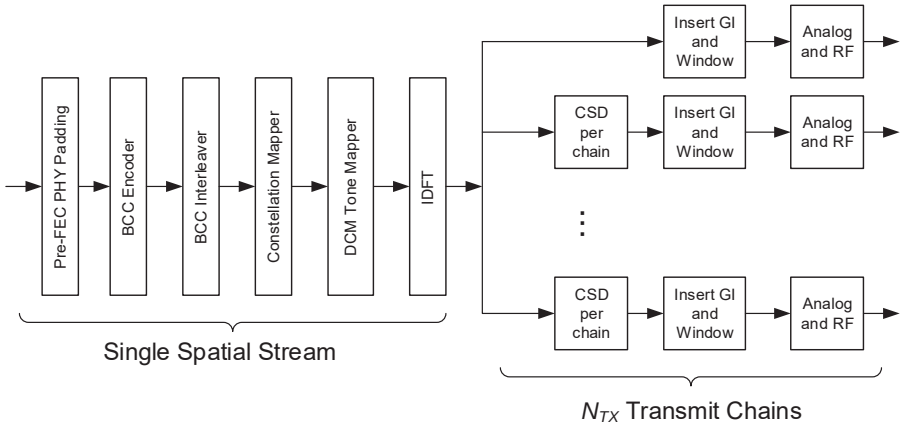

Figure 26-12—Transmitter block diagram for the HE-SIG-B field

Figure 26-13 (Transmitter block diagram for the Data field of an HE SU transmission in a 26-, 52-, 106- or 242-tone RU(#838) with BCC encoding) shows the transmitter blocks used to generate the Data field of a single user HE transmission within a 26-, 52-, 106-, or 242-tone RU(#838) with BCC encoding for a single frequency segment when the number of spatial stream is less than or equal to 4. This also includes the SU transmission in an RU that is part of a downlink or uplink OFDMA PPDU, and a transmission from one STA that is part of an UL MU-MIMO transmission in current RU. The STBC block may be applied only for single spatial stream and only when DCM is not applied. The DCM tone mapper is applied only when the DCM indication for the RU is set to 1. A subset of these transmitter blocks consisting of the constellation

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mapper and CSD blocks, as well as the blocks to the right of, and including, the spatial mapping block, are also used to generate the HE-LTF fields. This is illustrated in Figure 26-26 (Generation of HE-LTF symbols per frequency segment in an HE SU PPDU, HE MU PPDU, HE extended range SU PPDU and HE trigger-based PPDU(#1059)). A subset of these transmitter blocks consisting of the constellation mapper and CSD blocks, as well as the blocks to the right of, and including, the spatial and frequency mapping block of Figure 26-13 (Transmitter block diagram for the Data field of an HE SU transmission in a 26-, 52-, 106- or 242-tone RU(#838) with BCC encoding)(#1117), are also used to generate the HE-STF field. (#520)This figure also applies to the data field with BCC encoding in an(#2829) HE trigger-based PPDU.

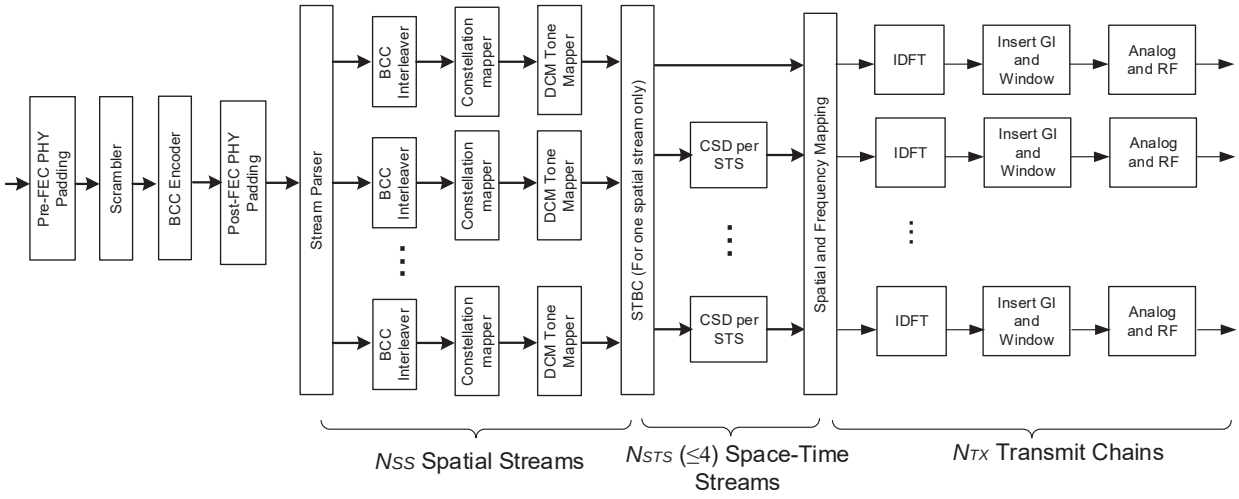

Figure 26-13—Transmitter block diagram for the Data field of an HE SU transmission in a 26-, 52-, 106- or 242-tone RU(#838) with BCC encoding

Figure 26-14 (Transmitter block diagram for the Data field of an HE SU transmission in 26-, 52-, 106-, 242-, 484- or 996-tone(#838) RU with LDPC encoding) shows the transmitter blocks used to generate the Data field of a single user HE transmission within a 26-, 52-, 106-, 242-, 484-, or 996-tone(#838) RU with LDPC encoding for a single frequency segment. This also includes the SU transmission in an RU that is part of a downlink or uplink OFDMA PPDU, and a transmission from one STA that is part of an UL MU-MIMO transmission in current RU. The STBC block may be applied only for single spatial stream and only when

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DCM is not applied. The DCM tone Mapper is applied only when the DCM indication for the RU is set to 1. (#519)This figure also applies to the data field with LDPC encoding in an(#2829) HE trigger-based PPDU.

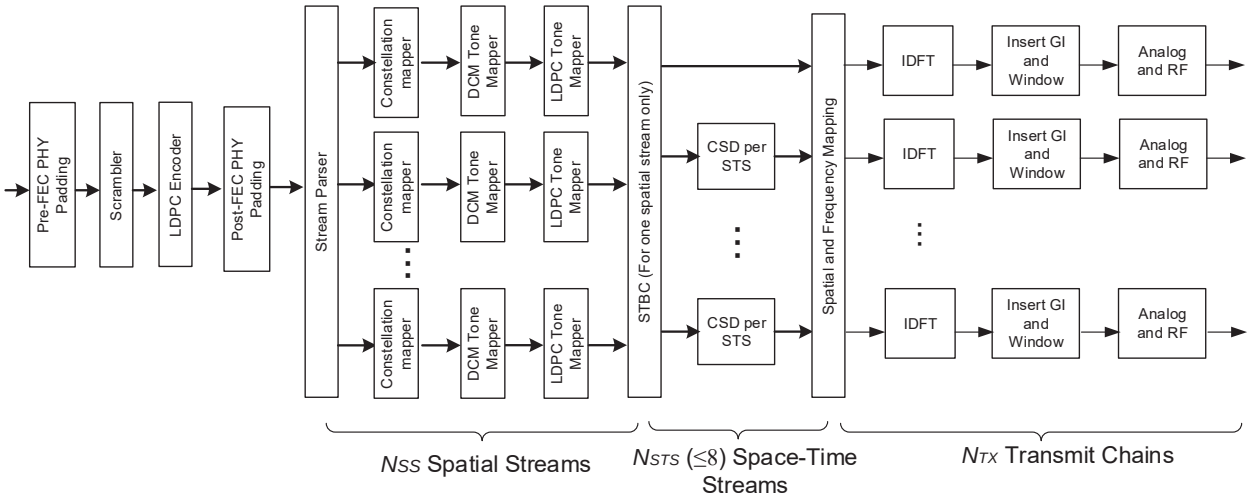

Figure 26-14—Transmitter block diagram for the Data field of an HE SU transmission in 26-, 52-, 106-, 242-, 484- or 996-tone(#838) RU with LDPC encoding

Figure 26-15 (Transmitter block diagram for the Data field of an HE downlink MU-MIMO transmission in 106-, 242-, 484- or 996-tone(#838) RU with LDPC encoding(#277)) shows the transmitter blocks used to generate the Data field of an(#2829) HE downlink MU-MIMO transmission within a 106-, 242-, 484-, or

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996-tone(#838) RU with LDPC encoding. This also includes the downlink MU-MIMO transmission in an RU that is part of a downlink (#276)OFDMA PPDU.

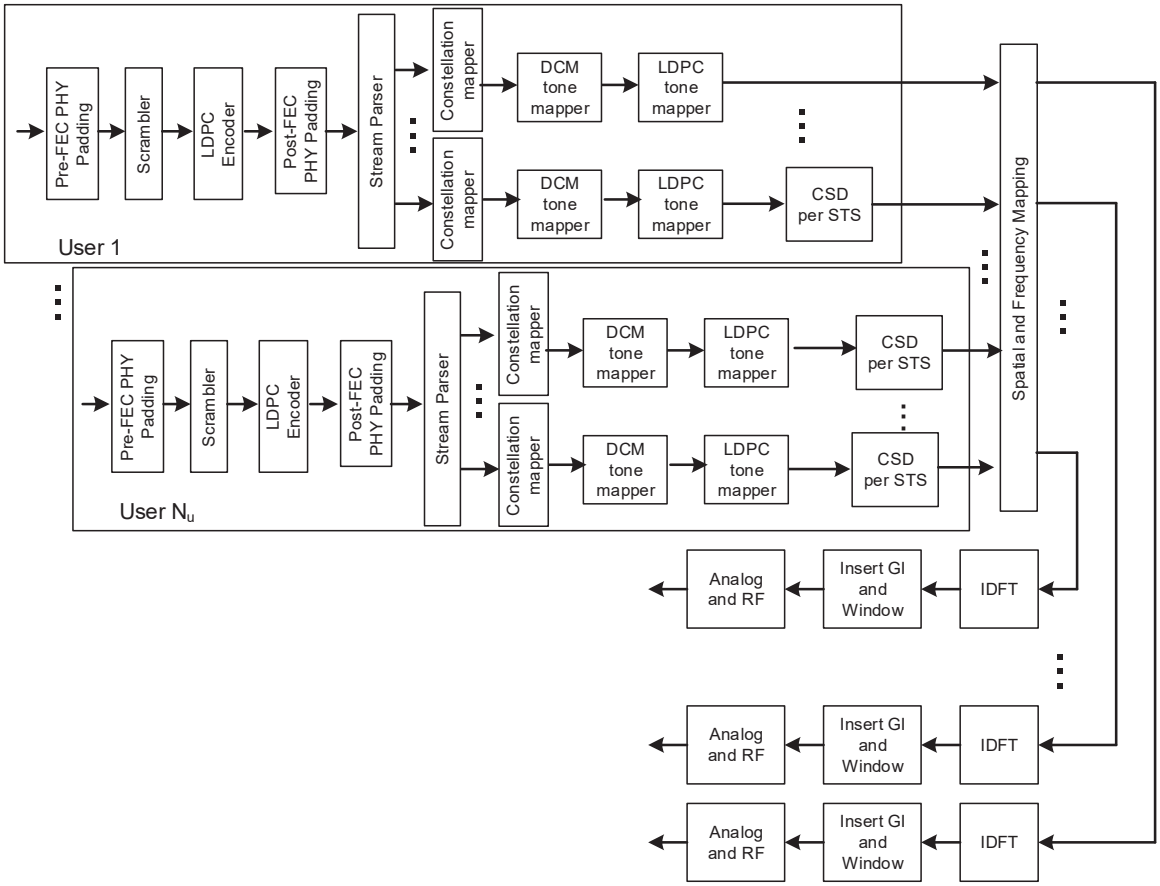

Figure 26-15—Transmitter block diagram for the Data field of an HE downlink MU-MIMO transmission in 106-, 242-, 484- or 996-tone(#838) RU with LDPC encoding(#277)

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Figure 26-16 (Transmitter block diagram for the Data field of an HE SU PPDU in 160 MHz with LDPC encoding) shows the transmitter blocks used to generate the Data field of a single-user HE transmission in 160 MHz with LDPC encoding.

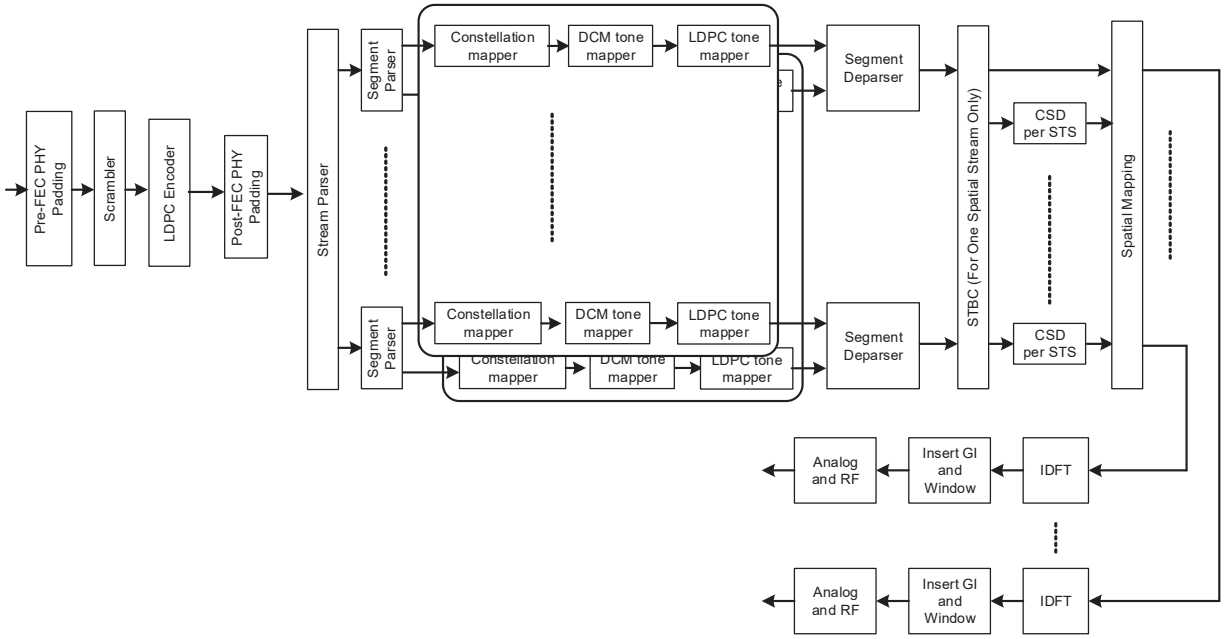

Figure 26-16—Transmitter block diagram for the Data field of an HE SU PPDU in 160 MHz with LDPC encoding

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Figure 26-17 (Transmitter block diagram for the Data field of an HE SU PPDU in 80+80 MHz with LDPC encoding) shows the transmitter blocks used to generate the Data field of a single-user HE transmission in 80+80 MHz with LDPC encoding.

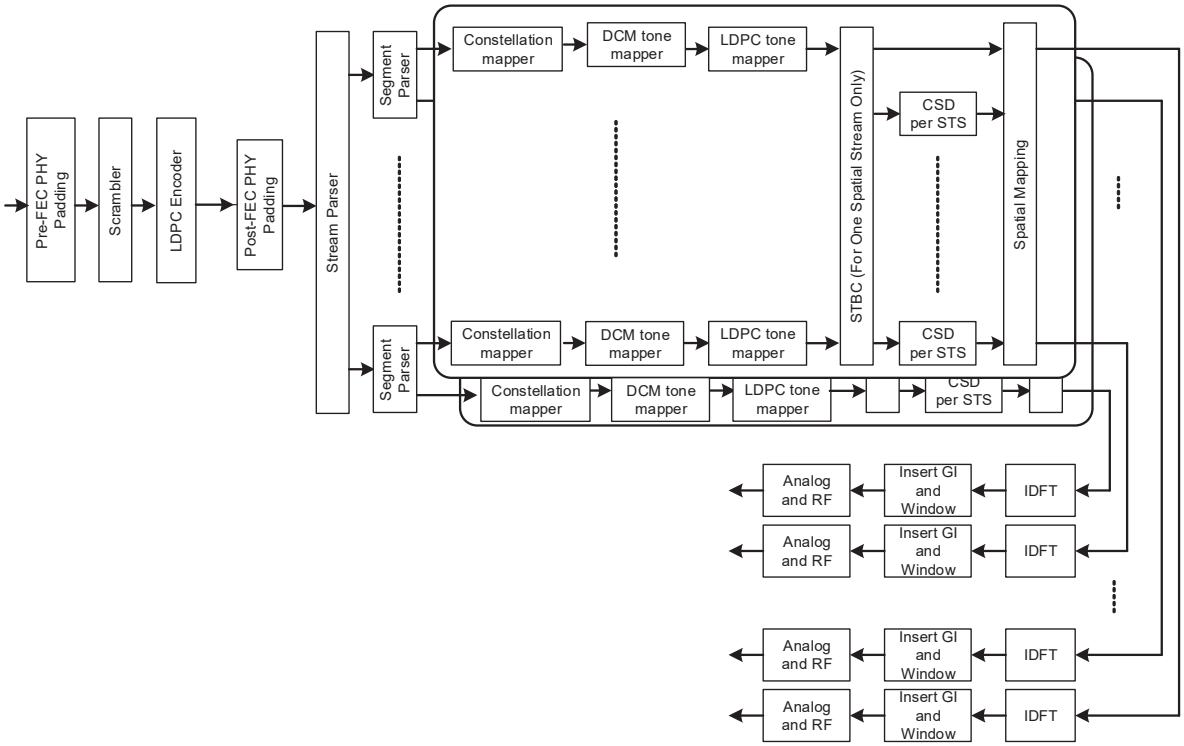

Figure 26-17—Transmitter block diagram for the Data field of an HE SU PPDU in 80+80 MHz with LDPC encoding

26.3.6 Overview of the PPDU encoding process

26.3.7 HE modulation and coding schemes (HE-MCSs)

The HE-MCS is a compact representation of the modulation and coding used in the Data field of the PPDU. For an HE SU PPDU and an HE extended range SU PPDU it is carried in the HE-SIG-A field. For an HE MU PPDU it is carried in the HE-SIG-B field. For an HE trigger-based PPDU, it is carried in the User Info fields(#Ed) of the Trigger frame.

The HE-SIG-B-MCS is a compact representation of the modulation and coding used in the HE-SIG-B field of the PPDU. For an HE MU PPDU, it is carried in the HE-SIG-A field. HE-SIG-B-MCS consists of indices 0 to 5 and each HE-SIG-B-MCS represents the same modulation and coding as the HE-MCS with the same index.(#2518)

Rate-dependent parameters for the full set of HE-MCSs are shown in Table 26-44 (HE-MCSs for mandatory 26-tone RU, NSS = 1) to Table 26-99 (HE-MCSs for optional non-OFDMA 160 MHz and 80+80 MHz, NSS = 8) (in 26.5 (Parameters for HE-MCSs(#552))). These tables give rate-dependent parameters for HE-MCSs with indices 0 to 11, with number of spatial streams from 1 to 8, RU options of 26-tone, 52-tone, 106-tone, 242-tone, 484-tone and 996-tone, and bandwidth options of 20 MHz, 40 MHz, 80 MHz, and either 160 MHz or 80+80 MHz. HE-MCSs with indices 10 and 11 (1024-QAM) are optionally applied to the Data field of an HE PPDU with RUs equal to or larger than 242-tone. The HE extended range SU PPDU is 20

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MHz and can only be transmitted with the <HE-MCS, NSS> tuples <MCS 0, 1>, <MCS 1, 1> and <MCS 2, 1>(#1616)(#278). The 106-tone RU can only be transmitted with the <HE-MCS, NSS> tuples <MCS 0, 1>. The 106-tone RU location within the 20MHz tone plan is fixed as the right one.(PHY Motion #166)

DCM is an optional modulation scheme used for the HE-SIG-B field and the Data field in an HE PPDU. It is indicated in the HE-SIG-A field for the HE-SIG-B field in an HE MU PPDU and for the Data field in HE SU PPDU, HE trigger-based PPDU and HE extended range SU PPDU and indicated in the HE-SIG-B field for the Data field in an HE MU PPDU. It is only applied for the HE-MCSs with indices 0, 1, 3 and 4.

26.3.8 Timing-related parameters

Refer to Table 19-6 (Timing-related constants) and Table 21-5 (Timing-related constants) for timing-related parameters for non-HE PPDU formats.

Table 26-9 (Timing-related constants) defines the timing-related parameters for HE PPDU formats..

Table 26-9— Timing-related constants

Parameter	Values	Description
$\Delta_{F,\text{ Pre-HE}}$	312.5 kHz	Subcarrier frequency spacing for the pre-HE modulated fields(#279).
$\Delta_{F,\text{ HE}}$	78.125 kHz	Subcarrier frequency spacing for the HE modulated fields(#279).
$T_{DFT,\text{Pre-HE}}$	3.2 µs	IDFT/DFT period for the pre-HE modulated fields(#279).
$T_{DFT,\text{HE}}$	12.8 µs	IDFT/DFT period for the HE Data field(#279)(#Ed).
$T_{GI,\text{LegacyPreamble}}$	0.8 µs	Guard interval duration for the legacy preamble, RL-SIG, HE-SIG-A and HE-SIG-B
$T_{GI,\text{L-LTF}}$	1.6 µs	Guard interval duration for the L-LTF field.
$T_{GI,\text{HE-LTF}}$	$T_{GI1,Data}$, $T_{GI2,Data}$ or $T_{GI4,Data}$ depending on the GI used for data	Guard interval duration for the HE-LTF field, same as $T_{GI,Data}$
$T_{GI,Data}$	$T_{GI1,Data}$, $T_{GI2,Data}$ or $T_{GI4,Data}$ depending on the GI used for data	Guard interval duration for the HE-Data field
$T_{GI1,Data}$	0.8 µs	Base guard interval duration for the HE-Data field.
$T_{GI2,Data}$	1.6 µs	Double guard interval duration for the HE-Data field.
$T_{GI4,Data}$	3.2 µs	Quadruple guard interval duration for the HE-Data field.
T_{SYM1}	13.6 µs = $T_{DFT,\text{HE}} + T_{GI1,Data} = 1.0625 \times T_{DFT,HE}$	OFDM symbol duration with base GI(#1108)(#279)
T_{SYM2}	14.4 µs = $T_{DFT,\text{HE}} + T_{GI2,Data} = 1.125 \times T_{DFT,HE}$	OFDM symbol duration with double GI(#1109)
T_{SYM4}	16 µs = $T_{DFT,\text{HE}} + T_{GI4,Data} = 1.25 \times T_{DFT,\text{HE}}$	OFDM symbol duration with quadruple GI(#1110)

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Table 26-9— Timing-related constants *(continued)*

T_{SYM}	T_{SYM1}, T_{SYM2}, or T_{SYM4} depending on the GI used (see Table 26-14 (Tone scaling factor and guard interval duration values for HE PPDU fields)(#2757))	Symbol interval
$T_{\text{L-STF}}$	8 µs = 10 × $T_{DFT,\text{Pre-HE}}$ /4	Non-HT Short Training field duration
$T_{\text{L-LTF}}$(#1040)	8 µs = 2 × $T_{DFT,\text{Pre-HE}}$ + $T_{GI2,Data}$	Non-HT Long Training field duration
$T_{\text{L-SIG}}$	4 µs	Non-HT SIGNAL field duration
$T_{\text{RL-SIG}}$	4 µs	Repeated non-HT SIGNAL field duration
$T_{\text{HE-SIG-A}}$	8 µs = 2 × 4 µs	HE-SIG-A field duration in an HE SU PPDU, HE MU PPDU and HE trigger-based PPDU
$T_{\text{HE-SIG-A-R}}$	16 µs = 4 × 4 µs(#279)	HE-SIG-A field duration in an HE extended range SU PPDU
$T_{\text{HE-STF-T}}$	8 µs = 5 × 1.6 µs	HE-STF field duration for an HE trigger-based PPDU
$T_{\text{HE-STF-NT}}$	4 µs = 5 × 0.8 µs	HE-STF field duration for an HE SU PPDU, HE extended range SU PPDU and HE MU PPDU
$T_{\text{HE-LTF-1X}}$	3.2 µs	Duration of each 1x HE-LTF OFDM symbol without GI
$T_{\text{HE-LTF-2X}}$	6.4 µs	Duration of each 2x HE-LTF OFDM symbol without GI
$T_{\text{HE-LTF-4X}}$	12.8 µs	Duration of each 4x HE-LTF OFDM symbol without GI
$T_{\text{HE-LTF}}$	$T_{\text{HE-LTF-1X}}$, $T_{\text{HE-LTF-2X}}$ or $T_{\text{HE-LTF-4X}}$ depending upon the LTF duration used	Duration of each OFDM symbol without GI in the HE-LTF field (#279)
$T_{\text{HE-LTF-SYM}}$	sum of $T_{\text{HE-LTF}}$ and $T_{GI,\text{HE-LTF}}$	Duration of each OFDM symbol including GI in the HE-LTF field
$T_{\text{HE-SIG-B}}$	4 µs = $T_{DFT,\text{Pre-HE}}$ + $T_{GI,\text{LegacyPreamble}}$	Duration of each OFDM symbol in the HE-SIG-B field(#Ed)
$N_{service}$	16	Number of bits in the SERVICE field
N_{tail}	6 for BCC encoder, 0 for LDPC encoder	Number of tail bits per encoder(#2521)
T_{SYML}	4 µs	Symbol duration including GI prior to the HE-STF field
T_{PE}	0, 4 µs, 8 µs, 12 µs or 16 µs depending on the actual extension duration used	Duration of the Packet Extension field(#279)

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Table 26-10 (Tone allocation related constants for Data field in a non-OFDMA HE PPDU) defines tone allocation related parameters for a non-OFDMA HE PPDU.

Table 26-10—Tone allocation related constants for Data field in a non-OFDMA HE PPDU

Parameter	CBW20	CBW40	CBW80	CBW80+80	CBW160	Description
N_{SD}	234	468	980	980	1960	Number of complex data numbers per frequency segment
N_{SP}	8	16	16	16	32	Number of pilot values per frequency segment
N_{ST}	242	484	996	996	1992	Total number of subcarriers per frequency segment
N_{SR}	122	244	500	500	1012	Highest data subcarrier index per frequency segment
N_{Seg}	1	1	1	2	1	Number of frequency segments
N_{DC}	3	5	5	5	23	Number of null tones at DC per segment
$N_{Guard,Left}$	6	12	12	12	12	Number of guard tones at the lower side of the spectrum
$N_{Guard,Right}$	5	11	11	11	11	Number of guard tones at the higher end of the spectrum
NOTE: $N_{ST} = N_{SD} + N_{SP}$						

Table 26-11 (Tone allocation related constants for RUs in an OFDMA HE PPDU(#2522))(#281) defines tone allocation related parameters for a OFDMA HE PPDU.

Table 26-11—Tone allocation related constants for RUs in an OFDMA HE PPDU(#2522)

Parameter	RU Size (tones)							Description
	26	52	106	242	484	996	2×996	
N_{SD}	24	48	102	234	468	980	1960	Number of complex data numbers per RU
N_{SP}	2	4	4	8	16	16	32	Number of pilot values per RU
N_{ST}	26	52	106	242	484	996	1992	Total number of subcarriers per RU
NOTE: $N_{ST} = N_{SD} + N_{SP}$								

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Table 26-12 (Frequently used parameters(#282)) defines parameters used frequently in Clause 26.

Table 26-12—Frequently used parameters(#282)

Symbol	Explanation
N_{CBPS}, $N_{CBPS,u}$	Number of coded bits per symbol at r-th RU for user u, $u = 0, ..., N_{user,total} - 1$.(#2522) For an HE SU PPDU, $N_{CBPS} = N_{CBPS,0,0}$(#1042) For an HE MU PPDU, N_{CBPS} is undefined
N_{CBPSS}, $N_{CBPSS,u}$	Number of coded bits per symbol per spatial stream. For the Data field, $N_{CBPSS,r,u}$ equals the number of coded bits per symbol per spatial stream at r-th RU for user u, $u = 0, ..., N_{user,total} - 1$.(#2522) For the Data field of an HE SU PPDU, $N_{CBPSS} = N_{CBPSS,0,0}$ For the Data field of an HE MU PPDU, N_{CBPSS} is undefined
N_{DBPS}, $N_{DBPS,u}$	Number of data bits per symbol for user u, $u = 0, ..., N_{user,total} - 1$.(#2522) For an HE SU PPDU, $N_{DBPS} = N_{DBPS,0}$ For an HE MU PPDU, N_{DBPS} is undefined
N_{BPSCS}, $N_{BPSCS,u}$	Number of coded bits per subcarrier per spatial stream at r-th RU for user u, $u = 0, ..., N_{user,total} - 1$.(#2522) For an HE SU PPDU, $N_{BPSCS} = N_{BPSCS,0,0}$ For an HE MU PPDU, N_{BPSCS} is undefined
N_{RX}	Number of receive chains
N_{RU}	For pre-HE modulated fields, $N_{RU} = 1$. For HE modulated fields, N_{RU} represents the number of RUs in the transmission (equal to the TXVECTOR parameter NUM_RUS).
$N_{user,r}$(#1043)	For pre-HE modulated fields, $N_{uset,r} = 1$. For HE modulated fields, $N_{uset,r}$ represents the number of users at r-th RU in the transmission (summing over all RUs equals to the TXVECTOR parameter NUM_USERS_TOTAL).
N_{STS}, $N_{STS,r,u}$	For pre-HE modulated fields, $N_{STS,r,u} = 1$ (see NOTE). For HE modulated fields, $N_{STS,r,u}$ represents(#1044) the number of space-time streams at r-th RU for user u, $u = 0, ..., N_{user,r} - 1$. In case of STBC, $N_{STS,r,u} = 2$ For an HE SU PPDU, $N_{STS} = N_{STS,0,0}$ For an HE MU PPDU, $N_{STS} = max_{r=0}^{N_{RU}-1} N_{STS,r,total}$
$N_{STS,r,total}$	For HE modulated fields, $N_{STS,r,total}$(#522) is the total number of space-time streams at the r-th RU in a PPDU. $N_{STS,r,total} = \sum_{u=0}^{N_{user,r}-1} N_{STS,r,u}$ For pre-HE modulated fields, $N_{STS,r,total}$ is undefined when the TXVECTOR parameter BEAM_CHANGE is 1 and $N_{STS,r,total} = N_{STS}$ when BEAM_CHANGE is 0(#2531). Note that $N_{STS,r,total} = N_{STS}$ for an HE SU PPDU.

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Table 26-12—Frequently used parameters(#282) *(continued)*

N_{SS}, $N_{SS,r,u}$, $N_{SS,u}$	Number of spatial streams. For the Data field, $N_{SS,r,u}$ is the number of spatial streams at r-th RU for user u, $u = 0, ..., N_{user,r} - 1$ and $N_{SS,u}$ is the number of spatial streams for user u, $u = 0, ..., N_{user,total} - 1$.(#2522) For the Data field of an HE SU PPDU, $N_{SS} = N_{SS,0,0}$ For the Data field of an HE MU PPDU, $N_{SS} = max_{r=0}^{N_{RU}-1} N_{SS,r,total}$
$N_{SS,r,total}$	For HE modulated fields, $N_{SS,r,total}$ is the total number of spatial streams at r-th RU in a PPDU. $N_{SS,r,total} = \sum_{u=0}^{N_{user,r}-1} N_{SS,r,u}$ For pre-HE modulated fields, $N_{SS,r,total}$ is undefined. Note that $N_{SS,r,total} = N_{SS}$ for an HE SU PPDU.
N_{TX}	Number of transmit chains
$N_{HE\text{-}LTF}$	The number of OFDM symbols in the HE-LTF field (see 26.3.9.10 (HE-LTF))
$N_{HE\text{-}SIG\text{-}B}$	The number of OFDM symbols in the HE-SIG-B field
K_r	Set of subcarrier indices in the r-th RU
R, R_u	R_u is the coding rate for user u, $u = 0, ..., N_{user,total} - 1$.(#2522) For an HE SU PPDU, $R = R_0$ For an HE MU PPDU, R is undefined
$M_{r,u}$	For pre-HE modulated fields, $M_{r,u} = 0$. For HE modulated fields, $M_{r,0} = 0$ for $u = 0$ and $M_{r,u} = \sum_{u'=0}^{u-1} N_{STS,r,u'}$ for u, $u = 1, ..., N_{user,r} - 1$.
(#472)NOTE—For pre-HE modulated fields, u and r are zeros only since $N_{user,r} = 1$ and $N_{RU} = 1$.	

26.3.9 Mathematical description of signals

For a description of the conventions used for the mathematical description of the signals, see 17.3.2.5 (Mathematical conventions in the signal descriptions). In addition, the following notational conventions are used in Clause 26:

$[Q]_{m,n}$ indicates the element in row m and column n of matrix, where $1 \le m \le N_{row}$ and $1 \le n \le N_{col}$(#2369)

N_{row} and N_{col} are the number of rows and columns, respectively, of the matrix Q.

$[Q]_{m:n}$ indicates a matrix consisting of columns m to n(#1966) of matrix Q.

For a description on subcarrier indices over which the signal is transmitted for non-HT, HT and VHT PPDUs, see 22.3.7 (Mathematical description of signals).

For a 20 MHz non-OFDMA HE PPDU(#Ed) transmission, the 20 MHz is divided into 256 subcarriers. The signal is transmitted on subcarriers –122 to –2 and 2 to 122, with 0 being the center (DC) subcarrier.

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For a 20 MHz OFDMA HE PPDU(#Ed) transmission, the 20 MHz is divided into 256 subcarriers. The signal is transmitted on subcarriers –122 to –4 and 4 to 122, with 0 being the center (DC) subcarrier.

For a 40 MHz non-OFDMA and OFDMA HE PPDU(#Ed) transmission, the 40 MHz is divided into 512 subcarriers. The signal is transmitted on subcarriers –244 to –3 and 3 to 244.

For an 80 MHz non-OFDMA HE PPDU(#Ed) transmission, the 80 MHz is divided into 1024 subcarriers. The signal is transmitted on subcarriers –500 to –3 and 3 to 500.

For an 80 MHz OFDMA HE PPDU(#Ed) transmission, the 80 MHz is divided into 1024 subcarriers. The signal is transmitted on subcarriers –500 to –4 and 4 to 500.

For a 160 MHz HE PPDU transmission or a noncontiguous 80+80 MHz transmission, and each half 80 MHz bandwidth is divided into 1024 subcarriers, and the subcarriers on which the signal is transmitted in each 80 MHz bandwidth is identical to an 80 MHz HE PPDU transmission, depending on non-OFDMA or OFDMA transmission within the corresponding(#898) 80 MHz.

The transmitted signal is described in complex baseband signal notation. The actual transmitted signal on transmit chain i_{TX} and frequency segment i_{Seg}(#1967) is related to the complex baseband signal by the relation shown in Equation (26-1).

$$r_{RF}^{(i_{Seg}, i_{TX})}(t) = \mathrm{Re}\left\{ \frac{1}{\sqrt{N_{Seg}}} r_{PPDU}^{(i_{Seg}, i_{TX})}(t) \exp\left(j2\pi f_c^{(i_{Seg})} t\right) \right\}, \quad i_{Seg} = 0, \ldots, N_{Seg} - 1; \; i_{TX} = 1, \ldots, N_{TX} \qquad (26\text{-}1)$$

where

N_{Seg} represents the number of frequency segments in the transmit signal as defined in Table 26-10 (Tone allocation related constants for Data field in a non-OFDMA HE PPDU)(#1671)

$r_{PPDU}^{(i_{Seg}, i_{TX})}$ represents the complex baseband signal of frequency segment i_{Seg} and transmit chain i_{TX}

$f_c^{(i_{Seg})}$ represents the center frequency of frequency segment i_{Seg}(#1968)

The transmitted RF signal is derived by up-converting the complex baseband signal, which consists of several fields. The timing boundaries for the various fields are shown in Figure 26-18 (Timing boundaries for HE PPDU fields(#899)), where $N_{\text{HE-LTF}}$ is the number of HE-LTF symbols and is defined in Table 26-12 (Frequently used parameters(#282)), $N_{\text{HE-SIG-B}}$ is the number of symbols in the HE-SIG-B field, and N_{SYM} is the number of symbols in the Data field.

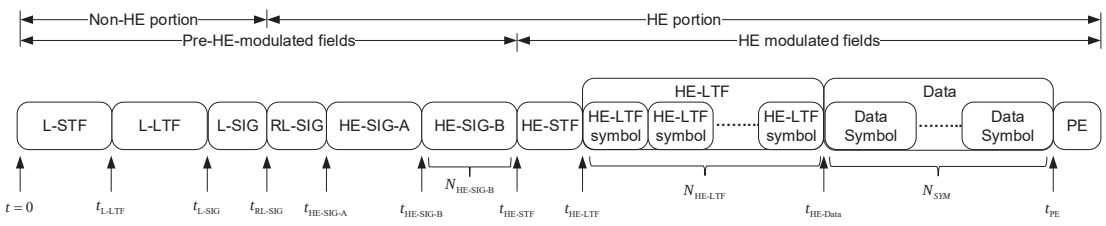

Figure 26-18—Timing boundaries for HE PPDU fields(#899)

The time offset, t_{Field}, determines the starting time of the corresponding field relative to the start of L-STF ($t = 0$).

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The signal transmitted on frequency segment i_{Seg} of transmit chain i_{TX} shall be as shown in Equation (26-2).

$$\begin{aligned} r_{PPDU}^{(i_{Seg}, i_{TX})}(t) = {} & r_{\text{L-STF}}^{(i_{Seg}, i_{TX})}(t) + r_{\text{L-LTF}}^{(i_{Seg}, i_{TX})}(t - t_{\text{L-LTF}}) \\ & + r_{\text{L-SIG}}^{(i_{Seg}, i_{TX})}(t - t_{\text{L-SIG}}) + r_{\text{RL-SIG}}^{(i_{Seg}, i_{TX})}(t - t_{\text{RL-SIG}}) + r_{\text{HE-SIG-A}}^{(i_{Seg}, i_{TX})}(t - t_{\text{HE-SIG-A}}) + r_{\text{HE-SIG-B}}^{(i_{Seg}, i_{TX})}(t - t_{\text{HE-SIG-B}}) \\ & + r_{\text{HE-STF}}^{(i_{Seg}, i_{TX})}(t - t_{\text{HE-STF}}) + r_{\text{HE-LTF}}^{(i_{Seg}, i_{TX})}(t - t_{\text{HE-LTF}}) + r_{\text{HE-Data}}^{(i_{Seg}, i_{TX})}(t - t_{\text{HE-Data}}) + r_{\text{HE-PE}}^{(i_{Seg}, i_{TX})}(t - t_{\text{HE-PE}}) \end{aligned} \quad (26\text{-}2)$$

where

$r_{\text{HE-SIG-B}}^{(i_{Seg}, i_{TX})}(t - t_{\text{HE-SIG-B}})$ is only applicable to an HE MU PPDU(#1970)

$0 \le i_{Seg} \le N_{Seg} - 1$

$1 \le i_{TX} \le N_{TX}$

$t_{\text{L-LTF}} = T_{\text{L-STF}}$

$t_{\text{L-SIG}} = t_{\text{L-LTF}} + T_{\text{L-LTF}}$

$t_{\text{RL-SIG}} = t_{\text{L-SIG}} + T_{\text{L-SIG}}$

$t_{\text{HE-SIG-A}} = t_{\text{RL-SIG}} + T_{\text{RL-SIG}}$

$$t_{\text{HE-SIG-B}} = \begin{cases} t_{\text{HE-SIG-A}} + T_{\text{HE-SIG-A}}, & \text{for an HE MU PPDU} \\ undefined, & \text{otherwise} \end{cases}$$

$$t_{\text{HE-STF}} = \begin{cases} t_{\text{HE-SIG-A}} + T_{\text{HE-SIG-A}}, & \text{for an HE SU PPDU and HE trigger-based PPDU} \\ t_{\text{HE-SIG-A}} + T_{\text{HE-SIG-A-R}}, & \text{for an HE extended range SU PPDU} \\ t_{\text{HE-SIG-B}} + N_{\text{HE-SIG-B}} T_{\text{HE-SIG-B}}, & \text{for an HE MU PPDU} \end{cases}$$

where $N_{HE\text{-}SIG\text{-}B}$ is the number of OFDM symbols in the HE-SIG-B field

$$t_{\text{HE-LTF}} = \begin{cases} t_{\text{HE-STF}} + T_{\text{HE-STF-T}}, & \text{for an HE trigger-based PPDU} \\ t_{\text{HE-STF}} + T_{\text{HE-STF-NT}}, & \text{otherwise} \end{cases}$$

$$t_{\text{HE-Data}} = \begin{cases} t_{\text{HE-LTF}} + N_{\text{HE-LTF}} \cdot (T_{\text{HE-LTF-1X}} + T_{\text{GI,HE-LTF}}), & \text{for 1x HE-LTF} \\ t_{\text{HE-LTF}} + N_{\text{HE-LTF}} \cdot (T_{\text{HE-LTF-2X}} + T_{\text{GI,HE-LTF}}), & \text{for 2x HE-LTF} \\ t_{\text{HE-LTF}} + N_{\text{HE-LTF}} \cdot (T_{\text{HE-LTF-4X}} + T_{\text{GI,HE-LTF}}), & \text{for 4x HE-LTF} \end{cases}$$

$t_{\text{HE-PE}} = t_{\text{HE-Data}} + N_{SYM} T_{SYM}$

In an HE SU PPDU, HE MU PPDU and HE extended range SU PPDU, for each field excluding the PE field, $r_{Field}^{(i_{Seg}, i_{TX})}(t)$ is defined in Equation (26-3) and Equation (26-4) as the summation of one or more subfields. Each subfield is defined to be an inverse discrete Fourier transform(#2158).(#526)(#286)(#1976)(#1971)(PHY Motion #172)

$$\begin{aligned} r_{Field}^{(i_{Seg}, i_{TX})}(t) = {} & w_{T_{Field}}(t) \sum_{r=0}^{N_{RU}-1} \frac{\alpha_r \beta_r^{Field}}{\sqrt{N_{Norm,r}}} \sum_{k \in K_r} \eta_{Field,k} \sum_{u=0}^{N_{user,r}-1} \sum_{m=1}^{N_{STS,r,u}} \left[Q_k^{(i_{Seg})} \right]_{i_{TX}, (M_{r,u}+m)} \Upsilon_{k,BW} \\ & X_{k,r,u}^{i_{Seg}, m} \exp(j 2\pi k \Delta_{F,Field}(t - T_{GI,Field} - T_{CS,\text{HE}}(M_{r,u} + m))) \end{aligned} \quad (26\text{-}3)$$

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In an HE trigger-based PPDU, transmitted by user-*u* in the *r*-th RU, each field, $r_{Field}^{(i_{Seg}, i_{TX})}(t)$, is defined in Equation (26-4).(#526)(#286)

$$r_{Field}^{(i_{Seg}, i_{TX})}(t) = \frac{\alpha_r \beta_r^{Field}}{\sqrt{N_{Norm, r}}} w_{T_{Field}}(t) \sum_{k \in K_r} \eta_{Field, k} \sum_{m=1}^{N_{STS, r, u}-1} \left[Q_k^{(i_{Seg})} \right]_{i_{TX}, (M_{r, u}+m)} \Upsilon_{k, BW} \quad (26\text{-}4)$$
$$X_{k, r, u}^{(i_{Seg}, m)} \exp(j2\pi k \Delta_{F, Field}(t - T_{GI, Field} - T_{CS, \mathrm{HE}}(M_{r, u}+m)))$$

In the remainder of this subclause, pre-HE modulated fields refer to the L-STF, L-LTF, L-SIG, RL-SIG, HE-SIG-A, and HE-SIG-B fields, while HE modulated fields refer to the HE-STF, HE-LTF, Data, and PE fields, as shown in Figure 26-18 (Timing boundaries for HE PPDU fields(#899)). The total power of the time domain HE modulated field signals summed over all transmit chains should not exceed the total power of the time domain pre-HE modulated field signals summed over all transmit chains. For notational simplicity, the parameter BW is omitted from some bandwidth dependent terms.

In Equation (26-3) the following notations(#1975) are used:

$N_{Norm,r}$ If the TXVECTOR parameter BEAM_CHANGE is 1, then for pre-HE modulated fields, $N_{Norm,r} = N_{TX}$. If the TXVECTOR parameter BEAM_CHANGE is 0, then for pre-HE modulated fields $N_{Norm,r} = N_{STS,r,total}$, where $N_{STS,r,total}$ is given in Table 26-12 (Frequently used parameters(#282)). For HE modulated fields $N_{Norm,r} = N_{STS,r,total}$.

$w_{T_{Field}}(t)$ is a windowing function. An example function, $w_{T_{Field}}(t)$, is given in 18.3.2.5 (Mathematical conventions in the signal descriptions).

K_r For pre-HE modulated fields, K_r(#2760) is the set of subcarriers indices from $-N_{SR}$ to N_{SR} as defined in Table 26-13 (Highest data subcarrier index NSR for pre-HE modulated fields).(#289) For HE modulated fields in a non-OFDMA HE PPDU, K_r is the set of subcarriers indices from $-N_{SR}$ to N_{SR} as defined in Table 26-10 (Tone allocation related constants for Data field in a non-OFDMA HE PPDU)(#289). For HE modulated fields in an OFDMA HE PPDU, K_r is the set of subcarrier indices for the tones in the *r*-th RU.

Table 26-13—Highest data subcarrier index N_{SR} for pre-HE modulated fields

Field	N_{SR} as a function of bandwidth			
	20 MHz	40 MHz	80 MHz	160 MHz
L-STF	26	52	104	208
L-LTF	26	52	104	208
L-SIG	28	56	112	224
RL-SIG	28	56	112	224
HE-SIG-A	28	56	112	224
HE-SIG-B	28	56	112	224

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$\eta_{Field,k}$ is the power boost factor per OFDM symbol, which is $\sqrt{2}$ for the L-STF, L-LTF, HE-STF and HE-LTF fields in the HE extended range SU PPDU, and 1 otherwise.(#526)

$$\eta_{\text{L-SIG},k} = \begin{cases} \sqrt{2}, k = -28, -27, 27, 28 \text{ for an HE extended range SU PPDU} \\ 1, \text{ otherwise} \end{cases} \quad \text{(\#526)} \qquad (26\text{-}5)$$

α_r is the power boost factor for the r-th RU. A STA shall support α_r in the range [0.7, $\sqrt{2}$]. A STA may support α_r in the range [0.5, 2].(#1689)

β_r^{Field} is the power normalization factor and is defined in Equation (26-6)(#286)

$$\beta_r^{Field} = \begin{cases} \dfrac{\varepsilon_{Field}}{\sqrt{N_{Field}^{\text{Tone}}}}, & \text{Pre-HE modulated fields when BEAM_CHANGE = 1} \\ \varepsilon_{Field} \sqrt{\dfrac{|K_r|}{|K_r^{Field}|}} \Big/ \sqrt{\sum_{r=1}^{N_{RU}} \alpha_r^2 |K_r|}, & \text{otherwise} \end{cases} \quad \text{(\#526)} \qquad (26\text{-}6)$$

$|K_r|$ is the cardinality of the set of subcarriers K_r

$|K_r^{Field}|$ is the cardinality of the set of modulated subcarriers within K_r for each field.(#298)(#1978)

N_{Field}^{Tone} Table 26-14 (Tone scaling factor and guard interval duration values for HE PPDU fields) summarizes the various values of N_{Field}^{Tone} as a function of bandwidth per frequency segment. In the case of an HE OFDMA PPDU, the N_{Field}^{Tone} value of HE-STF, HE-LTF and HE-Data fields is variable, and is determined by which RUs of the current full bandwidth are transmitted in the PPDU.(#1977)

Table 26-14—Tone scaling factor and guard interval duration values for HE PPDU fields

Field	N_{Field}^{Tone} as a function of bandwidth, and RU size per frequency segment				Guard interval duration
	20 MHz	40 MHz	80 MHz	160 MHz	
L-STF	12	24	48	96	-
L-LTF	52	104	208	416	$T_{GI2,\text{L-LTF}}$
L-SIG in an HE PPDU	56	112	224	448	$T_{GI,\text{LegacyPreamble}}$
L-SIG in a non-HT duplicate PPDU(#1988)	-	104	208	416	
RL-SIG	56	112	224	448	$T_{GI,\text{LegacyPreamble}}$
HE-SIG-A	56	112	224	448	$T_{GI,\text{LegacyPreamble}}$
HE-SIG-B	56	112	224	448	$T_{GI,\text{LegacyPreamble}}$

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Table 26-14—Tone scaling factor and guard interval duration values for HE PPDU fields

HE-STF not in an HE trigger-based PPDU	14	30	62	124(#287)	-
HE-STF in an HE trigger-based PPDU	30	60	124	248	-
HE-LTF 1x Duration	60	122	250	500	$T_{GI,\text{HE-LTF1}}$
HE-LTF 2x Duration	122	242	498	996	$T_{GI,\text{HE-LTF2}}$
HE-LTF 4x Duration	242	484	996	1992	$T_{GI,\text{HE-LTF4}}$
HE-Data	242	484	996	1992	$T_{GI,Data}$
NON_HT_DUP_OFDM-Data(#1988)	-	104	208	416	$T_{GI,\text{LegacyPreamble}}$
NOTE—in the case of an HE OFDMA PPDU, the N_{Field}^{Tone} value of HE-STF, HE-LTF and HE-Data fields is variable, and is determined by which RUs of the current full bandwidth are transmitted in the PPDU.					

$$\varepsilon_{Field} = \begin{cases} \sqrt{\dfrac{N_{\text{L-LTF}}^{\text{Tone}}}{N_{\text{L-SIG}}^{\text{Tone}}}}, \text{ For the L-STF and L-LTF fields} \\ 1, \text{ otherwise} \end{cases} \quad (\#526)$$

$Q_k^{(i_{Seg})}$ is the spatial mapping matrix for the subcarrier k in frequency segment i_{Seg}. For HE modulated fields, $Q_k^{(i_{Seg})}$ is a matrix with N_{TX} rows and $N_{STS,total}$ columns. If the TXVECTOR parameter BEAM_CHANGE is 1, then for pre-HE modulated fields $Q_k^{(i_{Seg})}$ is a column vector with N_{TX} elements with element i_{TX} being $\exp(-j2\pi k\Delta_{F,\text{Pre-HE}}T_{CS}^{i_{TX}})$, where $T_{CS}^{i_{TX}}$ represents the cyclic shift for the transmitter chain whose values are TBD; otherwise it is identical to the spatial mapping $Q_k^{(i_{Seg})}$ for HE modulated fields(#1848).

$\Delta_{F,Field}$ is the subcarrier frequency spacing. For pre-HE modulated fields, $\Delta_{F,Field} = \Delta_{F,\text{Pre-HE}}$ given in Table 26 3. For HE modulated fields, $\Delta_{F,Field} = \Delta_{F,\text{HE}}$ given in Table 26-9 (Timing-related constants).

$X_{k,r,u}^{(i_{Seg},m)}$ is the frequency-domain symbol in subcarrier k of user u in the r-th RU for frequency segment i_{Seg} of space-time stream m. Some of the $X_{k,r,u}^{(i_{Seg},m)}$ within $-N_{SR} \le k \le N_{SR}$ have a value of zero. Examples of such cases include the DC tones, guard tones on each side of the transmit spectrum, the null subcarriers(#902) in an HE OFDMA PPDU, as well as the unmodulated tones of L-STF, HE-STF, and HE-LTF fields. Note that the multiplication matrices $A_{\text{HE-LTF}}^{k}$ are included in the calculation of $X_{k,r,u}^{(i_{Seg},m)}$ for the HE-STF and HE-LTF fields. When the TXVECTOR parameter BEAM_CHANGE is 0, the first column of the multiplication matrices $A_{\text{HE-LTF}}^{k}$ are included in the calculation of $X_{k,r,u}^{(i_{Seg},m)}$ for the pre-HE modulated fields.

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$T_{GI, Field}$ is the guard interval duration used for each OFDM symbol in the field. The value for each field is as defined in Table 26-9 (Timing-related constants)(#1674).

$T_{CS, \mathrm{HE}}(l)$ For pre-HE modulated fields, $T_{CS, \mathrm{HE}}(l) = 0$. For HE modulated fields, $T_{CS, \mathrm{HE}}(l)$ represents the cyclic shift per space-time stream, whose value is defined in Table 25-xx (Cyclic shift values for the HE modulated fields of a PPDU).

$\Upsilon_{k, BW}$ is used to represent tone rotation. BW in $\Upsilon_{k, BW}$ is determined by the TXVECTOR parameter CH_BANDWIDTH as defined in Table 26-15 (CH_BANDWIDTH and for pre-HE modulated fields). In HE modulated fields, $\Upsilon_{k, BW} = 1$ in all the subcarriers. In pre-HE modulated fields, $\Upsilon_{k, BW}$ is defined as in 21.3.7.5 (Definition of tone rotation) when TXVECTOR parameter BEAM_CHANGE is set to 1 and $\Upsilon_{k, BW} = 1$ for all the tones when TXVECTOR parameter BEAM_CHANGE is set to 0. When the TXVECTOR parameter BEAM_CHANGE is not present (such as in an HE MU PPDU and HE trigger-based PPDU), BEAM_CHANGE is assumed to be set to 1.(#2761)(#293)

Table 26-15—CH_BANDWIDTH and $\Upsilon_{k, BW}$ for pre-HE modulated fields

CH_BANDWIDTH	$\Upsilon_{k,\mathrm{BW}}$
CBW20	$\Upsilon_{k, 20}$
CBW40	$\Upsilon_{k, 40}$
CBW80	$\Upsilon_{k, 80}$
CBW160	$\Upsilon_{k, 160}$
CBW80+80	$\Upsilon_{k, 80}$ per frequency segment

26.3.10 HE preamble

26.3.10.1 Introduction

The HE portion of HE format preamble consists of pre-HE modulated fields and HE modulated fields. The HE modulated fields consist of HE-STF, HE-LTF and Data fields(#2762). The pre-HE modulated fields for the various HE PPDU formats are the following(#291):

— RL-SIG and HE-SIG-A fields of an HE SU PPDU
— RL-SIG, HE-SIG-A and HE-SIG-B fields of an HE MU PPDU
— RL-SIG, HE-SIG-A and repeated HE-SIG-A fields of an HE extended range SU PPDU
— RL-SIG and HE-SIG-A fields of an HE trigger-based PPDU

26.3.10.2 Cyclic shift(#1052)

26.3.10.2.1 Cyclic shift for pre-HE modulated fields

When the TXVECTOR parameter BEAM_CHANGE is 1(#Ed), the cyclic shift value $T_{CS}^{i_{TX}}$ for the L-STF, L-LTF, L-SIG, RL-SIG, HE-SIG-A and HE-SIG-B fields of the PPDU for transmit chain i_{TX} out of a total of

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N_{TX} are defined in Table 21-10 (Cyclic shift values for L-STF, L-LTF, L-SIG, and VHT-SIG-A fields of the PPDU)(PHY Motion #172). In UL MU transmission the cyclic shift value $T_{CS}^{i_{TX}}$ is based on the transmit chain index of each STA.

When the TXVECTOR parameter BEAM_CHANGE is 0(#Ed), the cyclic shift value $T_{CS}^{i_{TX}}$ for the L-STF, L-LTF, L-SIG, RL-SIG, and HE-SIG-A fields is not specified.

26.3.10.2.2 Cyclic shift for HE modulated fields

The cyclic shift values defined in this subclause apply to the HE-STF, HE-LTF and Data fields of the HE PPDU when the TXVECTOR parameter BEAM_CHANGE is 1(#Ed), and apply to the entire PPDU when the TXVECTOR parameter BEAM_CHANGE is 0(#Ed).

Throughout the HE modulated fields of the preamble, cyclic shifts are applied to prevent unintended beamforming when correlated signals are transmitted in multiple space-time streams. The same cyclic shift is also applied to these streams during the transmission of the Data field of the HE PPDU. The cyclic shift value $T_{CS,\,\mathrm{HE}}(n)$ for the HE modulated fields for space-time stream n out of $N_{STS,total}$ total space-time streams is shown in Table 21-11 (Cyclic shift values for the VHT modulated fields of a PPDU)(PHY Motion #172).

26.3.10.3 L-STF

If the TXVECTOR parameter BEAM_CHANGE is 1, the time domain representation of the L-STF field shall be as specified in Equation (26-7). The equation applies to all contiguous signals up to 160 MHz and non contiguous 80+80 MHz.

$$r_{\text{L-STF}}^{(i_{Seg}i_{TX})}(t) = \frac{\varepsilon}{\sqrt{N_{TX}\cdot N_{\text{L-STF}}^{\text{Tone}}}} w_{T_{\text{L-STF}}}(t) \sum_{i_{BW}\in\Omega_{20\text{MHz}}} \sum_{k=-26}^{26} \eta_{\text{L-STF},\,k} \left(\Upsilon_{(k-K_{\text{Shift}}(i_{BW})),\,\text{BW}} S_{k,\,20} \cdot \exp(j2\pi(k-K_{\text{Shift}}(i_{\text{BW}}))\Delta_{F,\,\text{Pre-HE}}(t-T_{CS}^{i_{TX}})) \right) \quad (26\text{-}7)$$

(#525)where

ε is a power scaling factor with the value $\varepsilon = \sqrt{\frac{N_{\text{Tone}}^{\text{L-LTF}}}{N_{\text{Tone}}^{\text{L-SIG}}}}$

$\eta_{\text{L-STF},\,k}$ is a PPDU format dependent scaling factor for the L-STF field on tone index k with the following value

$$\eta_{\text{L-STF},\,k} = \begin{cases} \sqrt{2}, & \text{for an HE extended range SU PPDU} \\ 1, & \text{otherwise} \end{cases} \text{(\#1986)} \quad (26\text{-}8)$$

$N_{20\text{MHz}}$ is defined in 22.3.8.3.4 (L-SIG definition)

$K_{Shift}(i) = (N_{20\text{MHz}} - 1 - 2i)\cdot 32$

$T_{CS}^{i_{TX}}$ represents the cyclic shift for transmit chain i_{TX} with a value given in 26.3.10.2.1 (Cyclic shift for pre-HE modulated fields).

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$N_{\text{L-STF}}^{\text{Tone}}$ has the value given in Table 26-14 (Tone scaling factor and guard interval duration values for HE PPDU fields)(#1988).

$\Omega_{20\text{MHz}}$ is a set of 20 MHz channels that contains the channels where pre-HE modulated fields are located and the channel indices are within 0 to $N_{20\text{MHz}} - 1$ in an HE trigger-based PPDU or HE MU PPDU with preamble puncturing, or equal to $\{0, 1, \ldots, N_{20\text{MHz}} - 1\}$ otherwise.

$S_{k,20}$ is defined as $S_{-26,26}$ in Equation (18-6).(#1985)(#1989)

If the TXVECTOR parameter BEAM_CHANGE is 0, the time domain representation of the L-STF field of contiguous 20 MHz, 40 MHz, 80 MHz and 160 MHz transmission shall be as specified in Equation (26-9). The equation applies to all contiguous signals up to 160 MHz and non contiguous 80+80 MHz.

$$r_{\text{L-STF}}^{(i_{Seg} i_{TX})}(t) = \frac{\varepsilon}{\sqrt{N_{STS,\,total} \cdot N_{\text{L-STF}}^{\text{Tone}}}} w_{T_{\text{L-STF}}}(t) \sum_{i_{BW}=0}^{N_{20\text{MHz}}-1} \sum_{k=-26}^{26} \sum_{m=1}^{N_{STS}} \eta_{\text{L-STF},\,k} \left(\left[Q_{4(k-K_{\text{Shift}}(i_{BW}))}^{(i_{Seg})} \right]_{i_{TX},\,m} \left[A_{\text{HE-LTF}}^{4(k-K_{\text{Shift}}(i_{BW}))} \right]_{m,\,1} S_{k,\,20} \cdot \exp(j2\pi(k - K_{\text{Shift}}(i_{\text{BW}}))\Delta_{F,\,\text{Pre-HE}}(t - T_{CS,\,\text{HE}}(m))) \right) \quad \text{(\#2531)(26-9)}$$

(#1050)(#525)where

$T_{CS,\,\text{HE}}(m)$ represents the cyclic shift for space time stream m as defined in 26.3.10.2.2 (Cyclic shift for HE modulated fields)(#1052)

$Q_k^{(i_{Seg})}$ is the spatial mapping/steering matrix for subcarrier k, in frequency segment i_{Seg} on the data symbols over tone spacing $\Delta_{F,\,\text{HE}}$ as defined in Table 26-9 (Timing-related constants). Refer to the descriptions in 22.3.10.11.1 (Transmission in VHT format) for examples of $Q_k^{(i_{Seg})}$.(#1991)

$A_{\text{HE-LTF}}^{k}$ is defined in Equation (26-56)

26.3.10.4 L-LTF

If the TXVECTOR parameter BEAM_CHANGE is 1, the time domain representation of the L-LTF field shall be as specified in Equation (26-10). The equation applies to all contiguous signals up to 160 MHz and non contiguous 80+80 MHz.(PHY Motion #172)

$$r_{\text{L-LTF}}^{(i_{Seg} i_{TX})}(t) = \frac{\varepsilon}{\sqrt{N_{TX} \cdot N_{\text{L-LTF}}^{\text{Tone}}}} w_{T_{\text{L-LTF}}}(t) \sum_{i_{BW} \in \Omega_{20\text{MHz}}} \sum_{k=-26}^{26} \eta_{\text{L-LTF},\,k} \left(\Upsilon_{(k-K_{\text{Shift}}(i_{BW})),\,\text{BW}} L_{k,\,20} \cdot \exp(j2\pi(k - K_{\text{Shift}}(i_{\text{BW}}))\Delta_{F,\,\text{Pre-HE}}(t - T_{GI,\,\text{L-LTF}} - T_{CS}^{i_{TX}})) \right) \quad \text{(26-10)}$$

$\eta_{\text{L-LTF},\,k}$ is a PPDU format dependent scaling factor for the L-LTF field on tone index k with the same value as $\eta_{\text{L-STF},\,k}$.(#525)

$N_{20\text{MHz}}$ is defined in 21.3.7.3 (Channel frequencies)

$K_{Shift}(i) = (N_{20\text{MHz}} - 1 - 2i) \cdot 32$

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$T_{CS}^{i_{TX}}$ represents the cyclic shift for transmit chain i_{TX} with a value given in 26.3.10.2.1 (Cyclic shift for pre-HE modulated fields).

$N_{\text{L-LTF}}^{\text{Tone}}$ has the value given in Table 26-14 (Tone scaling factor and guard interval duration values for HE PPDU fields)(#1988).

$L_{k,20}$ is defined as $L_{-26,26}$ in Equation (18-8).(#1992)

If the TXVECTOR parameter BEAM_CHANGE is 0, the time domain representation of the L-LTF field of contiguous 20 MHz, 40 MHz, 80 MHz and 160 MHz transmission shall be as specified in Equation (26-11). The equation applies to all contiguous signals up to 160 MHz and non contiguous 80+80 MHz.

$$r_{\text{L-LTF}}^{(i_{Seg} i_{TX})}(t) = \frac{\varepsilon}{\sqrt{N_{STS,\,total} \cdot N_{\text{L-LTF}}^{\text{Tone}}}} w_{T_{\text{L-LTF}}}(t) \sum_{i_{BW}=0}^{N_{20\text{MHz}}} \sum_{k=-26}^{26} \sum_{m=1}^{N_{STS}} \eta_{\text{L-LTF},k} \left(\left[Q_{4(k-K_{\text{Shift}}(i_{BW}))}^{(i_{Seg})} \right]_{i_{TX},\,m} \left[A_{\text{HE-LTF}}^{4(k-K_{\text{Shift}}(i_{BW}))} \right]_{m,\,1} L_{k,\,20} \cdot \exp(j2\pi(k-K_{\text{Shift}}(i_{\text{BW}}))\Delta_{F,\,\text{Pre-HE}}(t - T_{GI,\,\text{LegacyPreamble}} - T_{CS,\,\text{HE}}(m))) \right) \quad (26\text{-}11)$$

(#2531)(#1050)where

$T_{CS,\,\text{HE}}(m)$ represents the cyclic shift for space time stream m as defined in 26.3.10.2.2 (Cyclic shift for HE modulated fields)(#1052)

$Q_k^{(i_{Seg})}$ is defined in 26.3.9 (Mathematical description of signals)(#1094)

$A_{\text{HE-LTF}}^{k}$ is defined in Equation (26-56)

26.3.10.5 L-SIG

The L-SIG field is used to communicate rate and length information. The structure of the L-SIG field is defined in Figure 17-5 (SIGNAL field bit assignment)(#1835).

In an(#2829) HE PPDU, the RATE field shall be set to the value representing 6 Mb/s in the 20 MHz channel spacing column of Table 17-6 (Contents of the SIGNAL field)(#1835). In a non-HT duplicate PPDU, the RATE field is defined in 17.3.4.2 (RATE field)(#1835) using the L_DATARATE parameter in the TXVECTOR.

The LENGTH field shall be set to the value given by Equation (26-12).

$$\text{Length} = \left\lceil \frac{\text{TXTIME} - 20}{4} \right\rceil \times 3 - 3 - m \text{ (\#1683)} \quad (26\text{-}12)$$

where

TXTIME (in μs) is defined in 26.4.3 (TXTIME and PSDU_LENGTH calculation).

m is 1 for an HE MU PPDU and HE extended range SU PPDU, and 2 otherwise.

The LSB of the binary expression of the Length value shall be mapped to B5. In a non-HT duplicate PPDU, the LENGTH field is defined in 17.3.4.3 (LENGTH field)(#2859) using the L_LENGTH parameter in the TXVECTOR.

The Reserved (R) field shall be set to 0.

The Parity (P) field has the even parity of bits 0-16.

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The SIGNAL TAIL field shall be set to 0.

The L-SIG field shall be encoded, interleaved, and mapped following the steps described in 17.3.5.6 (Convolutional encoder), 17.3.5.7 (Data interleaving), and 17.3.5.8 (Subcarrier modulation mapping). The stream of 48 complex numbers generated by these steps is denoted by $d_k, k = 0, \ldots, 47$. Pilots shall be inserted as described in 17.3.5.9 (Pilot subcarriers). Extra 4 BPSK modulated tones are added(#1997). The 4 extra tones [–28, –27, 27, 28] of L-SIG in 20 MHz HE PPDU is [–1, –1, –1, 1].(#1835)

If the TXVECTOR parameter BEAM_CHANGE is 1, the time domain waveform of the L-SIG field shall be as given by Equation (26-13).

$$r_{\text{L-SIG}}^{(i_{Seg} i_{TX})}(t) = \frac{1}{\sqrt{N_{TX} \cdot N_{\text{L-SIG}}^{\text{Tone}}}} w_{T_{\text{L-SIG}}}(t) \sum_{i_{BW} \in \Omega_{20\text{MHz}}} \sum_{k=-28}^{28} \left(\begin{array}{l} \Upsilon_{(k - K_{\text{Shift}}(i_{BW})), \text{BW}} \eta_{\text{L-SIG}, k} (D_{k,20} + p_0 P_k) \\ \cdot \exp(j2\pi(k - K_{\text{Shift}}(i_{\text{BW}})) \Delta_{F, \text{Pre-HE}} (t - T_{GI, \text{LegacyPreamble}} - T_{CS}^{i_{TX}})) \end{array} \right) \quad (26\text{-}13)$$

where

$N_{20\text{MHz}}$ is defined in 21.3.7.3 (Channel frequencies)

$K_{Shift}(i) = (N_{20\text{MHz}} - 1 - 2i) \cdot 32$

$$D_{k,20} = \begin{cases} 0, k = 0, \pm 7, \pm 21 \\ -1, k = -28, -27, 27 \\ 1, k = 28 \\ d_{M_{20}^r(k)}, \text{otherwise} \end{cases} \quad (\#1684)$$

$$M_{20}^r(k) = \begin{cases} k + 26, -26 \le k \le -22 \\ k + 25, -20 \le k \le -8 \\ k + 24, -6 \le k \le -1 \\ k + 23, 1 \le k \le 6 \\ k + 22, 8 \le k \le 20 \\ k + 21, 22 \le k \le 26 \end{cases}$$

P_k is defined in 17.3.5.10 (OFDM modulation)(#1835)

P_0 is the first pilot value in the sequence defined in 17.3.5.10 (OFDM modulation)

$N_{\text{L-SIG}}^{\text{Tone}}$ is defined in Table 26-14 (Tone scaling factor and guard interval duration values for HE PPDU fields)(#476)

$T_{CS}^{i_{TX}}$ represents the cyclic shift for transmit chain i_{TX} with a value given in 26.3.10.2.1 (Cyclic shift for pre-HE modulated fields).

NOTE—$M_{20}^r(k)$ is a "reverse" function of the function $M(k)$ defined in 17.3.5.10 (OFDM modulation)(#1835).

If the TXVECTOR parameter BEAM_CHANGE is 0, the time domain waveform of the L-SIG field shall be as given by Equation (26-14).

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$$r_{\text{L-SIG}}^{(i_{Seg} i_{TX})}(t) = \frac{1}{\sqrt{N_{STS,\,total} \cdot N_{\text{L-SIG}}^{\text{Tone}}}} w_{T_{\text{L-SIG}}}(t) \quad (26\text{-}14)$$

$$\sum_{i_{BW}=0}^{N_{20\text{MHz}}} \sum_{k=-28}^{28} \sum_{m=1}^{N_{STS}} \left(\left[Q_{4(k-K_{\text{Shift}}(i_{BW}))}^{(i_{Seg})} \right]_{i_{TX},\,m} \left[A_{\text{HE-LTF}}^{4(k-K_{\text{Shift}}(i_{BW}))} \right]_{m,\,1} \eta_{\text{L-SIG},\,k} (D_{k,\,20} + p_0 P_k) \cdot \exp(j2\pi(k - K_{\text{Shift}}(i_{\text{BW}}))\Delta_{F,\,\text{Pre-HE}}(t - T_{GI,\,\text{LegacyPreamble}} - T_{CS,\,\text{HE}}(m))) \right)$$

(#2531)(#1050)(#525)where

$\eta_{\text{L-SIG},\,k}$ is a PPDU dependent scaling factor for the L-SIG field on the tone index k with the following value:

$$\eta_{\text{L-SIG},\,k} = \begin{cases} \sqrt{2}, & k = \pm 28, \pm 27 \text{ for an HE extended range SUPPDU} \\ 1, & \text{otherwise} \end{cases} \quad (\#525)$$

$T_{CS,\,\text{HE}}(m)$ represents the cyclic shift for space time stream m as defined in 26.3.10.2.2 (Cyclic shift for HE modulated fields)(#1052)

$Q_k^{(i_{Seg})}$ is defined in 26.3.9 (Mathematical description of signals)(#1094)

$A_{\text{HE-LTF}}^{k}$ is defined in Equation (26-56)

26.3.10.6 RL-SIG

The RL-SIG field is used to identify an(#2829) HE PPDU.

If the TXVECTOR parameter BEAM_CHANGE is 1, the time domain waveform of the RL-SIG field shall be as given by Equation (26-15).(#294)

$$_{g}^{i_{TX})}_{\text{SIG}}(t) = \frac{1}{\sqrt{N_{TX} \cdot N_{\text{RL-SIG}}^{\text{Tone}}}} w_{T_{\text{RL-SIG}}}(t) \quad (26\text{-}15)$$

$$\sum_{i_{BW} \in \Omega_{20\text{MHz}}} \sum_{k=-28}^{28} \eta_{\text{L-SIG},\,k} \left(\Upsilon_{(k-K_{\text{Shift}}(i_{BW})),\,\text{BW}} \eta_{\text{L-SIG},\,k} (D_{k,\,20} + p_1 P_k) \cdot \exp(j2\pi(k - K_{\text{Shift}}(i_{\text{BW}}))\Delta_{F,\,\text{Pre-HE}}(t - T_{GI,\,\text{LegacyPreamble}} - T_{CS}^{i_{TX}})) \right)$$

If the TXVECTOR parameter BEAM_CHANGE is 1, the time domain waveform of the RL-SIG field shall be as given by Equation (26-16).(#294)

$$_{Seg}^{i_{TX})}_{\text{-SIG}}(t) = \frac{1}{\sqrt{N_{STS} \cdot N_{\text{RL-SIG}}^{\text{Tone}}}} w_{T_{\text{RL-SIG}}}(t) \quad (26\text{-}16)$$

$$\sum_{i_{BW}=0}^{N_{20\text{MHz}}-1} \sum_{k=-28}^{28} \eta_{\text{L-SIG},\,k} \sum_{m=1}^{N_{STS}} \left(\left[Q_{4(k-K_{\text{Shift}}(i_{BW}))}^{(i_{Seg})} \right]_{i_{TX},\,m} \left[A_{\text{HE-LTF}}^{4(k-K_{\text{Shift}}(i_{BW}))} \right]_{m,\,1} (D_{k,\,20} + p_0 P_k) \cdot \exp(j2\pi(k - K_{\text{Shift}}(i_{\text{BW}}))\Delta_{F,\,\text{Pre-HE}}(t - T_{GI,\,\text{LegacyPreamble}} - T_{CS,\,\text{HE}}(m))) \right)$$

26.3.10.7 HE-SIG-A

26.3.10.7.1 General

The HE-SIG-A field carries information required to interpret HE PPDUs.(#1846)

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26.3.10.7.2 Content

The HE-SIG-A field for an HE SU PPDU or an HE extended range SU PPDU contains the fields listed in Table 26-16 (HE-SIG-A field of an HE SU PPDU and HE extended range SU PPDU(#Ed)).

Table 26-16—HE-SIG-A field of an HE SU PPDU and HE extended range SU PPDU(#Ed)

Two Parts of HE-SIG-A	Bit	Field	Number of bits	Description
HE-SIG-A1	B0	Format	1	Differentiate an HE SU PPDU from an HE trigger-based PPDU:(#1685) Set to 0 for HE trigger-based PPDU Set to 1 for HE SU PPDU This field is reserved and set to 1 for an HE extended range SU PPDU.(#1196)
	B1	Beam Change	1	Set to 1 indicates that the pre-HE-STF portion of the PPDU(#481) is spatially mapped differently from HE-LTF1. Set to 0 indicates that the pre-HE-STF portion of the PPDU(#481) is spatially mapped the same way as HE-LTF1 on each tone.
	B2	UL/DL	1	Indicates whether the PPDU is sent UL or DL: Set to 0 for DL Set to 1 for UL(#2002) This field indicates DL for TDLS, mesh and IBSS(#2864). NOTE—The TDLS peer can identify the TDLS frame by To DS and From DS fields in the MAC header of the MPDU.
	B3-B6	MCS	4	For an HE SU PPDU: Set to *n* for MCS*n*, where *n* = 0, 1, 2, …., 11 Values 12-15 are reserved For HE extended range SU PPDU with Bandwidth field set to 0 (242-tone RU): Set to *n* for MCS*n*, where *n* = 0, 1, 2 Values 3-15 are reserved For HE extended range SU PPDU with Bandwidth field set to 1 (right 106-tone RU in P20): Set to 0 for MCS 0 Values 1-15 are reserved
	B7	DCM	1	Indicates whether or not DCM is applied to the Data field for the MCS indicated. Set to 1 to indicate that DCM is applied to the Data field Set to 0 to indicate that DCM is not applied to the Data field. DCM is only applied for MCS0, MCS1, MCS3 and MCS4. DCM is only applied for 1 and 2 spatial streams. DCM is not applied when STBC is used.(#2007)

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Table 26-16—HE-SIG-A field of an HE SU PPDU and HE extended range SU PPDU(#Ed)

	B8-B13	BSS Color	6	The BSS Color field is an identifier of the BSS
	B14	Reserved	1	Reserved and set to 1(PHY Motion #162)
	B15-B18	Spatial Reuse	4	Set to SR Disallowed to disallow SRP-based spatial reuse (see 25.9 (Spatial reuse operation) and 25.11a (TXVECTOR parameters SPATIAL_REUSE for an HE PPDU)).(#226) NOTE—This part needs further development.(#2169)
	B19-B20	Bandwidth	2	For an HE SU PPDU: Set to 0 for 20 MHz Set to 1 for 40 MHz Set to 2 for 80 MHz Set to 3 for 160 MHz and 80+80 MHz(#Ed) For an HE extended range SU PPDU: Set to 0 for 242-tone RU Set to 1 for right 106-tone RU within the primary 20 MHz
	B21-B22	GI+LTF Size(#1420)	3	Indicates the GI duration(#1420) and HE-LTF size. Set to 0 to indicate a 1x HE-LTF and 0.8 μs GI Set to 1 to indicate a 2x HE-LTF and 0.8 μs GI Set to 2 to indicate a 2x HE-LTF and 1.6 μs GI Set to 3 to indicate a 4x HE-LTF and 3.2 μs GI(#2005)
	B23-B25	Nsts	3	Indicates the number of space time streams.(#1457) For an HE SU PPDU: Set to the number of space time streams minus 1 For an HE extended range SU PPDU: Set to 0 for one space time stream when STBC field is set to 0 Set to 1 for two space time streams when STBC field is set to 1(#2001) Values 2-7 are reserved
HE-SIG-A2	B0-B6	TXOP Duration	7	Set to 127 to indicate no duration information. Set to value other than 127 to indicate duration information for NAV setting and protection of the TXOP. NOTE—The encoding of TXOP Duration field is the same as the TXOP_DURATION parameter(#Ed) in Table 26-1 (TXVECTOR and RXVECTOR parameters(#1780)).(#783)
	B7	Coding	1	Indicates whether BCC or LDPC is used: Set to 0 to indicate BCC Set to 1 to indicate LDPC(#1197)
	B8	LDPC Extra Symbol	1	Indicates the presence of the extra OFDM symbol for LDPC.(#1197) Set to 1 if an extra OFDM symbol for LDPC is present Set to 0 if an extra OFDM symbol for LDPC is present Reserved and set to 1 when the Coding field is 0.

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Table 26-16—HE-SIG-A field of an HE SU PPDU and HE extended range SU PPDU(#Ed)

	B9	STBC	1	Set to 1 if space time block coding is used Set to 0 otherwise
	B10	TxBF	1	Set to 1 if a Beamforming steering matrix is applied to the waveform in an SU transmission Set to 0 otherwise
	B11-B12	Pre-FEC Padding Factor(#2564)	2	Indicates the pre-FEC padding factor(#1626)(#2564) value as defined in Table 26-39 (Pre-FEC Padding Factor(#2564) subfield encoding).(#2534)
	B13	PE Disambiguity	1	Indicate PE Disambiguity as defined in 26.3.12 (Packet extension(#1781)).(#2534)
	B14	Reserved	1	Reserved and set to 1
	B15	Doppler	1	Set to 0 if Doppler mode is not used Set to 1 if Doppler mode is used(#2167)
	B16-B19	CRC	4	CRC for bits 0-41 of the HE-SIG-A field (see 26.3.10.7.3 (CRC computation)). The first bit to be transmitted is bit *c7* as explained in 26.3.10.7.3 (CRC computation)).(#2535)
	B20-B25	Tail	6	Used to terminate the trellis of the convolutional decoder. Set to 0.

NOTE—Integer fields are transmitted in unsigned binary format, LSB first, where the LSB is in the lowest numbered bit position.

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(#475)The HE-SIG-A field of an HE MU PPDU contains the fields listed in Table 26-17 (HE-SIG-A field of an HE MU PPDU(#Ed)).

Table 26-17—HE-SIG-A field of an HE MU PPDU(#Ed)

Two Parts of HE-SIG-A	Bit	Field	Number of bits	Description
HE-SIG-A1	B0	UL/DL	1	Indicates whether the PPDU is sent UL or DL: Set to 0 for DL Set to 1 for UL(#2002) This field indicates DL for TDLS, mesh and IBSS(#2864). NOTE—The TDLS peer can identify the TDLS frame by To DS and From DS fields in the MAC header of the MPDU.
	B1-B3	SIGB MCS	3	Indicates the MCS of the HE-SIG-B field: Set to 0 for MCS 0 Set to 1 for MCS 1 Set to 2 for MCS 2 Set to 3 for MCS 3 Set to 4 for MCS 4 Set to 5 for MCS 5(#1616) The values 6 and 7 are reserved(#847)
	B4	SIGB DCM	1	Set to 1 indicates that the HE-SIG-B is modulated with dual sub-carrier modulation for the MCS. Set to 0 indicates that the HE-SIB-B is not modulated with dual sub-carrier modulation for the MCS. DCM is only applicable to MCS0, MCS1, MCS3, and MCS4.
	B5-B10	BSS Color	6	The BSS Color field is an identifier of the BSS
	B11-B14	Spatial Reuse	4	Set to SR Disallowed to disallow SRP-based spatial reuse (see 25.9 (Spatial reuse operation) and 25.11a (TXVECTOR parameters SPATIAL_REUSE for an HE PPDU)).(#226) NOTE—This part needs further development.(#2169)
	B15-B17	Bandwidth	3(#846)	Set to 0 for full 20 MHz Set to 1 for full 40 MHz Set to 2 for full 80 MHz Set to 3 for full 160 MHz and 80+80 MHz(#Ed) Set to 4 for preamble puncturing in 80 MHz, where in the preamble only the secondary 20 MHz is punctured Set to 5 for preamble puncturing in 80 MHz, where in the preamble only one of the two 20 MHz sub-channels in secondary 40 MHz is punctured Set to 6 for preamble puncturing in 160 MHz or 80+80 MHz, where in the primary 80 MHz of the pre-amble only the secondary 20 MHz is punctured Set to 7 for preamble puncturing in 160 MHz or 80+80 MHz, where in the primary 80 MHz of the pre-amble the primary 40 MHz is present.(PHY Motion #161)

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Table 26-17—HE-SIG-A field of an HE MU PPDU(#Ed) *(continued)*

	B18-B21	Number Of HE-SIG-B Symbols Or MU-MIMO Users	4	If the SIGB Compression field is 0, indicates the number of OFDM symbols in the HE-SIG-B field minus 1.(#821) If the SIGB Compression field is 1, indicates the number of MU-MIMO users minus 1.(#296)
	B22	SIGB Compression	1	Set to 1 for full BW MU-MIMO. Set to 0 otherwise.
	B23-B24	GI+LTF Size(#1420)	3	Indicates the GI duration(#1420) and HE-LTF size. Set to 1 to indicate a 2x HE-LTF and 0.8 μs GI Set to 2 to indicate a 2x HE-LTF and 1.6 μs GI Set to 3 to indicate a 4x HE-LTF and 3.2 μs GI(#2005) The value 0 is reserved(#Ed)
	B25	Doppler	1	Set to 0 if Doppler mode is not used Set to 1 if Doppler mode is used(#2167)
HE-SIG-A2	B0-B6	TXOP Duration	7	Set to 127 to indicate no duration information. Set to value other than 127 to indicate duration information for NAV setting and protection of the TXOP. NOTE—The encoding of TXOP Duration field is the same as the TXOP_DURATION parameter(#Ed) in Table 26-1 (TXVECTOR and RXVECTOR parameters(#1780)).(#783)
	B7	Reserved	1	Reserved and set to 1
	B8-B10	Number of HE-LTF Symbols	3	Indicates the number of HE-LTF symbols: Set to 0 for 1 HE-LTF symbol Set to 1 for 2 HE-LTF symbols Set to 2 for 4 HE-LTF symbols Set to 3 for 6 HE-LTF symbols Set to 4 for 8 HE-LTF symbols Other values are reserved.(#2127)
	B11	LPDC Extra Symbol	1	Indication of the presence of the extra OFDM symbol for LDPC.
	B12	STBC	1	In an HE MU PPDU where each RU includes no more than 1 user, set to 1 to indicate all RUs are STBC encoded in the payload, set to 0 to indicate all RUs are not STBC encoded in the payload. STBC is not applied in MU-MIMO RUs. STBC doesn't apply to HE-SIG-B.(#540)
	B13-B14	Pre-FEC Padding Factor(#2564)	2	Indicates the pre-FEC padding factor(#1626)(#2564) value as defined in Table 26-39 (Pre-FEC Padding Factor(#2564) subfield encoding).(#2534)
	B15	PE Disambiguity	1	Indicate PE Disambiguity as defined in 26.3.12 (Packet extension(#1781)).(#2534)

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Table 26-17—HE-SIG-A field of an HE MU PPDU(#Ed) *(continued)*

	B16-B19	CRC	4	CRC for bits 0-41 of the HE-SIG-A field (see 26.3.10.7.3 (CRC computation)). The first bit to be transmitted is bit *c7* as explained in 26.3.10.7.3 (CRC computation)).(#2535)
	B20-B25	Tail	6	Used to terminate the trellis of the convolutional decoder. Set to 0.
NOTE—Integer fields are transmitted in unsigned binary format, LSB first, where the LSB is in the lowest numbered bit position.				

When the Bandwidth field is set to 5 or 7, the HE-SIG-B field may indicate which 20 MHz sub-channel(s) in the preamble of secondary 40 MHz channel are punctured by its RU allocation signaling; when the Bandwidth field is set to 6 or 7, the HE-SIG-B field may indicate which 20 MHz sub-channel(s) in the preamble of secondary 80 MHz channel are punctured by its RU allocation signaling. See 26.3.10.8 (HE-SIG-B) for the RU allocation signaling.

It is optional for an HE STA to receive a preamble-punctured HE MU PPDU with the Bandwidth field in HE-SIG-A setting to a values 4 to 7. Whether or not an HE STA is capable of receiving preamble-punctured HE MU PPDU with the Bandwidth field of HE-SIG-A field setting to 4, 5, 6, 7 are indicated by the Preamble Puncturing Receive Capable subfield in the HE Capabilities field (see 9.4.2.218 (HE Capabilities element)).

The HE-SIG-A field for an HE trigger-based PPDU contains the fields listed in Table 26-18 (HE-SIG-A field of an HE trigger-based PPDU(#Ed)).

Table 26-18—HE-SIG-A field of an HE trigger-based PPDU(#Ed)

Two Parts of HE-SIG-A	Bit	Field	Number of bits	Description
HE-SIG-A1	B0	Format	1	Set to 0 for an HE SU PPDU Set to 1 for an HE trigger-based PPDU
	B1-B6	BSS Color	6	The BSS Color field is an identifier of the BSS

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Table 26-18—HE-SIG-A field of an HE trigger-based PPDU(#Ed) *(continued)*

B7-B10	Spatial Reuse 1(SR Motion #11)	4	If the Bandwidth field indicates 20 MHz, 40 MHz, or 80 MHz: Spatial Reuse field for the first 20 MHz subband (see NOTE 1) If the Bandwidth field indicates 160/80+80 MHz: Spatial Reuse field for first 40 MHz subband of the 160 MHz operating band. (see NOTE 1) Set to 0 (SR disallowed Entry) to disallow SRP-based spatial reuse (see 25.9 (Spatial reuse operation) and 25.11a (TXVECTOR parameters SPATIAL_REUSE for an HE PPDU)). Set to value 1 to 14 corresponding to SRP value (see Table 26-19 (Spatial Reuse subfield encoding)) for SRP-based SR operation. The value 15 is reserved.(#226)
B11-B14	Spatial Reuse 2	4	If the Bandwidth field indicates 20 MHz, 40 MHz, or 80 MHz: Spatial Reuse field for the second 20 MHz subband (see NOTE 1) When operating 20 MHz, this field is set to same value as Spatial Reuse 1 field. When operating 40 MHz in 2.4 GHz band, this field is set to same value as Spatial Reuse 1 field If the Bandwidth field indicates 160/80+80 MHz: Spatial Reuse field for second 40 MHz subband of the 160 MHz operating band. (see NOTE 1) Set to 0 (SR disallowed Entry) to disallow SRP-based spatial reuse (see 25.9 (Spatial reuse operation) and 25.11a (TXVECTOR parameters SPATIAL_REUSE for an HE PPDU)). Set to value 1 to 14 corresponding to SRP value (see Table 26-19 (Spatial Reuse subfield encoding)) for SRP-based SR operation. The value 15 is reserved.(#226)

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Table 26-18—HE-SIG-A field of an HE trigger-based PPDU(#Ed) *(continued)*

B15-B18	Spatial Reuse 3	4	If the Bandwidth field indicates 20 MHz, 40 MHz or 80 MHz: Spatial Reuse field for the third 20 MHz subband (see NOTE 1) When operating in 20 MHz or 40 MHz, this field is set to same value as Spatial Reuse 1 field. If the Bandwidth field indicates 160/80+80 MHz: Spatial Reuse field for third 40 MHz subband of the 160 MHz operating band. (see NOTE 1) When operating in 80+80 MHz, this field is set to same value as Spatial Reuse 1 field. Set to 0 (SR disallowed Entry) to disallow SRP-based spatial reuse (see 25.9 (Spatial reuse operation) and 25.11a (TXVECTOR parameters SPATIAL_REUSE for an HE PPDU)). Set to value 1 to 14 corresponding to SRP value (see Table 26-19 (Spatial Reuse subfield encoding)) for SRP-based SR operation. The value 15 is reserved.(#226)
B19-B22	Spatial Reuse 4	4	If the Bandwidth field indicates 20 MHz, 40 MHz or 80 MHz: Spatial Reuse field for the fourth 20 MHz subband (see NOTE 1) When operating in 20 MHz, this field is set to same value as Spatial Reuse 1 field. When operating in 40 MHz, this field is set to same value as Spatial Reuse 2 field. If the Bandwidth field indicates 160/80+80 MHz: Spatial Reuse field for fourth 40 MHz subband of the 160 MHz operating band. (see NOTE 1) When operating in 80+80 MHz, this field is set to same value as Spatial Reuse 2 field Set to 0 (SR disallowed Entry) to disallow SRP-based spatial reuse (see 25.9 (Spatial reuse operation) and 25.11a (TXVECTOR parameters SPATIAL_REUSE for an HE PPDU)). Set to value 1 to 14 corresponding to SRP value (see Table 26-19 (Spatial Reuse subfield encoding)) for SRP-based SR operation. The value 15 is reserved.(#226)
B23	Reserved	1	Reserved and set to 1. NOTE—Unlike other Reserved fields in HE-SIG-A of the HE trigger-based PPDU, B23 does not have a corresponding bit in the Trigger frame.(PHY Motion #169)
B24-B25	Bandwidth	2	For HE trigger-based PPDU: Set to 0 for 20 MHz Set to 1 for 40 MHz Set to 2 for 80 MHz Set to 3 for 160 MHz and 80+80 MHz(#2001)

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Table 26-18—HE-SIG-A field of an HE trigger-based PPDU(#Ed) *(continued)*

HE-SIG-A2	B0-B6	TXOP Duration	7	Set to 127 to indicate no duration information. Set to value other than 127 to indicate duration information for NAV setting and protection of the TXOP. NOTE—The encoding of TXOP Duration field is the same as the TXOP_DURATION parameter(#Ed) in Table 26-1 (TXVECTOR and RXVECTOR parameters(#1780)).(#783)
	B7-B15	Reserved	9	Reserved and set to value indicated in the Trigger frame
	B16-B19	CRC	4	CRC of bits 0-41 of the HE-SIG-A field. See 26.3.10.7.3 (CRC computation). The first bit to be transmitted is bit C3 as explained in 26.3.10.7.3 (CRC computation)).(#2535)
	B20-B25	Tail	6	Used to terminate the trellis of the convolutional decoder. Set to 0.

NOTE 1—The four Spatial Reuse fields, 1, 2, 3, and 4, are arranged in increasing order of frequency and correspond to:

— For 20 MHz one Spatial Reuse field corresponding to the entire 20 MHz (other 3 fields indicate identical values)

— For 40 MHz two Spatial Reuse fields for each 20 MHz sub-band (other 2 fields indicate identical values)

— For 80 MHz four Spatial Reuse fields for each 20 MHz sub-band

- For an OFDMA transmission of a given BW, each of the Spatial Reuse fields that corresponds to a 20 MHz sub-band is also applicable to the 242-tone RU which is most closely aligned in frequency (in the tone-plan of that BW) with the aforementioned 20 MHz sub-band. The correspondence from an Spatial Reuse field to a 242-tone RU also holds for any RU within the 242-tone RU. The above also implies that a 20 MHz OBSS STA uses the Spatial Reuse field corresponding to its 20 MHz channel, a 40 MHz OBSS STA located on the lower frequency half of the 80 MHz BSS uses Spatial Reuse 1 field, Spatial Reuse 2 field values and a 40 MHz OBSS STA located on the upper frequency half of the 80 MHz BSS uses Spatial Reuse 3 field, Spatial Reuse 4 field values

— For 160 MHz and 80+80 MHz four Spatial Reuse fields for each 40 MHz sub-band

- For an OFDMA transmission of a given BW, each of the Spatial Reuse fields that corresponds to a 40 MHz sub-band is also applicable to the 484-tone RU which is most closely aligned in frequency (in the tone-plan of that BW) with the aforementioned 40 MHz sub-band. The correspondence from an Spatial Reuse field to a 484-tone RU also holds for any RU within the 484-tone RU.

NOTE 2—Integer fields are transmitted in unsigned binary format, LSB first, where the LSB is in the lowest numbered bit position.

(#226)Table 26-19 (Spatial Reuse subfield encoding) defines the encoding for the Spatial Reuse 1, Spatial Reuse 2, Spatial Reuse 3 and Spatial Reuse 4 subfields.

Table 26-19—Spatial Reuse subfield encoding

Value	Meaning
0	SR disallow
1	SRP = –80 dBm
2	SRP = –74 dBm

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Table 26-19—Spatial Reuse subfield encoding *(continued)*

Value	Meaning
3	SRP = –68 dBm
4	SRP = –62 dBm
5	SRP = –56 dBm
6	SRP = –50 dBm
7	SRP = –47 dBm
8	SRP = –44 dBm
9	SRP = –41 dBm
10	SRP = –38 dBm
11	SRP = –35 dBm
12	SRP = –32 dBm
13	SRP = –29 dBm
14	SRP = –26 dBm
15	Reserved

SRP = TX PWR_{AP} + Acceptable Receiver Interference $level_{AP}$

Adjustment range for parameters (referenced to the antenna connector and normalized to 20 MHz bandwidth):

— TX PWR_{AP}: –10 dBm to 26 dBm

— Acceptable Receiver Interference $Level_{AP}$: –82dBm to –36 dBm

If SRP is below < –80 dBm, set Spatial Reuse to 1, if SRP is above –26 dBm, set Spatial Reuse to 14. Same table is used for AP and STA.

26.3.10.7.3 CRC computation

The CRC computation defined in this subclause applies to HE-SIG-A, the Common field of HE-SIG-B and the User Specific field of HE-SIG-B.

The CRC is calculated over(#2015) bits 0 to 41 of the HE-SIG-A field and over bits 0 to L of the HE-SIG-B field ($L = x$ for each HE-SIG-B common block field where $x = N \times 8$ when the Center 26-tone RU subfield is present, and $x = N \times 8 - 1$ otherwise, and $L = 20$ for the HE-SIG-B user specific fields). Refer to Table 26-20 (Common Block field(#2024)) for N and the conditions under which the Center 26-tone RU subfield is present.(#2016)(#Ed)

The value of the CRC field shall be the 1s complement of

$$crc(D) = (M(D) + I(D))D^{8} mod\ G(D)$$

where

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$$M(D) = \sum_{i=0}^{L} m_{L-i} D^i$$

where

$$I(D) = \sum_{i=L-7}^{L} D^i$$

$G(D)$ is defined in Equation (19-18)(#2018)

The CRC field is transmitted from *c4* to *c7* with *c7* first.(#2286)

Figure 19-8 (HT-SIG CRC calculation) shows the operation of the CRC, where the serial input are from m_L to m_0, and the output is stopped at *c4*.

26.3.10.7.4 Encoding and modulation

For an HE SU PPDU, HE MU PPDU and HE trigger-based PPDU, the HE-SIG-A field is composed of two parts, HE-SIG-A1 and HE-SIG-A2, each containing 26 data bits. HE-SIG-A1 is transmitted before HE-SIG-A2. The HE-SIG-A symbols shall be BCC encoded at rate, R = 1/2, interleaved, mapped to a BPSK constellation, and have pilots inserted following the steps described in 17.3.5.6 (Convolutional encoder), 26.3.11.8 (BCC interleavers)(#2183), 17.3.5.8 (Subcarrier modulation mapping), and 17.3.5.9 (Pilot subcarriers)(#2771), respectively. The constellation mappings of HE-SIG-A in HE SU PPDU, HE MU PPDU and HE trigger-based PPDU are shown in Figure 26-19 (Data tone constellation of HE-SIG-A symbols)(#2772). The first and second half of the stream of 104 complex numbers generated by these steps (before pilot insertion) is divided into two groups of 52 complex numbers, where respectively, the first 52 complex numbers form the first symbol of HE-SIG-A and the second 52 complex numbers form the second symbol of HE-SIG-A. If the TXVECTOR parameter BEAM_CHANGE is 1, the time domain waveform for the HE-SIG-A field of an HE SU PPDU, HE MU PPDU and HE trigger-based PPDU shall be as specified in Equation (26-17).(#2287)(#525)

$$r_{\text{HE-SIG-A}}^{(i_{Seg} i_{TX})}(t) = \frac{1}{\sqrt{N_{TX} \cdot N_{\text{HE-SIG-A}}^{\text{Tone}}}} \sum_{n=0}^{1} w_{T_{SYML}}(t - nT_{SYML}) \sum_{i_{BW} \in \Omega_{20\text{MHz}}} \sum_{k=-28}^{28} \left(\begin{array}{l} \Upsilon_{(k - K_{\text{Shift}}(i_{BW})),\, \text{BW}}(D_{k,n,20} + p_{n+2} P_k) \\ \cdot \exp(j2\pi(k - K_{\text{Shift}}(i_{\text{BW}})) \Delta_{F,\, \text{Pre-HE}}(t - nT_{SYML} - T_{GI,\, \text{LegacyPreamble}} - T_{CS}^{i_{TX}})) \end{array} \right) \quad (26\text{-}17)$$

$N_{20\text{MHz}}$ is defined in 21.3.7.3 (Channel frequencies)

$$K_{\text{Shift}}(i) = (N_{20\text{MHz}} - 1 - 2i) \cdot 32$$

$$D_{k,n,20} = \begin{cases} 0, k = 0, \pm 7, \pm 21 \\ d_{M_{20}^r(k),n}, \text{otherwise} \end{cases}$$

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$$M_{20}^{r}(k) = \begin{cases} k+28, -28 \le k \le -22 \\ k+27, -20 \le k \le -8 \\ k+26, -6 \le k \le -1 \\ k+25, 1 \le k \le 6 \\ k+24, 8 \le k \le 20 \\ k+23, 22 \le k \le 28 \end{cases} \quad \text{(\#525)}$$

P_k and p_n are defined in 17.3.5.10 (OFDM modulation)

$N_{\text{HE-SIG-A}}^{\text{Tone}}$ is defined in Table 26-14 (Tone scaling factor and guard interval duration values for HE PPDU fields)(#476)

$T_{CS}^{i_{TX}}$ represents the cyclic shift for transmit chain i_{TX} with a value given in 26.3.10.2.1 (Cyclic shift for pre-HE modulated fields).

If the TXVECTOR parameter BEAM_CHANGE is 0, the time domain waveform of the HE-SIG-A field shall be as given by Equation (26-18).

$$w_{\text{HE-SIG-A}}^{(i_{Seg} i_{TX})}(t) = \frac{1}{\sqrt{N_{TX} \cdot N_{\text{HE-SIG-A}}^{\text{Tone}}}} \sum_{n=0}^{1} w_{T_{SYML}}(t - nT_{SYML}) \qquad (26\text{-}18)$$
$$\sum_{i_{BW}=0}^{N_{20\text{MHz}}-1} \sum_{k=-N_{SR}}^{N_{SR}} \left(\begin{array}{l} (D_{k,n,i_{BW}}^{i_{Seg}} + p_{n+4} P_k) \\ \cdot \exp(j2\pi(k - K_{\text{Shift}}(i_{\text{BW}}))\Delta_{F,\text{Pre-HE}}(t - nT_{SYML} - T_{GI,\text{LegacyPreamble}} - T_{CS}^{i_{TX}})) \end{array} \right)$$

(#2288)(#1050)(#525)where

$T_{CS,\text{HE}}(m)$ represents the cyclic shift for space time stream m as defined in 26.3.10.2.2 (Cyclic shift for HE modulated fields)(#1052)

$Q_k^{(i_{Seg})}$ is defined in 26.3.9 (Mathematical description of signals)(#1094)

$A_{\text{HE-LTF}}^{k}$ is defined in Equation (26-56)

For an HE extended range SU PPDU, the HE-SIG-A field is composed of four parts, i.e. HE-SIG-A1, HE-SIG-A2, HE-SIG-A3 and HE-SIG-A4, each part containing 26 data bits. These four parts are transmitted sequentially from HE-SIG-A1 to HE-SIG-A4. HE-SIG-A1 and HE-SIG-A2 have the same data bits. HE-SIG-A3 and HE-SIG-A4 have same data bits. The data bits of HE-SIG-A1 and HE-SIG-A3 shall be BCC encoded at rate, $R = 1/2$, interleaved, mapped to a BPSK constellation, and have pilots inserted. HE-SIG-A2 shall be BCC encoded at rate, $R = 1/2$, mapped to a QBPSK constellation without interleaving(#912) and have pilots inserted. The constellation mappings of the HE-SIG-A field in an HE extended range SU PPDU is shown in Figure 26-19 (Data tone constellation of HE-SIG-A symbols). The QBPSK constellation on HE-SIG-A2 is used to differentiate between an HE extended range SU PPDU and an HE MU PPDU when $m = 1$ in Equation (26-12), which indicates HE MU PPDU or HE extended range SU PPDU(#1687). HE-SIG-A4 shall be BCC encoded at rate, $R = 1/2$, mapped to a BPSK constellation without interleaving(#913) and have pilots inserted. BCC encoding, Data interleaving, constellation mapping and pilot insertion follow the steps described in 17.3.5.6 (Convolutional encoder), 26.3.11.8 (BCC

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interleavers)(#2183), 17.3.5.8 (Subcarrier modulation mapping), and 17.3.5.9 (Pilot subcarriers)(#2774), respectively.

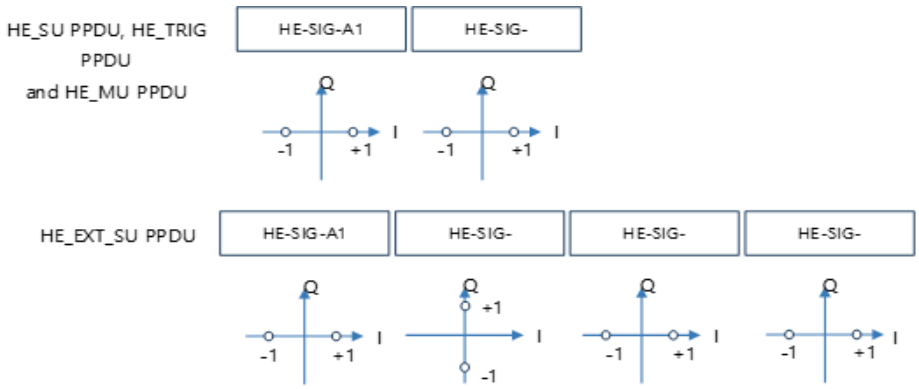

Figure 26-19—Data tone constellation of HE-SIG-A symbols

If the TXVECTOR parameter BEAM_CHANGE is 1, the time domain waveform for the HE-SIG-A field in an HE extended range SU PPDU, shall be as specified in Equation (26-19).

$$r_{\text{HE-SIG-A}}^{(i_{Seg} i_{TX})}(t) = \frac{1}{\sqrt{N_{TX} \cdot N_{\text{HE-SIG-A}}^{\text{Tone}}}} \sum_{n=0}^{3} w_{T_{\text{SYML}}}(t - nT_{SYML}) \quad (26\text{-}19)$$
$$\sum_{i_{BW}=0}^{N_{20\text{MHz}}-1} \sum_{k=-28}^{28} \left(\begin{array}{l} \Upsilon_{(k-K_{\text{Shift}}(i_{BW})),\,\text{BW}}(R_n D_{k,n,20} + p_{n+2} P_k) \\ \cdot \exp(j2\pi(k - K_{\text{Shift}}(i_{\text{BW}}))\Delta_{F,\,\text{Pre-HE}}(t - nT_{SYML} - T_{GI,\,\text{LegacyPreamble}} - T_{CS}^{i_{TX}})) \end{array} \right)$$

(#2289)where

R_n is a phase rotation vector defined as [1, j, 1, 1](#2372)

If the TXVECTOR parameter BEAM_CHANGE is 0, the time domain waveform for the HE-SIG-A field in an HE extended range SU PPDU, shall be as specified in Equation (26-20).(#2290)(#2531)

$$r_{\text{HE-SIG-A}}^{(i_{Seg} i_{TX})}(t) = \frac{1}{\sqrt{N_{STS} \cdot N_{\text{HE-SIG-A}}^{\text{Tone}}}} \sum_{n=0}^{3} w_{T_{SYML}}(t - nT_{SYML}) \quad (26\text{-}20)$$
$$\sum_{i_{BW}=0}^{N_{20\text{MHz}}-1} \sum_{k=-28}^{28} \sum_{m=1}^{N_{STS}} \left(\begin{array}{l} \left[Q_{4(k-K_{\text{Shift}}(i_{BW}))}^{(i_{Seg})} \right]_{i_{TX},\,m} \left[A_{\text{HE-LTF}}^{4(k-K_{\text{Shift}}(i_{BW}))} \right]_{m,\,1} (R_n D_{k,n,20} + p_{n+2} P_k) \\ \cdot \exp(j2\pi(k - K_{\text{Shift}}(i_{\text{BW}}))\Delta_{F,\,\text{Pre-HE}}(t - nT_{SYML} - T_{\text{GI, LegacyPreamble}} - T_{CS,\,HE}(m))) \end{array} \right)$$

26.3.10.8 HE-SIG-B

26.3.10.8.1 Encoding and modulation

The HE-SIG-B field is separately encoded on each 20 MHz band. The encoding structure in one such 20 MHz band is shown in Figure 26-20 (HE-SIG-B field encoding structure in each 20 MHz). It consists of a

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Common Block field followed by a User Specific field which together are referred to as the HE-SIG-B content channel(#2020).

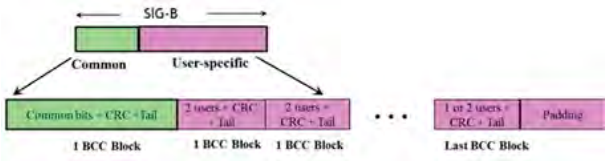

Figure 26-20—HE-SIG-B field encoding structure in each 20 MHz

The Common Block field of a HE-SIG-B content channel(#2020) contains information regarding the resource unit allocation such as the RU arrangement in frequency domain, the RUs allocated for MU-MIMO and the number of users in MU-MIMO allocations. The Common Block field is described in detail in 26.3.10.8.4 (HE-SIG-B common content).

The User Specific field of a HE-SIG-B content channel(#2020) consists of one or more(#2022) User Block fields. Each User Block field is made up of two user fields that contain(#2020) information for two STAs to decode their payloads. The last User Block field may contain information for one or two STAs depending on whether the number of users indicated by the RU allocation signaling is odd and depending on the signaling of the center 26-tone RU(#302). See 26.3.10.8.5 (HE-SIG-B per-user content) for a description of the contents of the User Block field.

When the SIGB Compression field in the HE-SIG-A field of an HE MU PPDU is set to 1 (indicating full bandwidth MU-MIMO transmission), the Common Block field is not present and the content channel consists of only the User Specific field.(#2543)

26.3.10.8.2 Frequency domain mapping

The 20 MHz PPDU contains one content channel in which the Common Block field and User Specific field are carried as shown in Figure 26-21 (HE-SIG-B content channel for a 20 MHz PPDU). The Common Block field contains the RU allocation signaling for RUs that occur within the 242-tone RU boundary.

Figure 26-21—HE-SIG-B content channel for a 20 MHz PPDU

The 40 MHz PPDU contains two content channels, each occupying a 20 MHz segment. Each content channel contains a Common Block field followed by User Specific field as shown in Figure 26-22 (HE-SIG-B content channel for a 40 MHz PPDU). The content channels are ordered in increasing order of the absolute frequency i.e., the first content channel carries Common Block field and User Specific field corresponding to RUs whose subcarrier indices fall between [–244: –3] and the second content channel carries Common Block field and User Specific field corresponding to RUs whose subcarrier indices fall

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between [3:244].(#2544) If a 484-tone RU is signaled, both content channels will carry Common Block field and User Specific field corresponding to the 484-subcarrier RU.

Figure 26-22—HE-SIG-B content channel for a 40 MHz PPDU

The 80 MHz PPDU contains two content channels each of which are duplicated once as shown in Figure 26-23 (Default mapping of the two HE-SIG-B channels and their duplication in an 80 MHz PPDU). The arrangement of the content channels are in increasing order of the absolute frequency where HE-SIG-B content channel 1 occupies the tones in the 20 MHz segment with the lowest subcarrier indices followed by the HE-SIG-B content channel 2 in the adjacent 20 MHz segment. This structure of the first content channel occupying the lower subcarrier index followed by the second content channel is repeated with content duplication in the remaining two 20 MHz segments, respectively. The first content channel appearing in the 20 MHz segments carries a Common Block field and User Specific field corresponding to RUs whose subcarriers indices overlap those segments.(#2544) The Common Block field of content channel 1 contains the following: an RU allocation signaling field for RUs with subcarrier indices in the range [−500:−259], followed by a second RU allocation signaling field for RUs with subcarrier indices between [17:258] and 1 bit to indicate the presence of the user field corresponding to the center 26-tone RU that spans subcarriers [−16:−4, 4:16].(#1692) The second content channel carries a Common Block field and User Specific field corresponding to RUs whose subcarrier indices fall in those segments. The Common Block field of content channel 2 contains the following: an RU allocation signaling field for RUs whose subcarrier indices fall in the range [−258:−17], followed by a second RU allocation signaling field for RUs with subcarrier indices between [259:500] and 1 bit to indicate presence of the user field corresponding to the center 26-tone RU that spans subcarriers [−16:−4, 4:16]. The same value for the bit signaling presence of the center 26-tone RU is carried in both content channels.(#1692) The user fields in the User Specific field that follow the common field are arranged in the same order as the RU allocation signaling. When assigned, the user field corresponding to the center 26-tone RU that spans subcarriers [−16:−4, 4:16] is carried as the last user field in the HE-SIG-B content channel 1.(#1692)(#2023) When RUs greater than 242 subcarriers are signaled in the RU allocation signaling in a portion of the bandwidth, the signaling is carried in both content channels placed in the order of the absolute subcarrier index.

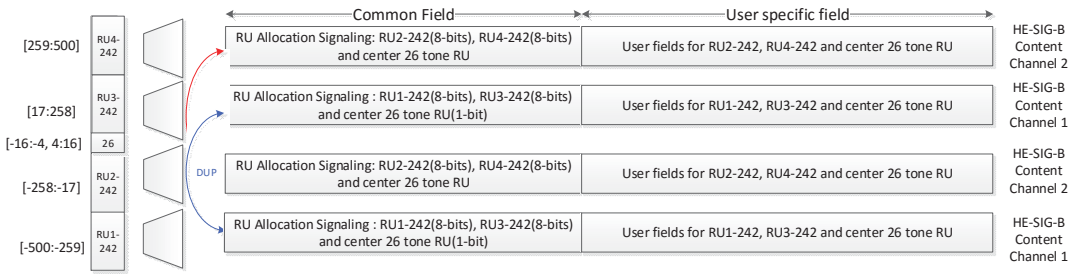

Figure 26-23—Default mapping of the two HE-SIG-B channels and their duplication in an 80 MHz PPDU

The 160 MHz PPDU contains two content channels each of which are duplicated four times as shown in Figure 26-24 (Default mapping of the two HE-SIG-B channels and their duplication in a 160 MHz PPDU). The arrangement of the content channels are in increasing order of the absolute frequency.(#2023) The first content channel occupies the tones in the 20 MHz segment with the lowest subcarrier indices and the second

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content channel in the adjacent 20 MHz segment. This pattern of arranging HE-SIG-B content channel 1 and HE-SIG-B content channel 2 is duplicated over the other segments. The HE-SIG-B content channel 1 and HE-SIG-B content channel 2 carries RU allocation signaling at 242-tone RU granularity that overlap with the 20 MHz segments in which the content channels are carried (including duplication). The signaling for the presence of the user field corresponding to a center 26-tone RU in the 80 MHz segment with the lower sub-carrier index is carried in HE-SIG-B content channel 1 as a 1-bit sub-field placed at the end of the Common field. Similarly, signaling for the center 26-tone RU in the 80 MHz segment with the higher subcarrier index is carried in HE-SIG-B content channel 2 as 1-bit sub-field placed at the end of the common field. When assigned, the user field corresponding to the center 26-tone RU in the 80 MHz segments is carried as the last user field in their respective content channels.(#1692) When RUs greater than 242 subcarriers are signaled in the RU allocation signaling in a portion of the bandwidth, the signaling is carried in both content channels placed in the order of the absolute sub-carrier index.

Figure 26-24—Default mapping of the two HE-SIG-B channels and their duplication in a 160 MHz PPDU

For an MU-MIMO allocation of RU size greater than 242 subcarriers(#2546), the User Block subfields are dynamically split between the two HE-SIG-B content channels (1/2) and the split is decided by the AP (on a per case basis). See 26.3.10.8.4 (HE-SIG-B common content) and 26.3.10.8.5 (HE-SIG-B per-user content)(#1006) for more details.

(PHY Motion #161)When preamble puncturing is present as indicated by values 4 to 7 in the Bandwidth field of HE-SIG-A field of an HE MU PPDU (see Table 26-17 (HE-SIG-A field of an HE MU PPDU(#Ed))), the frequency domain structure of HE-SIG-B is the same as defined for the full bandwidth, i.e. the HE-SIG-B field frequency domain structure is solely dependent on the total bandwidth.

26.3.10.8.3 Time domain encoding

In each 20 MHz band, the bits in the Common Block field shall have CRC and tail bits added and then be BCC encoded at rate R = ½. The CRC bits are computed as described in 26.3.10.7.3 (CRC computation).(#2025) Padding bits are not added after the common block.

In the User Specific field, in any 20 MHz band, the bits corresponding to two STAs (i.e. two User fields) are encoded together. Specifically, the STAs scheduled in the HE MU PPDU(#Ed) are split into groups of two. Each group of two User fields shall have CRC and tail bits added and then BCC encoded at rate R = ½ using

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the encoder described in 17.3.5.6 (Convolutional encoder)(#307). If the number of users in the content channel is odd, the User Block field corresponding to the last user, who is not grouped, is encoded after adding tail and CRC bits. After encoding, padding bits are added to each content channel to round up the number of symbols the content channel occupies to the nearest integer value. Further padding is added to each content channel until the number of OFDM symbols in the content channel equals the Number of HE-SIG-B symbols signaled by a 4-bit field in the HE-SIG-A field for an HE MU PPDU. Thus, padding ensures that the content channels in different 20 MHz bands end at the same OFDM symbol.(#306)(#2027)For both the Common Block and User Specific fields, when the code rate is not equal to ½, the convolutional encoder output bits for each field (including padding bits) are concatenated, then the concatenated bit streams are punctured as described in 17.3.5.6 (Convolutional encoder)(#307)(#2028).

The coded bits are interleaved as in 26.3.11.8 (BCC interleavers). The interleaved bits are mapped to constellation points from the MCS specified in HE-SIG-A and have pilots inserted following the steps described in 17.3.5.8 (Subcarrier modulation mapping) and 17.3.5.9 (Pilot subcarriers)(#307), respectively.(#2183)

The guard interval(#915) used for HE-SIG-B shall be 0.8 μs.(#2030)

The number of OFDM symbols in the HE-SIG-B field, denoted by $N_{SYM,\text{HE-SIG-B}}$, shall be signaled by a 4-bit field in the HE-SIG-A field of a HE MU PPDU(#477) (see (#1304)26.3.10.7.2 (Content)(#2781)).

(#2031)For the c-th content channel (c = 1 or 2), denote the sample on the k-th data(#525) subcarrier of the n-th symbol by $d_{k,n,c}$. The time domain waveform for the HE-SIG-B follows Equation (26-21).

$$r_{\text{HE-SIG-B}}^{(i_{Seg} i_{TX})}(t) = \frac{1}{\sqrt{N_{TX} \cdot N_{\text{HE-SIG-B}}^{\text{Tone}}}} \sum_{n=0}^{N_{SYM,\text{ HE-SIG_B}}} w_{T_{\text{HE-SIG-B}}}(t - nT_{SYML}) \tag{26-21}$$

$$\sum_{i_{BW} \in \Omega_{20\text{MHz}}} \sum_{k=-N_{SR}}^{N_{SR}} \left(\begin{array}{l} \Upsilon_{(k - K_{\text{Shift}}(i_{BW})),\ \text{BW}} \Gamma_{M_{20}^r(k)} (D_{k,\,n,\,i_{BW}}^{i_{Seg}} + p_{n+4} P_k) \\ \cdot \exp(j2\pi(k - K_{\text{Shift}}(i_{\text{BW}})) \Delta_{F,\ \text{Pre-HE}}(t - nT_{SYML} - T_{GI,\ \text{LegacyPreamble}} - T_{CS}^{i_{TX}})) \end{array} \right)$$

(#525)where

$\Gamma_{M_{20}^r(k)}$ is the phase rotation value for HE-SIG-B field PAPR reduction. When the HE-SIG-B field is modulated with MCS=0 and DCM=1, $\Gamma_{M_{20}^r(k)} = 1$. For all other modulation schemes of HE-SIG-B field,

$$\Gamma_{M_{20}^r(k)} = \begin{cases} 1 & 0 \le M_{20}^r(k) < 26 \\ (-1)^{M_{20}^r(k)} & 26 \le M_{20}^r(k) < 52 \end{cases} \quad \text{(\#525)}$$

$N_{20\text{MHz}}$ and $K_{\text{Shift}}(i)$ are defined in 21.3.8.2.4 (L-SIG definition)(#2782)

$$D_{k,\,n,\,i_{BW}}^{i_{Seg}} = \begin{cases} 0, k = 0, \pm 7, \pm 21 \\ d_{M_{20}^r(k),\,n,\,(i_{BW} mod\ 2)+1}, \text{otherwise} \end{cases}$$

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$$M_{20}^{r}(k) = \begin{cases} k+28, -28 \le k \le -22 \\ k+27, -20 \le k \le -8 \\ k+26, -6 \le k \le -1 \\ k+25, 1 \le k \le 6 \\ k+24, 8 \le k \le 20 \\ k+23, 22 \le k \le 28 \end{cases}$$

P_k and p_n are defined in 17.3.5.10 (OFDM modulation)(#307)

$N_{SYM, \text{HE-SIG-B}}$ his the number of OFDM symbols in the HE-SIG-B field

26.3.10.8.4 HE-SIG-B common content

The Common Block field in the HE-SIG-B field carries the RU allocation subfields. Depending on the PPDU bandwidth, the Common Block field can contain multiple RU Allocation subfields. The format of the Common Block field is defined in Table 26-20 (Common Block field(#2024)).

Table 26-20—Common Block field(#2024)

Subfield	Number of bits	Description
RU Allocation	*N* x 8	Indicates the RU arrangement in the frequency domain. It also indicates the number of user fields in each RU. For RUs of size greater than or equal to 106-tones that support MU-MIMO, it indicates the number of users multiplexed using MU-MIMO. *N* = 1 for a 20 MHz and a 40 MHz HE MU PPDU *N* = 2 for an 80 MHz HE MU PPDU *N* = 4 for a 160 MHz or 80+80 MHz HE MU PPDU
Center 26-tone RU	1	This field is present only for full bandwidth 80 MHz, 160 MHz and 80+80 MHz. For full bandwidth 80 MHz: Set to 1 to indicate that the center 26-tone RU is allocated in the Common Block fields of both HE-SIG-B content channels with the same value. Set to 0, otherwise. For full bandwidth 160 MHz or 80+80 MHz: Set to 1 to indicate that the center 26-tone RU is allocated for one individual 80 MHz in the Common Block fields of both HE-SIG-B content channels. Set to 0, otherwise.
CRC	4	See 26.3.10.7.3 (CRC computation)
Tail	6	Used to terminate the trellis of the convolutional decoder. Set to 0
NOTE—Integer fields are transmitted in unsigned binary format, LSB first, where the LSB is in the lowest numbered bit position.(#1010)		

An RU Allocation subfield in the Common Block field of HE-SIG-B consists of 8 bits that indicates the following for a 20 MHz PPDU BW:

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— The RU arrangement in the frequency domain: indexes the size of the RUs and their placement in the frequency domain.

— Number of user fields in each RU in the HE-SIG-B content channel: the number of users multiplexed in the RUs indicated by the arrangement; for RUs of size greater than or equal to 106 tones that support MU-MIMO, it indicates the number of users multiplexed using MU-MIMO.

The mapping of the 8-bit RU Allocation subfield to the RU arrangement and the number of user fields per RU is defined in the Table 26-21 (RU allocation signaling: arrangement and number of MU-MIMO allocations(#2032)). In the table, the number of entries column refers to the number of 8-bit indices that refer to the same RU arrangement in the frequency domain but differ in the number of users fields per RU. The RU arrangement and the number of user fields per RU together indicate the number of user-fields in the User specific field of HE-SIG-B. Signaling for the center 26-tone RU in BW ≥ 80 MHz follows the RU Allocation subfields. For full BW 80 MHz, 1 bit is added to indicate if center 26-tone RU is allocated in the Common Block fields of both HE-SIG-B content channels with same value. For full BW 160 MHz, 1 bit is added to indicate if center 26-tone RU is allocated for one individual 80 MHz in common block fields of both HE-SIG-B content channels(#1001).

Table 26-21—RU allocation signaling: arrangement and number of MU-MIMO allocations(#2032)

8 bits indices (B7 B6 B5 B4 B3 B2 B1 B0)	#1	#2	#3	#4	#5	#6	#7	#8	#9	Number of entries
00000000	26	26	26	26	26	26	26	26	26	1
00000001	26	26	26	26	26	26	26	52		1
00000010	26	26	26	26	26	52		26	26	1
00000011	26	26	26	26	26	52		52		1
00000100	26	26	52		26	26	26	26	26	1
00000101	26	26	52		26	26	26	52		1
00000110	26	26	52		26	52		26	26	1
00000111	26	26	52		26(#1060)	52		52		1
00001000	52		26	26	26	26	26	26	26	1
00001001	52		26	26	26	26	26	52		1
00001010	52		26	26	26	52		26	26	1
00001011	52		26	26	26	52		52		1
00001100	52		52		26	26	26	26	26	1
00001101	52		52		26	26	26	52		1
00001110	52		52		26	52		26	26	1

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Table 26-21—RU allocation signaling: arrangement and number of MU-MIMO allocations(#2032) *(continued)*

00001111	52		52		26(#1060)	52		52				1
00010$y_2y_1y_0$	52		52		-	106						8
00011$y_2y_1y_0$	106				-	52		52				8
00100$y_2y_1y_0$	26	26	26	26	26	106						8
00101$y_2y_1y_0$	26	26	52		26(#1060)	106						8
00110$y_2y_1y_0$	52		26	26	26	106						8
00111$y_2y_1y_0$	52		52		26	106						8
01000$y_2y_1y_0$	106				26	26	26	26	26			8
01001$y_2y_1y_0$	106				26	26	26	52				8
01010$y_2y_1y_0$	106				26	52		26	26			8
01011$y_2y_1y_0$	106				26	52		52				8
0110$y_1y_0z_1z_0$	106				-	106						16
01110000	52		52		-	52		52				1
01110001	242-tone RU empty											1
01110010	484-tone RU with zero HE-SIG-B User Specific field in the corresponding HE-SIG-B Content Channel											1
01110011	996-tone RU with zero HE-SIG-B User Specific field in the corresponding HE-SIG-B Content Channel											1
011101x_1x_0	Reserved(#2035)											4
011111x_1x_0	Reserved(#2035)											8
10$y_2y_1y_0z_2z_1z_0$	106				26	106						64
11000$y_2y_1y_0$	242											8
11001$y_2y_1y_0$	484											8
11010$y_2y_1y_0$	996											8

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Table 26-21—RU allocation signaling: arrangement and number of MU-MIMO allocations(#2032) *(continued)*

$11011y_2y_1y_0$	2×996	8
$111x_4x_3x_2x_1x_0$	Reserved(#2035)	32

$y_2y_1y_0$ = 000-111 indicates number of STAs multiplexed in the only 106-tone RU or the left 106-tone RU if there are two 106-tone RUs(#2035). The binary vector $y_2y_1y_0$ is indexed as [y[3]y[2]y[1]] indicates $2^2 \times y[3] + 2^1 \times y[2] + y[1] + 1$ STAs multiplexed in the RU.

$z_2z_1z_0$ = 000-111 indicates number of STAs multiplexed in the right 106-tone RU if there are two 106-tone RUs(#2035). The binary vector $z_2z_1z_0$ is indexed as [z[3]z[2]z[1]] indicates $2^2 \times z[3] + 2^1 \times z[2] + z[1] + 1$ STAs multiplexed in the RU.

Similarly, y_1y_0 = 00-11 indicates number of STAs multiplexed in the left 106-tone RU#2035). The binary vector y_1y_0 is indexed as [y[2]y[1]] indicates $2^1 \times y[2] + y[1] + 1$ STAs multiplexed in the RU.

Similarly, z_1z_0 = 00-11 indicates the number of STAs multiplexed in the right 106-tone RU(#2035). The binary vector z_1z_0 is indexed as [z[2]z[1]] indicates $2^1 \times z[2] + z[1] + 1$ STAs multiplexed in the RU.

#1 to #9 (from left to the right) is ordered in increasing order of the absolute frequency.(#2035)

x_1x_0 = 00-11, $x_4x_3x_2x_1x_0$ = 00000-11111.(#2035)

'-' means no STA in that RU.

The number of RU Allocation subfields in the Common Block field depends on the PPDU bandwidth

— In the default mode, for a 20 MHz and a 40 MHz PPDU, each HE-SIG-B content channel contains one RU Allocation subfield followed by multiple user fields. The position of the user-field in the user-specific field together with the 8-bit RU Allocation subfield indicates the RU assignment to the user.

— In the default mode for an 80 MHz PPDU, each HE-SIG-B content channel contains two RU Allocation subfields for a total of 16 bits of RU allocation signaling, one each for the RUs in the two 20 MHz segments of the HE-SIG-B content channel. The user fields corresponding to the first RU allocation signaling field are followed by the user fields indicated by the second RU allocation signaling field in the user specific field.

— In the default mode for a 160 MHz PPDU, each HE-SIG-B content channel contains four RU Allocation subfields for a total of 32 bits of RU allocation signaling, one each for the RUs in the four 20 MHz segments of the HE-SIG-B content channel. The user fields for each of the 20 MHz segments in the content channel are arranged by the order in which their RU allocation signaling fields appear in the common field.(#2784)

26.3.10.8.5 HE-SIG-B per-user content

The user-specific field consists of multiple user fields. The user fields follow the common block field of HE-SIG-B. The RU allocation subfield in the Common block field and the position of the user field in the HE-SIG-B user specific field together identify the RU used to transmit a STA's data. Multiple RU allocations addressed to a single STA shall not be allowed in 802.11ax. Therefore, the signaling that enables STAs to decode its data is carried in only one user field.(#1010) An example for the mapping of the 8-bit RU allocation subfield and the position of the user field to an STA's data is illustrated in Figure 26-25 (Illustration for the mapping of the 8-bit RU allocation subfield and the position of the user-field to the STA's assignment(PHY Motion #172)). The RU arrangement signaling indicates an arrangement of 106-tone RU followed by five 26-tone RUs and that the 106-tone RU contains three user-fields, i.e., the

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106-tone RU supports multiplexing of three users using MU-MIMO. The eight user fields in the HE-SIG-B user-specific field thus map to the 6 RUs, with the first three user fields indicating MU-MIMO allocations in the first 106-tone RU followed by user fields corresponding to the each of the five 26-tone RUs.

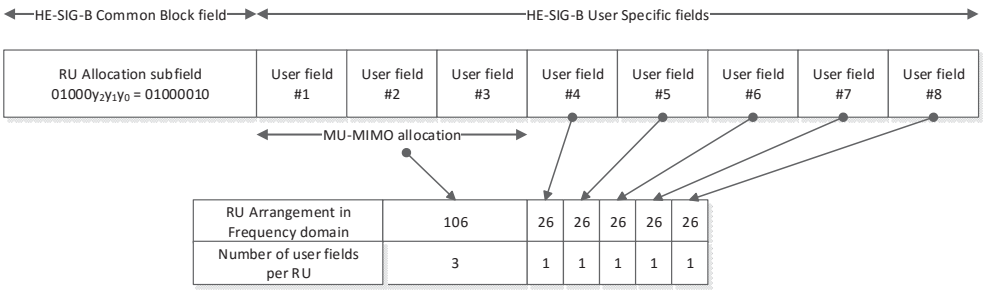

Figure 26-25—Illustration for the mapping of the 8-bit RU allocation subfield and the position of the user-field to the STA's assignment(PHY Motion #172)

The contents of the user field differ based on whether the field addresses a single-STA in an RU or a STA in an(#2817) MU-MIMO allocation in an RU. Irrespective of whether the allocation is for a STA in an(#196) SU or an MU-MIMO allocation, the size of the user field is the same.

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The HE-SIG-B user field for an(#916) SU allocation contain the subfields shown in Table 26-22 (Fields of the HE-SIG-B user field for an(#916) non-MU-MIMO(#1101) allocation(#2037)).

Table 26-22—Fields of the HE-SIG-B user field for an(#916) non-MU-MIMO(#1101) allocation(#2037)

Bit	Field	Number of bits	Description
B0-B10	STA-ID	11	The STA-ID refers to the AID described in 9.4.1.8 (AID field). The 11 LSBs of the AID field are used to address the STAs in this field.(#1002) For RUs that carry a broadcast allocation: — For single BSS AP, the STAID for broadcast will be 0 — For Multiple BSS AP, the STAID for broadcast to a specific BSS will follow the group addressed AID assignment in the TIM according to the existing Multi-BSSID TIM operation — For multiple BSS AP, the STAID for broadcast to all BSS of the AP is set to 2047(#2681) — STAID value 2046 is used to indicate that the RU carries no data — When a STA transmits on the uplink using the HE MU PPDU format, the STA-ID field is populated by the AID of the transmitter assigned by the AP
B11-B13	NSTS	3	Number of spatial streams. Set to the number of space time streams minus 1.(#Ed)
B14	Tx Beam-forming	1	Use of transmit beamforming. Set to 1 if a beamforming steering matrix is applied to the waveform in an SU transmission. Set to 0 otherwise.
B15-B18	MCS	4	Modulation and coding scheme Set to *n* for MCS*n*, where *n* = 0, 1 ,2 …., 11 Values 12 to 15 are reserved

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Table 26-22—Fields of the HE-SIG-B user field for an(#916) non-MU-MIMO(#1101) allocation(#2037) *(continued)*

B19	DCM	1	Indicates whether or not dual carrier modulation is used. Set to 1 to indicate that the payload of the HE MU PPDU is modulated with dual carrier modulation for the MCS. Set to 0 indicates that the payload of the PPDU is not modulated with dual carrier modulation for the MCS.
B20	Coding	1	Indicates whether BCC or LDPC is used. Set to 0 for BCC Set to 1 for LDPC
NOTE—Integer fields are transmitted in unsigned binary format, LSB first, where the LSB is in the lowest numbered bit position.(#1010)			

The HE-SIG-B user field for an STA in MU-MIMO allocation contain the subfields shown in Table 26-23 (Fields of the HE-SIG-B user field for an(#2817) MU-MIMO allocation(#2037)).

Table 26-23—Fields of the HE-SIG-B user field for an(#2817) MU-MIMO allocation(#2037)

Bit	Field	Number of bits	Description
B0-B10	STA-ID	11	The STA-ID refers to the AID described in 9.4.1.8 (AID field). The 11 LSBs of the AID field are used to address STAs in this field.(#1003)
B11-B14	Spatial Configuration	4	Indication for the number of spatial streams for a STA in an(#2817) MU-MIMO allocation. See Table 26-24 (Spatial Configuration subfield encoding).
B15-B18	MCS	4	Modulation and coding scheme. Set to n for MCS*n*, where $n = 0, 1, 2, \ldots..11$ Values 12 to 15 are reserved
B19	DCM	1	Indicates whether or not dual carrier modulation is used. Set to 1 to indicate that the payload of the HE MU PPDU is modulated with dual carrier modulation for the MCS. Set to 0 indicates that the payload of the PPDU is not modulated with dual carrier modulation for the MCS.
B20	Coding	1	Indicates whether BCC or LDPC is used. Set to 0 for BCC Set to 1 for LDPC
NOTE—Integer fields are transmitted in unsigned binary format, LSB first, where the LSB is in the lowest numbered bit position.(#1010)			

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A user field for an MU-MIMO allocation includes a Spatial Configuration subfield consisting of 4 bits that indicates the number of spatial streams for each STA and the total number of spatial streams in the MU-MIMO allocation. The subfield shown in Table 26-24 (Spatial Configuration subfield encoding) is constructed by using the entries corresponding to the value of number of users (N_{user}) multiplexed using MU-MIMO in an RU. When MU-MIMO is used in an RU of size less than or equal to 242 subcarriers(#310), the number of users (N_{user}) in an MU-MIMO allocation is equal to the number of user fields per RU signaled for the RU in the RU allocation subfield of an HE-SIG-B Common block field. When MU-MIMO is used in RUs of size greater than 242 subcarriers(#310), the number of users (N_{user}) in an MU-MIMO allocation is computed as the sum of the number of user-fields per RU indicated for the RU by the 8-bit RU allocation subfield in each HE-SIG-B content channel. For a given value of N_{user}(#2786), the four bits of the spatial configuration subfield are used as follows: A STA with a STA-ID that matches the 11-bit ID signaled in the user field for an MU-MIMO allocation derives the number of spatial streams allocated to it using the row corresponding to the signaled 4-bit spatial configuration subfield and the column corresponding to the position of the user field in the user-specific field. The starting stream index for the STA is computed by summing the Nsts in the columns prior to the column indicated by the STA's user-field position. In the case of load balancing for RUs of size greater than 242 subcarriers(#310) where user fields corresponding to the same MU-MIMO allocations are split into two HE-SIG-B content channels, the user-field positions are logically continuous with the first user field corresponding to the same RU(#310) in the second HE-SIG-B content channel updating its position (and therefore, column index) from that of the last user field in the first HE-SIG-B content channel.

Table 26-24—Spatial Configuration subfield encoding

N_{user}	B3...B0(#2035)	Nsts [1]	Nsts [2]	Nsts [3]	Nsts [4]	Nsts [5]	Nsts [6]	Nsts [7]	Nsts [8]	Total Nsts	Number of entries
2	0000-0011	1-4	1							2-5	10
	0100-0110	2-4	2							4-6	
	0111-1000	3-4	3							6-7	
	1001	4	4							8	
3	0000-0011	1-4	1	1						3-6	13
	0100-0110	2-4	2	1						5-7	
	0111-1000	3-4	3	1						7-8	
	1001-1011	2-4	2	2						6-8	
	1100	3	3	2						8	
4	0000-0011	1-4	1	1	1					4-7	11
	0100-0110	2-4	2	1	1					6-8	
	0111	3	3	1	1					8	
	1000-1001	2-3	2	2	1					7-8	
	1010	2	2	2	2					8	

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Table 26-24—Spatial Configuration subfield encoding *(continued)*

5	0000-0011	1-4	1	1	1	1				5-8	6
	0100-0101	2-3	2	1	1	1				7-8	
6	0000-0010	1-3	1	1	1	1	1			6-8	4
	0011	2	2	1	1	1	1			8	
7	0000-0001	1-2	1	1	1	1	1	1		7-8	2
8	0000	1	1	1	1	1	1	1	1	8	1

When the SIGB Compression field in the HE-SIG-A field of an HE MU PPDU is set to 1 (indicating full bandwidth MU-MIMO transmission), the number of STAs in the MU-MIMO group is indicated in the 'SIGB Number of Symbols/Number of MU-MIMO users field' in the HE-SIG-A field. For bandwidths larger than 20 MHz, the User block fields are split equitably between two HE-SIG-B content channels, i.e., for a k user MU-MIMO PPDU, $1, \ldots, \lceil k/2 \rceil$ User block fields are carried in HE-SIG-B content channel 1 and $\lceil k/2 \rceil + 1, \ldots, k$ User block fields in HE-SIG-B content channel 2.(#2543)

The total number of spatial streams (total N_{STS}) is computed by summing all columns for the row signaled by the spatial configuration subfield and is indicated in Table 26-24 (Spatial Configuration subfield encoding) under the column Total Nsts(#311).

26.3.10.9 HE-STF

The main purpose of the HE-STF field is to improve automatic gain control estimation in a MIMO transmission. The duration of the HE-STF field for HE PPDUs except HE trigger-based PPDUs is $T_{\text{HE-STF-NT}}$(#312) (periodicity of 0.8 μs with 5 periods) and the duration of the HE-STF field for an HE trigger-based PPDU is $T_{\text{HE-STF-T}}$(#312) (periodicity of 1.6 μs with 5 periods). The tone indices for HE-STF field for HE PPDUs except HE trigger-based PPDUs is defined in Equation (26-22).

$$i_{STF} \bmod 16 = 0, \lfloor N_{DC}/2 \rfloor < |i_{STF}| \le N_{SR}$$
$$i_{STF} : \text{HE-STF tone index} \qquad (26\text{-}22)$$

The tone indices for HE-STF fields for an HE trigger-based PPDU are defined in Equation (26-23).

$$i_{STF} \bmod 8 = 0, \lfloor N_{DC}/2 \rfloor < |i_{STF}| \le N_{SR}$$
$$i_{STF} : \text{HE-STF tone index} \qquad (26\text{-}23)$$

For the HE-STF field, the M sequence is defined by Equation (26-24).

$$M = \{-1, -1, -1, 1, 1, 1, -1, 1, 1, 1, -1, 1, 1, -1, 1\} \qquad (26\text{-}24)$$

The HE-STF field is constructed from the M sequence(s) multiplied by $(1+j)/\sqrt{2}$ or $(-1-j)/\sqrt{2}$ and extra coefficients selected out of $(1+j)/\sqrt{2}$ or $(-1-j)/\sqrt{2}$ at tone indices which are null but shall have the HE-STF coefficients after mapping M sequences to each 20 MHz subchannel.(#313)

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For a 20 MHz transmission, the frequency domain sequence for HE PPDUs except HE trigger-based PPDUs is given by Equation (26-25).

$$HES_{-112:16:112} = \{M\} \cdot (1+j)/\sqrt{2}$$
$$HES_{0} = 0 \quad (26\text{-}25)$$

where $HES_{a:b:c}$ means coefficients of the HE-STF on every b tone indices from a to c tone indices and coefficients on other tone indices are set to zero.

For a 40 MHz transmission, the frequency domain sequence for HE PPDUs except HE trigger-based PPDUs is given by Equation (26-26).

$$HES_{-240:16:240} = \{M, 0, -M\} \cdot (1+j)/\sqrt{2} \quad (26\text{-}26)$$

For an 80 MHz transmission, the frequency domain sequence for HE PPDUs except HE trigger-based PPDUs is given by Equation (26-27).

$$HES_{-496:16:496} = \{M, 1, -M, 0, -M, 1, -M\} \cdot (1+j)/\sqrt{2} \quad (26\text{-}27)$$

For a 160 MHz transmission, the frequency domain sequence for HE PPDUs except HE trigger-based PPDUs is given by Equation (26-28).(#529)

$$HES_{-1008:16:1008} = \{M, 1, -M, 0, -M, 1, -M, 0, -M, -1, M, 0, -M, 1, -M\} \cdot (1+j)/\sqrt{2} \quad (26\text{-}28)$$

For an 80+80 MHz transmission, the primary 80 MHz segment for HE PPDUs except HE trigger-based PPDUs shall use the HE-STF pattern for the 80 MHz defined in Equation (26-27).

For an 80+80 MHz transmission, the frequency domain sequence of the secondary 80 MHz segment for HE PPDUs except HE trigger-based PPDUs is given by Equation (26-29).(#529)

$$HES_{-496:16:496} = \{-M, -1, M, 0, -M, 1, -M\} \cdot (1+j)/\sqrt{2} \quad (26\text{-}29)$$

For a 20 MHz transmission, the frequency domain sequence for HE trigger-based PPDUs is given by Equation (26-30).

$$HES_{-120:8:120} = \{M, 0, -M\} \cdot (1+j)/\sqrt{2} \quad (26\text{-}30)$$

For a 40 MHz transmission, the frequency domain sequence for HE trigger-based PPDUs is given by Equation (26-31).

$$HES_{-248:8:248} = \{M, -1, -M, 0, M, -1, M\} \cdot (1+j)/\sqrt{2}$$
$$HES_{\pm 248} = 0 \quad (26\text{-}31)$$

For an 80 MHz transmission, the frequency domain sequence for HE trigger-based PPDUs is given by Equation (26-32).

$$HES_{-504:8:504} = \{M, -1, M, -1, -M, -1, M, 0, -M, 1, M, 1, -M, 1, -M\} \cdot (1+j)/\sqrt{2}$$
$$HES_{\pm 504} = 0 \quad (26\text{-}32)$$

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For a 160 MHz transmission, the frequency domain sequence for HE trigger-based PPDUs is given by Equation (26-33).(#530)

$$HES_{-1016:8:1016} = \{M, -1, M, -1, -M, -1, M, 0, -M, 1, M, 1, -M, 1, -M, 0$$
$$-M, 1, -M, 1, M, 1, -M, 0, -M, 1, M, 1, -M, 1, -M\} \cdot (1+j)/\sqrt{2} \quad (26\text{-}33)$$
$$HES_{\pm 8} = 0, HES_{\pm 1016} = 0$$

For an 80+80 MHz transmission, the primary 80 MHz segment for HE trigger-based PPDUs shall use the HE-STF pattern for the 80 MHz defined in Equation (26-32).(#530)

For an 80+80 MHz transmission, the frequency domain sequence of the secondary 80 MHz segment for HE trigger-based PPDUs is given by Equation (26-34).(#530)

$$HES_{-504:8:504} = \{-M, 1, -M, 1, M, 1, -M, 0, -M, 1, M, 1, -M, 1, -M\} \cdot (1+j)/\sqrt{2}$$
$$HES_{\pm 504} = 0 \quad (26\text{-}34)$$

For an OFDMA transmission, the coefficients in Equation (26-25) to Equation (26-32) are set to zero if those values are corresponding to tone indices for which no RUs are defined (see 26.3.9 (Mathematical description of signals))(#917).

The time domain representation of the signal for HE PPDUs except HE trigger-based PPDUs on frequency segment i_{Seg} of transmit chain i_{TX} shall be as specified in Equation (26-35).

$$r_{\text{HE-STF}}^{(i_{Seg} i_{TX})}(t) = w_{T_{\text{HE-STF-NT}}}(t) \cdot \sum_{r=0}^{N_{RU}-1} \frac{\alpha_r \beta_r}{\sqrt{N_{STS,r,total}}} \quad (26\text{-}35)$$
$$\sum_{k \in K} \sum_{u=0}^{N_{user,r}-1} \sum_{m=1}^{N_{STS,r,u}} \left(\eta_{\text{HE-STF},k} \left[Q_k^{(i_{Seg})} \right]_{i_{TX}, M_{r,u}+m} HES_k \cdot \exp(j2\pi k \Delta_{F,\text{HE}} (t - T_{CS,HE}(M_{r,u}+m))) \right)$$

where

α_r is the power boost factor for the r-th RU. A STA shall support α_r in the range [0.7, $\sqrt{2}$]. A STA may support α_r in the range [0.5, 2].(#1689)

$\eta_{\text{HE-STF},k}$ is an HE PPDU format dependent scaling factor, defined by

$$\eta_{\text{HE-STF},k} = \begin{cases} \sqrt{2}, & \text{for an HE extended range SU PPDU} \\ 1, & \text{otherwise} \end{cases} \text{(\#2045)(\#526)}$$

β_r is the per-RU power normalization factor and defined by

$$\beta_r = \left(\sqrt{\frac{|K_r|}{|K_r^{\text{HE-STF}}|}} \right) / \left(\sqrt{\sum_{r=1}^{N_{RU}} \alpha_r^2 |K_r|} \right) \text{(\#315)}$$

$|K_r|$ is the cardinality of the set of subcarriers K_r

$K_r^{\text{HE-STF}}$ is the set of subcarriers that have non-zero values within K_r in the HE-STF field(#2046)

$T_{CS,\text{HE}}(M_{r,u}+m)$ represents the cyclic shift for space time stream $M_{r,u}+m$ as defined in 26.3.10.2.2 (Cyclic shift for HE modulated fields)(#1052)

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$Q_k^{(i_{Seg})}$ is defined in 26.3.9 (Mathematical description of signals)(#1094)

$w_{T_{\text{HE-STF-NT}}}$ is the windowing function for HE-STF field in the non-HE trigger-based PPDU

The time domain representation of the signal for HE trigger-based PPDUs on frequency segment i_{Seg} of transmit chain i_{TX} shall be as specified in Equation (26-36).

$$r_{\text{HE-STF}}^{(i_{Seg} i_{TX})}(t) = \frac{1}{\sqrt{\left|K_r^{\text{HE-STF}}\right| N_{STS,\,r,\,total}}} w_{T_{\text{HE-STF-T}}}(t) \sum_{k \in K} \sum_{m=1}^{N_{STS,\,r,\,u}} \left(\left[Q_k^{(i_{Seg})} \right]_{i_{TX},\,(M_{r,\,u}+m)} HES_k \cdot \exp(j2\pi k \Delta_{F,\,\text{HE}}(t - T_{CS,\,HE}(M_{r,\,u}+m))) \right) \quad \text{(\#316)} \quad \text{(26-36)}$$

where

$w_{T_{\text{HE-STF-T}}}$ is the windowing function for HE-STF field in the HE trigger-based PPDU

26.3.10.10 HE-LTF

The HE-LTF field(#918) provides a means for the receiver to estimate the MIMO channel between the set of constellation mapper outputs (or, if STBC is applied, the STBC encoder outputs) and the receive chains. In an HE SU PPDU, HE extended range SU PPDU and HE MU PPDU, the transmitter provides training for $N_{STS,r,total}$ space-time streams (spatial mapper inputs) used for the transmission of the PSDU(s) in the *r*-th RU. In an HE trigger-based PPDU, the transmitter of user *u* in the *r*-th RU provides training for $N_{STS,r,u}$ space-time streams used for the transmission of the PSDU. For each tone in the *r*-th RU, the MIMO channel that can be estimated is an $N_{RX} \times N_{STS,r,total}$ matrix. A HE transmission has a preamble that contains HE-LTF symbols, where the data tones of each HE-LTF symbol are multiplied by entries belonging to a matrix $P_{\text{HE-LTF}}$, to enable channel estimation at the receiver. The pilot tones of each HE-LTF symbol are multiplied by the entries of a matrix $R_{\text{HE-LTF}}$ defined in the following text. The multiplication of the pilot tones in the HE-LTF symbol by the $R_{\text{HE-LTF}}$ matrix instead of the $P_{\text{HE-LTF}}$ matrix allows receivers to track phase and frequency offset during MIMO channel estimation using the HE-LTF. In an HE SU PPDU, HE extended range SU PPDU and HE MU PPDU with a single RU (the RU having an MU-MIMO allocation or an SU allocation)(PHY Motion #159), the number of HE-LTF symbols, $N_{\text{HE-LTF}}$, is a function of the total number of space-time streams N_{STS} as shown in Table 26-12 (Frequently used parameters(#282))(#2792). In an HE trigger-based PPDU, $N_{\text{HE-LTF}}$(#922) is indicated in the Trigger frame that triggers the transmission of the PPDU. In an HE MU PPDU, $N_{\text{HE-LTF}}$(#922) is indicated in the HE-SIG-A field. In an HE MU PPDU with more than one RU and an HE trigger-based PPDU, $N_{\text{HE-LTF}}$(#922) may take any value among one, two, four, six or eight, which is greater than or equal to the maximum value of the function in Table 26-12 (Frequently used parameters(#282)) when it is calculated for each $N_{STS,r,total}$ separately.(PHY Motion #159)

An HE PPDU supports 3 HE-LTF modes, which are 1x HE-LTF, 2x HE-LTF and 4x HE-LTF. It is optional to support the 1x HE-LTF mode in an HE SU PPDU, HE extended range SU PPDU and HE MU PPDU. It is mandatory to support transmission of 1x HE-LTF in an UL MU-MIMO PPDU over the full bandwidth, for a STA declaring support for UL MU-MIMO. The 1x HE-LTF mode is disallowed in an HE MU PPDU and in an HE trigger-based PPDU with more than one RUs, and is also disallowed in an HE MU PPDU with one RU whenever the RU has an MU-MIMO allocation.(PHY Motion #159) In an HE SU PPDU, HE MU PPDU and HE extended range SU PPDU, the combination of HE-LTF modes and GI duration is indicated in HE-SIG-A field. In an HE trigger-based PPDU, the combination of HE-LTF modes and GI duration is indicated in the Trigger frame that triggers the transmission of the PPDU. The mandatory combinations of HE-LTF modes and GI duration are:

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— 2x HE-LTF, $T_{GI1,Data}$(#2498)

— 2x HE-LTF, $T_{GI2,Data}$(#2496)

— 4x HE-LTF, $T_{GI4,Data}$(#2497)

The optional combinations of HE-LTF mode and GI duration are:

— 1x HE-LTF, $T_{GI1,Data}$(#2499) in an(#2829) HE SU PPDU or HE extended SU PPDU

— 1x HE-LTF, $T_{GI1,Data}$(#2500) in a non-OFDMA, MU-MIMO HE MU PPDU

— 1x HE-LTF, $T_{GI2,Data}$(#2501) in a non-OFDMA, MU-MIMO HE trigger-based PPDU

The duration of each HE-LTF symbol is $T_{\text{HE-LTF}}$(#2875) is defined in Equation (26-37). In an HE SU PPDU, HE MU PPDU or HE extended range SU PPDU, the HE-LTF symbol duration is indicated in HE-SIG-A field. In an HE trigger-based PPDU, the HE-LTF symbol duration is indicated in the Trigger frame that triggers the transmission of the PPDU.

$$T_{\text{HE-LTF}} = \begin{cases} T_{\text{HE-LTF-1X}}, \text{ if 1x HE-LTF} \\ T_{\text{HE-LTF-2X}}, \text{ if 2x HE-LTF} \\ T_{\text{HE-LTF-4X}}, \text{ if 4x HE-LTF} \end{cases} \quad (26\text{-}37)$$

where $T_{\text{HE-LTF-1X}}$, $T_{\text{HE-LTF-2X}}$, $T_{\text{HE-LTF-4X}}$ are defined in Table 26-9 (Timing-related constants).

In a 20 MHz transmission, the 1x HE-LTF sequence transmitted and located on subcarriers [−122:122](#2553) is given by Equation (26-38).

$$\begin{aligned} HELTF_{-122,122} = \\ &\{0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, \\ &0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, \\ &-1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, \\ &0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, 0, 0, 0, \\ &0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0, \\ &0, 0, −1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, −1, \\ &0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, \\ &−1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0\} \end{aligned} \quad (26\text{-}38)$$

In a 20 MHz transmission, the 2x HE-LTF sequence transmitted and located on subcarriers [−122:122](#2553) is given by Equation (26-39).

$$\begin{aligned} HELTF_{-122,122} = \\ &\{−1, 0, −1, 0, −1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, \\ &0, −1, 0, −1, 0, +1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, +1, \\ &0, −1, 0, −1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, \\ &0, +1, 0, −1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, +1, \\ &0, +1, 0, +1, 0, −1, 0, −1, 0, +1, 0, 0, 0, +1, 0, −1, 0, +1, 0, +1, 0, −1, 0, +1, 0, +1, 0, −1, \\ &0, +1, 0, +1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, +1, \\ &0, +1, 0, −1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, −1, \\ &0, −1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, \\ &0, −1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1\} \end{aligned} \quad (26\text{-}39)$$

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In a 20 MHz transmission, the 4x HE-LTF sequence transmitted and located on subcarriers [−122:122](#2553) is given by Equation (26-40).

$$HELTF_{-122,122} =$$
$$\{-1, -1, +1, -1, +1, -1, +1, +1, +1, -1, +1, +1, +1, -1, -1, +1, -1, -1, -1, -1, -1, +1,$$
$$+1, -1, -1, -1, -1, +1, +1, -1, +1, -1, -1, +1, -1, -1, +1, -1, +1, +1, +1, +1, -1, -1, +1, -1, -1, -1, +1, +1, +1, +1, -1, +1, +1, -1, -1, -1, -1, +1, -1, -1, +1,$$
$$+1, -1, +1, -1, -1, -1, -1, +1, -1, +1, -1, -1, -1, -1, -1, -1, +1, +1, -1, -1, -1, -1, -1,$$
$$+1, -1, -1, +1, +1, +1, -1, +1, +1, +1, -1, +1, -1, +1, -1, -1, -1, -1, -1, +1, +1, +1, -1,$$
$$-1, -1, +1, -1, +1, +1, +1, 0, 0, 0, -1, +1, -1, +1, -1, +1, +1, -1, +1, +1, +1, -1, -1, +1,$$
$$-1, -1, +1, -1, +1, -1, +1, +1, +1, -1, +1, +1, +1, -1, -1, -1, -1, -1, -1, +1, +1,$$
$$-1, -1, -1, -1, -1, -1, +1, -1, +1, -1, -1, -1, -1, +1, -1, +1, +1, -1, -1, +1, -1, -1, -1,$$
$$-1, +1, +1, -1, +1, +1, +1, +1, +1, +1, +1, -1, +1, +1, -1, -1, -1, -1, +1, -1, -1, +1, +1,$$
$$-1, +1, -1, -1, -1, -1, +1, -1, +1, -1, -1, +1, +1, +1, +1, -1, -1, +1, +1, +1, +1, +1, -1,$$
$$+1, +1, -1, -1, -1, +1, -1, -1, -1, +1, -1, +1, -1, +1, +1\}$$
(26-40)

In a 40 MHz transmission, the 1x HE-LTF sequence transmitted and located on subcarriers [−244:244](#2553) is given by Equation (26-41).

$$HELTF_{-244,244} =$$
$$\{+1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0,$$
$$0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0,$$
$$0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1,$$
$$0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0,$$
$$-1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0,$$
$$0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0,$$
$$0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1,$$
$$0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, 0, 0, 0, 0, +1,$$
$$0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0,$$
$$+1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0,$$
$$0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0,$$
$$0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1,$$
$$0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0,$$
$$+1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0,$$
$$0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0,$$
$$0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1\}$$
(26-41)

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In a 40 MHz transmission, the 2x HE-LTF sequence transmitted and located on subcarriers [−244:244](#2553) is given by Equation (26-42).

$HELTF_{-244,244}$ =

{+1, 0, −1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0, +1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, −1,
0, −1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1,
0, −1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0, +1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, −1, 0, +1,
0, +1, 0, +1, 0, +1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1,
0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, +1, 0, +1,
0, +1, 0, +1, 0, +1, 0, −1, 0, −1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, +1,
0, +1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, −1,
0, −1, 0, −1, 0, +1, 0, +1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, +1,
0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, −1, 0, 0, 0, 0, 0, 0, 0, −1, 0, −1, 0, (26-42)
−1, 0, −1, 0, −1, 0, +1, 0, +1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0,
−1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, +1, 0, +1, 0,
+1, 0, +1, 0, −1, 0, −1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0,
−1, 0, +1, 0, −1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, +1, 0, +1, 0, +1, 0,
+1, 0, −1, 0, −1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, −1, 0,
+1, 0, +1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0,
−1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0,
+1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0,
−1, 0, −1, 0, +1, 0, −1, 0, +1, 0, −1, 0, +1}

In a 40 MHz transmission, the 4x HE-LTF sequence transmitted and located on subcarriers [−244:244](#2553) is given by Equation (26-43).

$HELTF_{-244,244}$ =

{+1, −1, −1, −1, −1, +1, −1, −1, +1, +1, −1, +1, −1, +1, −1, +1, +1, −1, +1, −1, −1, −1,
+1, +1, −1, −1, −1, −1, −1, −1, −1, +1, −1, −1, +1, +1, −1, +1, −1, −1, −1, −1, −1, +1, −1,
+1, +1, +1, −1, −1, +1, +1, +1, −1, −1, +1, +1, +1, +1, −1, +1, +1, −1, −1, +1, −1, +1, −1,
+1, −1, −1, +1, −1, +1, +1, +1, −1, −1, +1, +1, +1, −1, −1, −1, −1, +1, −1, −1, +1, +1, −1,
+1, −1, −1, −1, −1, −1, +1, −1, +1, +1, +1, −1, −1, +1, +1, +1, +1, +1, +1, +1, +1, −1, +1,
+1, −1, −1, +1, −1, +1, +1, +1, +1, +1, −1, +1, −1, −1, −1, +1, +1, −1, −1, −1, −1, −1, −1,
−1, −1, +1, −1, −1, +1, +1, −1, +1, −1, +1, −1, +1, +1, −1, +1, −1, −1, −1, +1, +1, −1, −1,
−1, −1, −1, −1, −1, +1, −1, −1, +1, +1, −1, +1, −1, −1, −1, −1, −1, +1, −1, +1, +1, +1, −1,
−1, +1, +1, +1, −1, −1, −1, −1, −1, −1, +1, −1, −1, +1, +1, −1, +1, −1, +1, −1, +1, +1, −1,
+1, −1, −1, −1, +1, +1, −1, −1, −1, +1, +1, +1, +1, −1, +1, +1, −1, −1, +1, −1, +1, +1, +1,
+1, +1, −1, +1, −1, −1, −1, +1, +1, −1, −1, −1, +1, 0, 0, 0, 0, 0, −1, +1, +1, +1, +1, −1, +1, (26-43)
+1, −1, −1, +1, −1, +1, −1, +1, −1, −1, +1, −1, +1, +1, +1, −1, −1, +1, +1, +1, +1, +1, +1,
+1, −1, +1, +1, −1, −1, +1, −1, +1, +1, +1, +1, +1, −1, +1, −1, −1, −1, +1, +1, −1, −1, −1,
+1, +1, −1, −1, −1, −1, +1, −1, −1, +1, +1, −1, +1, −1, +1, −1, +1, +1, −1, +1, −1, −1, −1,
+1, +1, −1, −1, −1, +1, +1, +1, +1, −1, +1, +1, −1, −1, +1, −1, +1, +1, +1, +1, +1, −1, +1,
−1, −1, −1, +1, +1, −1, −1, −1, +1, −1, −1, −1, −1, +1, −1, −1, +1, +1, −1, +1, −1, +1, −1,
+1, +1, −1, +1, −1, −1, −1, +1, +1, −1, −1, −1, +1, −1, −1, −1, −1, +1, −1, −1, +1, +1, −1,
+1, −1, +1, −1, +1, +1, −1, +1, −1, −1, −1, +1, +1, −1, −1, −1, −1, −1, −1, −1, +1, −1, −1,
+1, +1, −1, +1, −1, −1, −1, −1, −1, +1, −1, +1, +1, +1, −1, −1, +1, +1, +1, −1, +1, −1, −1,
−1, −1, +1, −1, −1, +1, +1, −1, +1, −1, +1, −1, +1, +1, −1, +1, −1, −1, −1, +1, +1, −1, −1,
−1, +1, +1, +1, +1, −1, +1, +1, −1, −1, +1, −1, +1, +1, +1, +1, +1, −1, +1, −1, −1, −1, +1,
+1, −1, −1, −1, −1}

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In an 80 MHz transmission, the 1x HE-LTF sequence transmitted and located on subcarriers [−500:500](#2553) is given by Equation (26-44).

$$
\begin{aligned}
HELTF_{-500,500} = \{&-1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0,\\
&0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0,\\
&0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1,\\
&0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0,\\
&-1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0,\\
&0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0,\\
&0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1,\\
&0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0,\\
&-1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0,\\
&0, -1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0, 0, 0, -1, 0, 0, 0, +1, 0,\\
&0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, +1,\\
&0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0,\\
&+1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0,\\
&0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0,\\
&0, 0, −1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1,\\
&0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0,\\
&−1, 0, 0, 0, 0, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0,\\
&+1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0,\\
&0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, −1, 0,\\
&0, 0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1,\\
&0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0,\\
&+1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0,\\
&0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, 0,\\
&0, 0, −1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1,\\
&0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0,\\
&−1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0,\\
&0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, +1, 0,\\
&0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, −1,\\
&0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0,\\
&−1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0,\\
&0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, −1, 0,\\
&0, 0, −1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, −1, 0, 0, 0, −1,\\
&0, 0, 0, +1, 0, 0, 0, +1\}
\end{aligned}
\tag{26-44}
$$

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In an 80 MHz transmission, the 2x HE-LTF sequence transmitted and located on subcarriers [−500:500](#2553) is given by Equation (26-45).

$HELTF_{-500,500}$ =

{+1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, +1, 0, −1, 0, −1, 0, −1,
0, +1, 0, −1, 0, −1, 0, +1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1,
0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, +1, 0, −1, 0, −1,
0, −1, 0, +1, 0, +1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, −1,
0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1,
0, −1, 0, +1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1,
0, +1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0, +1, 0, +1, 0, −1,
0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1,
0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, −1, 0, +1, 0, +1, 0, −1, 0, −1, 0, −1, 0, +1,
0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0, −1, 0, +1,
0, +1, 0, +1, 0, −1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1,
0, −1, 0, +1, 0, +1, 0, +1, 0, +1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, −1, 0, +1, 0, +1, 0, −1,
0, +1, 0, +1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1,
0, +1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0, −1, 0, +1, 0, +1, 0, +1,
0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, +1,
0, −1, 0, +1, 0, +1, 0, −1, 0, +1, 0, +1, 0, −1, 0, +1, 0, +1, 0, −1, 0, −1, 0, +1, 0, −1, 0, −1,
0, −1, 0, +1, 0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1,
0, −1, 0, +1, 0, +1, 0, +1, 0, +1, 0, −1, 0, −1, 0, −1, 0, +1, 0, +1, 0, +1, 0, 0, 0, 0, 0, 0, 0, 0, (26-45)
+1, 0, −1, 0, −1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, +1, 0, +1, 0, +1, 0, +1, 0,
−1, 0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0,
+1, 0, +1, 0, −1, 0, −1, 0, +1, 0, −1, 0, −1, 0, +1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0,
+1, 0, −1, 0, +1, 0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0,
+1, 0, +1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0,
+1, 0, −1, 0, −1, 0, −1, 0, +1, 0, +1, 0, +1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0,
+1, 0, +1, 0, −1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0,
+1, 0, −1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, +1, 0, +1, 0,
−1, 0, −1, 0, −1, 0, +1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0, +1, 0,
+1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, −1, 0,
−1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0, −1, 0, +1, 0,
+1, 0, −1, 0, −1, 0, −1, 0, +1, 0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0,
−1, 0, −1, 0, −1, 0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0, +1, 0, −1, 0, −1, 0, +1, 0, −1, 0,
−1, 0, −1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, −1, 0, +1, 0, +1, 0,
−1, 0, +1, 0, −1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, +1, 0, +1, 0, −1, 0, −1, 0, −1, 0, +1, 0,
−1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0, −1, 0, +1, 0, +1, 0, +1, 0, +1, 0, −1, 0,
−1, 0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0, +1, 0, −1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0,
+1, 0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0, +1}

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In an 80 MHz transmission, the 4x HE-LTF sequence transmitted and located on subcarriers [−500:500](#2553) is given by Equation (26-46).

$$
\begin{aligned}
HELTF_{-500,500} = \\
&\{+1, +1, -1, +1, -1, +1, -1, -1, -1, +1, -1, -1, -1, +1, +1, -1, +1, +1, +1, +1, +1, -1, \\
&-1, +1, +1, +1, +1, -1, +1, -1, +1, -1, -1, +1, +1, -1, +1, +1, +1, -1, -1, +1, -1, -1, -1, \\
&-1, +1, +1, +1, -1, -1, -1, -1, -1, -1, +1, +1, +1, +1, +1, +1, -1, +1, +1, +1, -1, +1, +1, \\
&-1, -1, -1, +1, -1, +1, -1, -1, +1, +1, -1, +1, -1, +1, +1, +1, +1, +1, -1, -1, +1, +1, +1, \\
&-1, +1, +1, -1, -1, -1, +1, -1, +1, +1, -1, +1, +1, -1, +1, -1, -1, +1, +1, +1, +1, -1, -1, \\
&+1, +1, +1, +1, +1, -1, +1, +1, -1, -1, -1, +1, -1, -1, -1, +1, -1, +1, -1, +1, +1, -1, +1, \\
&-1, +1, -1, +1, +1, +1, -1, +1, +1, +1, -1, -1, +1, -1, -1, -1, -1, -1, +1, +1, -1, -1, -1, \\
&-1, +1, -1, +1, -1, +1, +1, -1, -1, +1, -1, -1, -1, +1, +1, -1, +1, +1, +1, +1, -1, -1, -1, \\
&+1, +1, +1, +1, -1, +1, +1, +1, +1, +1, +1, +1, -1, +1, +1, +1, -1, +1, +1, -1, -1, -1, +1, \\
&-1, +1, -1, -1, +1, +1, -1, +1, -1, +1, +1, +1, +1, +1, -1, -1, +1, +1, +1, -1, +1, +1, -1, \\
&-1, -1, +1, -1, +1, +1, -1, +1, +1, -1, +1, -1, -1, +1, -1, +1, -1, +1, -1, +1, +1, +1, -1, \\
&+1, +1, +1, -1, -1, +1, -1, -1, -1, -1, -1, +1, +1, -1, -1, -1, -1, +1, -1, +1, -1, +1, +1, \\
&-1, -1, +1, -1, -1, -1, +1, +1, -1, +1, +1, +1, +1, -1, -1, -1, +1, +1, +1, +1, -1, +1, -1, \\
&-1, -1, -1, -1, -1, +1, -1, -1, -1, +1, -1, -1, +1, +1, +1, -1, +1, -1, +1, +1, -1, -1, +1, \\
&-1, +1, -1, -1, -1, -1, -1, +1, +1, -1, -1, -1, +1, -1, -1, +1, +1, +1, -1, +1, -1, -1, +1, \\
&-1, -1, +1, -1, +1, +1, +1, +1, +1, +1, -1, -1, +1, +1, +1, +1, +1, -1, +1, +1, -1, -1, -1, \\
&+1, -1, -1, -1, +1, -1, +1, -1, +1, +1, -1, +1, -1, +1, -1, +1, +1, +1, -1, +1, +1, +1, -1, \\
&-1, +1, -1, -1, -1, -1, -1, +1, +1, -1, -1, -1, -1, +1, -1, +1, -1, +1, +1, -1, -1, +1, -1, \\
&-1, -1, +1, +1, -1, +1, +1, +1, +1, -1, -1, -1, +1, +1, +1, +1, -1, -1, +1, +1, +1, +1, +1, \\
&+1, -1, +1, +1, +1, -1, +1, +1, -1, -1, -1, +1, -1, +1, -1, -1, +1, +1, -1, +1, -1, +1, +1, \\
&+1, +1, +1, -1, -1, +1, +1, +1, -1, +1, +1, -1, -1, -1, +1, -1, +1, +1, -1, +1, +1, -1, +1, \\
&-1, -1, -1, +1, -1, +1, -1, -1, -1, -1, +1, +1, +1, -1, -1, +1, 0, 0, 0, 0, 0, +1, -1, -1, -1, \\
&-1, -1, -1, +1, -1, +1, +1, -1, -1, +1, +1, -1, +1, -1, +1, +1, -1, -1, +1, -1, +1, -1, -1, \\
&-1, +1, +1, -1, +1, +1, +1, -1, +1, +1, +1, +1, +1, +1, +1, -1, +1, -1, -1, +1, -1, -1, +1, \\
&-1, +1, +1, +1, -1, -1, +1, -1, -1, -1, +1, +1, -1, -1, -1, -1, -1, +1, -1, -1, -1, -1, -1, \\
&+1, +1, -1, -1, -1, -1, -1, +1, -1, -1, +1, +1, +1, -1, +1, +1, +1, -1, +1, -1, +1, -1, -1, \\
&-1, -1, -1, +1, +1, +1, -1, -1, -1, -1, +1, -1, -1, +1, +1, +1, -1, +1, +1, -1, -1, +1, -1, \\
&+1, -1, -1, -1, -1, -1, -1, -1, -1, +1, +1, -1, -1, -1, +1, -1, -1, +1, +1, +1, -1, +1, -1, -1, \\
&+1, -1, -1, +1, -1, +1, +1, +1, -1, +1, -1, -1, +1, +1, -1, +1, -1, +1, +1, +1, -1, -1, +1, \\
&-1, -1, -1, +1, -1, -1, -1, -1, -1, -1, -1, +1, -1, +1, +1, -1, +1, +1, -1, +1, -1, -1, -1, \\
&+1, +1, -1, +1, +1, +1, -1, -1, +1, +1, +1, +1, +1, -1, +1, -1, -1, -1, -1, +1, +1, -1, -1, \\
&-1, -1, -1, +1, -1, -1, +1, +1, +1, -1, +1, +1, +1, -1, +1, -1, +1, -1, -1, -1, -1, -1, +1, \\
&+1, +1, -1, -1, -1, -1, +1, -1, -1, +1, +1, +1, -1, +1, +1, -1, -1, +1, -1, +1, -1, +1, +1, \\
&+1, -1, +1, -1, -1, +1, +1, -1, +1, -1, +1, +1, +1, -1, -1, +1, -1, -1, -1, +1, -1, -1, -1, \\
&-1, -1, -1, -1, +1, -1, +1, +1, -1, +1, +1, -1, +1, -1, -1, -1, +1, +1, -1, +1, +1, +1, -1, \\
&-1, +1, +1, +1, +1, +1, -1, +1, +1, +1, +1, +1, -1, -1, +1, +1, +1, +1, +1, -1, +1, +1, -1, \\
&-1, -1, +1, -1, -1, -1, +1, -1, +1, -1, +1, +1, +1, +1, +1, -1, -1, -1, +1, +1, +1, +1, -1, \\
&+1, +1, -1, -1, -1, +1, -1, -1, +1, +1, -1, +1, -1, +1, -1, -1, -1, -1, -1, -1, +1, +1, -1, \\
&-1, -1, +1, -1, -1, +1, +1, +1, -1, +1, -1, -1, +1, -1, -1, +1, -1, +1, -1, +1, -1, +1, -1, \\
&-1, +1, +1, -1, +1, -1, +1, +1, +1, -1, -1, +1, -1, -1, -1, +1, -1, -1, -1, -1, -1, -1, -1, \\
&+1, -1, +1, +1, -1, +1, +1, -1, +1, -1, -1, -1, +1, +1, -1, +1, +1, +1, -1, -1, +1, +1, +1, \\
&+1, +1, -1, +1, -1, -1, -1, -1, -1, +1, +1, -1, -1, -1, -1, -1, +1, -1, -1, +1, +1, +1, -1, +1, \\
&+1, +1, -1, +1, -1, +1, -1, -1, -1, -1, -1, +1, +1, +1, -1, -1, -1, -1, +1, -1, -1, +1, +1, \\
&+1, -1, +1, +1, -1, -1, +1, -1, +1, -1, +1\}
\end{aligned}
\tag{26-46}
$$

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In a 160 MHz transmission, the 1x HE-LTF sequence is given by Equation (26-47).

$$HELTF_{-1012,1012} = \{LTF_{80MHz_primary_1x},\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ 0,\ LTF_{80MHz_secondary_1x}\} \quad (26\text{-}47)$$

where

$LTF_{80MHz_primary_1x} = \{LTF_{80MHz_left_1x}, 0, LTF_{80MHz_right_1x}\}$ and shall be used in the primary 80 MHz frequency segment

$LTF_{80MHz_secondary_1x} = \{LTF_{80MHz_left_1x}, 0, (-1)*LTF_{80MHz_right_1x}\}$ and shall be used in the secondary 80 MHz frequency segment

$LTF_{80MHz_left_1x}$ = {−1, 0, 0, 0, −1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, +1, 0, 0, 0, −1, 0, 0, 0, −

where

$$LTF_{80MHz_primary_2x} = \{LTF_{80MHz_part1_2x}, LTF_{80MHz_part2_2x}, LTF_{80MHz_part3_2x}, LTF_{80MHz_part4_2x}, LTF_{80MHz_part5_2x}\} \quad (26\text{-}49)$$

$$LTF_{80MHz_secondary_2x} = \{LTF_{80MHz_part1_2x}, LTF_{80MHz_part2_2x}, LTF_{80MHz_part3_2x}, LTF_{80MHz_part4_2x}, LTF_{80MHz_part5_2x}\} \quad (26\text{-}50)$$

$LTF_{80MHz_part1_2x}$ = {+1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, −1, 0, +1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, +1, 0, +1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, −1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, +1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0, −1, 0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0, −1, 0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, −1, 0, −1, 0, +1, 0, −1, 0, +1, 0, +1, 0, +1, 0, −1, 0, +

where

$$LTF_{80MHz_primary_4x} = \{LTF_{80MHz_left_4x}, 0, LTF_{80MHz_right_4x}\} \quad (26\text{-}52)$$

$$LTF_{80MHz_secondary_4x} = \{LTF_{80MHz_left_4x}, 0, (-1)^{*}LTF_{80MHz_right_4x}\} \quad (26\text{-}53)$$

$LTF_{80MHz_left_4x}$ = {+1, +1, −1, +1, −1, +1, −1, −1, −1, +1, −1, −1, −1, +1, +1, −1, +1, +1, +1, +1, +1, −1,
−1, +1, +1, +1, +1, −1, +1, −1, +1, −1, −1, +1, +1, −1, +1, +1, +1, −1, −1, +1, −1, −1, −1, −1,
+1, +1, +1, −1, −1, −1, −1, −1, −1, +1, +1, +1, +1, +1, +1, −1, +1, +1, +1, −1, +1, +1, −1, −1,
−1, +1, −1, +1, −1, −1, +1, +1, −1, +1, −1, +1, +1, +1, +1, +1, −1, −1, +1, +1, +1, −1, +1, +1,
−1, −1, −1, +1, −1, +1, +1, −1, +1, +1, −1, +1, −1, −1, +1, +1, +1, +1, −1, −1, +1, +1, +1, +1,
+1, −1, +1, +1, −1, −1, −1, +1, −1, −1, −1, +1, −1, +1, −1, +1, +1, −1, +1, −1, +1, −1, +1, +1,
+1, −1, +1, +1, +1, −1, −1, +1, −1, −1, −1, −1, −1, +1, +1, −1, −1, −1, −1, +1, −1, +1, −1, +1,
+1, −1, −1, +1, −1, −1, −1, +1, +1, −1, +1, +1, +1, +1, −1, −1, −1, +1, +1, +1, +1, −1, +1, +1,
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−1, +1, +1, +1, +1, +1, −1, −1, +1, +1, +1, −1, +1, +1, −1, −1, −1, −1, −1, +1, +1, −1, +1, +1,
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−1, +1, +1, −1, −1, −1, −1, +1, −1, +1, −1, +1, +1, −1, −1, +1, −1, −1, −1, +1, +1, −1, +1, +1,
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−1, −1, +1, +1, +1, −1, +1, −1, −1, +1, −1, −1, +1, −1, +1, +1, +1, +1, +1, +1, −1, −1, +1, +1,
+1, +1, +1, −1, +1, +1, −1, −1, −1, +1, −1, −1, −1, +1, −1, +1, −1, +1, +1, −1, +1, −1, +1, −1,
+1, +1, +1, −1, +1, +1, +1, −1, −1, +1, −1, −1, −1, −1, −1, +1, +1, −1, −1, −1, −1, +1, −1, +1,
−1, +1, +1, −1, −1, +1, −1, −1, −1, +1, +1, −1, +1, +1, +1, +1, −1, −1, −1, +1, +1, +1, +1, −1,
−1, +1, +1, +1, +1, +1, +1, −1, +1, +1, +1, −1, +1, +1, −1, −1, −1, +1, −1, +1, −1, −1, +1, +1,
−1, +1, −1, +1, +1, +1, +1, +1, −1, −1, +1, +1, +1, −1, +1, +1, −1, −1, −1, +1, −1, +1, +1, −1,
+1, +1, −1, +1, −1, −1, −1, +1, −1, +1, −1, −1, −1, −1, +1, +1, +1, −1, −1, +1, 0, 0}

$LTF_{80MHz_right_4x}$ = {0, 0, +1, −1, −1, −1, −1, −1, −1, +1, −1, +1, +1, −1, −1, +1, +1, −1, +1, −1, +1, −1,
−1, −1, +1, −1, +1, −1, −1, −1, +1, +1, −1, +1, +1, +1, −1, +1, +1, +1, +1, +1, +1, +1, −1, +1,
−1, −1, +1, −1, −1, +1, −1, +1, +1, +1, −1, −1, +1, −1, −1, −1, +1, +1, −1, −1, −1, −1, −1, +1,
−1, −1, −1, −1, −1, +1, +1, −1, −1, −1, −1, −1, +1, −1, −1, +1, +1, +1, −1, +1, +1, +1, −1, +1,
−1, +1, −1, −1, −1, −1, −1, +1, +1, +1, −1, −1, −1, −1, +1, −1, −1, +1, +1, +1, −1, +1, +1, −1,
−1, +1, −1, +1, −1, −1, −1, −1, −1, −1, −1, +1, +1, −1, −1, −1, +1, −1, −1, +1, +1, +1, −1, +1,
−1, −1, +1, −1, −1, +1, −1, +1, +1, +1, −1, +1, −1, −1, +1, +1, −1, +1, −1, +1, +1, +1, −1, −1,
+1, −1, −1, −1, +1, −1, −1, −1, −1, −1, −1, −1, −1, +1, −1, +1, +1, −1, +1, +1, −1, +1, −1, −1, −1,
+1, +1, −1, +1, +1, +1, −1, −1, +1, +1, +1, +1, +1, −1, +1, −1, −1, −1, −1, +1, +1, −1, −1, −1,
−1, −1, +1, −1, −1, +1, +1, +1, −1, +1, +1, +1, −1, +1, −1, +1, −1, −1, −1, −1, −1, −1, −1, +1,
−1, −1, −1, −1, −1, +1, −1, −1, +1, +1, +1, −1, +1, +1, −1, −1, +1, −1, +1, −1, +1, +1, +1, −1, +1,
−1, −1, +1, +1, −1, +1, −1, +1, +1, +1, −1, −1, +1, −1, −1, −1, +1, −1, −1, −1, −1, −1, −1, −1,
+1, −1, +1, +1, −1, +1, +1, −1, +1, −1, −1, −1, +1, +1, −1, +1, +1, +1, −1, −1, +1, +1, +1, +1,
+1, −1, +1, +1, +1, +1, +1, −1, −1, +1, +1, +1, +1, +1, −1, +1, +1, −1, −1, −1, +1, −1, −1, −1,
+1, −1, +1, −1, +1, +1, +1, +1, +1, −1, −1, −1, +1, +1, +1, +1, −1, +1, +1, −1, −1, −1, +1, −1,
−1, +1, +1, −1, +1, −1, +1, −1, −1, −1, −1, −1, −1, +1, +1, −1, −1, −1, +1, −1, −1, +1, +1, +1,
−1, +1, −1, −1, +1, −1, −1, +1, −1, +1, −1, +1, −1, +1, −1, −1, +1, +1, −1, +1, −1, +1, +1, +1,
−1, −1, +1, −1, −1, −1, +1, −1, −1, −1, −1, −1, −1, −1, +1, −1, +1, +1, −1, +1, +1, −1, +1, −1,
+1, −1, +1, +1, −1, +1, +1, −1, +1, −1, −1, −1, +1, +1, −1, +1, +1, +1, −1, −1, +1, +1, +1, +1,
+1, −1, +1, +1, +1, +1, +1, −1, −1, +1, +1, +1, +1, +1, −1, +1, +1, −1, −1, −1, +1, −1, −1, −1,
+1, −1, +1, −1, +1, +1, +1, +1, +1, −1, −1, −1, +1, +1, +1, +1, −1, +1, +1, −1, −1, −1, +1, −1,
−1, +1, +1, −1, +1, −1, +1, −1, −1, −1, −1, −1, −1, +1, +1, −1, −1, −1, +1, −1, −1, +1, +1, +1,
−1, +1, −1, −1, +1, −1, −1, +1, −1, +1, −1, +1, −1, +1, −1, −1, +1, +1, −1, +1, −1, +1, +1, +1,
−1, −1, +1, −1, −1, −1, +1, −1, −1, −1, −1, −1, −1, −1, +1, −1, +1, +1, −1, +1, +1, −1, +1, −1,
−1, −1, +1, +1, −1, +1, +1, +1, −1, −1, +1, +1, +1, +1, +1, −1, +1, −1, −1, −1, −1, +1, +1, −1,
−1, −1, −1, −1, +1, −1, −1, +1, +1, +1, −1, +1, +1, +1, +1, −1, +1, −1, +1, −1, −1, −1, −1, +1,
+1, +1, −1, −1, −1, −1, +1, −1, −1, +1, +1, +1, −1, +1, +1, −1, −1, +1, −1, +1, −1, +1, +1}

For an 80+80 MHz transmission, the primary 80 MHz frequency segment shall use the 80 MHz 1x HE-LTF sequence, $HELTF_{-500,500} = LTF_{80MHz_primary_1x}$, and the secondary 80 MHz frequency segment shall use the 80 MHz 1x HE-LTF sequence, $HELTF_{-500,500} = LTF_{80MHz_secondary_1x}$.

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For an 80+80 MHz transmission, the primary 80 MHz frequency segment shall use the 80 MHz 2x HE-LTF sequence, $HELTF_{-500,500} = LTF_{80\text{MHz_primary_2x}}$, and secondary 80 MHz frequency segment shall use the 80 MHz 2x HE-LTF sequence, $HELTF_{-500,500} = LTF_{80\text{MHz_secondary_2x}}$.

For an 80+80 MHz transmission, the primary 80 MHz frequency segment shall use the 80 MHz 4x HE-LTF sequence, $HELTF_{-500,500} = LTF_{80\text{MHz_primary_4x}}$, and secondary 80 MHz frequency segment shall use the 80 MHz 4x HE-LTF sequence, $HELTF_{-500,500} = LTF_{80\text{MHz_secondary_4x}}$.(#323)(#2557)

In an UL MU-MIMO transmission not using single stream pilots, the generation of the HE-LTF sequence per frequency segment is to mask the non-zero elements in the common HE-LTF sequence repeatedly by a distinct orthogonal code as defined by Equation (26-54).

$$HELTF_k' = \begin{cases} HELTF_k \cdot Porth_k^{\,u}, & \text{if } HELTF_k \neq 0 \\ HELTF_k, & \text{if } HELTF_k = 0 \end{cases} \tag{26-54}$$

Where $HELTF_k$ is the k-th element of the common HE-LTF sequence generated by the one of the bandwidth specific $HELTF$ equations above(#Ed). For user u of any UL MU-MIMO frequency allocation, the orthogonal code $Porth_k^{\,u}$ is defined by Equation (26-55).

$$Porth_k^{\,u} = \left\{ \left[P_{8\times 8}\right]_u^1, \left[P_{8\times 8}\right]_u^2, \ldots, \left[P_{8\times 8}\right]_u^{\frac{N_{\text{nz-HE-LTF}}}{8}}, \left[P_{8\times 8}\right]_{u,\,1:M} \right\} \tag{26-55}$$

Where $\left[P_{8\times 8}\right]_u^i, i = 1, 2, \ldots, \left\lfloor \frac{N_{\text{nz-HE-LTF}}}{8} \right\rfloor$ is the i-th repetition of the u-th row of the $P_{8\times 8}$ matrix defined in Equation (22-46). $N_{\text{nz-HE-LTF}}$ is the number of nonzero elements in the common HE-LTF. $\left[P_{8\times 8}\right]_{u,\,1:M}$ is the first M elements of the u-th row of the $P_{8\times 8}$. If $N_{\text{nz-HE-LTF}}$ is not a multiple of 8, the remaining M nonzero elements of the common HE-LTF sequence are masked by the first M elements of the orthogonal code.(#1059)

The generation of the time domain HE-LTF symbols per frequency segment in an HE SU PPDU, HE MU PPDU, HE extended range SU PPDU, HE trigger-based PPDU (#1059)is shown in Figure 26-26

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(Generation of HE-LTF symbols per frequency segment in an HE SU PPDU, HE MU PPDU, HE extended range SU PPDU and HE trigger-based PPDU(#1059)) where $A^{k}_{\text{HE-LTF}}$ is given by Equation (26-56).

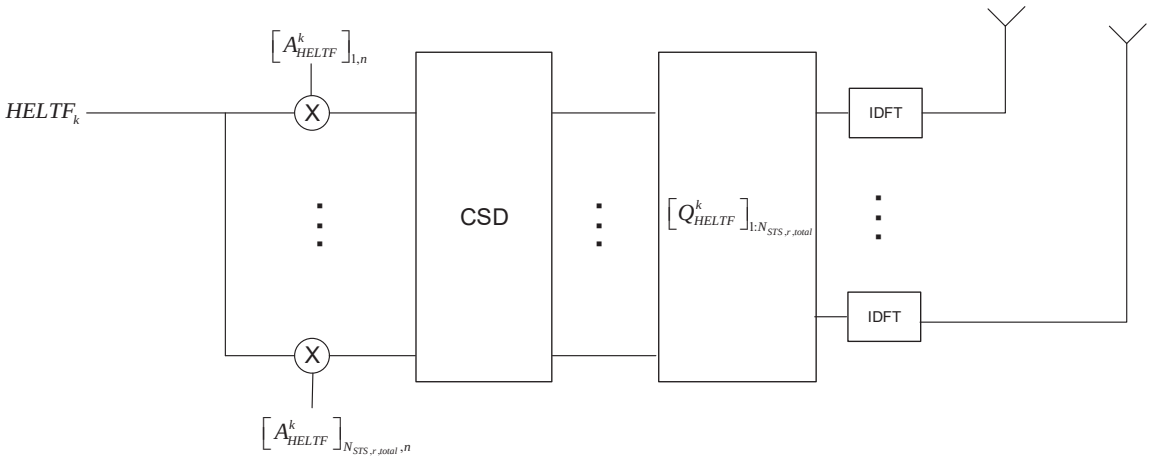

Figure 26-26—Generation of HE-LTF symbols per frequency segment in an HE SU PPDU, HE MU PPDU, HE extended range SU PPDU and HE trigger-based PPDU(#1059)

$A^{k}_{\text{HE-LTF}}$ is given by Equation (26-56).

$$A^{k}_{\text{HE-LTF}} = \begin{cases} R_{\text{HE-LTF}}, \text{ if } k \in K_{\text{Pilot}} \text{ and single stream pilots are used} \\ P_{\text{HE-LTF}}, \text{ otherwise} \end{cases} \quad (26\text{-}56)$$

where

K_{Pilot} is the set of subcarrier indices for the pilot tones as defined in 26.3.3.3 (Pilot tones)(#2794).

$R_{\text{HE-LTF}}$ is a $N_{\text{HE-LTF}} \times N_{\text{HE-LTF}}$ matrix whose elements are defined in Equation (26-57)(#2877).

$$\left[R_{\text{HE-LTF}}\right]_{m,n} = \left[P_{\text{HE-LTF}}\right]_{1,n},\ 1 \le m, n \le N_{\text{HE-LTF}} \quad (26\text{-}57)$$

$P_{\text{HE-LTF}}$ is defined in Equation (26-58).

$$P_{\text{HE-LTF}} = \begin{cases} P_{4\times 4}, N_{\text{HE-LTF}} \le 4 \\ P_{6\times 6}, N_{\text{HE-LTF}} = 6 \\ P_{8\times 8}, N_{\text{HE-LTF}} = 8 \end{cases} \quad (26\text{-}58)$$

where $P_{4\times 4}$ is defined in Equation (19-27), $P_{6\times 6}$ is defined in Equation (21-45), and $P_{8\times 8}$ is defined in Equation (22-46)(#2878).

When the 1x HE-LTF is used for non-OFDMA UL MU-MIMO, single stream pilot are not used.(#1059)

In an HE SU PPDU, HE MU PPDU, HE extended range SU PPDU and HE trigger-based PPDU(#1059), the time domain representation of the waveform transmitted on frequency segment i_{Seg} of transmit chain i_{TX} shall be as described by Equation (26-59)(#2798).

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$$\overset{\wedge}{}_{\text{HE-LTF}}^{(i_{Seg} i_{TX})}(t) = \frac{\eta_{\text{HE-LTF-Mode}}}{\sqrt{\sum_{r=0}^{N_{RU}-1} \alpha_r^2 |K_r|}} \sum_{n=0}^{N_{\text{HE-LTF}}-1} w_{T_{\text{HE-LTF}}}(t - nT_{\text{HE-LTF}}) \sum_{r=0}^{N_{RU}-1} \frac{\alpha_r}{\sqrt{N_{STS,r,total}}} \eta_{\text{HE-LTF},k} \quad (26\text{-}59)$$

$$\sum_{k \in K_r} \sum_{u=0}^{N_{user,r}-1} \sum_{m=1}^{N_{STS,r,u}} \left(\left[Q_k^{(i_{Seg})} \right]_{i_{TX},(M_{r,u}+m)} \left[A_{\text{HE-LTF}}^k \right]_{(M_{r,u}+m),(n+1)} HELTF_k'' \cdot \exp(j2\pi k \Delta_{F,\text{HE}}(t - nT_{\text{HE-LTF}} - T_{GI} - T_{CS,\text{HE}}(M_{r,u}+m))) \right)$$

(#1050)where

$HELTF_k'' = HELTF_k$ if single stream pilots are used or when the 1x HE-LTF is used for non-OFDMA UL MU-MIMO, and $HELTF_k'' = HELTF_k'$ if single stream pilots are not used.(#1059)

26.3.11 Data field

26.3.11.1 General

The number of OFDM symbols in the Data field is determined by the Length field in L-SIG (see Equation (26-12)(#1625)), the preamble duration and the settings of the GI+LTF Size(#1420), Pre-FEC Padding Factor(#2564) and PE Disambiguity fields(#2560) in the HE-SIG-A field (see 26.3.10.7 (HE-SIG-A)). Data symbols in an HE PPDU shall use a DFT period of 12.8 µs and subcarrier spacing of 78.125 kHz. Data symbols in an HE PPDU shall support guard interval durations of 0.8 µs, 1.6 µs and 3.2 µs. HE PPDUs shall have single stream pilots in the Data field. In UL MU-MIMO transmissions, all streams use the same pilot sequence.(#2561)

When BCC encoding is used, the Data field shall consist of the SERVICE field, the PSDU, the tail bits, the post-FEC padding bits and the packet extension (bits for SU and bits for each user u in MU). When LDPC encoding is used, the Data field shall consist of the SERVICE field, the PSDU, the post-FEC padding bits and the packet extension. No tail bits are present when LDPC encoding is used.

The Data field of the HE PPDU contains data for one or more users.

26.3.11.2 Pre-FEC encoding process

A two-step padding process is applied on all HE PPDUs. A pre-FEC padding with both MAC and PHY padding is applied before conducting FEC coding, and a post-FEC PHY padding is applied on the FEC encoded bits.

The pre-FEC padding may pad toward 4 possible boundaries in the last one (in the case of non STBC), or two (in the case of STBC) OFDM symbols of an(#2829) HE PPDU, the 4 possible boundaries partition(#1837) the FEC output bit stream of the last OFDM symbol(s) into 4 symbol segments. The 4 possible boundaries are represented by a pre-FEC padding factor parameter(#326)(#2564).

Figure 26-27 (HE PPDU padding process in the last OFDM symbol (non STBC) when a = 1) illustrates these 4 possible symbol segments in the last OFDM symbol of a non STBC case, and the general padding process assuming the desired pre-FEC padding boundary, pre-FEC padding factor, is 1. In the case of STBC, the FEC output bits and post-FEC padding bits as shown in Figure 26-28 (HE PPDU padding process in the last OFDM symbol (STBC) when a = 1), are modulated into the last two OFDM symbols by STBC

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encoding, each with the same number of effective symbol segments, the pre-FEC padding factor(#2564) being 1.

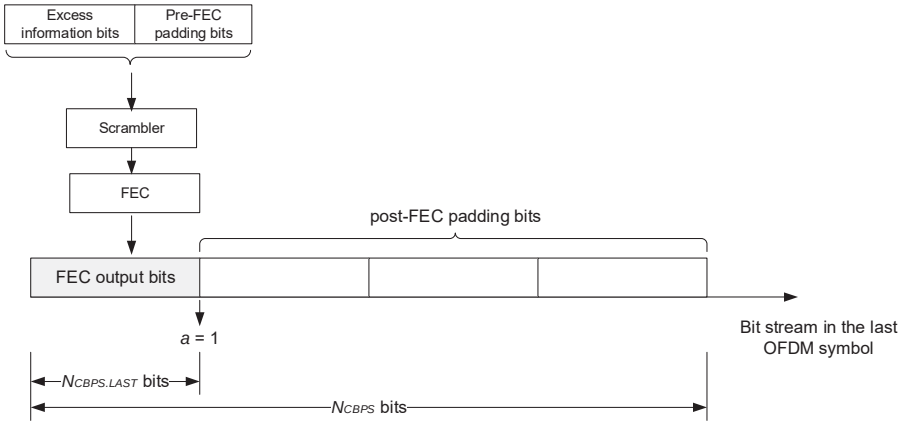

Figure 26-27—HE PPDU padding process in the last OFDM symbol (non STBC) when *a* = 1

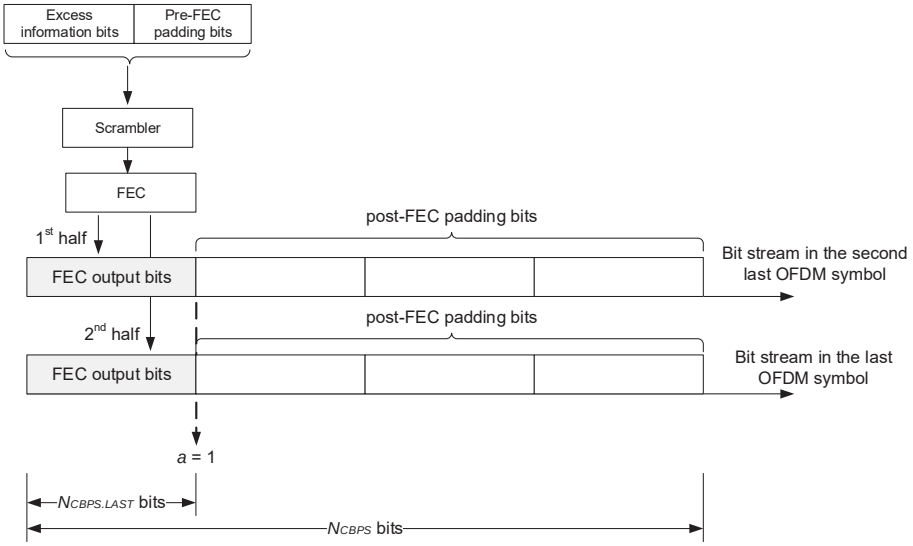

Figure 26-28—HE PPDU padding process in the last OFDM symbol (STBC) when *a* = 1

The pre-FEC padding process is described in this subclause, and the encoding and post-FEC padding process are described in 26.3.11.5 (Coding)(#1113). While this subclause describes the pre-FEC padding processing of an SU transmission, its extension to MU transmission is described in 25.3.10.3.4 (Encoding Process for HE MU PPDUs).

In an HE SU PPDU transmission, the transmitter first computes the number of excess bits in the last OFDM symbol(s). Specifically, for HE SU PPDU, the number of excess bits is calculated based on Equation (26-60).

$$N_{Excess} = mod(8 \cdot \text{APEP_LENGTH} + N_{Tail} + N_{service}, m_{STBC} \cdot N_{DBPS}) \quad (26\text{-}60)$$

where

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m_{STBC} is 2 when STBC is used, and 1 otherwise
APEP_LENGTH is the TXVECTOR parameter APEP_LENGTH

(#2521)Based(#2060) on N_{Excess}, compute the initial number of symbol segments in the last OFDM symbol(s), pre-FEC padding factor(#1626)(#2564) value or a_{init}, as shown in Equation (26-61).

$$a_{init} = \begin{cases} 4, & \text{if } N_{Excess} = 0 \\ \min\left(\left\lceil \frac{N_{Excess}}{m_{STBC} \cdot N_{DBPS,SHORT}} \right\rceil, 4\right), & \text{otherwise} \end{cases} \quad \text{(PHY Motion \#174)} \qquad (26\text{-}61)$$

where

$N_{DBPS,SHORT} = N_{CBPS,SHORT} \cdot R$, in which R is the coding rate, and

$N_{CBPS,SHORT} = N_{SD,SHORT} \cdot N_{SS} \cdot N_{BPSCS}$;

The parameter $N_{SD,SHORT}$ values for different RU sizes are as shown in Table 26-25 (NSD,SHORT values(#1857)).

Table 26-25—$N_{SD,SHORT}$ values(#1857)

RU Size	$N_{SD,SHORT}$	
	DCM = 0	DCM = 1
26-tone	6	2
52-tone	12	6
106-tone	24	12
242-tone	60	30
484-tone	120	60
996-tone	240	120
2×996-tone	492	246

Given the a_{init} values, the initial number of data bits per symbol and the initial number of coded bits per symbol in the last OFDM symbol(s) are defined in Equation (26-62).

$$N_{DBPS.LAST.init} = \begin{cases} a_{init} N_{DBPS.SHORT}, & \text{if } a_{init} < 4 \\ N_{DBPS}, & \text{if } a_{init} = 4 \end{cases}$$

$$N_{CBPS.LAST.init} = \begin{cases} a_{init} N_{CBPS.SHORT}, & \text{if } a_{init} < 4 \\ N_{CBPS}, & \text{if } a_{init} = 4 \end{cases} \qquad (26\text{-}62)$$

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For an(#2829) HE SU PPDU with BCC encoding, the number of pre-FEC pad bits is calculated using Equation (26-63).

$$N_{PAD,\text{ Pre-FEC}} = (N_{SYM.init} - m_{STBC})N_{DBPS} + m_{STBC}N_{DBPS.LAST.init} - 8 \cdot \text{APEP_LENGTH} - N_{Tail} - N_{service} \quad (26\text{-}63)$$

where $N_{SYM.init}$ is defined as in Equation (26-66) for BCC encoding, and Equation (26-71)(#2802) for LDPC encoding.

For an(#2829) HE SU PPDU with LDPC encoding, the number of pre-FEC pad bits is calculated using Equation (26-64).

$$N_{PAD,\text{ Pre-FEC}} = (N_{SYM.init} - m_{STBC})N_{DBPS} + m_{STBC}N_{DBPS.LAST.init} - 8 \cdot \text{APEP_LENGTH} - N_{service} \quad (26\text{-}64)$$

Among the pre-FEC padding bits, the MAC delivers a PSDU that fills the available octets in the Data field of the HE PPDU, toward the desired pre-FEC padding boundary, represented by a_init value, in the the last OFDM symbol(s). The PHY then determines the number of pad bits to add and appends them to the PSDU. The number of pre-FEC pad bits added by PHY will always be 0 to 7. The procedure is defined in Equation (26-65).

$$N_{PAD,\text{ Pre-FEC,MAC}} = \left\lfloor \frac{N_{PAD,\text{ Pre-FEC}}}{8} \right\rfloor \cdot 8$$
$$N_{PAD,\text{ Pre-FEC,PHY}} = N_{PAD,\text{ Pre-FEC}} \bmod 8 \quad (26\text{-}65)$$

26.3.11.3 SERVICE field

The SERVICE field of HE PPDU is as shown in Table 26-26 (SERVICE field).

Table 26-26—SERVICE field

Bits	Field	Description
B0-B6	Scrambler Initialization	Set to 0
B7-B15	Reserved	Set to 0

26.3.11.4 Scrambler

The SERVICE field, PSDU, and PHY padding of the Data field shall be scrambled by the scrambler defined in 17.3.5.5 (PHY DATA scrambler and descrambler). The Clause 17 (Orthogonal frequency division multiplexing (OFDM) PHY specification) TXVECTOR parameters CH_BANDWIDTH_IN_NON_HT and DYN_BANDWIDTH_IN_NON_HT are not present and therefore the initial state of the scrambler is set to a nonzero pseudorandom seed. A different nonzero pseudorandom seed may be used for each user in a HE MU PPDU.(#2442)

26.3.11.5 Coding

The Data field shall be encoded using either the binary convolutional code (BCC) defined in 26.3.11.5.1 (Binary convolutional coding and puncturing) or the low density parity check (LDPC) code defined in

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26.3.11.5.2 (LDPC coding)(#2803). The encoder is selected by the Coding field in HE-SIG-A in an HE SU PPDU or an HE extended range SU PPDU, or HE-SIG-B per-user subfield(s) in an(#2829) HE MU PPDU, as defined in 26.3.10.7 (HE-SIG-A) and 26.3.10.8 (HE-SIG-B) respectively.

When conducting BCC FEC encoding for an HE PPDU, the number of encoders is always 1.

LDPC is the only FEC coding scheme in the HE PPDU Data field for a 484-, 996-, and 2×996-tone RU(#838). LDPC is the only FEC coding scheme in the HE PPDU Data field for MCS10 and MCS11 in a 242- 484-, 996- and 2×996-tone RU.(PHY Motion #158) Support of BCC code is limited to less than or equal to four spatial streams and MCS0 to MCS9 (per user in case of MU-MIMO), and is mandatory (for both transmit and receive) for RU sizes less than or equal to a 242-tone RU(#838). Support of LDPC code (for both transmit and receive) is mandatory for HE STAs declaring support for at least one of HE 40/80/160/80+80 SU PPDU bandwidths, for HE STAs declaring support for more than 4 spatial streams, or for HE STAs declaring support for MCS10 and MCS11(PHY Motion #158), according to HE capabilities field as defined in 9.4.2.218 (HE Capabilities element). Otherwise, support of LDPC code for either transmit or receive is optional.

26.3.11.5.1 Binary convolutional coding and puncturing

The information bits and pre-FEC padding bits of user u are encoded by a rate R = ½ convolutional encoder defined in 17.3.5.6 (Convolutional encoder). After encoding, the encoded data is punctured by the method defined in 17.3.5.6 (Convolutional encoder)(#2804) (except for rate 5/6), to achieve the rate selected by the modulation and coding scheme. In the case that rate 5/6 coding is selected, the puncturing scheme will be the same as described in 21.3.10.5.3 (Binary convolutional coding and puncturing)(#2805).

The initial number of OFDM symbols in the Data field with BCC encoding in an(#2829) HE SU PPDU is calculated using Equation (26-66).

$$N_{SYM,\,init} = m_{STBC} \cdot \left\lceil \frac{8 \cdot \text{APEP_LENGTH} + N_{Tail} + N_{service}}{m_{STBC} N_{DBPS}} \right\rceil \text{(\#282)} \qquad \text{(26-66)}$$

For an(#2829) HE SU PPDU with BCC encoding,

$$N_{SYM} = N_{SYM.init} \qquad \text{(26-67)}$$

and

$$a = a_{init} \qquad \text{(26-68)}$$

The number of data bits per symbol in the last OFDM symbol(s) of an HE SU PPDU is $N_{DBPS.LAST} = N_{DBPS.LAST.init}$.(#328)

The number of coded bits per symbol in the last OFDM symbol(s) of an(#2829) HE SU PPDU is given by Equation (26-69).

$$N_{CBPS,\,LAST} = \begin{cases} a \cdot N_{CBPS,\,SHORT}, & \text{if } a < 4 \\ N_{CBPS}, & \text{if } a = 4 \end{cases} \qquad \text{(26-69)}$$

26.3.11.5.2 LDPC coding

For an(#2829) HE SU PPDU using LDPC coding to encode the Data field, the LDPC code and encoding process described in 19.3.11.7 (LDPC codes)(#2806) shall be used with the following modifications. First,

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all bits in the Data field including the scrambled SERVICE, PSDU, and pre-FEC pad bits are encoded, i.e., $N_{pld} = N_{service} + 8 \times \text{APEP_LENGTH} + N_{PAD,Pre\text{-}FEC}$(#2067). Thus, N_{pld} for HE PPDUs shall be computed using Equation (26-70) instead of Equation (20-35).

$$N_{pld} = (N_{SYM.init} - m_{STBC})N_{DBPS} + m_{STBC}N_{DBPS.LAST.init} \tag{26-70}$$

where

$$N_{SYM.init} = m_{STBC} \cdot \left\lceil \frac{8 \cdot \text{APEP_LENGTH} + N_{service}}{m_{STBC} \cdot N_{DBPS}} \right\rceil \tag{26-71}$$

Following the calculation of N_{pld}, N_{avbits} shall be computed using Equation (26-72) instead of Equation (20-36).

$$N_{avbits} = (N_{SYM,\,init} - m_{STBC}) \cdot N_{CBPS} + m_{STBC} \cdot N_{CBPS,\,LAST,\,init} \tag{26-72}$$

In addition, in step d) of LDPC encoding process as described in 19.3.11.7.5 (LDPC PPDU encoding process)(#1405)(#2807), if the following condition is met:

$(N_{punc} > 0.1 \times N_{CW} \times L_{LDPC} \times (1 - R))$ AND $\left(N_{shrt} < 1.2 \times N_{punc} \times \frac{R}{1-R}\right)$ is true OR if

$N_{punc} > 0.3 \times N_{CW} \times L_{LDPC} \times (1 - R)$ is true,

then the LDPC Extra OFDM Symbol field of HE-SIG-A shall be set to 1, and increment N_{avbits} by the following Equation (26-73) instead of Equations (19-39), followed by recomputing N_{punc} as in Equation (19-40)(#2808):

$$N_{avbits} = \begin{cases} N_{avbits} + m_{STBC} \cdot (N_{CBPS} - 3N_{CBPS.SHORT}), & \text{if } a_{init} = 3 \\ N_{avbits} + m_{STBC} \cdot N_{CBPS.SHORT}, & \text{otherwise} \end{cases} \tag{26-73}$$

and then update a and N_{SYM} values by the following Equation (26-74):

$$\begin{cases} N_{SYM} = N_{SYM.init} + m_{STBC} \text{ and } a = 1, & \text{if } a_{init} = 4 \\ N_{SYM} = N_{SYM.init} \text{ and } a = a_{init} + 1, & \text{otherwise} \end{cases} \tag{26-74}$$

If in step d) of LDPC encoding process as described in 19.3.11.7.5 (LDPC PPDU encoding process)(#1405)(#2809), the above mentioned condition is not met, then the LDPC Extra OFDM Symbol field of HE-SIG-A shall be set to 0, and

$$\begin{aligned} N_{SYM} &= N_{SYM,\,init} \quad \text{(\#2068)} \\ a &= a_{init} \end{aligned} \tag{26-75}$$

With the final pre-FEC padding factor(#2564) value a, update the N_{CBPS} of the last symbol as:

$$N_{CBPS.LAST} = \begin{cases} a \cdot N_{CBPS.SHORT}, & \text{if } a < 4 \\ N_{CBPS}, & \text{if } a = 4 \end{cases} \tag{26-76}$$

For completeness, the number of data bits of the last symbol $N_{DBPS.LAST} = N_{DBPS.LAST.init}$.(#329)

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LDPC codes used in HE MU PPDUs shall also follow the definitions in 19.3.11.7 (LDPC codes)(#2810). Refer to 26.3.11.5.4 (Encoding process for an HE MU PPDU)(#2069) for a description of the LDPC encoding process for HE MU PPDUs.

26.3.11.5.3 Post-FEC padding

The number of post-FEC padding bits in each of the last m_{STBC} symbol(s) is computed by:

$$N_{PAD.POST\text{-}FEC} = N_{CBPS} - N_{CBPS.LAST} \tag{26-77}$$

The last m_{STBC} symbols shall consist of $N_{CBPS.LAST}$ bits from the FEC output followed by $N_{PAD.POST\text{-}FEC}$ post-FEC padding bits. The values of the post-FEC padding bits are not specified and are left up to implementation.(#2070)

26.3.11.5.4 Encoding process for an HE MU PPDU

For an HE MU PPDU, all the users shall use a common pre-FEC padding factor(#2564) value and a common N_{SYM} value. The padding process is described as follows.

First compute initial pre-FEC padding factor(#2564) value ($a_{init,u}$) for each user u using Equation (26-61), and the initial number of OFDM symbols ($N_{init,init}$)(#2071) for each user u using Equation (26-66) if user u is BCC encoded, or Equation (26-71) if user u is LDPC encoded. Among all the users, derive the user index with the longest encoded packet duration, as in Equation (26-78).

$$u_{\max} = \arg\max_{u=0}^{N_u - 1} (N_{SYM.init.u} - m_{STBC} + 0.25 m_{STBC} a_{init.u}) \tag{26-78}$$

where m_{STBC} is the common STBC setting among all the users, as described in 26.3.10.8.

Then the common a_{init} and N_{init} values among all the users are derived by Equation (26-79):

$$\begin{aligned} N_{SYM.init} &= N_{SYM.init.u_{\max}} \\ a_{init} &= a_{init.u_{\max}} \end{aligned} \tag{26-79}$$

Update each user's initial number of coded bits in its last symbol as below:

$$\begin{aligned} N_{DBPS.LAST.init.u} &= \begin{cases} a_{init} N_{DBPS.SHORT.u}, \text{ if } a_{init} < 4 \\ N_{DBPS.u}, \text{ if } a_{init} = 4 \end{cases} \\ N_{CBPS.LAST.init.u} &= \begin{cases} a_{init} N_{CBPS.SHORT.u}, \text{ if } a_{init} < 4 \\ N_{CBPS.u}, \text{ if } a_{init} = 4 \end{cases} \end{aligned} \tag{26-80}$$

For each user with LDPC encoding, the number of pre-FEC padding bits is computed as in Equation (26-81):

$$\begin{aligned} N_{PAD,\,\text{Pre-FEC},\,u} = {} & (N_{SYM.init} - m_{STBC}) N_{DBPS,\,u} + m_{STBC} N_{DBPS.LAST.init.u} \\ & - 8 \cdot \text{APEP_LENGTH}_u - N_{service} \end{aligned} \tag{26-81}$$

For each user with LDPC encoding, the parameters $N_{pld,u}$ and $N_{avbits,u}$ are computed using Equation (26-82) and Equation (26-83) respectively:

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$$N_{pld,\,u} = (N_{SYM.init} - m_{STBC})N_{DBPS,\,u} + m_{STBC}N_{DBPS.LAST.init.u} \quad (26\text{-}82)$$

$$N_{avbits,\,u} = (N_{SYM.init} - m_{STBC})N_{CBPS,\,u} + m_{STBC}N_{CBPS.LAST.init.u} \quad (26\text{-}83)$$

For each user(#2072) with LDPC encoding continue LDPC encoding process as in 19.3.11.7.5 (LDPC PPDU encoding process)(#1405)(#2811) starting with the parameters $N_{pld,u}$ and $_{avbits,u}$. If there is at least one user with LDPC encoding, where step d) of its LDPC encoding process of 19.3.11.7.5 (LDPC PPDU encoding process)(#1405)(#2812), meets the following condition:

$(N_{punc,\,u} > 0.1 \times N_{CW,\,u} \times L_{LDPC,\,u} \times (1 - R_u))$ AND $\left(N_{shrt,\,u} < 1.2 \times N_{punc,\,u} \times \frac{R_u}{1 - R_u}\right)$ is true OR if

$N_{punc,\,u} > 0.3 \times N_{CW,\,u} \times L_{LDPC,\,u} \times (1 - R_u)$ is true,

where $N_{punc,u}$, $N_{CW,u}$, $L_{LDPC,u}$ and $N_{shrt,u}$ are the LDPC encoding parameters for user u, as defined in 19.3.11.7.5 (LDPC PPDU encoding process)(#2813), and R_u is the coding rate of user u, then the LDPC Extra symbol bit in HE-SIG-A shall be set to 1, and all the users with LDPC encoding shall increment N_{avbits} and recomputed N_{punc}, by the following two equations once:

$$N_{avbits,\,u} = \begin{cases} N_{avbits,\,u} + m_{STBC} \cdot (N_{CBPS} - 3N_{CBPS.SHORT.u}), & \text{if } a_{init} = 3 \\ N_{avbits,\,u} + m_{STBC} \cdot N_{CBPS.SHORT.u}, & \text{otherwise} \end{cases} \quad (26\text{-}84)$$

$$N_{punc,\,u} = \max(0, (N_{CW,\,u} \times L_{LDPC,\,u}) - N_{avbits,\,u} - N_{shrt,\,u}) \quad (26\text{-}85)$$

Update the common pre-FEC padding factor(#2564) and N_{SYM} values for all users by the following equation:

$$\begin{cases} N_{SYM} = N_{SYM.init} + m_{STBC} \text{ and } a = 1, & \text{if } a_{init} = 4 \\ N_{SYM} = N_{SYM.init} \text{ and } a = a_{init} + 1, & \text{otherwise} \end{cases} \quad (26\text{-}86)$$

If among all the users with LDPC encoding, in step d) of 19.3.11.7.5 (LDPC PPDU encoding process)(#1405)(#2814), the above mentioned condition is not met, or if all the users in the HE MU PPDU are BCC encoded, then the LDPC Extra symbol bit in HE-SIG-A shall be set to 0, and:

$$a = a_{init}, N_{SYM} = N_{SYM,\,init} \quad (26\text{-}87)$$

Note that users with BCC encoding shall also use the common N_{SYM} and a parameters as in Equation (26-86)(#2073).

(#331)For the users with LDPC encoding, $N_{DBPS.LAST.u} = N_{DBPS.LAST.init.u}$.

For the users with BCC encoding, update the N_{DBPS} of the last symbol as

$$N_{DBPS.LAST.u} = \begin{cases} a \cdot N_{DBPS.SHORT.u}, \text{ if } a < 4 \\ N_{DBPS.u}, \text{ if } a = 4 \end{cases}$$

For each user with either LDPC or BCC encoding, update the N_{CBPS} of the last symbol as

$$N_{CBPS.LAST.u} = \begin{cases} a \cdot N_{CBPS.SHORT.u}, \text{ if } a < 4 \\ N_{CBPS.u}, \text{ if } a_{init} = 4 \end{cases}$$

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For the users with BCC encoding, the number of pre-FEC padding bits is shown in Equation (26-88).

$$N_{PAD,\,\text{Pre-FEC},\,u} = (N_{SYM} - m_{STBC})N_{DBPS,\,u} + m_{STBC}N_{DBPS.LAST.u} - 8 \cdot \text{APEP_LENGTH}_u - N_{Tail} - N_{service} \quad (26\text{-}88)$$

For each user with either LDPC or BCC encoding, the number of post-FEC padding bits in each of the last m_{STBC} symbol(s) is computed as in Equation (26-89):

$$N_{PAD,\,\text{Post-FEC},\,u} = N_{CBPS,\,u} - N_{CBPS.LAST.u} \text{ (\#2070)} \quad (26\text{-}89)$$

Among the pre-FEC padding bits, the MAC delivers a PSDU that fills the available octets in the Data field of the HE PPDU, toward the desired pre-FEC padding boundary, represented by a_{init}, in the last OFDM symbol(s). The PHY then determines the number of pad bits to add and appends them to the PSDU. The number of pre-FEC pad bits added by PHY will always be 0 to 7. The procedure is defined in Equation (26-90) and Equation (26-91).(#2076)

$$N_{PAD,\,\text{Pre-FEC},\,MAC} = 8 \cdot \left\lfloor \frac{N_{PAD,\,\text{Pre-FEC}}}{8} \right\rfloor \quad (26\text{-}90)$$

$$N_{PAD,\,\text{Pre-FEC},\,PHY} = N_{PAD,\,\text{Pre-FEC}} \bmod 8 \quad (26\text{-}91)$$

26.3.11.5.5 Encoding process for an HE trigger-based PPDU

The AP indicates the common N_{SYM}, pre-FEC padding factor(#2564), STBC indication and LDPC Extra Symbol in the Trigger frame.

For an HE trigger-based PPDU with BCC encoding, follow the HE SU PPDU padding and encoding process as introduced in 25.3.10.1.1 (pre-FEC padding process), 26.3.11.5.1 (Binary convolutional coding and puncturing), and 26.3.11.5.3 (Post-FEC padding), with initial parameters setting to $N_{SYM.init} = N_{SYM}$, and $a_{init} = a$, where N_{SYM} and a are the common number of symbols and pre-FEC padding factor(#2564) indicated in the Trigger frame, respectively.

For an HE trigger-based PPDU with LDPC encoding, follow the HE SU PPDU padding and encoding process as introduced in 26.3.11.2 (Pre-FEC encoding process), 26.3.11.5.2 (LDPC coding), and 26.3.11.5.3 (Post-FEC padding), with the following exceptions:

When the Trigger frame indicates LDPC Extra Symbol = 1, set the initial parameters following Equation (26-92):

$$\begin{cases} a_{init} = 4 \text{ and } N_{SYM.init} = N_{SYM} - m_{STBC}, & \text{if } a = 1 \\ a_{init} = a - 1 \text{ and } N_{SYM.init} = N_{SYM}, & \text{otherwise} \end{cases} \quad (26\text{-}92)$$

where N_{SYM} and a are the common number of symbols and pre-FEC padding factor(#2564) indicated in the Trigger frame respectively, and m_{STBC} is 2 if the Trigger frame indicates STBC and 1 otherwise. Then continue with the LDPC encoding process as in 20.3.11.7.5 (LDPC PPDU encoding process)(#1405), during which in step d) of 20.3.11.7.5 (LDPC PPDU encoding process)(#1405), always increment N_{avbits} as in Equation (26-73), and always recompute N_{punc} as in Equation (20-40), followed by updating $a = a_{init} + 1$ if $a_{init} < 4$, or $a = 1$ if $a_{init} = 4$.

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When the Trigger frame indicates LDPC Extra Symbol = 0, set initial parameters to $N_{SYM,init} = N_{SYM}$, and $a_{init} = a$, where N_{SYM} and a are the common number of symbols and pre-FEC padding factor(#1626)(#2564) indicated in the Trigger frame respectively. Then continue with the LDPC encoding process as in 20.3.11.7.5 (LDPC PPDU encoding process)(#1405), during which in step d) of 20.3.11.7.5 (LDPC PPDU encoding process)(#1405), N_{avbits} and N_{punc} are not changed, and $a = a_{init}$.

26.3.11.6 Stream parser

After coding, scrambling,(#2078) puncturing and post-FEC padding, the data bit streams at the output of the FEC encoder are processed in groups of N_{CBPS} bits. Each of these groups is re-arranged into N_{SS} blocks of N_{CBPSS} bits ($N_{SS,u}$ blocks of $N_{CBPSS,u}$ bits in the case of an(#2829) HE MU transmission). This operation is referred to as "stream parsing" and is described in this subclause(#1304).

The description is given in terms of an SU transmission. For MU transmissions, the rearrangements are carried out in the same way per user.

The number of bits assigned to a single axis (real or imaginary) in a constellation point in a spatial stream is denoted by Equation (26-93).

$$s = max(1, \frac{N_{BPSCS}}{2}) \quad (26\text{-}93)$$

The sum of these over all streams is $S = N_{SS} \cdot s$.

Consecutive blocks of s bits are assigned to different spatial streams in a round robin fashion.

For the N_{CBPS} bits of each OFDM symbol, S bits from the output of the encoder are divided among all spatial streams, s bits per stream.

Note that for all RU sizes the coded bits of each OFDM symbol are always evenly allocated to N_{SS} spatial streams.(#2079)(#Ed)

The following equations are an equivalent description to the above procedure. Bit i at the output of the encoder is assigned to input bit k of spatial stream i_{SS} where

$$i = (i_{SS} - 1)s + S \cdot \left\lfloor \frac{k}{s} \right\rfloor + (k \bmod s) \text{ (\#2080)}$$

$$i_{SS} = 1, 2, \ldots, N_{SS}$$

$$i = 0, 1, \ldots, N_{CBPS} - 1$$

$$k = 0, 1, \ldots, N_{CBPSS} - 1 \text{ (\#2081)}$$

26.3.11.7 Segment parser

The description in this subclause is for an SU transmission. For an MU transmissions, the rearrangements are carried out in the same way but per user.(#Ed)

For a 20 MHz, 40 MHz, 80 MHz, 160 MHz and 80+80 MHz transmission with a 26-, 52-, 106-, 242-, 484- or 996-tone RU, the segment parser is bypassed and the output bits of each stream parser are as specified in Equation (26-94).

$$y_{k,l} = x_k \quad (26\text{-}94)$$

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where

x_k is bit k of a block of N_{CBPSS} bits, $k = 0$ to $N_{CBPSS} - 1$

l is the frequency subblock index and $l = 0$ for a 26-, 52-, 106-, 242-, 484- and 996-tone RU.

$y_{k,l}$ is bit k of the frequency subblock l

For a 160 MHz and 80+80 MHz transmission with a 2×996-tone RU, the output bits of each stream parser are first divided into blocks of N_{CBPSS} bits ($N_{CBPSS,u}$ bits in the case of an MU transmission). Then, each block is further divided into two frequency subblocks of $N_{CBPSS}/2$ bits as shown in Equation (26-95).

$$y_{k,l} = x_m \tag{26-95}$$

$$m = 2s \cdot \left\lfloor \frac{k}{s} \right\rfloor + l \cdot s + (k \bmod s), \quad k = 0, 1, \ldots, \frac{N_{CBPSS}}{2} - 1 \tag{26-96}$$

and

x_m is bit m of a block of N_{CBPSS} bits and $m = 0, \ldots, N_{CBPSS} - 1$

l is the frequency subblock index and $l = 0, 1$

$y_{k,l}$ is bit k of the frequency subblock l

s is defined in Equation (26-93)(#2566)

26.3.11.8 BCC interleavers

(#1866)For ease of explanation, the operation of the interleaver is described only for the SU case. For user u of an MU transmission, the interleaver operates in the same way on the output bits for the user from the stream parser by replacing N_{SS}, N_{CBPSS}, N_{CBPS}, and N_{BPSCS} with $N_{SS,u}$, $N_{CBPSS,u}$, $N_{CBPS,u}$ and $N_{BPSCS,u}$, respectively(#2522). That is, the operation of the interleaver is the same as if the transmission were an SU one, consisting of bits from only that user.

The BCC interleaver operation is specified in 21.3.10.8 (BCC interleaver). When DCM is used with BPSK modulation in a 106-tone RU or a 242-tone RU with $N_{SS} = 1$, after the $2 \times N_{DBPS}$ coded bits in each OFDM symbol, 1 padding bit is added before the bits are interleaved.(#482) (#2183)The interleaver parameters, N_{COL}, N_{ROW}, and N_{ROT}, for the Data field depend on the RU size and whether or not DCM is used and are defined in the RU size column of Table 26-27 (BCC interleaver parameters).

Table 26-27—BCC interleaver parameters

DCM	Parameter	RU size (tones)				HE-SIG-A/ HE-SIG-B (tones)
		26	52	106	242	56
Not used	N_{COL}	8	16	17	26	13
	N_{ROW}	$3 \times N_{BPSCS}$	$3 \times N_{BPSCS}$	$6 \times N_{BPSCS}$	$9 \times N_{BPSCS}$	$4 \times N_{BPSCS}$
	N_{ROT} ($2 \le N_{SS} \le 4$)	2	11	29	58	-
Used	N_{COL}	48	8	17	13	13
	N_{ROW}	$3 \times N_{BPSCS}$	$3 \times N_{BPSCS}$	$3 \times N_{BPSCS}$	$9 \times N_{BPSCS}$	$2 \times N_{BPSCS}$
	N_{ROT} ($N_{SS} = 2$)	2	2	11	29	-

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The interleaver parameters, N_{COL} and N_{ROW}, for the HE-SIG-A and HE-SIG-B fields are defined in the HE-SIG-A/HE-SIG-B column of Table 26-27 (BCC interleaver parameters).

NOTE—DCM is not used on the HE-SIG-A field.

26.3.11.9 Constellation mapping

The mapping between the input bits of the constellation mapper and complex constellation points for BPSK, QPSK, 16-QAM, 64-QAM and 256-QAM is as defined in 21.3.10.9 (Constellation mapping).

1024-QAM is optional for SU and MU for RUs equal to or larger than 242 subcarriers(#1782)(#Ed). For 1024-QAM, the mapping of the bits at the output of the interleaver to the complex constellation points is defined in Figure 26-29 (Constellation bit encoding for 1024-QAM (1st quadrant)), Figure 26-30 (Constellation bit encoding for 1024-QAM (2nd quadrant)), Figure 26-31 (Constellation bit encoding for 1024-QAM (3rd quadrant)) and Figure 26-32 (Constellation bit encoding for 1024-QAM (4th quadrant)).

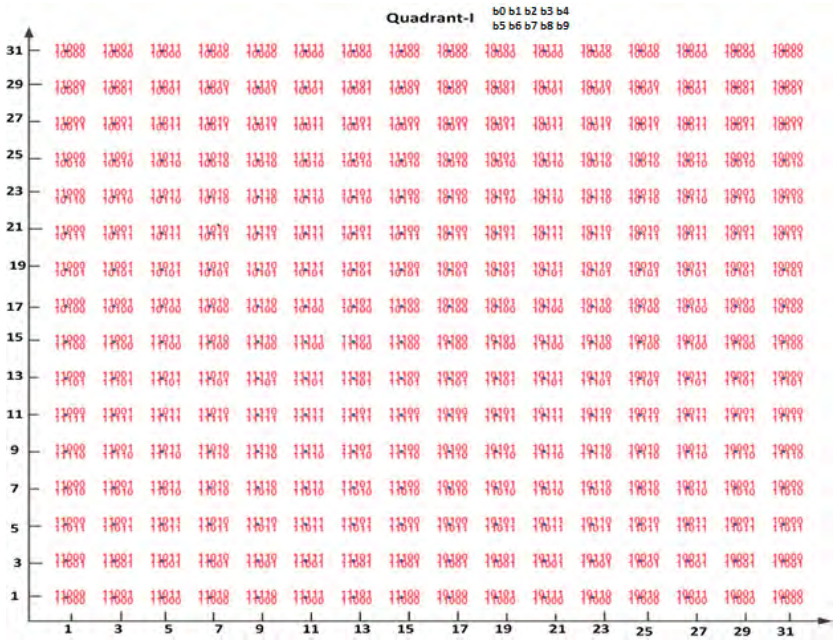

Figure 26-29—Constellation bit encoding for 1024-QAM (1st quadrant)

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Figure 26-30—Constellation bit encoding for 1024-QAM (2nd quadrant)

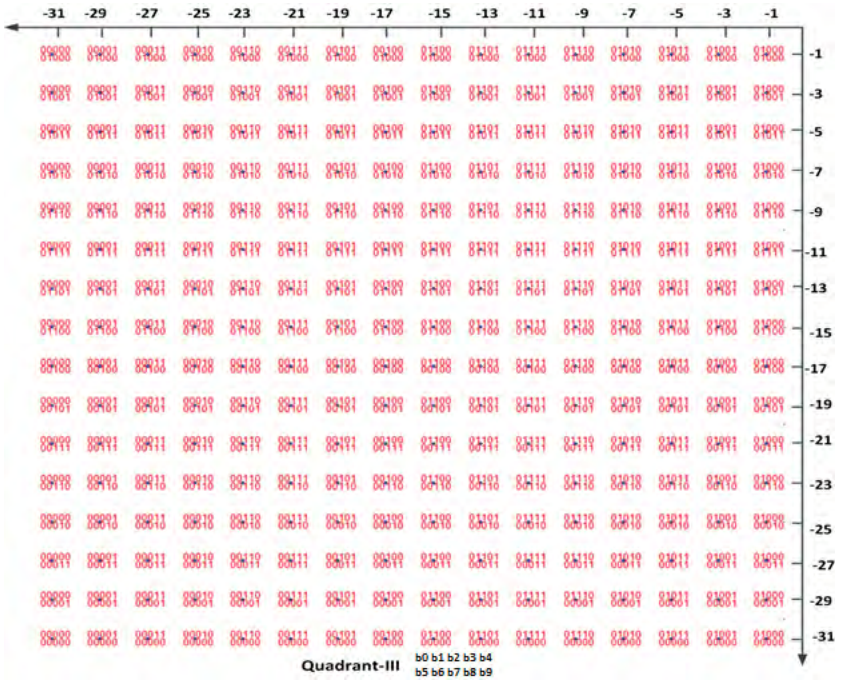

Figure 26-31—Constellation bit encoding for 1024-QAM (3rd quadrant)

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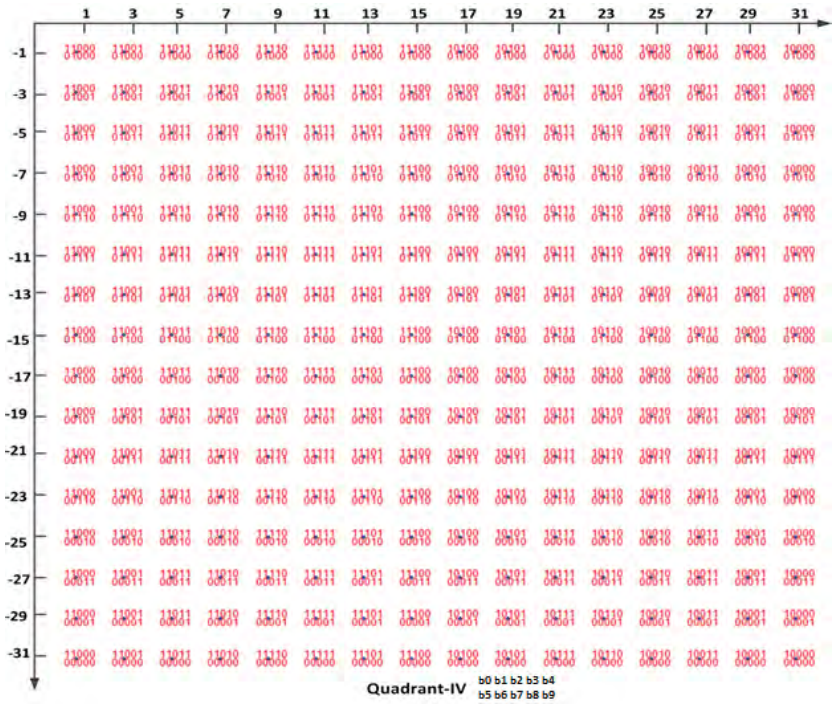

Figure 26-32—Constellation bit encoding for 1024-QAM (4th quadrant)

The normalization factor K_{mod} for 1024 QAM is $1/\sqrt{682}$.(#1782)

Dual subcarrier modulation (DCM) is an optional modulation scheme for the HE-SIG-B and Data fields. DCM can be applied to an HE SU PPDU and an HE extended range SU PPDU. In an HE MU PPDU, DCM can be applied only to RUs containing data for 1 user.(#482)

DCM is only applied to MCS0, MCS 1, MCS 3 and MCS 4. DCM is applied only with $N_{SS} = 1$ or $N_{SS} = 2$ (in the case of single user RU in an HE MU PPDU, $N_{SS,r,u} = 1$ or $N_{SS,r,u} = 2$). DCM is not applied with MU-MIMO or with STBC.

When DCM is employed, bit sequences are mapped to a pair symbols $(d_k, d_{q(k)})$ where k is in the range of $0 \le k \le N_{SD} - 1$ and $q(k)$ is in the range of $N_{SD} \le k \le N_{SD} - 1$ in order to exploit frequency diversity. To maximize the frequency diversity, the indices of a pair of DCM subcarriers $(k, q(k))$ is $q(k) = k + N_{SD}$. The N_{SD} here refers to the N_{SD} with DCM = 1, which is half the value of N_{SD} with DCM = 0.(#482)

For BPSK modulation with DCM, the input stream is broken into groups of N_{CBPS} or $N_{CBPS,u}$ bits $(B_0, B_1, \ldots, B_{N_{CBPS,u}-1})$(#2522). Each bit B_k is BPSK modulated to a sample d_k. This generates the samples for the lower half of the data subcarriers. For the upper half of the subcarriers, the samples are generated as $d_{k+N_{SD}} = d_k \times e^{j(k+N_{SD})\pi}$, $k = 0, 1, \ldots, N_{SD} - 1$. The N_{SD} here refers to the N_{SD} with DCM = 1, which is half the value of N_{SD} with DCM = 0.(#482)

For QPSK modulation with DCM, the input stream is broken into groups of N_{CBPS} or $N_{CBPS,u}$(#333) bits $(B_0, B_1, \ldots, B_{N_{CBPS,u}-1})$ (#2522). Each pair of bits (B_{2k}, B_{2k+1}) is QPSK modulated to a symbol d_k . This

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generates the constellation points for the lower half the data subcarriers in the RU. For the upper half of the data sub-carriers in the RU, $d_{k+N_{SD}} = conj(d_k)$ (#482).

For 16-QAM modulation with DCM, the input stream is broken into groups of N_{CBPS} or $N_{CBPS,u}$ bits ($B_0, B_1, \ldots, B_{N_{CBPS,u}-1}$)(#2522). A group of 4 bits (B_{4k}, B_{4k+1}, B_{4k+2}, B_{4k+3}) is 16-QAM modulated to a sample d_k as described in 18.3.5.8. This is the sample on subcarrier k in the lower half. In the upper half, the sample $d_{k+N_{SD}}$ on subcarrier $k + N_{SD}$ is obtained by 16-QAM modulating a permutation of the bits (B_{4k}, B_{4k+1}, B_{4k+2}, B_{4k+3}). Specifically, $d_{k+N_{SD}}$ is obtained by applying the 16-QAM modulation procedure in 18.3.5.8 to the bit group (B_{4k+1}, B_{4k}, B_{4k+3}, B_{4k+2}). he N_{SD} here refers to the N_{SD} with DCM = 1, which is half the value of N_{SD} with DCM = 0.(#482)

26.3.11.10 Space-time block coding

This subclause defines a set of optional robust transmission techniques that are applicable only when using STBC coding. For an HE PPDU, STBC is allowed only with single spatial stream and two space-time streams, and its application is as indicated by the STBC bit in HE-SIG-A (TBD: undecided whether in HE-SIG-A for HE_MU). In an HE MU PPDU, STBC coding is used in all RUs or not used in any of the RUs. If in an RU, DL MU-MIMO is applied, STBC shall not be used in any RU in the HE MU PPDU.

The STBC encoding process is as described in 22.3.10.9.4 (Space-time block coding)(#1405), with $N_{SS,0} = 1$ and $N_{STS,0} = 2$.

26.3.11.11 LDPC tone mapper

(#1859)The LDPC tone mapping shall be performed on all LDPC encoded streams mapped in an(#Ed) RU as described in this subclause. LDPC tone mapping shall not be performed on streams that are encoded using BCC. When DCM is applied to LDPC encoded streams, $D_{\text{TM_DCM}}$(#1860) shall be applied on both the lower half data subcarriers in an(#Ed) RU and the upper half data subcarriers of the RU. The LDPC tone-mapping distance parameters D_{TM} and D_{TM_DCM} are constant for each RU size and the values for different RU sizes are given in Table 26-28 (LDPC tone mapping distance for each RU size).

Table 26-28—LDPC tone mapping distance for each RU size

Parameter	RU Size (tones)						
	26	52	106	242	484	996	2×996(#1337)
D_{TM}	1	3	6	9	12	20	20
D_{TM_DCM}	1	1	3	9	9	14	14(#1861)

NOTE—The LDPC tone mapping parameters D_{TM} and D_{TM_DCM} are applied for each frequency subblock, $l = 0$ and $l = 1$.(#1866)

For an HE PPDU without DCM, the LDPC tone mapping for the LDPC encoded stream for user u in the r-th RU is done by permuting the stream of complex numbers generated by the constellation mappers (see 26.3.11.9 (Constellation mapping)) to

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$$d''_{t(k),\,i,\,n,\,l,\,r,\,u} = d'_{k,\,i,\,n,\,l,\,r,\,u};$$

$k = 0, 1, \ldots, N_{SD} - 1$ for a 26-, 52-, 106-, 242-, 484- and 996-tone RU

$k = 0, 1, \ldots, \frac{N_{SD}}{2} - 1$ for a 2x996-tone RU

$i = 1, \ldots, N_{SS,\,r,\,u}$

$n = 0, 1, \ldots, N_{SYM} - 1$

$l = 0$ for a 26-, 52-, 106-, 242-, 484- and 996-tone RU

$l = 0, 1$ for a 2x996-tone RU

$u = 0, \ldots, N_{user,\,r} - 1$

$r = 0, \ldots, N_{RU} - 1$

(26-97)

where N_{SD} is the number of data tones in the r-th RU.

$$t(k) = \begin{cases} D_{TM}\left(k \bmod \frac{N_{SD}}{D_{TM}}\right) + \left\lfloor \frac{k \cdot D_{TM}}{N_{SD}} \right\rfloor, & \text{for a 26-, 52-, 106-, 242-, 484- and 996-tone RU} \\ D_{TM}\left(k \bmod \frac{N_{SD}/2}{D_{TM}}\right) + \left\lfloor \frac{k \cdot D_{TM}}{N_{SD}/2} \right\rfloor, & \text{for a 2x996-tone RU} \end{cases} \quad (26\text{-}98)$$

For an(#2829) HE PPDU with DCM, the LDPC tone mapping for the LDPC encoded stream corresponding to user u in the r-th RU is done by permuting the stream of complex numbers generated by the constellation mappers (see 25.3.10.7) to

$$d''_{t(k),i,n,l,r,u} = \begin{cases} d'_{k,i,n,l,r,u}; \\ d'_{k',i,n,l,r,u}; \end{cases} \quad (26\text{-}99)$$

where

$k = 0, 1, \ldots, \frac{N_{SD}}{2} - 1$

$k' = k - \frac{N_{SD}}{2}$, for $k = \frac{N_{SD}}{2}, \frac{N_{SD}}{2} + 1, \ldots, N_{SD} - 1$

$i = 1, \ldots, N_{SS,\,r,\,u}$

$n = 0, 1, \ldots, N_{SYM} - 1$

$l = \begin{cases} 0 \text{ for a 26-, 52-, 106-, 242-, 494- and 996-tone RU} \\ 0, 1 \text{ for a 2x996-tone RU} \end{cases}$

$u = 0, \ldots, N_{user,\,r} - 1$

$r = 0, \ldots, N_{RU} - 1$

N_{SD} is the number of data tones in the r-th RU and

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$$t(k) = \begin{cases} D_{\mathrm{TM_DCM}}\left(k \bmod \dfrac{N_{SD}/2}{D_{\mathrm{TM_DCM}}}\right) + \left\lfloor \dfrac{k \cdot D_{\mathrm{TM_DCM}}}{N_{SD}/2} \right\rfloor, & \text{for a 26-, 52-, 106-, 242-, 484- and 996-tone RU} \\ D_{\mathrm{TM_DCM}}\left(k' \bmod \dfrac{N_{SD}/2}{D_{\mathrm{TM_DCM}}}\right) + \left\lfloor \dfrac{k' \cdot D_{\mathrm{TM_DCM}}}{N_{SD}/2} \right\rfloor + \dfrac{N_{SD}}{2}, & \text{for a 26-, 52-, 106-, 242-, 484- and 996-tone RU} \\ D_{\mathrm{TM_DCM}}\left(k \bmod \dfrac{N_{SD}/2}{D_{\mathrm{TM_DCM}}}\right) + \left\lfloor \dfrac{k \cdot D_{\mathrm{TM_DCM}}}{N_{SD}/2} \right\rfloor, & \text{for a 2x996-tone RU} \end{cases} \quad (26\text{-}100)$$

D_{TM_DCM} is the LDPC tone mapping distance for the r-th RU when DCM is applied.

NOTE—LDPC tone mapper for a 26-, 52-, 106-, 242-, 484- and 996-tone RU is defined as one segment(#2088). LDPC tone mapping is performed separately for the upper and lower 80 MHz frequency segments of a 2×996-tone RU(#1337) as indicated by the frequency subblock index l in Error! Reference source not found. and Error! Reference source not found.

Since LDPC tone mapping is not performed on BCC-coded streams, for BCC-coded streams, the following applies:

$$d''_{k,i,n,l,r,u} = d'_{k,i,n,l,r,u};$$

$k = 0, 1, \ldots, N_{SD} - 1$ for a 26-, 52-, 106-, 242-, 484- and 996-tone RU

$k = 0, 1, \ldots, \dfrac{N_{SD}}{2} - 1$ for a 2x996-tone RU

$i = 1, \ldots, N_{SS,r,u}$

$n = 0, 1, \ldots, N_{SYM} - 1$ (26-101)

$l = 0$ for a 26-, 52-, 106-, 242-, 484- and 996-tone RU

$l = 0, 1$ for a 2x996-tone RU

$u = 0, \ldots, N_{user,r} - 1$

$r = 0, \ldots, N_{RU} - 1$

26.3.11.12 Segment deparser

For a 26-, 52-, 106-, 242-, 484- and 996-tone RU(#Ed), the segment deparsing is not performed and $d^{(i_{Seg})}_{k,i,n,l,r,u}$ is specified in Equation (26-102).

$$d^{(i_{Seg})}_{k,i,n,l,r,u} = d''_{k,i,n,0,r,u}, \quad \text{if } 0 \le k \le N_{SD} - 1, i_{Seg} = 0 \quad (26\text{-}102)$$

For a 2×996-tone RU in a 160 MHz HE PPDU(#Ed), the two frequency subblocks at the output of the LDPC tone mapper are combined into one frequency segment as specified in Equation (26-103).

$$d^{(i_{Seg})}_{k,i,n,l,r,u} = \begin{cases} d''_{k,i,n,0,r,u}, & \text{if } 0 \le k \le \dfrac{N_{SD}}{2} - 1 \\ d''_{k-\frac{N_{SD}}{2},i,n,l,r,u}, & \text{if } \dfrac{N_{SD}}{2} \le k \le N_{SD} - 1 \end{cases}, i_{Seg} = 0 \quad (26\text{-}103)$$

For a 2×996-tone RU in an 80+80 MHz HE PPDU, the segment deparsing is not performed and $d^{(i_{Seg})}_{k,i,n,l,r,u}$ is specified in Equation (26-104).

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$$d^{(i_{Seg})}_{k,\,i,\,n,\,r,\,u} = d''_{k,\,i,\,n,\,i_{Seg},\,r,\,u}, \quad \text{if } 0 \le k \le N_{SD} - 1,\ i_{Seg} = 0, 1 \tag{26-104}$$

NOTE—As per Table 21-7 (center frequency for frequency segment iSeg = 0), $f_c^{(0)}$ is always less than $f_c^{(1)}$ in case of 80+80 MHz HE PPDU. Hence, $d''_{k,\,i,\,n,\,0,\,r,\,u}$ (frequency subblock 0) is always transmitted in the frequency segment lower in frequency, while $d''_{k,\,i,\,n,\,1,\,r,\,u}$ (frequency subblock 1) is always transmitted in the frequency segment higher in frequency.(#2092)

26.3.11.13 Pilot subcarriers

For a user transmitting on the *i*-th 26-tone RU in a given PPDU BW, two pilot tones shall be inserted in subcarriers $k \in K_{R26_i}$, where K_{R26_i} is given by the(#926) *i*-th pilot index set in the row of given PPDU BW of Table 26-29 (Pilot indices for a 26-tone RU).

Table 26-29—Pilot indices for a 26-tone RU

PPDU BW	K_{R26_i}
20 MHz, *i* = 1:9	−116/−102, −90/−76, −62/−48, −36/−22, −10/10, 22/36, 48/62, 76/90, 102/116
40 MHz, *i* = 1:18	−238/−224, −212/−198, −184/−170, −158/−144, −130/−116, −104/−90, −78/−64, −50/−36, −24/−10, 10/24, 36/50, 64/78, 90/104, 116/130, 144/158, 170/184, 198/212, 224/238
80 MHz, *i* = 1:37	−494/−480, −468/−454, −440/−426, −414/−400, −386/−372, −360/−346, −334/−320, −306/−292, −280/−266, −252/−238, −226/−212, −198/−184, −172/−158, −144/−130, −118/−104, −92/−78, −64/−50, −38/−24, −10/10, 24/38, 50/64, 78/92, 104/118, 130/144, 158/172, 184/198, 212/226, 238/252, 266/280, 292/306, 320/334, 346/360, 372/386, 400/414, 426/440, 454/468, 480/494
160 MHz, *i* = 1:74	{pilot tone indices in 80 MHz −512, pilot tone indices in 80 MHz +512}

The pilot mapping P_n^k(#346) for the(#927) subcarrier *k* for symbol *n* shall be as specified in Equation (26-105).

$$\begin{aligned} P_n^{K_{R26_i}} &= \{\Psi_{n \bmod 2}, \Psi_{(n+1) \bmod 2}\} \text{ (\#347)} \\ P_n^{k \notin K_{R26_i}} &= 0 \end{aligned} \tag{26-105}$$

where

Ψ_m is defined in Table 26-30 (The 2 pilot values for a 26-tone RU(#347))

Table 26-30—The 2 pilot values for a 26-tone RU(#347)

Ψ_0	Ψ_1
1	−1

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For a user transmitting on the *i*-th 52-tone RU in a given PPDU BW, four pilot tones shall be inserted in subcarriers $k \in K_{R52_i}$, where K_{R52_i} is given by the(#Ed) *i*-th pilot index set in the row of given PPDU BW of Table 26-31 (Pilot indices for 52-tone RU transmission).

Table 26-31—Pilot indices for 52-tone RU transmission

PPD BW	K_{R52_i}
20 MHz, i = 1:4	−116/−102/−90/−76, −62/−48/−36/−22, 22/36/48/62, 76/90/102/116
40 MHz, i = 1:8	−238/−224/−212/−198, −184/−170/−158/−144, −104/−90/−78/−64, −50/−36/−24/−10, 10/24/36/50, 64/78/90/104, 144/158/170/184, 198/212/224/238
80 MHz, i = 1:16	−494/−480/−468/−454, −440/−426/−414/−400, −360/−346/−334/−320, −306/−292/−280/−266, −252/−238/−226/−212, −198/−184/−172/−158, −118/−104/−92/−78, −64/−50/−38/−24, 24/38/50/64, 78/92/104/118, 158/172/184/198, 212/226/238/252, 266/280/292/306, 320/334/346/360, 400/414/426/440, 454/468/480/494
160 MHz, i = 1:32	{pilot tone indices in 80 MHz −512, pilot tone indices in 80 MHz +512}

The pilot mapping P_n^k(#346) for the(#933) subcarrier k for symbol n shall be as specified in Equation (26-106).

$$P_n^{K_{R52_i}} = \{\Psi_{n \bmod 4}, \Psi_{(n+1) \bmod 4}, \Psi_{(n+2) \bmod 4}, \Psi_{(n+3) \bmod 4}\} \text{ (#347)}$$
$$P_n^{k \notin K_{R52_i}} = 0 \qquad (26\text{-}106)$$

where

Ψ_m is defined in Table 26-32 (The 4 pilot values in a 52- and 106-tone RU(#347))

Table 26-32—The 4 pilot values in a 52- and 106-tone RU(#347)

Ψ_0	Ψ_1	Ψ_2	Ψ_3
1	1	1	−1

For a user transmitting on the *i*-th 106-tone RU in a given PPDU BW, four pilot tones shall be inserted in subcarriers $k \in K_{R106_i}$, where K_{R106_i} is given by the(#932) *i*-th pilot index set in the row of given PPDU BW of Table 26-33 (Pilot indices for 106-tone RU transmission).

Table 26-33—Pilot indices for 106-tone RU transmission

PPD BW	K_{R106_i}
20 MHz, i = 1:2	−116/−90/−48/−22, 22/48/90/116

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Table 26-33—Pilot indices for 106-tone RU transmission *(continued)*

40 MHz, i = 1:4	−238/−212/−170/−144, −104/−78/−36/−10, 10/36/78/104, 144/170/212/238
80 MHz, i = 1:8	−494/−468/−426/−400, −360/−334/−292/−266, −252/−226/−184/−158, −118/−92/−50/−24, 24/50/92/118, 158/184/226/252, 266/292/334/360, 400/426/468/494
160 MHz, i = 1:16	{pilot tone indices in 80 MHz −512, pilot tone indices in 80 MHz +512}

The pilot mapping P_n^k (#346) for the(#930) subcarrier k for symbol n shall be as specified in Equation (26-107).

$$P_n^{K_{R106_i}} = \{\Psi_{n \bmod 4}, \Psi_{(n+1) \bmod 4}, \Psi_{(n+2) \bmod 4}, \Psi_{(n+3) \bmod 4}\}$$
$$P_n^{k \notin K_{R106_i}} = 0 \quad (26\text{-}107)$$

where

Ψ_m is defined in Table 26-32 (The 4 pilot values in a 52- and 106-tone RU(#347))

For a user transmitting on the i-th 242-tone RU in a given PPDU BW, eight pilot tones shall be inserted in subcarriers $k \in K_{R242_i}$, where K_{R242_i} is given by the(#929) i-th pilot index set in the row of given PPDU BW of Table 26-34 (Pilot indices for 242-tone RU transmission).

Table 26-34—Pilot indices for 242-tone RU transmission

PPD BW	K_{R242_i}
20 MHz, i = 1	−116/−90/−48/−22/22/48/90/116
40 MHz, i = 1:2	−238/−212/−170/−144/−104/−78/−36/−10, 10/36/78/104/144/170/212/238
80 MHz, i = 1:4	−494/−468/−426/−400/−360/−334/−292/−266,−252/−226/−184/−158/−118/−92/−50/−24, 24/50/92/118/158/184/226/252, 266/292/334/360/400/426/468/494
160 MHz, i = 1:8	{pilot tone indices in 80 MHz −512, pilot tone indices in 80 MHz +512}

The pilot mapping P_n^k (#346) for the(#936) subcarrier k for symbol n shall be as specified in Equation (26-108).

$$P_n^{K_{R242_i}} = \{\Psi_{n \bmod 8}, \Psi_{n+1 \bmod 8}, \Psi_{n+2 \bmod 8}, \Psi_{n+3 \bmod 8}, \Psi_{(n+4) \bmod 8}, \Psi_{(n+5) \bmod 8}, \Psi_{(n+6) \bmod 8}, \Psi_{(n+7) \bmod 8}\}$$
$$P_n^{k \notin K_{R242_i}} = 0 \quad (26\text{-}108)$$

where

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Ψ_m is defined in Table 26-35 (The 8 pilot values in a 242-tone RU(#347))

Table 26-35—The 8 pilot values in a 242-tone RU(#347)

Ψ_0	Ψ_1	Ψ_2	Ψ_3	Ψ_4	Ψ_5	Ψ_6	Ψ_7
1	1	1	−1	−1	1	1	1

For a 484-tone RU transmission, the pilot mapping for 8 pilots in 242-tone RU is replicated in the two 242-RUs of the 484-tone RU transmission. Specifically, for(#347) a user transmitting on the *i*-th 484-tone RU in a given PPDU BW, sixteen pilot tones shall be inserted in subcarriers $k \in K_{R484_i}$, where K_{R484_i} is given by the(#938) *i*-th pilot index set in the row of given PPDU BW of Table 26-36 (Pilot indices for 484-tone RU transmission).

Table 26-36—Pilot indices for 484-tone RU transmission

PPD BW	K_{R484_i}
40 MHz, i = 1	−238/−212/−170/−144/−104/−78/−36/−10/10/36/78/104/144/170/212/238
80 MHz, i = 1:2	−494/−468/−426/−400/−360/−334/−292/−266/−252/−226/−184/−158/−118/−92/−50/−24, 24/50/92/118/158/184/226/252/266/292/334/360/400/426/468/494
160 MHz, i = 1:4	{pilot tone indices in 80 MHz −512, pilot tone indices in 80 MHz +512}

The pilot mapping P_n^k(#346) for the(#942) subcarrier k for symbol n shall be as specified in Equation (26-109).

$$
\begin{aligned}
P_n^{K_{R484_i}} = \{ & \Psi_{n \bmod 8}, \Psi_{n+1 \bmod 8}, \Psi_{n+2 \bmod 8}, \Psi_{n+3 \bmod 8}, \\
& \Psi_{(n+4) \bmod 8}, \Psi_{(n+5) \bmod 8}, \Psi_{(n+6) \bmod 8}, \Psi_{(n+7) \bmod 8}, \\
& \Psi_{(n+8) \bmod 8}, \Psi_{(n+9) \bmod 8}, \Psi_{(n+10) \bmod 8}, \Psi_{(n+11) \bmod 8}, \quad \text{(\#347)} \\
& \Psi_{(n+12) \bmod 8}, \Psi_{(n+13) \bmod 8}, \Psi_{(n+14) \bmod 8}, \Psi_{(n+15) \bmod 8} \} \\
P_n^{k \notin K_{R484_i}} = 0 &
\end{aligned}
\qquad \text{(26-109)}
$$

where

Ψ_m is defined in Table 26-35 (The 8 pilot values in a 242-tone RU(#347))

For a 996-tone RU transmission, the pilot mapping for its 16 pilots is the same as the mapping for 484-tone RU transmission. Specifically, for(#347) a user transmitting on the *i*-th 996-tone RU in a given PPDU BW,

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sixteen pilot tones shall be inserted in subcarriers $k \in K_{R996_i}$, where K_{R996_i} is given by the(#941) i-th pilot index set in the row of given PPDU BW of Table 26-37 (Pilot indices for 996-tone RU transmission).

Table 26-37—Pilot indices for 996-tone RU transmission

PPD BW	K_{R996_i}
80 MHz, i = 1	–468/–400/–334/–266/–226/–158/–92/–24/24/92/158/226/266/334/400/468
160 MHz, i = 1:2	{for i = 1 pilot tone indices in 80 MHz –512, for i = 2 pilot tone indices in 80 MHz +512}(#2095)

The pilot mapping P_n^k(#346) for the(#939) subcarrier k for symbol n shall be as specified in Equation (26-110).

$$
\begin{aligned}
P_n^{K_{R996_i}} = \{ & \Psi_{n \bmod 8}, \Psi_{(n+1) \bmod 8}, \Psi_{(n+2) \bmod 8}, \Psi_{(n+3) \bmod 8}, \\
& \Psi_{(n+4) \bmod 8}, \Psi_{(n+5) \bmod 8}, \Psi_{(n+6) \bmod 8}, \Psi_{(n+7) \bmod 8}, \\
& \Psi_{(n+8) \bmod 8}, \Psi_{(n+9) \bmod 8}, \Psi_{(n+10) \bmod 8}, \Psi_{(n+11) \bmod 8}, \quad \text{(\#347)} \\
& \Psi_{(n+12) \bmod 8}, \Psi_{(n+13) \bmod 8}, \Psi_{(n+14) \bmod 8}, \Psi_{(n+15) \bmod 8} \} \\
P_n^{k \notin K_{R996_i}} = 0 &
\end{aligned}
\qquad \text{(26-110)}
$$

where

Ψ_m is defined in Table 26-35 (The 8 pilot values in a 242-tone RU(#347))

For a 160 MHz transmission (equivalently two 996-tone RU transmissions), the 80 MHz (equivalently 996-tone RU)(#347) pilot mapping is replicated in the two 80 MHz subchannels of the 160 MHz transmission. Specifically, thirty-two pilot tones shall be inserted in subcarriers $k \in K_{R2x996_i}$, where K_{R2x996_i} is given by {–980, –912, –846, –778, –738, –670, –604, –536, –488, –420, –354, –286, –246, –178, –112, –44, 44, 112, 178, 246, 286, 354, 420, 488, 536, 604, 670, 738, 778, 846, 912, 980}. The pilot mapping P_n^k(#346) for the(#944) subcarrier k for symbol n shall be as specified in Equation (26-111).

$$
\begin{aligned}
P_n^{K_{R2x996_i}} = \{ & \Psi_{n \bmod 8}, \Psi_{(n+1) \bmod 8}, \Psi_{(n+2) \bmod 8}, \Psi_{(n+3) \bmod 8}, \\
& \Psi_{(n+4) \bmod 8}, \Psi_{(n+5) \bmod 8}, \Psi_{(n+6) \bmod 8}, \Psi_{(n+7) \bmod 8}, \\
& \Psi_{(n+8) \bmod 8}, \Psi_{(n+9) \bmod 8}, \Psi_{(n+10) \bmod 8}, \Psi_{(n+11) \bmod 8}, \\
& \Psi_{(n+12) \bmod 8}, \Psi_{(n+13) \bmod 8}, \Psi_{(n+14) \bmod 8}, \Psi_{(n+15) \bmod 8}, \\
& \Psi_{n \bmod 8}, \Psi_{(n+1) \bmod 8}, \Psi_{(n+2) \bmod 8}, \Psi_{(n+3) \bmod 8}, \quad \text{(\#347)} \\
& \Psi_{(n+4) \bmod 8}, \Psi_{(n+5) \bmod 8}, \Psi_{(n+6) \bmod 8}, \Psi_{(n+7) \bmod 8}, \\
& \Psi_{(n+8) \bmod 8}, \Psi_{(n+9) \bmod 8}, \Psi_{(n+10) \bmod 8}, \Psi_{(n+11) \bmod 8}, \\
& \Psi_{(n+12) \bmod 8}, \Psi_{(n+13) \bmod 8}, \Psi_{(n+14) \bmod 8}, \Psi_{(n+15) \bmod 8} \} \\
P_n^{k \notin K_{R2x996_i}} = 0 &
\end{aligned}
\qquad \text{(26-111)}
$$

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where

Ψ_m is defined in Table 26-35 (The 8 pilot values in a 242-tone RU(#347))

For a noncontiguous 80+80 MHz transmission, each frequency segment shall follow the 80 MHz pilot tone allocation and values defined for 996-tone RU in 80 MHz transmission as specified in Equation (26-110) and TBD pilot values for 996-tone RU in 80 MHz PPDU BW.

The above pilot mapping shall be copied to all space-time streams before the space-time stream cyclic shifts are applied.

26.3.11.14 OFDM modulation

The time domain waveform of the Data field of an HE PPDU that is not an HE trigger-based PPDU, from transmit chain i_{TX}, $1 \le i_{TX} \le N_{TX}$ and frequency segment i_{Seg}(#2097), shall be as defined in Equation (26-112).

$$r_{\text{HE-Data}}^{(i_{Seg} i_{TX})}(t) = \frac{1}{\sqrt{\sum_{r=1}^{N_{RU}} \alpha_r^2 |K_r|}} \sum_{n=0}^{N_{SYM}-1} w_{T_{\text{HE-Data}}}(t - nT_{SYM}) \sum_{r=0}^{N_{RU}-1} \frac{\alpha_r}{\sqrt{N_{STS,\,r,\,total}}} \sum_{k \in K_r} \sum_{u=0}^{N_{user,\,r}-1} \sum_{m=1}^{N_{STS,\,r,\,u}} \left(\left[Q_k^{(i_{Seg})} \right]_{i_{TX},\,(M_{r,\,u}+m)} \left(\tilde{D}_{k,\,m,\,n,\,r}^{(i_{Seg},\,u)} + p_{n+2+N_{\text{HE-SIG-A}}+N_{\text{HE-SIG-B}}} P_n^k \right) \cdot \exp(j2\pi k \Delta_{F,\,\text{HE}}(t - nT_{SYM} - T_{GI,\,Data} - T_{CS,\,\text{HE}}(M_{r,\,u}+m))) \right) \quad (26\text{-}112)$$

where

p_n is defined in 18.3.5.10 (OFDM modulation)

P_n^k is defined in 26.3.11.13 (Pilot subcarriers)(#1056)(#334)

$N_{\text{HE-Data}}^{\text{Tone}}$ is defined in Table 26-14 (Tone scaling factor and guard interval duration values for HE PPDU fields)(#476)

$T_{CS,\,\text{HE}}(M_{r,\,u}+m)$ represents the cyclic shift for space time stream $M_{r,u}+m$ as defined in 26.3.10.2.2 (Cyclic shift for HE modulated fields)(#1052)

$T_{GI,\,Data}$ is the guard interval duration as defined in Table 26-9 (Timing-related constants)

$\tilde{D}_{k,\,m,\,n,\,r}^{(i_{Seg},\,u)}$ is the transmitted constellation for user u in the r-th RU at subcarrier k, space-time stream m, and Data field OFDM symbol n and is defined by Equation (26-113).

$$\tilde{D}_{k,\,m,\,n,\,r}^{(i_{Seg},\,u)} = \begin{cases} 0, & k \in K_{\text{Pilot}} \\ \tilde{d}_{M_r(k),\,m,\,n,\,r,\,u}^{(i_{Seg})}, & \text{otherwise} \end{cases} \quad (26\text{-}113)$$

where

K_{Pilot} is the set of subcarrier indices of pilot tones, as defined in 26.3.3.3 (Pilot tones)

$M_r(k)$ is defined in Equation (26-114)

$$M_r(k) = k - K_{r,\,\min} - \left| \{ k' : K_{r,\,\min} \le k' < k \} \cap K_{\text{Pilot}} \right| \quad (26\text{-}114)$$

where

$K_{r,min}$ is the minimum value of the set K_r

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$|\Phi|$ is the cardinality of a set Φ

NOTE – $M_r(k)$ translates a subcarrier index k ($-N_{SR} \le k \le N_{SR}$) into the index of data symbols in a transmission over an RU(#1948) ($0 \le M_r(k) \le N_{SD,r}$). The subcarrier index k for the data tone is first offset by the minimum value of subcarrier index $K_{r,min}$ (for the lower edge tone) in this RU, and then subtracted by the number of pilot tones falling in between the data tone and the edge tone.

In a noncontiguous 80+80 MHz transmission, each frequency segment shall follow the 80 MHz HE subcarrier mapping as specified in 26.3.9 (Mathematical description of signals).

The time domain waveform of the Data field of an HE trigger-based PPDU for user u in the r-th RU from transmit chain i_{TX}, $1 \le i_{TX} \le N_{TX}$ shall be as defined in Equation (26-115).

$$r_{\text{HE-Data}}^{(i_{Seg} i_{TX})}(t) = \frac{\alpha_r}{\sqrt{|K_r|}} \sum_{n=0}^{N_{SYM}-1} w_{T_{\text{HE-Data}}}(t - nT_{SYM}) \frac{1}{\sqrt{N_{STS,\,r,\,total}}} \sum_{k \in K_r} \sum_{m=1}^{N_{STS,\,r,\,u}} \left(\left[Q_k^{(i_{Seg})} \right]_{i_{TX},\,(M_{r,\,u}+m)} (\tilde{D}_{k,\,m,\,n,\,r}^{(i_{Seg},\,u)} + p_{n+4} P_n^k) \cdot \exp(j2\pi k \Delta_{F,\,\text{HE}}(t - nT_{SYM} - T_{GI,\,Data} - T_{CS,\,HE}(M_{r,\,u}+m))) \right) \quad \text{(26-115)}$$

(#2099)

where

$Q_k^{(i_{Seg})}$ is a spatial mapping/steering matrix with N_{TX} rows and $N_{STS,r,total}$ columns for subcarrier k in frequency segment i_{Seg}. $Q_k^{(i_{Seg})}$ may be frequency dependent, and the dimension may be variant in each RU. Refer to the descriptions in 22.3.10.11.1 (Transmission in VHT format) for examples of $Q_k^{(i_{Seg})}$.

26.3.11.15 Dual carrier modulation

Dual carrier modulation (DCM)(#2567) modulates the same information on a pair of sub-carriers. DCM is an optional modulation scheme for the HE-SIG-B and Data fields. DCM is only applied to BPSK, QPSK and 16-QAM modulations.

The constellation mapper for DCM is defined in 26.3.11.9 (Constellation mapping). The LDPC tone mapper for DCM is defined in 26.3.11.11 (LDPC tone mapper). The BCC interleaver for DCM is defined in 26.3.11.8 (BCC interleavers)(#2183).(#335)

26.3.12 Packet extension(#1781)

A HE PPDU may have a Packet Extension (PE) field appended at the end of the PPDU, with possible durations being 0 µs, 4 µs, 8 µs, 12 µs, or 16 µs. The PE field, when present, shall be transmitted with the same average power as the Data field, and its content is arbitrary(#2100).

The PE field is applied for the recipient of the PPDU to obtain longer processing time at the end of an(#2829) HE PPDU, and its duration is determined by both the pre-FEC padding factor(#2564) value in the last OFDM symbol(s) of the Data field, and the maximum PE duration requested by the recipient for the signal bandwidth (or RU size), the number of spatial streams, and the constellation size of the current PPDU, which is based on the PPE Thresholds(#1459) field in HE Capabilities element (see 9.4.2.218 (HE Capabilities element))(#1460)(#Ed).

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For an(#2829) HE PPDU, the maximum PE durations as defined by the PPE Thresholds field in the HE Capabilities element (see 9.4.2.218 (HE Capabilities element))(#1459)(#Ed) are 0 µs, 8 µs and 16 µs.

— A 0 µs maximum PE duration means no PE is present.

— A 8 µs maximum PE duration means that a PE field of 0 µs, 0 µs, 4 µs, and 8 µs are appended at the end of the PPDU, corresponding to a pre-FEC padding factor of(#2564) 1, 2, 3 and 4, respectively, as shown in Figure 26-33 (PE field when maximum PE duration is 8 µs (non STBC)).

— A 16 µs maximum PE duration means that a PE field of 4 µs, 8 µs, 12 µs, and 16 µs are appended at the end of the PPDU, corresponding to a pre-FEC padding factor of(#2564) 1, 2, 3 and 4, respectively, as shown in Figure 26-34 (PE field when maximum PE duration is 16 µs (non STBC)).

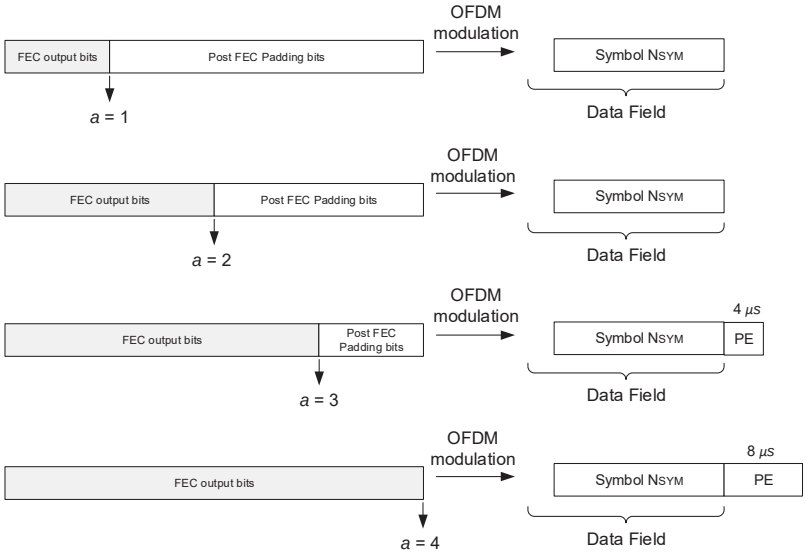

Figure 26-33—PE field when maximum PE duration is 8 µs (non STBC)

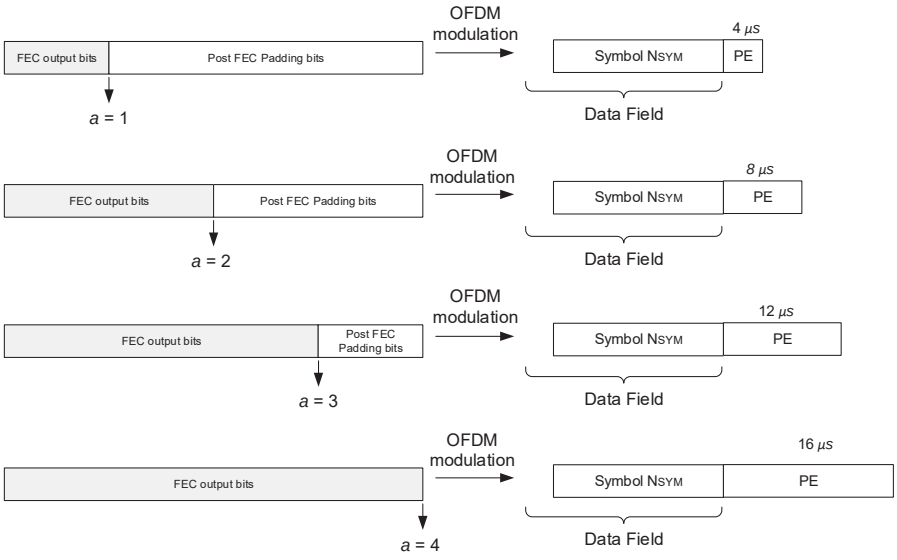

Figure 26-34—PE field when maximum PE duration is 16 µs (non STBC)

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For an HE MU PPDU, the AP computes the PE duration, $T_{PE,u}$, for each user u, according to the common pre-FEC padding factor(#1626)(#2564) value among all users as described in 26.3.11.5.4 (Encoding process for an HE MU PPDU), the Maximum PE Duration capabilities, the RU size, the number of spatial streams and constellation size for user u. The AP shall choose the largest PE duration among all the users as the common PE duration of the current HE MU PPDU as:

$$T_{PE} = \max_u(T_{PE,u}) \tag{26-116}$$

and then append the PE field at the end of the current HE MU PPDU, with duration T_{PE}.

For an HE trigger-based PPDU, the AP indicates the packet extension duration information for all users in the Packet Extension subfield in the Common Info field of the Trigger frame(#Ed). The first two bits in the Packet Extension subfield indicate the pre-FEC padding factor(#2564) and the third bit indicates the PE-Disambiguity. Each user, when responding to(#2103) the Trigger frame with an HE trigger-based PPDU, shall append PE field at the end of the current HE trigger-based PPDU, with a duration T_{PE}. The value of T_{PE} can be calculated using Equation (26-117).(#2135)

$$T_{PE} = \left\lfloor \frac{\left(\frac{\text{LENGTH} + m + 3}{3} \times 4 - T_{\text{RL-SIG}} - T_{\text{HE-SIG-A}} - T_{\text{HE-PREAMBLE}}\right) - N_{SYM} T_{SYM}}{4} \right\rfloor \times 4 \tag{26-117}$$

where

$$N_{SYM} = \left\lfloor \left(\frac{\text{LENGTH} + m + 3}{3} \times 4 - T_{\text{RL-SIG}} - T_{\text{HE-SIG-A}} - T_{\text{HE-PREAMBLE}}\right) / T_{SYM} \right\rfloor - b_{\text{PE-Disambiguity}}$$

LENGTH is the value indicated by Length subfield of the Common Info field in the Trigger frame

$b_{\text{PE-Disambiguity}}$ is B2 of the Packet Extension subfield of the Common Info field in the Trigger frame

$T_{\text{HE-PREAMBLE}} = T_{\text{HE-STF-T}} + N_{\text{HE-LTF}} T_{\text{HE-LTF},SYM}$

$T_{\text{HE-STF-T}}$, $T_{\text{HE-LTF},SYM}$, $T_{\text{RL-SIG}}$ and $T_{\text{HE-SIG-A}}$ are defined in Table 26-9 (Timing-related constants)

Editor's Note: The HE-SIG-A bits definition below should be moved into 26.3.10.7 (HE-SIG-A)

The 3-bit Packet Extension field in HE-SIG-A are defined as in Table 26-38 (Packet Extension field in HE-SIG-A).

Table 26-38—Packet Extension field in HE-SIG-A

Name	bits	Definition
Pre-FEC Padding Factor(#2564)	B0-B1	Indicates the pre-FEC padding factor(#1626)(#2564) value of the current PPDU
PE Disambiguity	B2	Indicates PE disambiguity

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The Pre-FEC Padding Factor(#2564) subfield of the Packet Extension field is encoded as shown in Table 26-39 (Pre-FEC Padding Factor(#2564) subfield encoding).

Table 26-39—Pre-FEC Padding Factor(#2564) subfield encoding

Pre-FEC padding factor value	Pre-FEC Padding Factor subfield encoding
1	b01
2	b10
3	b11
4	b00

The PE Disambiguity(#1049) subfield of the Packet Extension field shall be set to 1 if the condition in Equation (26-118) is met, otherwise it shall be set to 0.

$$T_{PE} + 4 \times \left(\left\lceil \frac{\text{TXTIME} - 20}{4} \right\rceil - \left(\frac{\text{TXTIME} - 20}{4} \right) \right) \geq T_{SYM} \quad (26\text{-}118)$$

where

T_{PE} is the PE field duration

T_{SYM} is the symbol duration of the Data field as defined in 26.3.8 (Timing-related parameters)

TXTIME (in µs) is defined in 26.4.2 (TXTIME and PSDU_LENGTH calculation).

(#2105)The receiver computes N_{SYM} and T_{PE} using Equation (26-119) and Equation (26-120), respectively.

$$N_{SYM} = \left\lfloor \left(\frac{\text{L_LENGTH} + m + 3}{3} \times 4 - T_{\text{HE-PREAMBLE}} \right) / T_{SYM} \right\rfloor - b_{\text{PE-Disambiguity}} \quad (26\text{-}119)$$

$$T_{PE} = \left\lfloor \frac{\left(\frac{\text{L_LENGTH} + m + 3}{3} \times 4 - T_{\text{HE-PREAMBLE}} \right) - N_{SYM} T_{SYM}}{4} \right\rfloor \times 4 \quad (26\text{-}120)$$

where

$$T_{\text{HE-PREAMBLE}} = \begin{cases} T_{\text{RL-SIG}} + T_{\text{HE-SIG-A}} + T_{\text{HE-STF-T}} + N_{\text{HE-LTF}} T_{\text{HE-STF, SYM}}, \text{ for an HE trigger-based PPDU} \\ T_{\text{RL-SIG}} + T_{\text{HE-SIG-A}} + T_{\text{HE-STF-NT}} + N_{\text{HE-LTF}} T_{\text{HE-STF, SYM}}, \text{ for an HE SU PPDU} \\ T_{\text{RL-SIG}} + T_{\text{HE-SIG-A}} + N_{\text{HE-SIG-B}} T_{\text{HE-SIG-B}} + T_{\text{HE-STF-NT}} + N_{\text{HE-LTF}} T_{\text{HE-STF, SYM}}, \text{ for an HE MU PPDU} \\ T_{\text{RL-SIG}} + T_{\text{HE-SIG-A}} + T_{\text{HE-SIG-A-R}} + T_{\text{HE-STF-NT}} + N_{\text{HE-LTF}} T_{\text{HE-STF, SYM}}, \text{ for an HE extended range SU PPDU} \end{cases}$$

$T_{\text{RL-SIG}}$, $T_{\text{HE-STF-T}}$, $T_{\text{HE-STF-NT}}$, $T_{\text{HE-LTF,SYM}}$, $T_{\text{HE-SIG-A}}$, $T_{\text{HE-SIG-A-R}}$, $T_{\text{HE-SIG-B}}$ are defined in Table 26-9 (Timing-related constants)

$N_{\text{HE-SIG-B}}$, $N_{\text{HE-LTF}}$ are defined in Table 26-12 (Frequently used parameters(#282))

$b_{\text{PE-Disambiguity}}$ is PE Disambiguity subfield in the Packet Extension subfield of the HE-SIG-A field

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26.3.13 Non-HT duplicate transmission

When the TXVECTOR parameter FORMAT is NON_HT and the TXVECTOR parameter NON_HT_MODULATION is NON_HT_DUP_OFDM, the transmitted PPDU is a non-HT duplicate. Non-HT duplicate transmission is used to transmit to non-HT OFDM STAs, HT STAs, VHT STAs, HE STAs that may be present in a part of a 40 MHz, 80 MHz, or 160 MHz channel (see Error! Reference source not found.). The RL-SIG, HE-SIG-A, HE-SIG-B, HE-STF, and HE-LTF fields are not transmitted. The L-STF, L-LTF, and L-SIG fields shall be transmitted in the same way as in the HE transmission when the TXVECTOR parameter BEAM_CHANGE is 0, with the exceptions for the Rate and Length fields which shall follow 17.3.4 (SIGNAL field).

In a 40 MHz non-HT duplicate transmission, the Data field shall be as defined by Equation (26-60).

For 80 MHz and 160 MHz non-HT duplicate transmissions, the Data field shall be as defined by Error! Reference source not found..

In a noncontiguous 80+80 MHz non-HT duplicate transmission, data transmission in each frequency segment shall be as defined for an 80 MHz non-HT duplicate transmission in Error! Reference source not found..

26.3.14 Transmit requirements for an HE trigger-based PPDU(#340)

26.3.14.1 Introduction

HE trigger-based PPDU transmissions are preceded by a Trigger frame from the AP. Since multiple transmitters take part in an HE trigger-based PPDU transmission, it requires transmission time, frequency, sampling symbol clock, and power pre-correction by the participating STAs to mitigate the synchronization related issues at the AP. Frequency and sampling clock pre-corrections are needed to prevent inter-carrier interference. Power pre-correction is required to control interference among participating STAs HE trigger-based PPDU transmission. An AP can schedule in the same HE trigger-based PPDU transmission both Class A and Class B devices. A STA participating in HE trigger-based PPDU transmissions shall support power pre-correction described in 26.3.14.2 (Power pre-correction) and shall meet pre-correction accuracy requirements described in 26.3.14.3 (Pre-correction accuracy requirements).

26.3.14.2 Power pre-correction

An AP indicates in the AP Tx Power subfield of the Common Info field in Trigger frame the combined transmit power of all the transmit antennas used to transmit the Trigger frame normalized to 20 MHz bandwidth. An AP indicates in the Target RSSI subfield of the User Info field in Trigger frame the target receive signal power averaged over the AP's antennas for the HE trigger-based PPDU.

Each STA that is scheduled in the Trigger frame calculates UL transmit power, Tx_{pwr}^{STA}, of the HE trigger-based PPDU for the assigned MCS using Equation (26-121).

$$Tx_{pwr}^{STA} = PL_{DL} + \mathrm{Target}_{RSSI} \quad (26\text{-}121)$$

where PL_{DL} represents DL pathloss and $Target_{RSSI}$ represents target receive signal power averaged over the AP's antennas for the HE trigger-based PPDU. $Target_{RSSI}$ is dBm value of Target RSSI subfield of User Info field in Trigger frame, the encoding of which is specified in Table 9-25g (Target RSSI subfield encoding). Note that an encoded value of 127 in Target RSSI subfield indicates to the STA to transmit an HE trigger-based PPDU at its maximum transmit power for the assigned MCS.

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Each STA computes PL_{DL} using Equation (26-122).

$$PL_{DL} = Tx_{pwr}^{AP} - DL_{RSSI} \quad (26\text{-}122)$$

where Tx_{pwr}^{AP} represents AP's combined transmit power of all the transmit antennas used to transmit the Trigger frame normalized to 20 MHz bandwidth and DL_{RSSI} represents measured received power from the legacy preamble portion of the Trigger frame at the STA, also normalized to 20 MHz bandwidth. Tx_{pwr}^{AP} is dBm value of AP Tx Power subfield of the Common Info field in Trigger frame, the encoding of which is specified in Table 9-25e (AP Tx Power subfield encoding). DL_{RSSI} is an average of the received power over the antennas on which the average PL_{DL} is being computed.

A STA that applies beamforming (BF) in the UL should take the BF gain into account when calculating the transmit power needed to meet the target RSSI.(PHY Motion #170)

The UL transmit power of HE trigger-based PPDU is further subject to a STA's minimum and maximum transmit power limit due to hardware capability, regulatory requirements as well as non-802.11 in-device coexistence requirements.

Each STA that is scheduled in the Trigger frame transmits UL Power headroom HR_{STA} in the HE trigger-based PPDU to assist in the AP's MCS selection. The UL power headroom for the assigned MCS is defined in Equation (26-123).

$$HR_{STA} = Tx_{pwr}^{Max} - Tx_{pwr}^{STA} \quad (26\text{-}123)$$

where Tx_{pwr}^{Max} and Tx_{pwr}^{STA} represent maximum UL transmit power of HE trigger-based PPDU for the assigned MCS and current UL transmit power of HE trigger-based PPDU for the assigned MCS, respectively. HR_{STA} is dB value of UL Headroom in HE trigger-based PPDU, the encoding of which is specified in 9.2.4.6.5.1 (UL power headroom). Note that the MSB bit of the UL Headroom subfield being set to 1 indicates that the STA is transmitting the HE trigger-based PPDU at its minimum Tx_{pwr}^{STA} for the assigned MCS.

26.3.14.3 Pre-correction accuracy requirements

A STA that transmits an HE trigger-based PPDU shall support per chain max(P−32, −10 dBm)(#1422) as the minimum transmit power, with P the maximum power the STA can transmit at the antenna connector of that chain using MCS 0(#1616) while meeting the TX EVM and spectral mask requirements. A STA transmitting at and above the minimum power shall support the EVM requirements for MCS 7(#1616)(PHY Motion #173).

A STA that transmits an HE trigger-based PPDU shall support the absolute transmit power requirements and the RSSI measurement accuracy requirements defined in Table 26-40 (Transmit power and RSSI

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measurement accuracy). The absolute transmit power accuracy is applicable for the entire range of transmit

Table 26-40—Transmit power and RSSI measurement accuracy

Parameter	Minimum Requirement		Comments
	Class A	Class B	
Absolute transmit power accuracy	±3 dB	±9 dB	Accuracy of achieving a specified transmit power
RSSI measurement accuracy	±3 dB(#340)	±5 dB	The difference between the RSSI and the received power(#1786) Requirements are valid from minimum Rx to maximum Rx input power
Relative transmit power accuracy	-	±3 dB	Accuracy of achieving a change in transmit power for consecutive HE trigger-based PPDU The relative transmit power accuracy is applicable only to Class B devices.(#340)

power that the STA is capable of. The RSSI accuracy requirements shall be applied to receive signal level range from −82 dBm to −20 dBm in 2.4 GHz and −82 dBm to −30 dBm in 5 GHz. The requirements are for nominal (room) temperature conditions. The RSSI shall be measured during the reception of the PHY legacy preamble.(#340)

A STA that transmits an HE trigger-based PPDU shall pre-compensate for carrier frequency offset (CFO) error and symbol clock error. After compensation, the absolute value of residual CFO error with respect to the PPDU carrying the associated Trigger frame shall not exceed 350 Hz for data subcarriers when measured as the 10% point of CCDF of CFO errors in AWGN at a received power of −60 dBm in the primary 20 MHz. The residual CFO error measurement shall be made on the HE trigger-based PPDU following the HE-SIG-A field. The symbol clock error shall be pre-compensated by the same ppm amount as CFO error.(#340)

A STA that transmits an HE trigger-based PPDU shall have timing accuracy of ±0.4 μs relative to the PPDU carrying the Trigger frame. This requirement does not include round trip delay.

26.3.15 SU-MIMO and DL MU-MIMO beamforming

26.3.15.1 General

(#507)For SU-MIMO DL MU-MIMO beamforming in RU r, the receive signal vector in subcarrier k (where subcarrier k is one of the subcarriers in RU r, $k \in K_r$) at beamformee u, $\boldsymbol{y}_{k,u} = [y_{k,0}, y_{k,1}, \ldots, y_{k,N_{RX_u}-1}]^T$, is shown in Equation (26-124), where $\boldsymbol{x}_k = [\boldsymbol{x}_{k,0}^T, \boldsymbol{x}_{k,1}^T, \ldots, \boldsymbol{x}_{k,N_{user,r}-1}^T]^T$ denotes the transmit signal vector in subcarrier k for all N_{user} beamformees, with $\boldsymbol{x}_{k,u} = [x_{k,0}, x_{k,1}, \ldots, x_{k,N_{STS,r,u}-1}]^T$ being the transmit signal for beamformee u.

$$\boldsymbol{y}_{k,u} = \boldsymbol{H}_{k,u} \times [Q_{k,0}, Q_{k,1}, \ldots, Q_{k,N_{user}-1}] \times \boldsymbol{x}_k + \boldsymbol{n} \quad (26\text{-}124)$$

where

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$\boldsymbol{H}_{k,u}$ is the channel matrix from the beamformer to beamformee u in subcarrier k with dimensions $N_{RX_u} \times N_{TX}$

N_{RX_u} is the number of receive antennas at beamformee u

$Q_{k,\,u}$ is a steering matrix for beamformee u in subcarrier k with dimensions $N_{TX} \times N_{STS,\,r,\,u}$

$N_{user,r}$ is the number of HE MU PPDU recipients (see Table 26-12 (Frequently used parameters(#282))) in RU r

$\boldsymbol{n}$ is a vector of additive noise and may include interference

The DL MU-MIMO steering matrix $Q_k = [Q_{k,\,0}, Q_{k,\,1}, \ldots, Q_{k,\,N_{user,\,r}-1}]$ can be determined by the beamformer using the beamforming feedback for subcarrier k from beamformee u, where $u = 0, 1, \ldots, N_{user,\,r} - 1$. The feedback report format is described in 9.4.1.63 (HE Compressed Beamforming Report field) and 9.4.1.64 (HE MU Exclusive Beamforming Report field). The steering matrix that is computed (or updated) using new beamforming feedback from some or all of participating beamformees might replace the existing steering matrix Q_k for the next DL MU-MIMO data transmission.

For SU-MIMO beamforming, the steering matrix Q_k can be determined from the beamforming feedback matrix V_k that is sent back to the beamformer by the beamformee using the compressed beamforming feedback matrix format as defined in 19.3.12.3.6 (Compressed beamforming feedback matrix). The feedback report format is described in 9.4.1.63 (HE Compressed Beamforming Report field).

26.3.15.2 Beamforming feedback matrix *V*

Upon receipt of a HE NDP PPDU, the beamformee computes a set of matrices for feedback to the beamformer as described in 21.3.11.2 (Beamforming Feedback Matrix V). The eligible beamformees shall remove the space-time stream CSD in Table 21-11 (Cyclic shift values for the VHT modulated fields of a PPDU) from the measured channel before computing a set of matrices for feedback to the beamformer.

The beamforming feedback matrix, $V_{k,u}$, found by the beamformee u for subcarrier k in RU r shall be compressed in the form of angles using the method described in 20.3.12.3.6. The angles, $\phi(k,v)$ and $\psi(k,u)$, are quantized according to Table 8-53e. The number of bits for quantization is set by the beamformer, i.e., HE AP. The number of bits for quantization, tone grouping factor, and the number of columns in the HE Compressed beamforming feedback are set by the beamformee, i.e., non-AP STA, only if the NDP Announcement frame is addressed to a single non-AP STA and SU type feedback is solicited. The compressed beamforming feedback matrix as defined in(#Ed) 19.3.12.3.6 (Compressed beamforming feedback matrix) is the only Clause 26 beamforming feedback matrix defined.

The beamformee shall generate the beamforming feedback matrices with the number of rows (Nr) equal to the N_{STS} of the NDP.

After receiving the angle information, $\phi(k,v)$ and $\psi(k,u)$, the beamformer reconstructs $V_{k,u}$ using Equation (20-79). For SU-MIMO beamforming, the beamformer uses $V_{k,0}$, matrix to determine the steering matrix Q_k. For MU-MIMO beamforming, the beamformer may calculate a steering matrix $Q_k = [Q_{k,\,0}, Q_{k,\,1}, \ldots, Q_{k,\,N_{user,\,r}-1}]$ using $V_{k,u}$ and $SNR_{k,u}$ ($0 \le u \le N_{user,r}-1$) in order to suppress crosstalk between participating beamformees. The method used by the beamformer to calculate the steering matrix Q_k is implementation specific.

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26.3.15.3 CQI-only feedback

Whenever the HE NDP Announcement frame is requesting a CQI-only feedback, upon receipt of the HE NDP, the beamformee computes HE CQI-only feedback as described in 9.4.1.64. The CQI-only feedback $CQI_{s,r,u}$, in RU r for space time stream s shall be estimated using the method described in 9.4.1.64. The CQI values to be fed back are derived from quantized SNRs according to Table XX-4. The beamformee shall transmit the HE CQI-only feedback for space-time stream 1, …, Nc for each of the RU indices for which the CQI-only report is being requested by the beamformer. After receiving the CQI information, the beamformer may use it to identify the best range of RUs for compressed beamforming feedback or for RU assignment during subsequent MU transmissions. The actual use is implementation specific.

26.3.16 Transmit specification

26.3.16.1 Transmit spectral mask

(#2351)The bandwidth of the spectral mask applied to an HE PPDU(#Ed) shall be determined by the bandwidth indicated in the Bandwidth subfield of the HE-SIG-A field. All HE PPDU formats shall be compliant with the transmit spectral mask described in this section.

NOTE 1—In the presence of additional regulatory restrictions, the device has to meet both the regulatory requirements and the mask defined in this subclause.

NOTE 2—Transmit spectral mask figures in this subclause are not drawn to scale.

NOTE 3—For rules regarding TX center frequency leakage levels, see 26.3.16.4.2 (Transmit center frequency leakage). The spectral mask requirements in this subclause do not apply to the RF LO.

For a 20 MHz mask PPDU of HE format, the interim transmit spectral mask shall have a 0 dBr (dB relative to the maximum spectral density of the signal) bandwidth of 19.5 MHz, –20 dBr at 10.25 MHz frequency offset, –28 dBr at 20 MHz frequency offset, and –40 dBr at 30 MHz frequency offset and above. The interim transmit spectral mask for frequency offsets in between 9.75 and 10.25 MHz, 10.25 and 20 MHz, and 20 and 30 MHz shall be linearly interpolated in dB domain from the requirements for 9.75 MHz, 10.25 MHz, 20 MHz, and 30 MHz frequency offsets. The transmit spectrum shall not exceed the maximum of the interim transmit spectral mask and –53 dBm/MHz at any frequency offset. Figure 26-35 (Example transmit spectral

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mask for a 20 MHz mask PPDU) shows an example of the resulting overall spectral mask when the –40 dBr spectrum level is above –53 dBm/MHz.

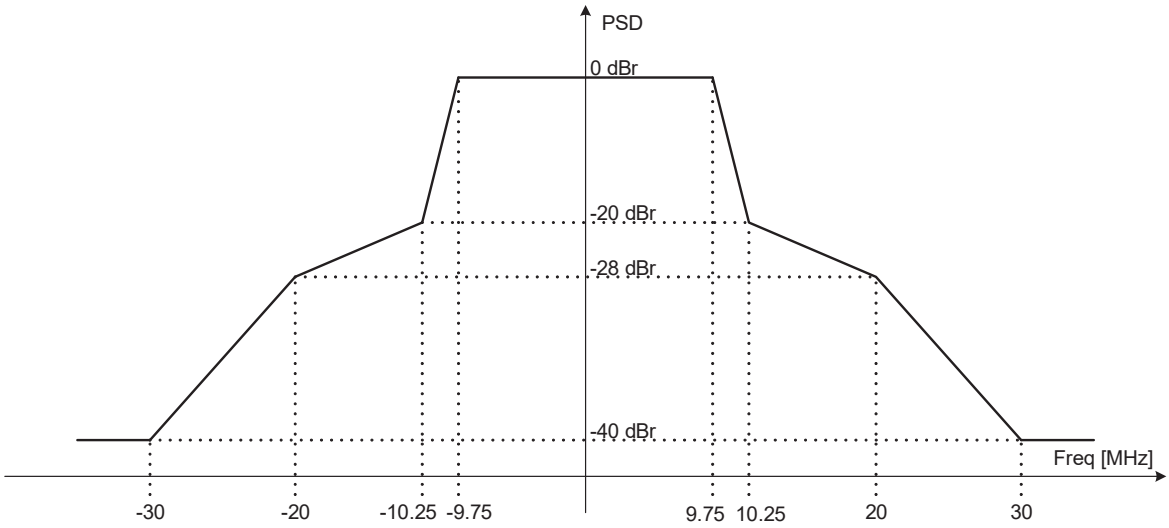

Figure 26-35—Example transmit spectral mask for a 20 MHz mask PPDU

For a 40 MHz mask PPDU of HE format, the interim transmit spectral mask shall have a 0 dBr (dB relative to the maximum spectral density of the signal) bandwidth of 39 MHz, –20 dBr at 20.5 MHz frequency offset, –28 dBr at 40 MHz frequency offset, and –40 dBr at 60 MHz frequency offset and above. The interim transmit spectral mask for frequency offsets in between 19.5 and 20.5 MHz, 20.5 and 40 MHz, and 40 and 60 MHz shall be linearly interpolated in dB domain from the requirements for 19.5 MHz, 20.5 MHz, 40 MHz, and 60 MHz frequency offsets. The transmit spectrum shall not exceed the maximum of the interim transmit spectral mask and –56 dBm/MHz at any frequency offset greater than 19.5 MHz. Figure 26-36 (Example transmit spectral mask for a 40 MHz mask PPDU) shows an example of the resulting overall spectral mask when the –40 dBr spectrum level is above –56 dBm/MHz.

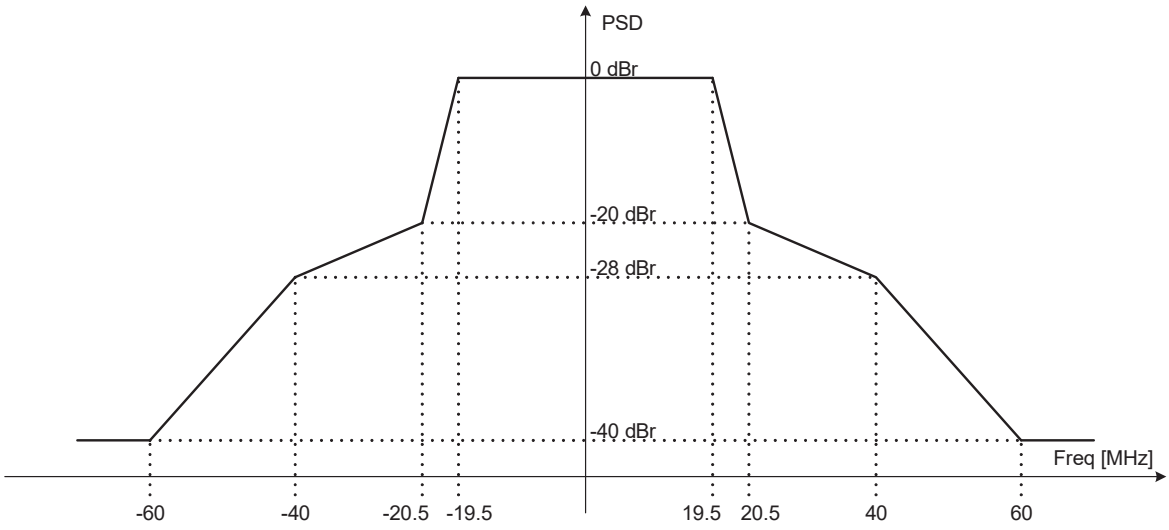

Figure 26-36—Example transmit spectral mask for a 40 MHz mask PPDU

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For an 80 MHz mask PPDU of HE format, the interim transmit spectral mask shall have a 0 dBr (dB relative to the maximum spectral density of the signal) bandwidth of 79 MHz, –20 dBr at 40.5 MHz frequency offset, –28 dBr at 80 MHz frequency offset, and –40 dBr at 120 MHz frequency offset and above. The interim transmit spectral mask for frequency offsets in between 39.5 and 40.5 MHz, 40.5 and 80 MHz, and 80 and 120 MHz shall be linearly interpolated in dB domain from the requirements for 39.5 MHz, 40.5 MHz, 80 MHz, and 120 MHz frequency offsets. The transmit spectrum shall not exceed the maximum of the interim transmit spectrum mask and –59 dBm/MHz at any frequency offset. Figure 26-37 (Example transmit spectral mask for a 80 MHz mask PPDU) shows an example of the resulting overall spectral mask when the –40 dBr spectrum level is above –59 dBm/MHz.

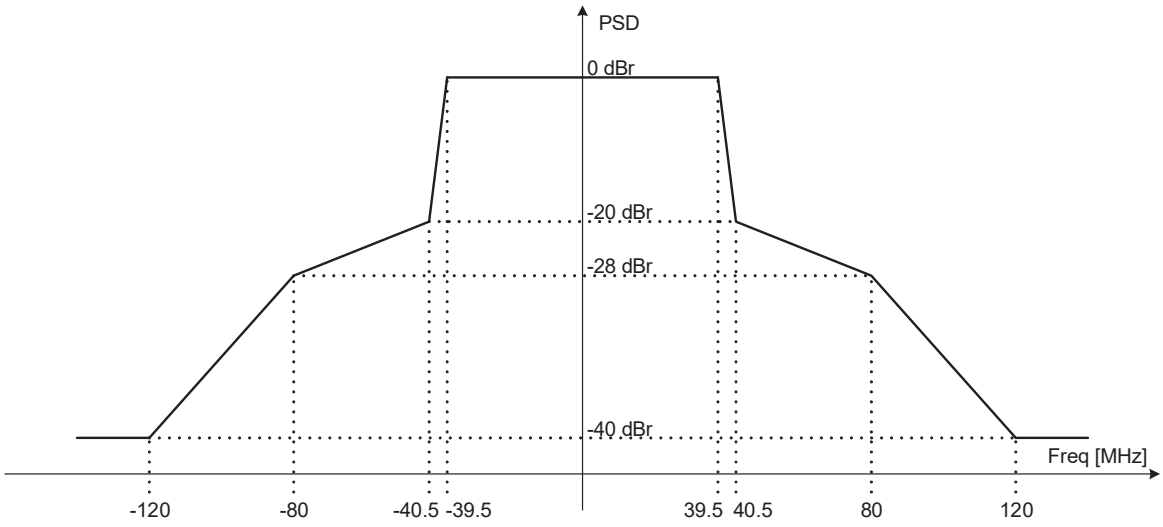

Figure 26-37—Example transmit spectral mask for a 80 MHz mask PPDU

For a 160 MHz mask PPDU of HE format, the interim transmit spectral mask shall have a 0 dBr (dB relative to the maximum spectral density of the signal) bandwidth of 159 MHz, –20 dBr at 80.5 MHz frequency offset, –28 dBr at 160 MHz frequency offset, and –40 dBr at 240 MHz frequency offset and above. The interim transmit spectral mask for frequency offsets in between 79.5 and 80.5 MHz, 80.5 and 160 MHz, and 160 and 240 MHz shall be linearly interpolated in dB domain from the requirements for 79.5 MHz, 80.5 MHz, 160 MHz, and 240 MHz frequency offsets. The transmit spectrum shall not exceed the maximum of the interim transmit spectrum mask and –59 dBm/MHz at any frequency offset. Figure 26-38 (Example

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transmit spectral mask for a 160 MHz mask PPDU) shows an example of the resulting overall spectral mask when the –40 dBr spectrum level is above –59 dBm/MHz.

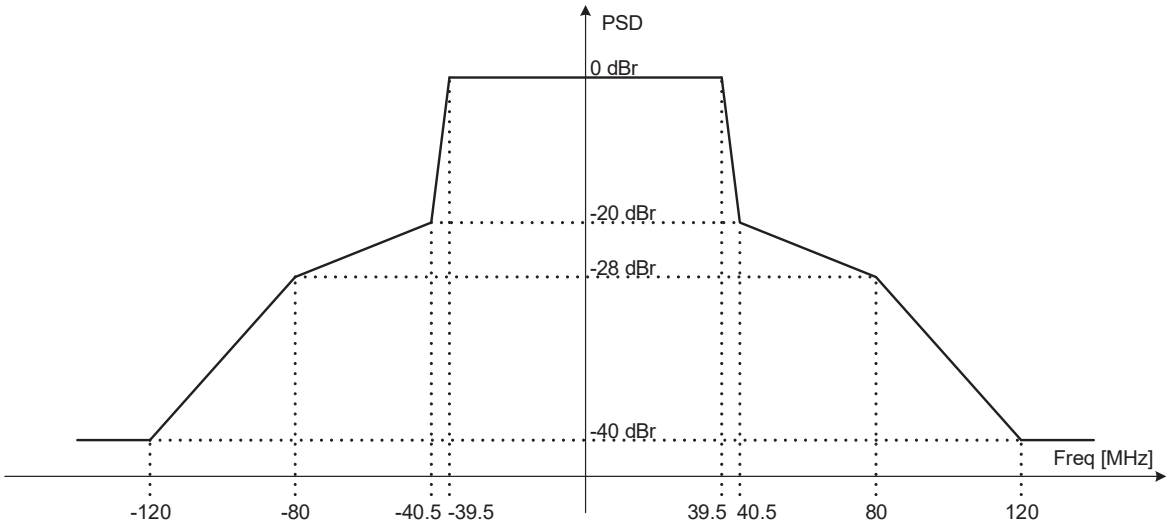

Figure 26-38—Example transmit spectral mask for a 160 MHz mask PPDU

For an 80+80 MHz mask PPDU of HE format, the overall transmit spectral mask is constructed in the following manner. First, the 80 MHz interim spectral mask is placed on each of the two 80 MHz segments. Then, for each frequency at which both of the 80 MHz interim spectral masks have values greater than –40 dBr and less than –20 dBr, the sum of the two interim mask values (summed in linear domain) shall be taken as the overall spectral mask value. Next, for each frequency at which neither of the two 80 MHz interim masks have values greater than or equal to –20 dBr and less than or equal to 0 dBr, the higher value of the two interim masks shall be taken as the overall interim spectral value. Finally, for any frequency region where the mask value has not been defined yet, linear interpolation (in dB domain) between the nearest two frequency points with the interim spectral mask value defined shall be used to define the interim spectral mask value. The transmit spectrum shall not exceed the maximum of the interim transmit spectrum mask and –59 dBm/MHz at any frequency offset. Figure 26-39 (Example transmit spectral mask for a 80+80 MHz mask PPDU) shows an example of a transmit spectral mask for a noncontiguous transmission using

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two 80 MHz channels where the center frequency of the two 80 MHz channels are separated by 160 MHz and the –40 dBr spectrum level is above –59 dBm/MHz.

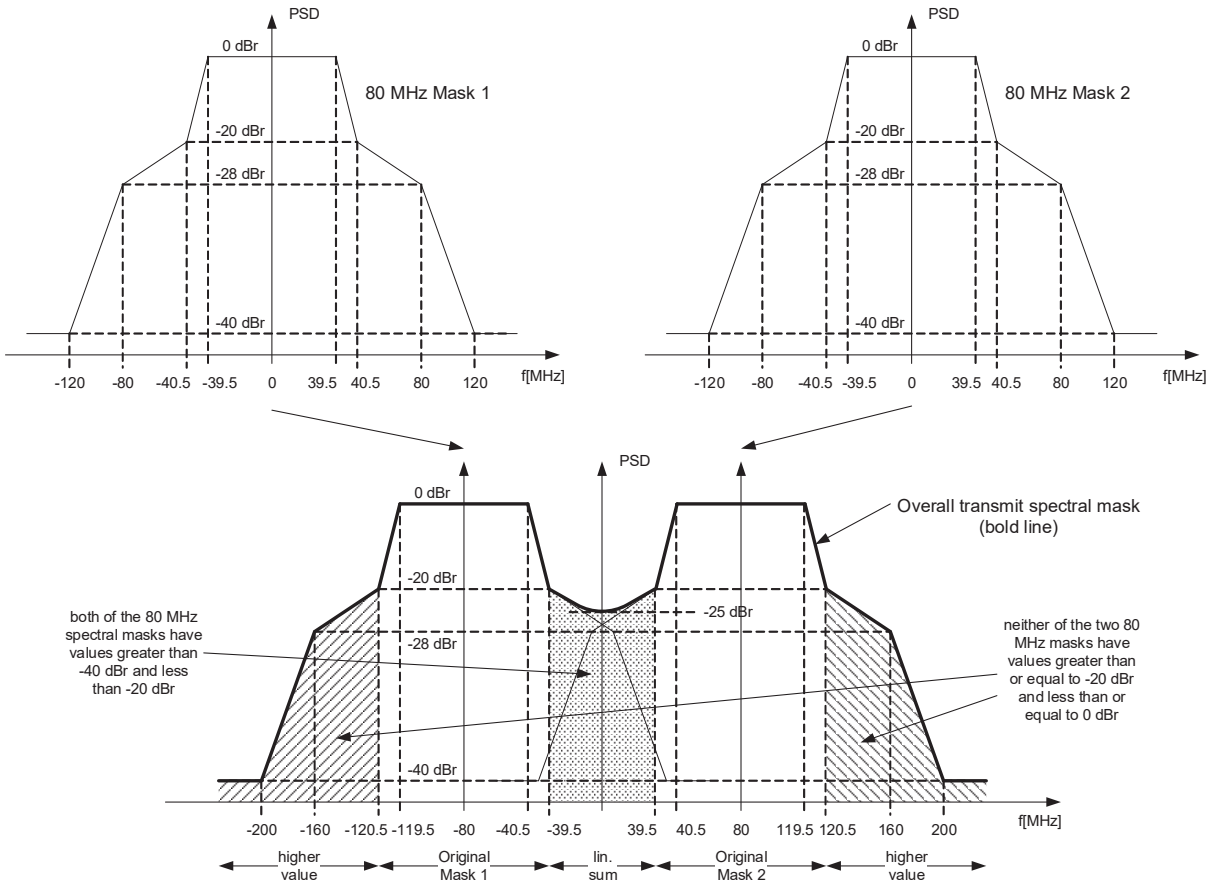

Figure 26-39—Example transmit spectral mask for a 80+80 MHz mask PPDU

Different center frequency separation between the two 80 MHz frequency segments of the spectral mask as well as different peak levels of each 80 MHz frequency segment of the spectral mask are possible, in which case a similar procedure in determining the spectral mask as in Figure 26-39 (Example transmit spectral mask for a 80+80 MHz mask PPDU) is followed.

The transmit spectral mask for noncontiguous transmissions using two nonadjacent 80 MHz channels is applicable only in regulatory domains that allow for such transmissions.

Measurements shall be made using a 25 kHz resolution bandwidth and a 7.5 kHz video bandwidth.

(PHY Motion #161)When channel puncturing happens in an HE MU PPDU, the HE MU PPDU is still treated as an 80 MHz or 160 MHz (80+80 MHz) PPDU, therefore the spectral mask is the same as those defined for the total channel width.

26.3.16.2 Spectral flatness

(#2351)Spectral flatness measurements shall be conducted using BPSK modulated HE PPDUs. Demodulate the HE PPDUs according to the following (or equivalent) procedure:

a) Start of PPDU shall be detected.

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b) Transition from L-STF to L-LTF shall be detected and fine timing shall be established.

c) Coarse and fine frequency offsets shall be estimated.

d) Symbols in a PPDU shall be manipulated to account for both frequency error and timing drift error.

e) For each HE-LTF symbol, transform the symbol into subcarrier received values, estimate the phase from the pilot subcarriers, and compensate the subcarrier values according to the estimated phase.

f) For each of the data OFDM symbols: transform the symbol into subcarrier received values.

The spectral flatness test shall be performed over at least 20 HE PPDUs. The PPDUs under test shall be at least 16 data OFDM symbols long.

Evaluate spectral flatness using the subcarrier received values or the magnitude of the channel estimation of the occupied subcarriers of the transmission HE PPDUs. Non-occupied subcarriers of the transmitted HE PPDUs shall be ignored during averaging and testing. Resource unit power boosting and beamforming should not be used when measuring spectral flatness.

Let $E_{i,avg}$ denote the magnitude of the channel estimation on subcarrier i or the average constellation energy of a BPSK modulated subcarrier i in a HE data symbol. In a contiguous HE transmission having a bandwidth listed in Table 26-41 (Maximum transmit spectral flatness deviations), $E_{i,avg}$ of each of the subcarriers with indices listed as tested subcarrier indices shall not deviate by more than the specified maximum deviation in Table 26-41 (Maximum transmit spectral flatness deviations) from the average of $E_{i,avg}$ over subcarrier indices listed as averaging subcarrier indices. Averaging of $E_{i,avg}$ is done in the linear domain.

Table 26-41—Maximum transmit spectral flatness deviations

Bandwidth of transmission (MHz)	Averaging subcarrier indices (inclusive)	Tested subcarrier indices (inclusive)	Maximum deviation (dB)
20	–84 to –2 and +2 to +84	–84 to –2 and +2 to +84	±4
		–122 to –85 and +85 to +122	+4/–6
40	–168 to –3 and +3 to +168	–168 to –3 and +3 to +168	±4
		–244 to –169 and +169 to +244	+4/–6
80	–344 to –3 and +3 to +3441	–344 to –3 and +3 to +344	±4
		–500 to –345 and +345 to +500	+4/–6
160	–696 to –515, –509 to –166, +166 to +509, and +515 to +696	–696 to –515, –509 to –166, +166 to +509, and +515 to +696	±4
		–1012 to –697, –165 to –12, +12 to +165, and +697 to +1012	+4/–6

In an 80+80 MHz transmission, each segment shall meet the spectral flatness requirement for an 80 MHz transmission.

For the spectral flatness test, the transmitting STA shall be configured to use a spatial mapping matrix Q_k (see 26.3.11.14 (OFDM modulation)) with flat frequency response. Each output port under test of the transmitting STA shall be connected through a cable to one input port of the testing instrumentation. The requirements apply to 20 MHz, 40 MHz, 80 MHz, and 160 MHz contiguous transmissions as well as 80+80 MHz transmissions.

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26.3.16.3 Transmit center frequency and symbol clock frequency tolerance

Transmit center frequency and the symbol clock frequency for all transmit antennas and frequency segments shall be derived from the same reference oscillator. The symbol clock frequency and transmit center frequency maximum tolerance shall be ±20 ppm. HE trigger-based PPDU format is subject to additional requirements as defined in 26.3.14 (Transmit requirements for an HE trigger-based PPDU(#340)).(#2351)

26.3.16.4 Modulation accuracy

26.3.16.4.1 Introduction to modulation accuracy tests

Transmit modulation accuracy specifications are described in 26.3.16.4.2 (Transmit center frequency leakage) and 26.3.16.4.3 (Transmitter constellation error). The test method is described in 26.3.16.4.4 (Transmitter modulation accuracy (EVM) test).(#2351)

26.3.16.4.2 Transmit center frequency leakage

The TX LO leakage requirement for all transmission modes shall be the following. The power measured at the location of the RF LO using resolution BW 78.125 kHz shall not exceed the maximum of –32 dB relative to the total transmit power and –20 dBm, or equivalently max(P–32, –20), where P is the transmit power per antenna in dBm. The transmit center frequency leakage is specified per antenna.

For an 80+80 MHz transmission where the RF LO falls outside both frequency segments, the RF LO shall additionally met the spectral mask requirements as defined in 26.3.16.1 (Transmit spectral mask).(#2351)

26.3.16.4.3 Transmitter constellation error

(#2351)The relative constellation RMS error, calculated by first averaging over subcarriers, frequency segments, HE PPDUs, and spatial streams (see Equation (26-125)) shall not exceed a data-rate dependent value according to Table 26-42 (Allowed relative constellation error versus constellation size and coding rate). The number of spatial streams under test shall be equal to the number of utilized transmitting STA antenna (output) ports and also equal to the number of utilized testing instrumentation input ports. In the test, $N_{SS} = N_{STS}$ (no STBC) shall be used. Each output port of the transmitting STA shall be connected through a cable to one input port of the testing instrumentation. The requirements apply to 20 MHz, 40 MHz, 80 MHz, and 160 MHz contiguous transmissions as well as 80+80 MHz noncontiguous transmissions.

Table 26-42—Allowed relative constellation error versus constellation size and coding rate

Modulation		Coding rate	Relative constellation error in an HE SU PPDU, HE extended rate SU PPDU and HE MU PPDU without preamble puncturing (dB)	Relative constellation error in HE MU PPDU with preambling puncturing and HE trigger-based PPDU (dB)
Without DCM	With DCM			
N/A	BPSK	1/2	–5	TBD
BPSK	QPSK	1/2	–5	TBD
QPSK	16-QAM	1/2	–10	TBD
QPSK	16-QAM	3/4	–13	TBD
16-QAM	N/A	1/2	–16	TBD
16-QAM	N/A	3/4	–19	TBD

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Table 26-42—Allowed relative constellation error versus constellation size and coding rate

Modulation		Coding rate	Relative constellation error in an HE SU PPDU, HE extended rate SU PPDU and HE MU PPDU without preamble puncturing (dB)	Relative constellation error in HE MU PPDU with preambling puncturing and HE trigger-based PPDU (dB)
Without DCM	With DCM			
64-QAM	N/A	2/3	–22	TBD
64-QAM	N/A	3/4	–25	TBD
64-QAM	N/A	5/6	–27	TBD
256-QAM	N/A	3/4	–30	TBD
256-QAM	N/A	5/6	–32	TBD
1024-QAM	N/A	3/4	–35	TBD
1024-QAM	N/A	5/6	–35	TBD

26.3.16.4.4 Transmitter modulation accuracy (EVM) test

(#2351)The transmit modulation accuracy test shall be performed by instrumentation capable of converting the transmitted signals into a stream of complex samples at sampling rate greater than or equal to the bandwidth of the signal being transmitted except that for a noncontiguous transmissions each frequency segment may be tested independently.

In this case, transmit modulation accuracy of each segment shall meet the required value in Table 26-42 (Allowed relative constellation error versus constellation size and coding rate) using only the occupied data subcarriers within the corresponding segment.

LO leakage that can potentially show up in center frequency of the HE PPDU tone plan and its ±3 tone neighbors shall be excluded from the computation of the transmitter modulation accuracy test. The potential LO leakage tones for 20 MHz operating devices are the center of primary 20 MHz of the HE PPDU tone plan and ±3 tones. The potential LO leakage tones for 40MHz operating devices are the center of the primary 40 MHz of the PPDU tone plan and ±3 tones. For 80 MHz capable devices that transmits 20 MHz or 40 MHz PPDU, the potential LO leakage tone exist outside the PPDU bandwidth and should not affect the transmitter modulation accuracy test.

The instrument shall have sufficient accuracy in terms of I/Q branch amplitude and phase balance, DC offsets, phase noise, and analog to digital quantization noise. A possible embodiment of such a setup is converting the signals to a low IF frequency with a microwave synthesizer, sampling the signal with a digital oscilloscope and decomposing it digitally into quadrature components. The sampled signal shall be processed in a manner similar to an actual receiver, according to the following steps, or equivalent procedure:

a) Start of PPDU shall be detected.
b) Transition from L-STF to L-LTF shall be detected and fine timing shall be established.
c) Coarse and fine frequency offsets shall be estimated.
d) Symbols in a PPDU shall be derotated according to estimated frequency offset. Sampling offset drift shall be also compensated. Note that amplitude drift shall not be compensated by the testing instrument.
e) For each HE-LTF symbol, transform the symbol into subcarrier received values, estimate the phase from the pilot subcarriers, and derotate the subcarrier values according to the estimated phase.

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f) Estimate the complex channel response coefficient for each of the subcarriers and each of the transmit streams.

g) For each of the data OFDM symbols: transform the symbol into subcarrier received values, estimate the phase from the pilot subcarriers, and compensate the subcarrier values according to the estimated phase, group the results from all of the receiver chains in each subcarrier to a vector, and multiply the vector by a zero-forcing equalization matrix generated from the estimated channel.

h) For each data-carrying subcarrier in each spatial stream of RU under test, find the closest constellation point and compute the Euclidean distance from it.

i) Compute the average across PPDUs of the RMS of all errors per PPDU as given by Equation (26-125).

$$Error_{RMS} = \frac{1}{N_f}\sum_{i_f=1}^{N_f}\sqrt{\frac{\sum_{i_s=1}^{N_{SYM}}\sum_{i_{ss}=1}^{N_{SS}}\sum_{i_{sc}=1}^{N_{ST}}\left(I_e(i_f, i_s, i_{ss}, i_{sc}) - I_0(i_f, i_s, i_{ss}, i_{sc})\right)^2 + \left(Q_e(i_f, i_s, i_{ss}, i_{sc}) - Q_0(i_f, i_s, i_{ss}, i_{sc})\right)^2}{N_{SYM}N_{SS}N_{ST}P_0}} \quad (26\text{-}125)$$

where

$I_0(i_f, i_s, i_{ss}, i_{sc})$ $Q_0(i_f, i_s, i_{ss}, i_{sc})$ denotes the ideal symbol point in the complex plane in i_{sc}-th data tone of the RU under test, spatial stream i_{ss}, and the OFDM symbol of frame i_f.

$I_e(i_f, i_s, i_{ss}, i_{sc})$ $Q_e(i_f, i_s, i_{ss}, i_{sc})$ denotes the equalized observed symbol point in the complex plane of the i_{sc}-th data tone of the RU under test, spatial stream i_{ss}, and the OFDM symbol of frame i_f.

P_0 is the average power of constellation

N_f is the number of tested frames

N_{ST} is the number of data tones of the occupied RU

N_{SS} is the number of spatial streams of the data

N_{SYM} is the number of data OFDM symbols

NOTE 1—In the case the transmit modulation accuracy test is performed simultaneously for the two frequency segments of the 80+80 MHz transmissions with 2×996-subcarrier RU.

The test shall be performed over at least 20 PPDUs (N_f as defined in Equation (26-125)). The PPDUs under test shall be at least 16 data OFDM symbols long. Random data shall be used for the symbols.

For an HE trigger-based PPDU and a preamble-punctured HE MU PPDU, additional transmit modulation accuracy test for the unoccupied subcarriers of the PPDU shall be performed. The transmit modulation accuracy of unoccupied subcarriers of the PPDU test shall be performed by instrumentation capable of converting the transmitted signals into a stream of complex samples at sampling rate greater than or equal to the bandwidth of the signal being transmitted except that for noncontiguous transmissions, only the frequency segment with occupied subcarriers is tested. The transmit modulation accuracy of maximum average unoccupied subcarriers error of the PPDU shall meet relative constellation error minus TBD margin in dB scale for each modulation and code rates using the unoccupied subcarriers within the corresponding segment.

The instrument shall have sufficient accuracy in terms of I/Q branch amplitude and phase balance, DC offsets, phase noise, and analog to digital quantization noise. A possible embodiment of such a setup is converting the signals to a low IF frequency with a microwave synthesizer, sampling the signal with a digital oscilloscope and decomposing it digitally into quadrature components. The sampled signal shall be

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processed in a manner similar to an actual receiver, according to the following steps, or equivalent procedure:

a) Start of PPDU shall be detected.

b) Transition from L-STF to L-LTF shall be detected and fine timing shall be established.

c) Coarse and fine frequency offsets shall be estimated.

d) Symbols in a PPDU shall be derotated according to estimated frequency offset. Sampling offset drift shall be also compensated. Note that amplitude drift shall not be compensated by the testing instrument.

e) For each of the data OFDM symbols: transform the symbol into subcarrier received values, estimate the power of each subcarriers.

f) Compute the average un-occupied subcarrier error vetor magnitude for each PPDU over 26 subcarriers and average across PPDUs of the RMS of all errors per PPDU as given by Equation (26-126).

$$UnusedToneError_{RMS}(k) = TBD \quad (26\text{-}126)$$

g) Compute the maximum average unoccupied subcarrier error vector magnitude as given by Equation (26-127).

$$UnusedToneError_{\text{MAX-RMS}} = \max_{\forall k}(UnusedToneError_{RMS}(k)) \quad (26\text{-}127)$$

The test shall be performed over at least 20 PPDUs (N_f as defined in Equation (26-125)). The PPDUs under test shall be at least 16 data OFDM symbols long. The unequalized observed symbol of potential LO leakage subcarrier locations shall be treated as zero during un-occupied subcarriers transmit modulation accuracy test. Random data shall be used for the symbols.

26.3.16.5 Time of Departure accuracy

(#2351)The Time of Departure accuracy test evaluates TIME_OF_DEPARTURE against aTxPHYTxStartRMS and aTxPHYTxStartRMS against TIME_OF_DEPARTURE_ACCURACY_TEST_THRESH as defined in Annex P with the following test parameters:

— MULTICHANNEL_SAMPLING_RATE is:

$20 \times 10^6\left(1 + \left\lceil \frac{f_H - f_L}{20\ \text{MHz}} \right\rceil\right)$ sample/s, for a CH_BANDWIDTH parameter equal to CBW20

$40 \times 10^6\left(1 + \left\lceil \frac{f_H - f_L}{40\ \text{MHz}} \right\rceil\right)$ sample/s, for a CH_BANDWIDTH parameter equal to CBW40

$80 \times 10^6\left(1 + \left\lceil \frac{f_H - f_L}{80\ \text{MHz}} \right\rceil\right)$ sample/s, for a CH_BANDWIDTH parameter equal to CBW80

$160 \times 10^6\left(1 + \left\lceil \frac{f_H - f_L}{160\ \text{MHz}} \right\rceil\right)$ sample/s, for a CH_BANDWIDTH parameter equal to CBW160 or CBW80+80

where

f_H is the nominal center frequency in Hz of the highest channel in the channel set

f_L is the nominal center frequency in Hz of the lowest channel in the channel set, the channel set is the set of channels upon which frames providing measurements are transmitted, the channel set comprises channels uniformly spaced across.

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— FIRST_TRANSITION_FIELD is L-STF.

— SECOND_TRANSITION_FIELD is L-LTF.

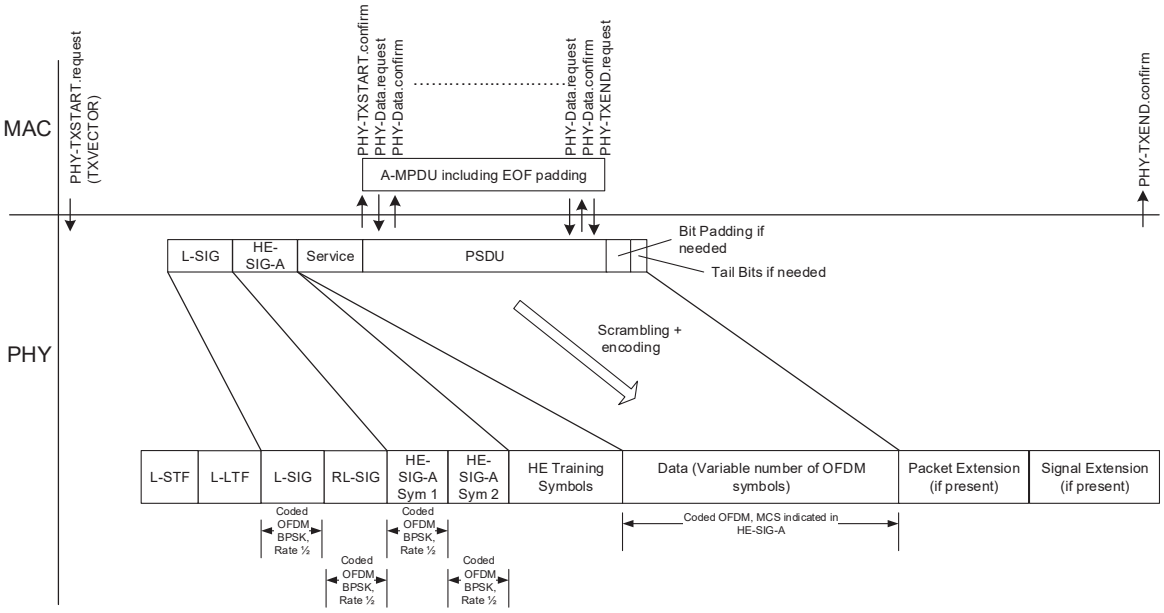
— TRAINING_FIELD is L-LTF windowed in a manner which should approximate the windowing described in 17.3.2.5 (Mathematical conventions in the signal descriptions) with TTR = 100 ns.

— TIME_OF_DEPARTURE_ACCURACY_TEST_THRESH is 80 ns.

NOTE—The indicated windowing applies to the time of departure accuracy test equipment, and not the transmitter or receiver.

26.3.17 HE transmit procedure

(#493)There are five options for the transmit PHY procedure. The first four options, for which typical transmit procedures are shown in Figure 26-40 (PHY transmit procedure for an HE SU PPDU), Figure 26-42 (PHY transmit procedure for an HE MU PPDU), Figure 26-41 (PHY transmit procedure for an HE extended range SU PPDU) and Figure 26-43 (PHY transmit procedure for an HE trigger-based PPDU), are selected if the FORMAT field of the PHY-TXSTART.request(TXVECTOR) primitive is equal to HE_SU, HE_MU, HE_EXT_SU, or HT_TRIG, respectively. These transmit procedures do not describe the operation of optional features, such as DCM(PHY Motion #173).



NOTE—This procedure does not describe the operation of optional features, such as xxx.

Figure 26-40—PHY transmit procedure for an HE SU PPDU

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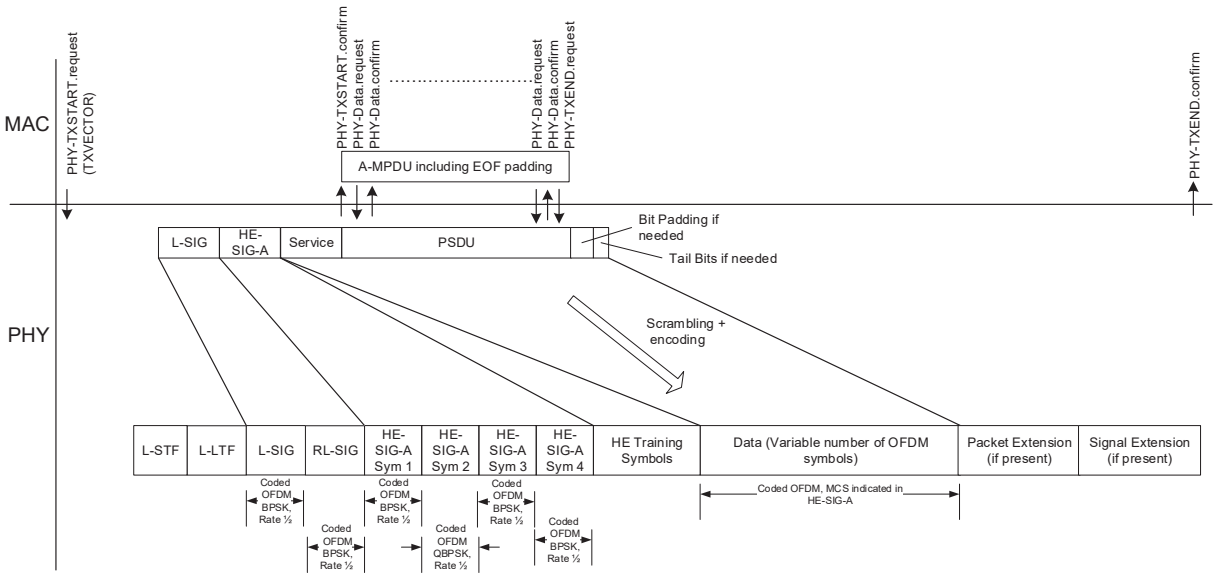
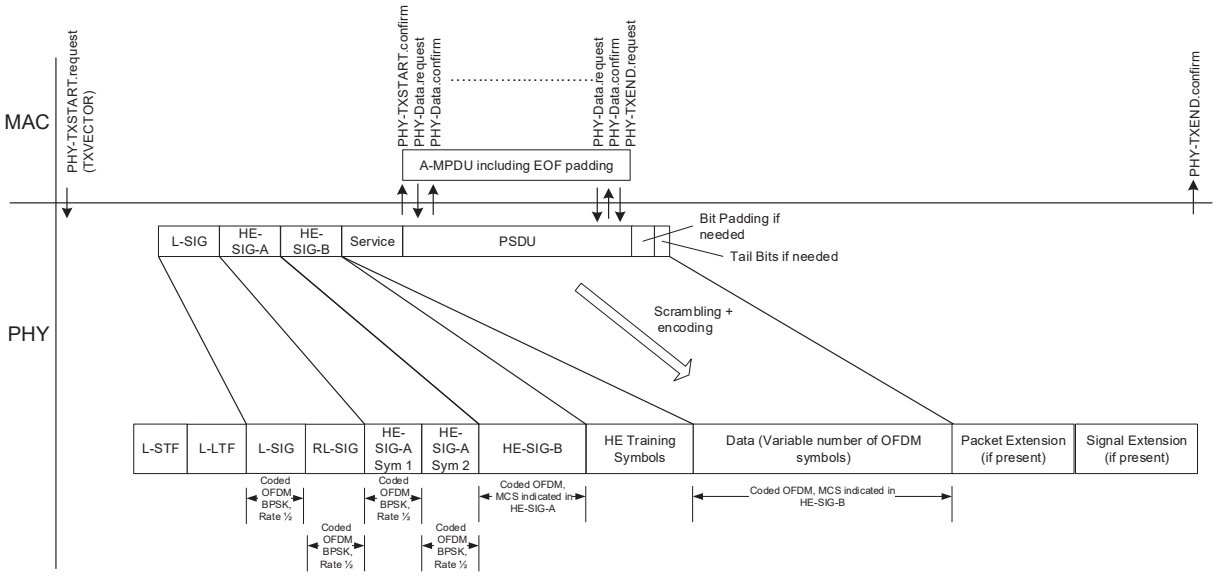


NOTE—This procedure does not describe the operation of optional features, such as xxx.

Figure 26-41—PHY transmit procedure for an HE extended range SU PPDU



NOTE—This procedure does not describe the operation of optional features, such as xxx.

Figure 26-42—PHY transmit procedure for an HE MU PPDU

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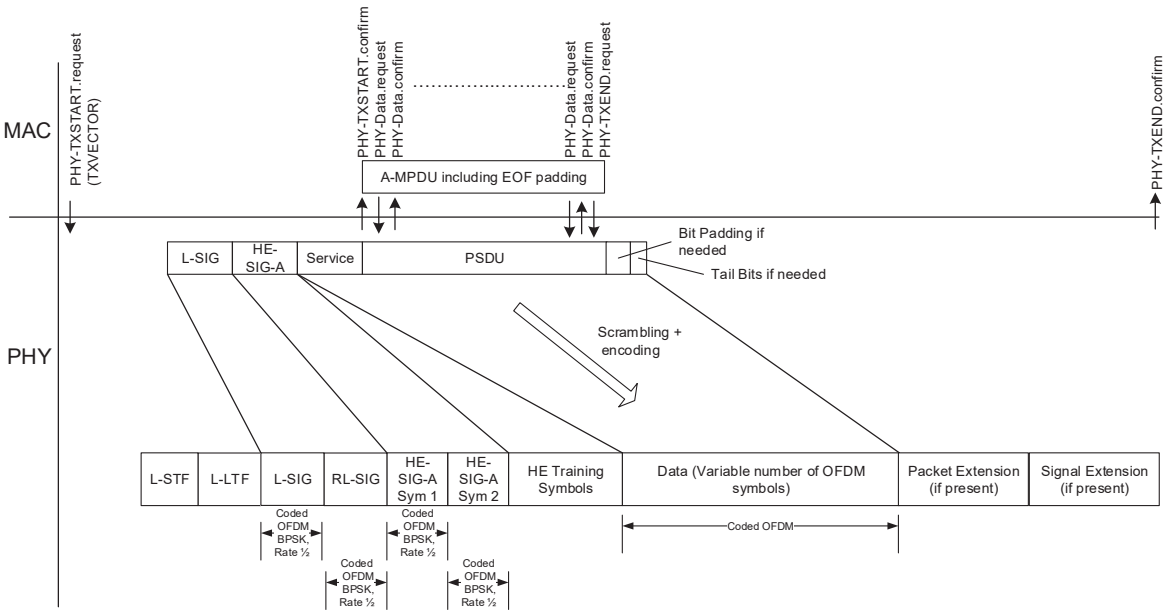

NOTE—This procedure does not describe the operation of optional features, such as xxx.

Figure 26-43—PHY transmit procedure for an HE trigger-based PPDU

The fifth option is to follow the transmit procedure in Clause 17 (Orthogonal frequency division multiplexing (OFDM) PHY specification) if the FORMAT parameter of the PHYTXSTART.request(TXVECTOR) primitive is NON_HT and the NON_HT_MODULATION parameter is set to NON_HT_DUP_OFDM except that the signal referred to in Clause 17 (Orthogonal frequency division multiplexing (OFDM) PHY specification) is instead generated simultaneously on each of the 20 MHz channels that are indicated by the CH_BANDWIDTH parameter as defined in 26.3.10 (HE preamble) and 26.3.13 (Non-HT duplicate transmission).

NOTE 1—For an HE MU PPDU the A-MPDU is per user in the MAC sublayer and the HE Training Symbols, and Data are per user in the PHY in Figure 26-42 (PHY transmit procedure for an HE MU PPDU), with the number HE Training Symbols depending on the maximum total number of space-time streams across all RUs.

NOTE 2—The transmit procedure for NON_HT, HT_MF, HT_GF, and VHT format are specified in 26.2.x (Support for NON-HT, HT, and VHT formats).

In all options, in order to transmit data, the MAC generates a PHY-TXSTART.request primitive, which causes the PHY entity to enter the transmit state. Further, the PHY is set to operate at the appropriate frequency through station management via the PLME, as specified in 26.4 (HE PLME). Other transmit parameters, such as HE-MCS Coding types and transmit power, are set via the PHY-SAP using the PHYTXSTART.request(TXVECTOR) primitive, as described in 26.2.2 (TXVECTOR and RXVECTOR parameters). The remainder of the clause applies to the first four options.

The PHY indicates the state of the primary channel and other channels (if any) via the PHY-CCA.indication primitive (see 22.3.18.5 (CCA sensitivity) and 7.3.5.12 (PHY-CCA.indication)). Transmission of the PPDU shall be initiated by the PHY after receiving the PHY-TXSTART.request(TXVECTOR) primitive. The TXVECTOR elements for the PHY-TXSTART.request primitive are specified in Table 26-1 (TXVECTOR and RXVECTOR parameters(#1780)).

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Transmission of the PHY preamble may start if TIME_OF_DEPARTURE_REQUESTED is false, and shall start immediately if TIME_OF_DEPARTURE_REQUESTED is true, based on the parameters passed in the PHY-TXSTART.request primitive.

If all of the following conditions are met:

— if dot11TODImplemented and dot11TODActivated are true or if dot11TimingMsmtActivated is true,

— the TXVECTOR parameter TIME_OF_DEPARTURE_REQUESTED is true,

then the PHY shall issue a PHY-TXSTART.confirm(TXSTATUS) primitive to the MAC, forwarding the TIME_OF_DEPARTURE corresponding to the time when the first frame energy is sent by the transmitting port and TIME_OF_DEPARTURE_ClockRate parameter within the TXSTATUS vector. If dot11TimingMsmtActivated is true, then the PHY shall forward the value of TX_START_OF_FRAME_OFFSET in TXSTATUS vector.

After the PHY preamble transmission is started, the PHY entity immediately initiates data scrambling and data encoding. The encoding method for the Data field is based on the FEC_CODING, CH_BANDWIDTH, NUM_STS, STBC, MCS, and NUM_USERS parameter of the TXVECTOR, as described in 26.3.4 (HE PPDU formats).

The SERVICE field and PSDU are encoded as described in 26.3.5 (Transmitter block diagram). The data shall be exchanged between the MAC and the PHY through a series of PHY-DATA.request(DATA) primitives issued by the MAC, and PHY-DATA.confirm primitives issued by the PHY. PHY padding bits are appended to the PSDU to make the number of bits in the coded PSDU an integral multiple of the number of coded bits per OFDM symbol.

Transmission can be prematurely terminated by the MAC through the PHY-TXEND.request primitive. PSDU transmission is terminated by receiving a PHY-TXEND.request primitive. Each PHYTXEND.request primitive is acknowledged with a PHY-TXEND.confirm primitive from the PHY.

A packet extension and/or a signal extension may be present in the PPDU. When no packet extension and signal extension are present, the PHY-TXEND.confirm primitive is generated at the end of last symbol of the PPDU. When a packet extension and/or a signal extension present, the PHY-TXEND.confirm primitive is generated at the end of the packet extension or signal extension.

In the PHY, the GI with GI duration indicated in GI_TYPE parameter of the TXVECTOR is inserted in every data OFDM symbol as a countermeasure against delay spread.

When the PPDU transmission is completed the PHY entity enters the receive state.

A typical state machine implementation of the transmit PHY for an HE PPDU transmission is provided in Figure 26-44 (PHY transmit state machine for an HE PPDU). Request (.request) and confirmation(.confirm)

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primitives are issued once per state as shown. This state machine does not describe the operation of optional features, such as DCM.

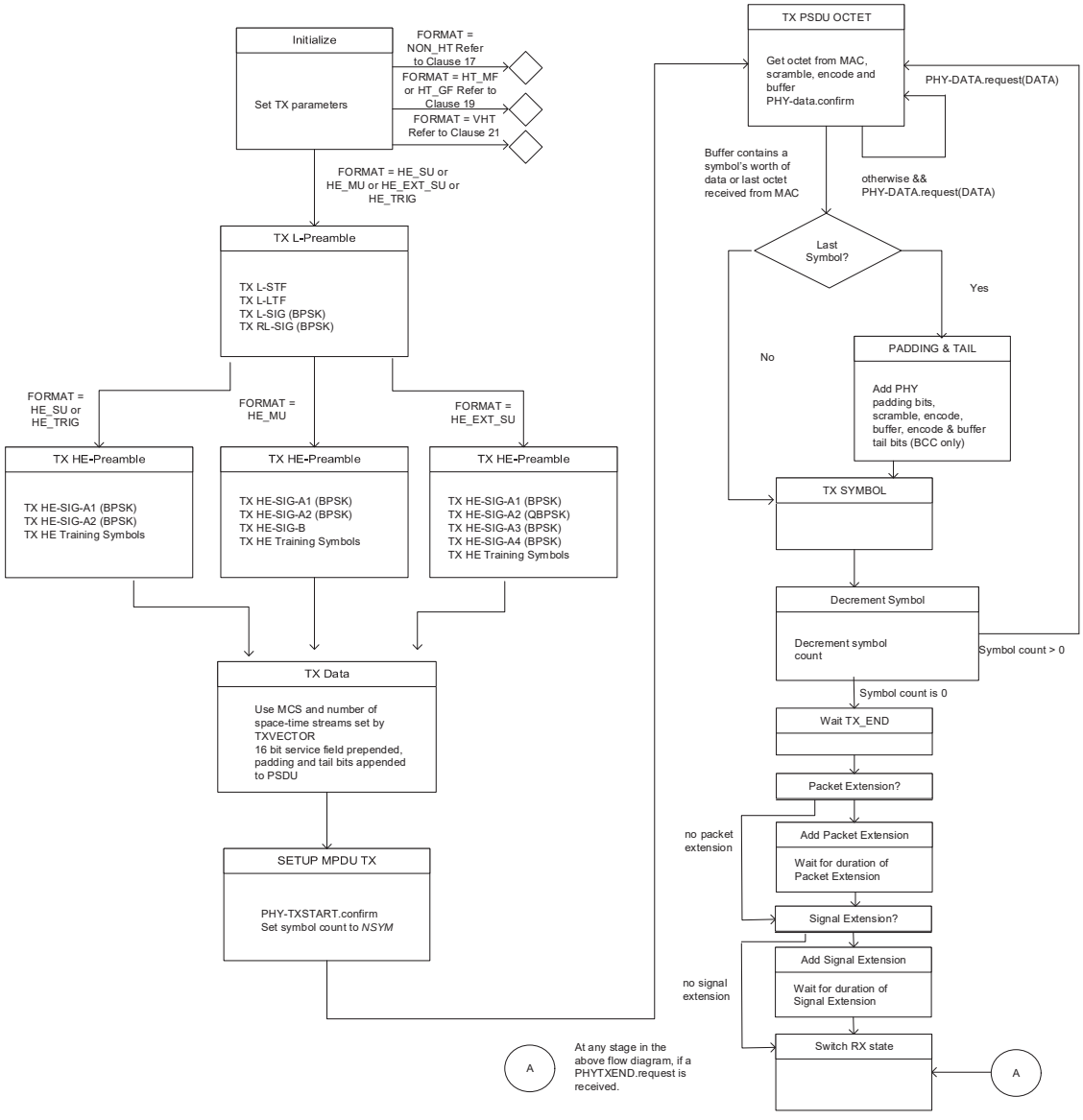

Figure 26-44—PHY transmit state machine for an HE PPDU

26.3.18 HE receive procedure

(#494)Typical PHY receive procedures are shown in Figure 26-45 (PHY receive procedure for an HE SU PPDU), Figure 26-46 (PHY receive procedure for an HE extended range SU PPDU), Figure 26-47 (PHY receive procedure for an HE MU PPDU), and Figure 26-48 (PHY receive procedure for an HE trigger-based PPDU) respectively. A typical state machine implementation of the receive PHY is given in Figure 26-49 (PHY receive state machine). This receive procedure and state machine do not describe the operation of optional features, such as DCM. If the detected format indicates a Non-HT PPDU, refer to the receive procedure and state machine in Clause 17 (Orthogonal frequency division multiplexing (OFDM) PHY specification). If the detected format indicates an HT PPDU format, refer to the receive procedure and state

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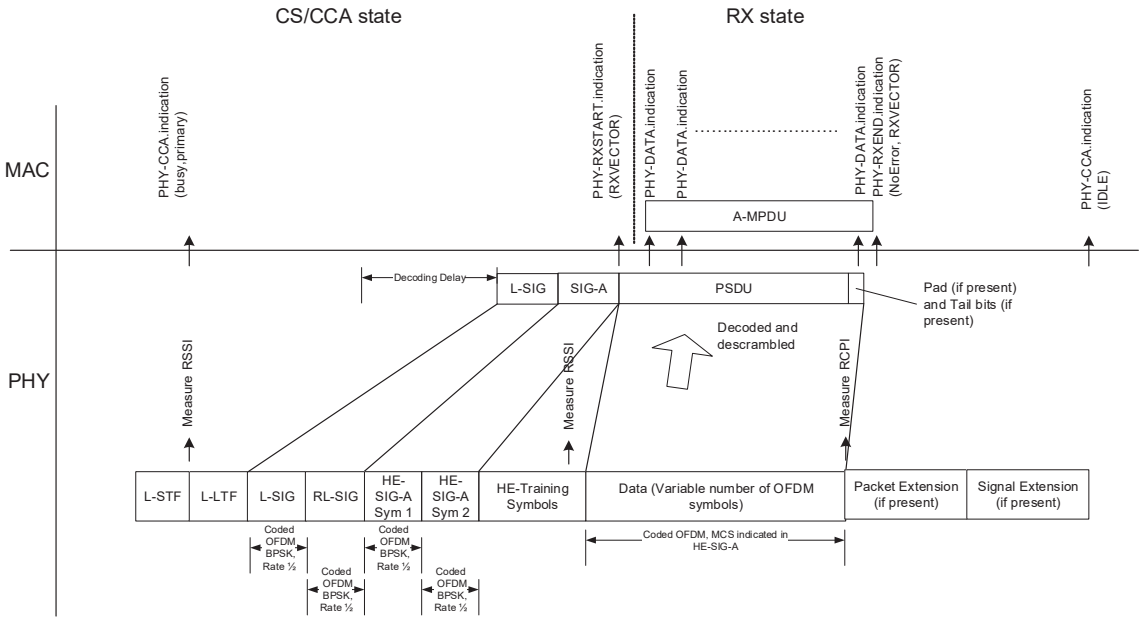
machine in Clause 19 (High Throughput (HT) PHY specification). If the detected format indicates a VHT PPDU format, refer to the receive procedure and state machine in Clause 21 (Very High Throughput (VHT) PHY specification).Through station management (via the PLME) the PHY is set to the appropriate frequency, as specified in 26.4 (HE PLME). The PHY has also been configured with cell identification information and STA identification information (i.e., BSS Color value and STA ID in the cell) so that it can receive data intended for the STA in the specific cell. Other receive parameters, such as RSSI and indicated DATARATE, may be accessed via the PHY-SAP.



NOTE—This procedure does not describe the operation of optional features, such as xxx.

Figure 26-45—PHY receive procedure for an HE SU PPDU

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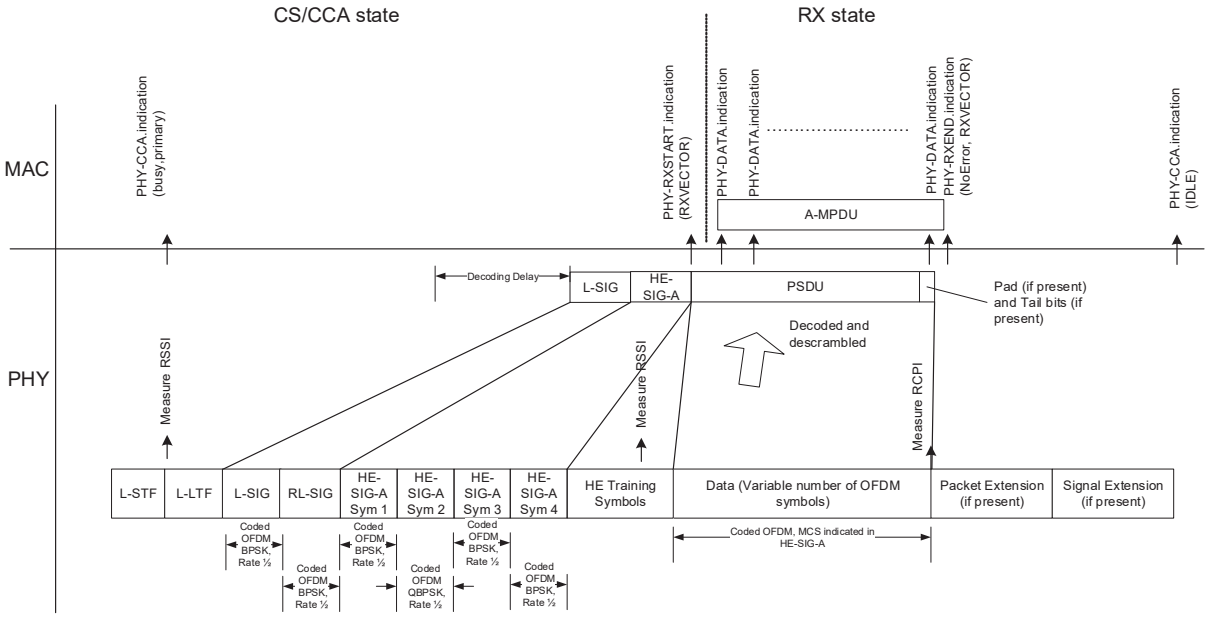
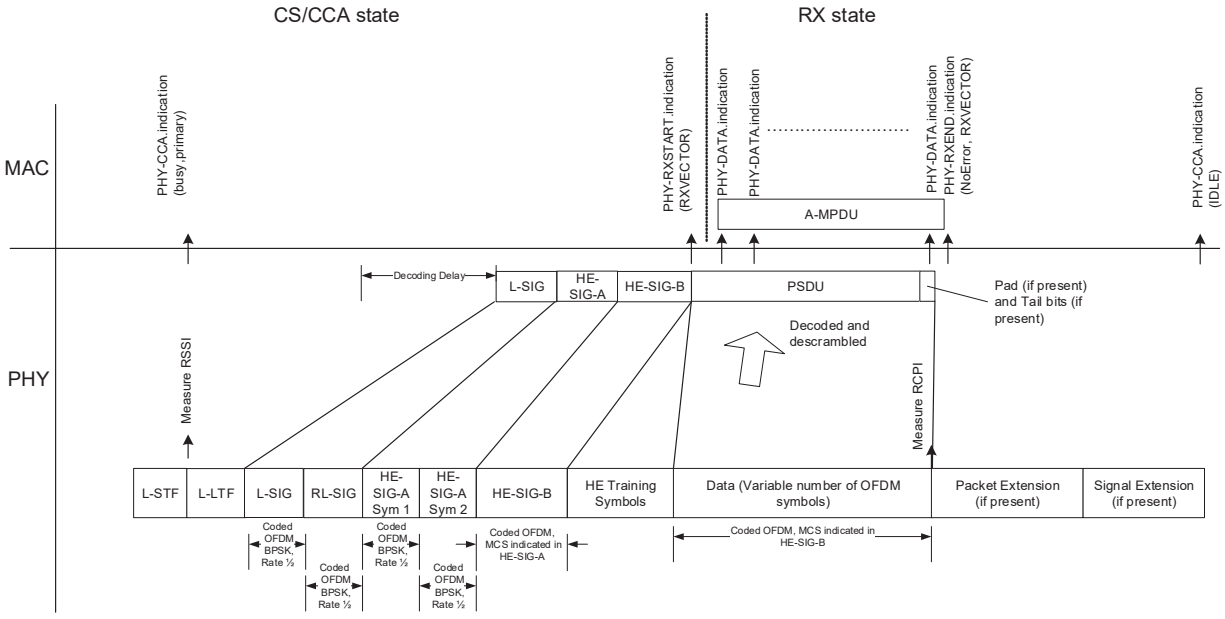


NOTE—This procedure does not describe the operation of optional features, such as xxx.

Figure 26-46—PHY receive procedure for an HE extended range SU PPDU



NOTE—This procedure does not describe the operation of optional features, such as xxx.

Figure 26-47—PHY receive procedure for an HE MU PPDU

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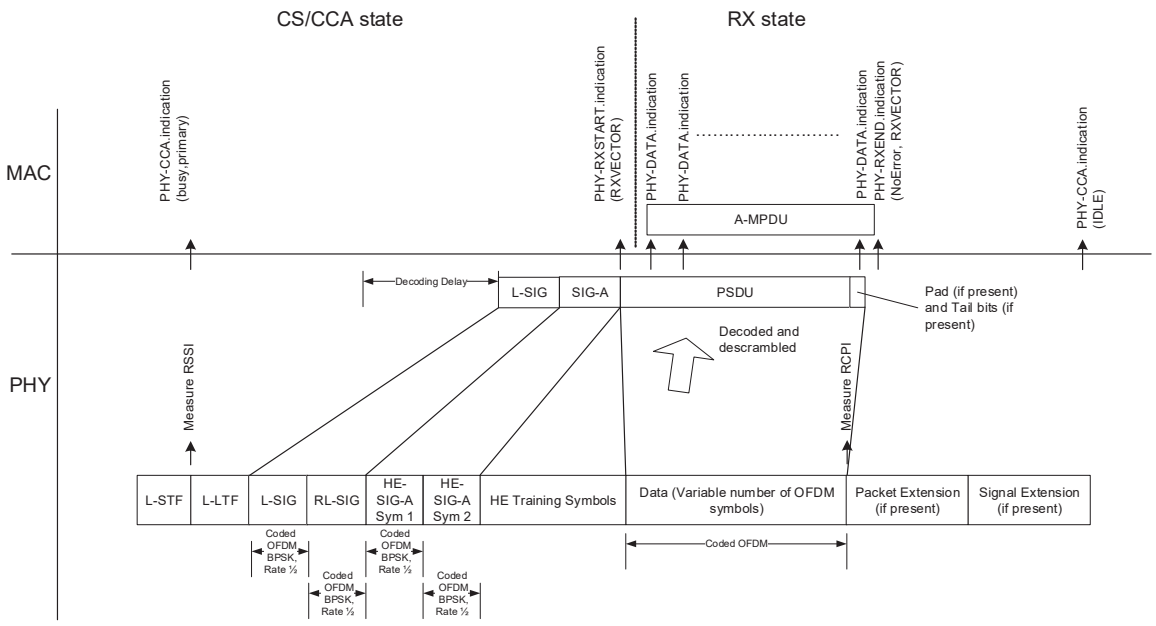

NOTE—This procedure does not describe the operation of optional features, such as xxx.

Figure 26-48—PHY receive procedure for an HE trigger-based PPDU

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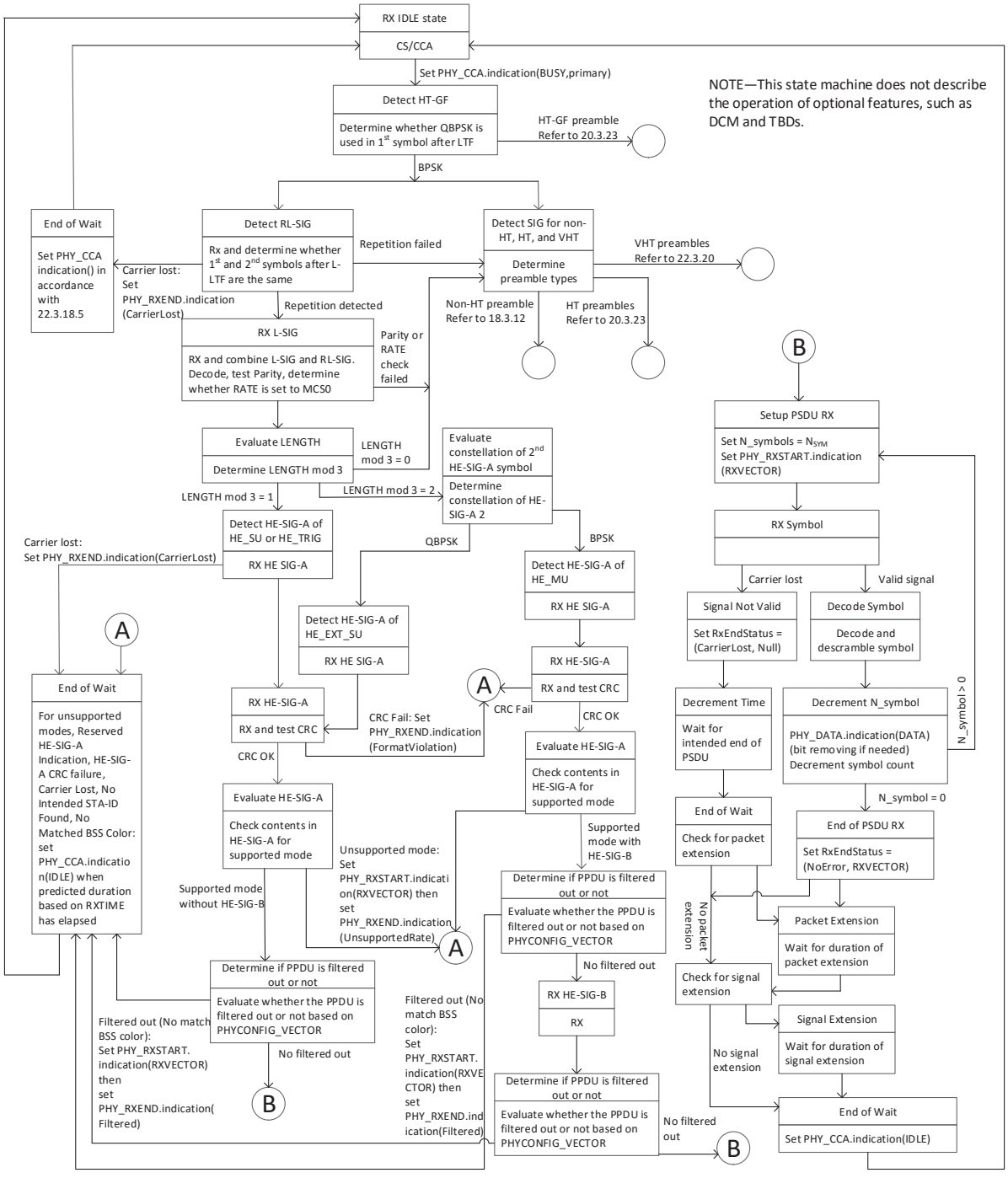

Figure 26-49—PHY receive state machine

Upon receiving the transmitted PHY preamble overlapping the primary 20 MHz channel in a greater than or equal to 20 MHz BSS, the PHY measures a receive signal strength. This activity is indicated by the PHY to the MAC via a PHY-CCA.indication primitive. A PHY-CCA.indication(BUSY, channel-list) primitive is also issued as an initial indication of reception of a signal as specified in 22.3.18.5 (CCA sensitivity). The channel-list parameter of the PHYCCA.indication primitive is absent when the operating channel width is

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20 MHz. The channel-list parameter is present and includes the element primary when the operating channel width is 40 MHz, 80 MHz, 160 MHz, or 80+80 MHz.

The PHY shall not issue a PHY-RXSTART.indication primitive in response to a PPDU that does not overlap the primary channel, except when the PHY at an AP receives the HE-trigger based PPDU. In such case, the PHY shall issue a PHY-RXSTART.indication primitive in response to a PPDU transmission either at the primary or at the secondary channel.

The PHY includes the most recently measured RSSI value in the PHY-RXSTART.indication(RXVECTOR) primitive issued to the MAC.(PHY Motion #173)

After the PHY-CCA.indication(BUSY, channel-list) primitive is issued, the PHY entity shall begin receiving the training symbols and searching for the preambles for NON-HT, HT, VHT, and HE PPDUs, respectively. If the constellation used in the first symbol after the first long traing field is QBPSK, the PHY entity shall continue to detect the received signal using the receive procedure for HT-GF depicted in Clause 19. Otherwise, for detecting the HE preamble, the PHY entity shall search for L-SIG and RL-SIG in order to set the maximum duration of the data stream. If RL-SIG is detected, the PHY entity should check the parity bit and RATE fields in L-SIG and RL-SIG. If either the check of the parity bit is invalid or the RATE field is not set to MCS0 in NON-HT, a PHY-RXSTART.indication primitive is not issued. If the check of the parity bit is valid and the RATE field is set to MCS0 but the LENGTH field value in L-SIG is a multiple of 3, a PHY-RXSTART.indication primitive is not issued. In both cases, the PHY should continue to detect the received signal using non-HT, HT, and VHT receive procedure in Clauses 17, 19, and 21, respectively.

If a valid parity bit and the RATE with MCS0 are indicated in L-SIG and RL-SIG and the LENGTH field value in L-SIG and RL-SIG meet the condition that the remainder is 1 after LENGTH divided by 3, the PHY entity should begin receiving the sequence of HE-SIG-A, HE-STF, and HE-LTF for HE SU PPDU and HE trigger-based PPDU as shown in Figure 26-45 (PHY receive procedure for an HE SU PPDU) and Figure 26-48 (PHY receive procedure for an HE trigger-based PPDU), respectively. After RL-SIG, the PHY entity shall receive two symbols of HE-SIG-A immediately followed by HE-STF. The PHY entity shall check CRC of HE-SIG-A. If the CRC check is valid, the PHY entity shall report TXOP, BSS Color and check Format field, and continue to receive HE-STF. The PHY entity shall report to the MAC entity the predicted duration of the TXOP in HE-SIG-A. The PHY entity shall check the BSS color in HE-SIG-A. If the BSS color doesn't contain an intended value, the PHY entity shall set PHY_RXSTART.indication(RXVECTOR) then set PHY_RXEND.indication(Filtered). The PHY entity shall check Format field in HE-SIG-A. If the Format field indicates an HE SU PPDU, the PHY entity shall receive HE-STF for 4 μs after HE-SIG-A. If the Format field indicates an HE trigger-based PPDU, the PHY entity shall receive HE-STF for 8 μs after HE-SIG-A. The PHY entity shall maintain PHY-CCA.indication(BUSY, channellist) primitive for the predicted duration of the transmitted PPDU, as defined by RXTIME in Equation (21-106), for all supported modes, unsupported modes, Reserved HE-SIG-A Indication, and invalid HE-SIG-A CRC. Reserved HE-SIG-A Indication is defined as an HE-SIG-A with Reserved bits equal to 0(PHY Motion #169). If the HE-SIG-A indicates an unsupported mode, the PHY shall issue a PHY-RXEND.indication(UnsupportedRate)primitive. If the HE-SIG-A indicates an invalid CRC or Reserved HE-SIG-A Indication, the PHY shall issue the error condition PHY-RXEND.indication(FormatViolation)primitive.

If a valid parity bit of L-SIG and RL-SIG is indicated and the LENGTH field value in L-SIG and RL-SIG meet the condition that the remainder is 2 after LENGTH divided by 3, the PHY entity should detect the signal constellations in the second symbol after RL-SIG. If the constellation is QBPSK, the PHY entity shall continue receiving the sequence of HE-SIG-A, HE-STF, and HE-LTF for HE_EXT_SU PPDU shown in Figure 26-42. After RL-SIG, the PHY entity shall receive four symbols of HE-SIG-A immediately followed by HE-STF. The PHY entity shall check CRC of HE-SIG-A. If the CRC check is valid, the PHY entity shall report TXOP, BSS Color, and continue to receive HE-STF. The PHY entity shall report to the MAC entity the predicted duration of the TXOP in HE-SIG-A. The PHY entity shall check the BSS color in HE-SIG-A. If the BSS color doesn't contain an intended value, the PHY entity shall set

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PHY_RXSTART.indication(RXVECTOR) then set PHY_RXEND.indication(Filtered). The PHY entity shall receive HE-STF for 4 μs after HE-SIG-A. The PHY entity shall maintain PHY-CCA.indication(BUSY, channellist) primitive for the predicted duration of the transmitted PPDU, as defined by RXTIME in Equation (21-106), for all supported modes, unsupported modes, Reserved HE-SIG-A Indication, and invalid HE-SIG-A CRC. Reserved HE-SIG-A Indication is defined as an HE-SIG-A with Reserved bits equal to 0(PHY Motion #169). If the HE-SIG-A indicates an unsupported mode, the PHY shall issue a PHY-RXEND.indication(UnsupportedRate)primitive. If the HE-SIG-A indicates an invalid CRC or Reserved HE-SIG-A Indication, the PHY shall issue the error condition PHY-RXEND.indication(FormatViolation)primitive.

If a valid parity bit of L-SIG and RL-SIG is indicated and the LENGTH field value in L-SIG and RL-SIG meet the condition that the remainder is 2 after LENGTH divided by 3, the PHY entity should detect the signal constellations in the second symbol after RL-SIG. If the constellation is BPSK, the PHY entity shall continue receiving the sequence of HE-SIG-A, HE-SIG-B, HE-STF, and HE-LTF for HE_MU PPDU shown in Figure 26-43. After RL-SIG, the PHY entity shall receive two symbols of HE-SIG-A immediately followed by HE-SIG-B. The PHY entity shall check CRC of HE-SIG-A. If the CRC check is valid, the PHY entity shall report TXOP, BSS Color, and continue to receive HE-SIG-B. The PHY entity shall report to the MAC entity the predicted duration of the TXOP in HE-SIG-A. The PHY entity shall check the BSS color in HE-SIG-A. If the BSS color doesn't contain an intended value, the PHY entity shall set PHY_RXSTART.indication(RXVECTOR) then set PHY_RXEND.indication(Filtered). After HE-SIG-A, the PHY entity shall receive HE-SIG-B for the number of symbols predicted from HE-SIG-A. If the common field presents in HE-SIG-B, the PHY entity shall check the CRC of the common field. If the CRC in the common field is valid or the common field is not present, the PHY entity shall search for intended STA-ID in each user-specific subfield with a valid CRC. If no CRC is valid or no intended STA-ID is detected, the PHY entity shall set PHY_RXSTART.indication(RXVECTOR) then set PHY_RXEND.indication(Filtered). If a complete allocation of an intended STA-ID is detected in block with valid CRC, the PHY entity shall continue receiving HE-STF for 4 μs after HE-SIG-B for the detected and intended STA. The PHY entity shall maintain PHY-CCA.indication(BUSY, channellist) primitive for the predicted duration of the transmitted PPDU, as defined by RXTIME in Equation (26-128), for all supported modes, unsupported modes, Reserved HE-SIG-A Indication, and invalid HE-SIG-A CRC. Reserved HE-SIG-A Indication is defined as an HE-SIG-A with Reserved bits equal to 0(PHY Motion #169). If the HE-SIG-A indicates an unsupported mode, the PHY shall issue a PHY-RXEND.indication(UnsupportedRate)primitive. If the HE-SIG-A indicates an invalid CRC or Reserved HE-SIG-A Indication, the PHY shall issue the error condition PHY-RXEND.indication(FormatViolation)primitive.

If signal loss occurs during reception prior to completion of the PSDU reception, the error condition PHYRXEND. indication(CarrierLost) shall be reported to the MAC. After waiting for the end of the PPDU as determined by Equation (26-128) the PHY shall set the PHY-CCA.indication (IDLE) primitive and return to the RX IDLE state.

$$\text{RXTIME}(\mu s) = \left\lceil \frac{\text{L_LENGTH} + 3}{3} \right\rceil 4 + 20 + \text{Signal Extension} \qquad (26\text{-}128)$$

Signal Extension is 0 μs when TXVECTOR parameter NO_SIG_EXTN is true and is aSignalExtension as defined in Table xxx of 26.3 (HE PHY) when TXVECTOR parameter NO_SIG_EXTN is false.

Except in an HE NDP PPDU, a Data field follows the HE-STF and HE-LTF fields. The number of symbols in the Data field and the packet extension duration are computed from Equation (26-119) and Equation (26-120), respectively.(#2105)

The received PSDU bits are assembled into octets, decoded, and present to the MAC using a series of PHY-DATA.indication(DATA) primitive exchanges. Any final bits that cannot be assembled into a complete octet are considered pad bits and discarded. After the reception of the final bit of the last PSDU octet, and

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possible padding and tail bits, the PHY entity shall check whether packet extension and/or signal extension is applied. If packet extension and/or signal extension is applied, the PHY entity shall wait until the packet extension and/or signal extension expires before returning to the RX IDLE state, as shown in Figure 26-49 (PHY receive state machine).

The receiving procedures are subject to further changes depending on the decisions of spatial reuse and 20 MHz only devices.

26.4 HE PLME

26.4.1 PLME_SAP sublayer management primitives

Table 25-1 (HE PHY MIB attributes (11ax)) lists the MIB attributes that may be accessed by the PHY entities and the intralayer of higher level LMEs. These attributes are accessed via the PLME-GET, PLME-SET, PLME-RESET, and PLME-CHARACTERISTICS primitives defined in 6.5 (PLME SAP interface).(PHY Motion #173)

26.4.2 TXTIME and PSDU_LENGTH calculation

The value of the TXTIME parameter returned by the PLME-TXTIME.confirm primitive shall be calculated for an(#2829) HE PPDU using Equation (26-129) for an HE SU PPDU and HE trigger-based PPDU, Equation (26-130) for an HE MU PPDU and Equation (26-131) for an HE extended range SU PPDU.

$$\text{TXTIME} = T_{\text{LEG_PREAMBLE}} + T_{\text{L-SIG}} + T_{\text{RL-SIG}} + T_{\text{HE-SIG-A}} + T_{\text{HE_PREAMBLE}} + N_{SYM}T_{SYM} + T_{PE} \quad (26\text{-}129)$$

$$\text{TXTIME} = T_{\text{LEG_PREAMBLE}} + T_{\text{L-SIG}} + T_{\text{RL-SIG}} + T_{\text{HE-SIG-A}} + N_{\text{HE-SIG-B}}T_{\text{HE-SIG-B}} + T_{\text{HE_PREAMBLE}} + N_{SYM}T_{SYM} + T_{PE} \quad (26\text{-}130)$$

$$\text{TXTIME} = T_{LEG_PREAMBLE} + T_{L-SIG} + T_{RL-SIG} + T_{HE-SIG-A} + T_{HE-SIG-A-R} + T_{HE_PREAMBLE} + N_{SYM}T_{SYM} + T_{PE} \quad (26\text{-}131)$$

where

$T_{\text{LEG_PREAMBLE}} = T_{L-STF} + T_{L-LTF}$

$$T_{\text{HE_PREAMBLE}} = \begin{cases} T_{\text{HE-STF-T}} + N_{HELTF}T_{\text{HE-LTF,SYM}}, & \text{for an HE trigger-based PPDU} \\ T_{\text{HE-STF-NT}} + N_{HELTF}T_{\text{HE-LTF,SYM}}, & \text{otherwise} \end{cases}$$

$T_{\text{L-STF}}$, $T_{\text{L-LTF}}$, $T_{\text{HE-STF-T}}$, $T_{\text{HE-STF-NT}}$, $T_{\text{HE-LTF,SYM}}$, $T_{\text{L-SIG}}$, $T_{\text{RL-SIG}}$, $T_{\text{HE-SIG-A}}$, $T_{\text{HE-SIG-A-R}}$, $T_{\text{HE-SIG-B}}$, and T_{SYM} are defined in Table 26-9 (Timing-related constants)

$N_{\text{HE-SIG-B}}$ and $N_{\text{HE-LTF}}$ are defined in Table 26-12 (Frequently used parameters(#282))

For an HE NDP PPDU, there is no Data field and $N_{SYM} = 0$.

For an HE SU PPDU and HE extended range SU PPDU using BCC encoding, the total number of OFDM symbols in the Data field is given by Equation (26-67)(#2108).

For an HE SU PPDU and HE extended range SU PPDU using LDPC encoding, the total number of OFDM symbols in the Data field, N_{SYM}, is given in 26.3.11.5.2 (LDPC coding).

For an HE MU PPDU (including both MU-MIMO and OFDMA), the total number of OFDM symbols in the Data field, NSYM, is given in 26.3.11.5.4 (Encoding process for an HE MU PPDU).

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For an HE trigger-based PPDU, the total number of OFDM symbols in the Data field, N_{SYM}, is given in 26.3.11.5.5 (Encoding process for an HE trigger-based PPDU).

T_{PE} is given by Equation (26-116).

The value of the PSDU_LENGTH parameter returned in the PLME-TXTIME.confirm primitive for an HE SU PPDU and HE extended range SU PPDU is calculated using Equation (26-132).(#2521)

$$\text{PSDU_LENGTH} = \left\lfloor \frac{(N_{SYM,\,init} - m_{STBC})N_{DBPS} + m_{STBC}N_{DBPS,\,Last,\,init} - N_{service} - N_{tail}}{8} \right\rfloor \quad (26\text{-}132)$$

where

$N_{SYM,init}$ is given by Equation (26-66) for BCC encoding and by Equation (26-71) for LDPC encoding;
m_{STBC} is 2 when STBC is used, and 1 otherwise;
N_{DBPS} is given in 26.5 (Parameters for HE-MCSs);
$N_{DBPS,Last,init}$ is given by Equation (26-62)

The value of the PSDU_LENGTH parameter for user u returned in the PLME-TXTIME.confirm primitive and in the RXVECTOR for an(#2829) HE MU PPDU is calculated using Equation (26-133).(#2521)

$$\text{PSDU_LENGTH}_u = \left\lfloor \frac{(N_{SYM,\,init} - m_{STBC})N_{DBPS} + m_{STBC}N_{DBPS,\,Last,\,init} - N_{service} - N_{tail}}{8} \right\rfloor \quad (26\text{-}133)$$

$N_{SYM,init}$ is given by Equation (26-79)
$N_{DBPS,Last,init}$is given by Equation (26-80)

The value of the PSDU_LENGTH parameter returned in the PLME-TXTIME.confirm primitive for an HE NDP PPDU is 0.

26.4.3 HE PHY

The static HE PHY characteristics, provided through the PLME-CHARACTERISTICS service primitive, shall be as shown in Table 20-25 (HT PHY characteristics) unless otherwise listed in Table 26-43 (HE PHY characteristics). The definitions for these characteristics are given in 6.5 (PLME SAP interface).

Table 26-43—HE PHY characteristics

Characteristic	Value
aTxPHYDelay	Implementation dependent
aRxPHYDelay	Implementation dependent
aCCAMidTIme	25 µs
aPPDUMaxTime	5.484 ms
aPSDUMaxLength	TBD

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26.5 Parameters for HE-MCSs(#552)

The rate-dependent parameters for 26-tone RU, 52-tone RU, 106-tone RU, 242-tone RU and non-OFDMA 20 MHz, 484-tone RU and non-OFDMA 40 MHz, 996-tone RU and non-OFDMA 80 MHz, non-OFDMA 160 MHz and 80+80 MHz $N_{SS} = 1, \ldots, 8$ are given in Table 26-92 (HE-MCSs for optional non-OFDMA 160 MHz and 80+80 MHz, NSS = 1) through Table 26-99 (HE-MCSs for optional non-OFDMA 160 MHz and 80+80 MHz, NSS = 8). Support for HE-MCS 8, 9, 10, and 11 (when valid) is optional in all cases. HE-MCS 10 and 11 (1024-QAM) are applicable only to RU sizes equal to or larger than 242 tones.

Dual sub-carrier modulation (DCM) is an optional modulation scheme for any OFDMA and non OFDMA transmissions. DCM is only applied to MCS 0, MCS 1, MCS 3 and MCS 4. DCM is applied only with $N_{SS} = 1$ or $N_{SS} = 2$ (in the case of single user RU in an HE MU PPDU, $N_{SS,r,u} = 1$ or $N_{SS,r,u} = 2$).(PHY Motion #171) A HE STA shall support single spatial stream HE-MCSs within the range HE-MCS 0 to HE-MCS 7 for all channel widths for which it has indicated support regardless of the Tx or Rx Highest Supported Long GI Data Rate subfield values in the Supported HE-MCS and NSS Set field. When more than one spatial stream is supported, the Tx or Rx Highest Supported Long GI Data Rate subfield values in the Supported HE-MCS and NSS Set field may result in a reduced HE-MCS range (cut-off) for $N_{SS} = 2, \ldots, 8$. Support for OFDMA 26-tone RU, 52-tone RU, 106-tone RU, 242-tone RU and 996-tone RU with $N_{SS} = 1$ is mandatory(PHY Motion #173). Support for non-OFDMA 20 MHz, 40 MHz, and 80 MHz with $N_{SS} = 1$ is mandatory. Support for more than one spatial stream is optional in all cases. Support for OFDMA and non-OFDMA 160 MHz and 80+80 MHz with $N_{SS} = 1, \ldots, 8$ is optional.(#282)

Table 26-44 (HE-MCSs for mandatory 26-tone RU, NSS = 1) to Table 26-99 (HE-MCSs for optional non-OFDMA 160 MHz and 80+80 MHz, NSS = 8) define HE-MCSs not only for SU transmission but also for user u at r-th RU of an MU transmission. In the case of HE-MCSs for MU transmissions, the parameters, N_{SS}, R, N_{BPSCS}, N_{CBPS}, and N_{DBPS} are replaced with $N_{SS,u}$, R_u, $N_{BPSCS,u}$, $N_{CBPS,u}$, and $N_{DBPS,u}$, respectively(#2522).

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In the tables below, the number of streams and RU sizes that DCM is applicable to are TBD.

Table 26-44—HE-MCSs for mandatory 26-tone RU, N_{SS} = 1

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
									0.8 μs GI	1.6 μs GI	3.2 μs GI
0	1	BPSK	1/4	1	24	2	24	6	0.4	0.4	0.4
0	0		1/2	1			24	12	0.9	0.8	0.8
1	1	QPSK	1/4	2			48	12	0.9	0.8	0.8
1	0		1/2	2			48	24	1.8	1.7	1.5
2	N/A		3/4	2			48	36	2.6	2.5	2.3
3	1	16-QAM	1/4	4			96	24	1.8	1.7	1.5
3	0		1/2	4			96	48	3.5	3.3	3.0
4	1		3/8	4			96	36	2.6	2.5	2.3
4	0		3/4	4			96	72	5.3	5.0	4.5
5	N/A	64-QAM	2/3	6			144	96	7.1	6.7	6.0
6			3/4	6			144	108	7.9	7.5	6.8
7			5/6	6			144	120	8.8	8.3	7.5
8		256-QAM	3/4	8			192	144	10.6	1.0	9.0
9			5/6	8			192	160	11.8	11.1	10.0

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Table 26-45—HE-MCSs for mandatory 26-tone RU, N_{SS} = 2

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
									0.8 μs GI	1.6 μs GI	3.2 μs GI
0	1	BPSK	1/4	1	24	2	48	12	0.9	0.8	0.8
0	0		1/2	1			48	24	1.8	1.7	1.5
1	1	QPSK	1/4	2			96	24	1.8	1.7	1.5
1	0		1/2	2			96	48	3.5	3.3	3.0
2	N/A		3/4	2			96	72	5.3	5.0	4.5
3	1	16-QAM	1/4	4			192	48	3.5	3.3	3.0
3	0		1/2	4			192	96	7.1	6.7	6.0
4	1		3/8	4			192	72	5.3	5.0	4.5
4	0		3/4	4			192	144	10.6	10.0	9.0
5	N/A	64-QAM	2/3	6			288	192	14.1	13.3	12.0
6			3/4	6			288	216	15.9	15.0	13.5
7			5/6	6			288	240	17.6	16.7	15.0
8		256-QAM	3/4	8			384	288	21.2	20.0	18.0
9			5/6	8			384	320	23.5	22.2	20.0

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Table 26-46—HE-MCSs for mandatory 26-tone RU, N_{SS} = 3

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
									0.8 μs GI	1.6 μs GI	3.2 μs GI
0	1	BPSK	1/4	1	24	2	72	18	1.3	1.3	1.1
0	0		1/2	1			72	36	2.6	2.5	2.3
1	1	QPSK	1/4	2			144	36	2.6	2.5	2.3
1	0		1/2	2			144	72	5.3	5.0	4.5
2	N/A		3/4	2			144	108	7.9	7.5	6.8
3	1	16-QAM	1/4	4			288	72	5.3	5.0	4.5
3	0		1/2	4			288	144	10.6	10.0	9.0
4	1		3/8	4			288	108	7.9	7.5	6.8
4	0		3/4	4			288	216	15.9	15.0	13.5
5	N/A	64-QAM	2/3	6			432	288	21.2	20.0	20.3
6			3/4	6			432	324	23.8	22.5	20.3
7			5/6	6			432	360	26.5	25.0	22.5
8		256-QAM	3/4	8			576	432	31.8	30.0	27.0
9			5/6	8			576	480	35.3	33.3	30.0

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Table 26-47—HE-MCSs for mandatory 26-tone RU, N_{SS} = 4

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
									0.8 μs GI	1.6 μs GI	3.2 μs GI
0	1	BPSK	1/4	1	24	2	96	24	1.8	1.7	1.5
0	0		1/2	1			96	48	3.5	3.3	3.0
1	1	QPSK	1/4	2			192	48	3.5	3.3	3.0
1	0		1/2	2			192	96	7.1	6.7	6.0
2	N/A		3/4	2			192	144	10.6	10.0	9.0
3	1	16-QAM	1/4	4			384	96	7.1	6.7	6.0
3	0		1/2	4			384	192	14.1	13.3	12.0
4	1		3/8	4			384	144	10.6	10.0	9.0
4	0		3/4	4			384	288	21.2	20.0	18.0
5	N/A	64-QAM	2/3	6			576	384	28.2	26.7	24.0
6			3/4	6			576	432	31.8	30.0	27.0
7			5/6	6			576	480	35.3	33.3	30.0
8		256-QAM	3/4	8			768	576	42.4	40.0	36.0
9			5/6	8			768	640	47.1	44.4	40.0

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Table 26-48—HE-MCSs for mandatory 26-tone RU, N_{SS} = 5

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
									0.8 μs GI	1.6 μs GI	3.2 μs GI
0	1	BPSK	1/4	1	24	2	120	30	2.2	2.1	1.9
0	0		1/2	1			120	60	4.4	4.2	3.8
1	1	QPSK	1/4	2			240	60	4.4	4.2	3.8
1	0		1/2	2			240	120	8.8	8.3	7.5
2	N/A		3/4	2			240	180	13.2	12.5	11.3
3	1	16-QAM	1/4	4			480	120	8.8	8.3	7.5
3	0		1/2	4			480	240	17.6	16.7	15.0
4	1		3/8	4			480	180	13.2	12.5	11.3
4	0		3/4	4			480	360	26.5	25.0	22.5
5	N/A	64-QAM	2/3	6			720	480	35.3	33.3	30.0
6			3/4	6			720	540	39.7	37.5	33.8
7			5/6	6			720	600	44.1	41.7	37.5
8		256-QAM	3/4	8			960	720	52.9	50.0	45.0
9			5/6	8			960	800	58.8	55.6	50.0

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Table 26-49—HE-MCSs for mandatory 26-tone RU, N_{SS} = 6

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
									0.8 μs GI	1.6 μs GI	3.2 μs GI
0	1	BPSK	1/4	1	24	2	144	36	2.6	2.5	2.3
0	0		1/2	1			144	72	5.3	5.0	4.5
1	1	QPSK	1/4	2			288	72	5.3	5.0	4.5
1	0		1/2	2			288	144	10.6	10.0	9.0
2	N/A		3/4	2			288	216	15.9	15.0	13.5
3	1	16-QAM	1/4	4			576	144	10.6	10.0	9.0
3	0		1/2	4			576	288	21.2	20.0	18.0
4	1		3/8	4			576	216	15.9	15.0	13.5
4	0		3/4	4			576	432	31.8	30.0	27.0
5	N/A	64-QAM	2/3	6			864	576	42.4	40.0	36.0
6			3/4	6			864	648	47.6	45.0	40.5
7			5/6	6			864	720	52.9	50.0	45.0
8		256-QAM	3/4	8			1 152	864	63.5	60.0	54.0
9			5/6	8			1 152	960	70.6	66.7	60.0

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Table 26-50—HE-MCSs for mandatory 26-tone RU, N_{SS} = 7

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
									0.8 μs GI	1.6 μs GI	3.2 μs GI
0	1	BPSK	1/4	1	24	2	168	42	3.1	2.9	2.6
0	0		1/2	1			168	84	6.2	5.8	5.3
1	1	QPSK	1/4	2			336	84	6.2	5.8	5.3
1	0		1/2	2			336	168	12.4	11.7	10.5
2	N/A		3/4	2			336	252	18.5	17.5	15.8
3	1	16-QAM	1/4	4			672	168	12.4	11.7	10.5
3	0		1/2	4			672	336	24.7	23.3	21.0
4	1		3/8	4			672	252	18.5	17.5	15.8
4	0		3/4	4			672	504	37.1	35.0	31.5
5	N/A	64-QAM	2/3	6			1 008	672	49.4	46.7	42.0
6			3/4	6			1 008	756	55.6	52.5	47.3
7			5/6	6			1 008	840	61.8	58.3	52.5
8		256-QAM	3/4	8			1 344	1 008	74.1	70.0	63.0
9			5/6	8			1 344	1 120	82.4	77.8	70.0

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Table 26-51—HE-MCSs for mandatory 26-tone RU, N_{SS} = 8

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
									0.8 μs GI	1.6 μs GI	3.2 μs GI
0	1	BPSK	1/4	1	24	2	192	48	3.5	3.3	3.0
0	0		1/2	1			192	96	7.1	6.7	6.0
1	1	QPSK	1/4	2			384	96	7.1	6.7	6.0
1	0		1/2	2			384	192	14.1	13.3	12.0
2	N/A		3/4	2			384	288	21.2	20.0	18.0
3	1	16-QAM	1/4	4			768	192	14.1	13.3	12.0
3	0		1/2	4			768	384	28.2	26.7	24.0
4	1		3/8	4			768	288	21.2	20.0	18.0
4	0		3/4	4			768	576	42.4	40.0	36.0
5	N/A	64-QAM	2/3	6			1 152	768	56.5	53.3	48.0
6			3/4	6			1 152	864	63.5	60.0	54.0
7			5/6	6			1 152	960	70.6	66.7	60.0
8		256-QAM	3/4	8			1 536	1 152	84.7	80.0	72.0
9			5/6	8			1 536	1 280	94.1	88.9	80.0

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Table 26-52—HE-MCSs for mandatory 52-tone RU, N_{SS} = 1

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
									0.8 μs GI	1.6 μs GI	3.2 μs GI
0	1	BPSK	1/4	1	48	4	48	12	0.9	0.8	0.8
0	0		1/2	1			48	24	1.8	1.7	1.5
1	1	QPSK	1/4	2			96	24	1.8	1.7	1.5
1	0		1/2	2			96	48	3.5	3.3	3.0
2	N/A		3/4	2			96	72	5.3	5.0	4.5
3	1	16-QAM	1/4	4			192	48	3.5	3.3	3.0
3	0		1/2	4			192	96	7.1	6.7	6.0
4	1		3/8	4			192	72	5.3	5.0	4.5
4	0		3/4	4			192	144	10.6	10.0	9.0
5	N/A	64-QAM	2/3	6			288	192	14.1	13.3	12.0
6			3/4	6			288	216	15.9	15.0	13.5
7			5/6	6			288	240	17.6	16.7	15.0
8		256-QAM	3/4	8			384	288	21.2	20.0	18.0
9			5/6	8			384	320	23.5	22.2	20.0

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Table 26-53—HE-MCSs for mandatory 52-tone RU, N_{SS} = 2

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
									0.8 μs GI	1.6 μs GI	3.2 μs GI
0	1	BPSK	1/4	1	48	4	96	24	1.8	1.7	1.5
0	0		1/2	1			96	48	3.5	3.3	3.0
1	1	QPSK	1/4	2			192	48	3.5	3.3	3.0
1	0		1/2	2			192	96	7.1	6.7	6.0
2	N/A		3/4	2			192	144	10.6	10.0	9.0
3	1	16-QAM	1/4	4			384	96	7.1	6.7	6.0
3	0		1/2	4			384	192	14.1	13.3	12.0
4	1		3/8	4			384	144	10.6	10.0	9.0
4	0		3/4	4			384	288	21.2	20.0	18.0
5	N/A	64-QAM	2/3	6			576	384	28.2	26.7	24.0
6			3/4	6			576	432	31.8	30.0	27.0
7			5/6	6			576	480	35.3	33.3	30.0
8		256-QAM	3/4	8			768	576	42.4	40.0	36.0
9			5/6	8			768	640	47.1	44.4	40.0

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Table 26-54—HE-MCSs for mandatory 52-tone RU, N_{SS} = 3

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
									0.8 μs GI	1.6 μs GI	3.2 μs GI
0	1	BPSK	1/4	1	48	4	144	36	2.6	2.5	2.3
0	0		1/2	1			144	72	5.3	5.0	4.5
1	1	QPSK	1/4	2			288	72	5.3	5.0	4.5
1	0		1/2	2			288	144	10.6	10.0	9.0
2	N/A		3/4	2			288	216	15.9	15.0	13.5
3	1	16-QAM	1/4	4			576	144	10.6	10.0	9.0
3	0		1/2	4			576	288	21.2	20.0	18.0
4	1		3/8	4			576	216	15.9	15.0	13.5
4	0		3/4	4			576	432	31.8	30.0	27.0
5	N/A	64-QAM	2/3	6			864	576	42.4	40.0	36.0
6			3/4	6			864	648	47.6	45.0	40.5
7			5/6	6			864	720	52.9	50.0	45.0
8		256-QAM	3/4	8			1 152	864	63.5	60.0	54.0
9			5/6	8			1 152	960	70.6	66.7	60.0

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Table 26-55—HE-MCSs for mandatory 52-tone RU, N_{SS} = 4

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
									0.8 μs GI	1.6 μs GI	3.2 μs GI
0	1	BPSK	1/4	1	48	4	192	48	3.5	3.3	3.0
0	0		1/2	1			192	96	7.1	6.7	6.0
1	1	QPSK	1/4	2			384	96	7.1	6.7	6.0
1	0		1/2	2			384	192	14.1	13.3	12.0
2	N/A		3/4	2			384	288	21.2	20.0	18.0
3	1	16-QAM	1/4	4			768	192	14.1	13.3	12.0
3	0		1/2	4			768	384	28.2	26.7	24.0
4	1		3/8	4			768	288	21.2	20.0	18.0
4	0		3/4	4			768	576	42.4	40.0	36.0
5	N/A	64-QAM	2/3	6			1 152	768	56.5	53.3	48.0
6			3/4	6			1 152	864	63.5	60.0	54.0
7			5/6	6			1 152	960	70.6	66.7	60.0
8		256-QAM	3/4	8			1 536	1 152	84.7	80.0	72.0
9			5/6	8			1 536	1 280	94.1	88.9	80.0

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Table 26-56—HE-MCSs for mandatory 52-tone RU, N_{SS} = 5

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
									0.8 μs GI	1.6 μs GI	3.2 μs GI
0	1	BPSK	1/4	1	48	4	240	60	4.4	4.2	3.8
0	0		1/2	1			240	120	8.8	8.3	7.5
1	1	QPSK	1/4	2			480	120	8.8	8.3	7.5
1	0		1/2	2			480	240	17.6	16.7	15.0
2	N/A		3/4	2			480	360	26.5	25.0	22.5
3	1	16-QAM	1/4	4			960	240	17.6	16.7	15.0
3	0		1/2	4			960	480	35.3	33.3	30.0
4	1		3/8	4			960	360	26.5	25.0	45.0
4	0		3/4	4			960	720	52.9	50.0	45.0
5	N/A	64-QAM	2/3	6			1 440	960	70.6	66.7	60.0
6			3/4	6			1 440	1080	79.4	75.0	67.5
7			5/6	6			1 440	1 200	88.2	83.3	75.0
8		256-QAM	3/4	8			1 920	1 440	105.9	100.0	90.0
9			5/6	8			1 920	1 600	117.6	111.1	100.0

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Table 26-57—HE-MCSs for mandatory 52-tone RU, N_{SS} = 6

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
									0.8 μs GI	1.6 μs GI	3.2 μs GI
0	1	BPSK	1/4	1	48	4	288	72	5.3	5.0	4.5
0	0		1/2	1			288	144	10.6	10.0	9.0
1	1	QPSK	1/4	2			576	144	10.6	10.0	9.0
1	0		1/2	2			576	288	21.2	20.0	18.0
2	N/A		3/4	2			576	432	31.8	30.0	27.0
3	1	16-QAM	1/4	4			1 152	288	21.2	20.0	18.0
3	0		1/2	4			1 152	576	42.4	40.0	36.0
4	1		3/8	4			1 152	432	31.8	30.0	27.0
4	0		3/4	4			1 152	864	63.5	60.0	54.0
5	N/A	64-QAM	2/3	6			1 728	1 152	84.7	80.0	72.0
6			3/4	6			1 728	1 296	95.3	90.0	81.0
7			5/6	6			1 728	1 440	105.9	100.0	90.0
8		256-QAM	3/4	8			2 304	1 728	127.1	120.0	108.0
9			5/6	8			2 304	1 920	141.2	133.3	120.0

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Table 26-58—HE-MCSs for mandatory 52-tone RU, N_{SS} = 7

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
									0.8 μs GI	1.6 μs GI	3.2 μs GI
0	1	BPSK	1/4	1	48	4	336	84	6.2	5.8	5.3
0	0		1/2	1			336	168	12.4	11.7	10.5
1	1	QPSK	1/4	2			672	168	12.4	11.7	10.5
1	0		1/2	2			672	336	24.7	23.3	21.0
2	N/A		3/4	2			672	504	37.1	35.0	31.5
3	1	16-QAM	1/4	4			1 344	336	24.7	23.3	21.0
3	0		1/2	4			1 344	672	49.4	46.7	42.0
4	1		3/8	4			1 344	504	37.1	35.0	31.5
4	0		3/4	4			1 344	1 008	74.1	70.0	63.0
5	N/A	64-QAM	2/3	6			2 016	1 344	98.8	93.3	84.0
6			3/4	6			2 016	1 512	111.2	105.0	94.5
7			5/6	6			2 016	1 680	123.5	116.7	105.0
8		256-QAM	3/4	8			2 688	2 016	148.2	140.0	126.0
9			5/6	8			2 688	2 240	164.7	155.6	140.0

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Table 26-59—HE-MCSs for mandatory 52-tone RU, N_{SS} = 8

HE-MCS Index	DCM	Modulation	R	N_{BPCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	Data rate (Mbps)		
									0.8 μs GI	1.6 μs GI	3.2 μs GI
0	1	BPSK	1/4	1	48	4	384	96	7.1	6.7	6.0
0	0		1/2	1			384	192	14.1	13.3	12.0
1	1	QPSK	1/4	2			768	192	14.1	13.3	12.0
1	0		1/2	2			768	384	28.2	26.7	24.0
2	N/A		3/4	2			768	576	42.4	40.0	36.0
3	1	16-QAM	1/4	4			1 536	384	28.2	26.7	24.0
3	0		1/2	4			1 536	768	56.5	53.3	48.0
4	1		3/8	4			1 536	576	42.4	40.0	36.0
4	0		3/4	4			1 536	1 152	84.7	80.0	72.0
5	N/A	64-QAM	2/3	6			2 304	1 536	112.9	106.7	96.0
6			3/4	6			2 304	1 728	127.1	120.0	108.0
7			5/6	6			2 304	1 920	141.2	133.3	120.0
8		256-QAM	3/4	8			3 072	2 304	169.4	160.0	144.0
9			5/6	8			3 072	2 560	188.2	177.8	160.0

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Table 26-60—HE-MCSs for mandatory 106-tone RU, N_{SS} = 1

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	102	4	102	25	1	1.8	1.7	1.6
0	0		1/2	1			102	51	1	3.8	3.5	3.2
1	1	QPSK	1/4	2			204	51	1	3.8	3.5	3.2
1	0		1/2	2			204	102	1	7.5	7.1	6.4
2	N/A		3/4	2			204	153	1	11.3	10.6	9.6
3	1	16-QAM	1/4	4			408	102	1	7.5	7.1	6.4
3	0		1/2	4			408	204	1	15.0	14.2	12.8
4	1		3/8	4			408	153	1	11.3	10.6	9.6
4	0		3/4	4			408	306	1	22.5	21.3	19.1
5	N/A	64-QAM	2/3	6			612	408	1	30.0	28.3	25.5
6			3/4	6			612	459	1	33.8	31.9	28.7
7			5/6	6			612	510	1	37.5	35.4	31.9
8		256-QAM	3/4	8			816	612	1	45.0	42.5	38.3
9			5/6	8			816	680	1	50.0	47.2	42.5

Table 26-61—HE-MCSs for mandatory 106-tone RU, N_{SS} = 2

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	102	4	204	51	1	3.8	3.5	3.2
0	0		1/2	1			204	102	1	7.5	7.1	6.4
1	1	QPSK	1/4	2			408	102	1	7.5	7.1	6.4
1	0		1/2	2			408	204	1	15.0	14.2	12.8
2	N/A		3/4	2			408	306	1	22.5	21.3	19.1
3	1	16-QAM	1/4	4			816	204	1	15.0	14.2	12.8
3	0		1/2	4			816	408	1	30.0	28.3	25.5
4	1		3/8	4			816	306	1	22.5	21.3	19.1
4	0		3/4	4			816	612	1	45.0	42.5	38.3
5	N/A	64-QAM	2/3	6			1224	816	1	60.0	56.7	51.0
6			3/4	6			1224	918	1	67.5	63.8	57.4
7			5/6	6			1224	1,020	1	75.0	70.8	63.8
8		256-QAM	3/4	8			1632	1,224	1	90.0	85.0	76.5
9			5/6	8			1632	1,360	1	100.0	94.4	85.0

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Table 26-62—HE-MCSs for mandatory 106-tone RU, N_{SS} = 3

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	102	4	306	76	1	5.6	5.3	4.8
0	0		1/2	1			306	153	1	11.3	10.6	9.6
1	1	QPSK	1/4	2			612	153	1	11.3	10.6	9.6
1	0		1/2	2			612	306	1	22.5	21.3	19.1
2	N/A		3/4	2			612	459	1	33.8	31.9	28.7
3	1	16-QAM	1/4	4			1224	306	1	22.5	21.3	19.1
3	0		1/2	4			1224	612	1	45.0	42.5	38.3
4	1		3/8	4			1224	459	1	33.8	31.9	28.7
4	0		3/4	4			1224	918	1	67.5	63.8	57.4
5	N/A	64-QAM	2/3	6			1836	1,224	1	90.0	85.0	76.5
6			3/4	6			1836	1,377	1	101.3	95.6	86.1
7			5/6	6			1836	1,530	1	112.5	106.3	95.6
8		256-QAM	3/4	8			2448	1,836	1	135.0	127.5	114.8
9			5/6	8			2448	2,040	1	150.0	141.7	127.5

Table 26-63—HE-MCSs for mandatory 106-tone RU, N_{SS} = 4

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	102	4	408	102	1	7.5	7.1	6.4
0	0		1/2	1			408	204	1	15.0	14.2	12.8
1	1	QPSK	1/4	2			816	204	1	15.0	14.2	12.8
1	0		1/2	2			816	408	1	30.0	28.3	25.5
2	N/A		3/4	2			816	612	1	45.0	42.5	38.3
3	1	16-QAM	1/4	4			1632	408	1	30.0	28.3	25.5
3	0		1/2	4			1632	816	1	60.0	56.7	51.0
4	1		3/8	4			1632	612	1	45.0	42.5	38.3
4	0		3/4	4			1632	1,224	1	90.0	85.0	76.5
5	N/A	64-QAM	2/3	6			2448	1,632	1	120.0	113.3	102.0
6			3/4	6			2448	1,836	1	135.0	127.5	114.8
7			5/6	6			2448	2,040	1	150.0	141.7	127.5
8		256-QAM	3/4	8			3264	2,448	1	180.0	170.0	153.0
9			5/6	8			3264	2,720	1	200.0	188.9	170.0

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Table 26-64—HE-MCSs for mandatory 106-tone RU, N_{SS} = 5

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	102	4	510	127	1	9.3	8.8	7.9
0	0		1/2	1			510	255	1	18.8	17.7	15.9
1	1	QPSK	1/4	2			1020	255	1	18.8	17.7	15.9
1	0		1/2	2			1020	510	1	37.5	35.4	31.9
2	N/A		3/4	2			1020	765	1	56.3	53.1	47.8
3	1	16-QAM	1/4	4			2040	510	1	37.5	35.4	31.9
3	0		1/2	4			2040	1,020	1	75.0	70.8	63.8
4	1		3/8	4			2040	765	1	56.3	53.1	47.8
4	0		3/4	4			2040	1,530	1	112.5	106.3	95.6
5	N/A	64-QAM	2/3	6			3060	2,040	1	150.0	141.7	127.5
6			3/4	6			3060	2,295	1	168.8	159.4	143.4
7			5/6	6			3060	2,550	1	187.5	177.1	159.4
8		256-QAM	3/4	8			4080	3,060	1	225.0	212.5	191.3
9			5/6	8			4080	3,400	1	250.0	236.1	212.5

Table 26-65—HE-MCSs for mandatory 106-tone RU, N_{SS} = 6

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	102	4	612	153	1	11.3	10.6	9.6
0	0		1/2	1			612	306	1	22.5	21.3	19.1
1	1	QPSK	1/4	2			1224	306	1	22.5	21.3	19.1
1	0		1/2	2			1224	612	1	45.0	42.5	38.3
2	N/A		3/4	2			1224	918	1	67.5	63.8	57.4
3	1	16-QAM	1/4	4			2448	612	1	45.0	42.5	38.3
3	0		1/2	4			2448	1,224	1	90.0	85.0	76.5
4	1		3/8	4			2448	918	1	67.5	63.8	57.4
4	0		3/4	4			2448	1,836	1	135.0	127.5	114.8
5	N/A	64-QAM	2/3	6			3672	2,448	1	180.0	170.0	153.0
6			3/4	6			3672	2,754	1	202.5	191.3	172.1
7			5/6	6			3672	3,060	1	225.0	212.5	191.3
8		256-QAM	3/4	8			4896	3,672	1	270.0	255.0	229.5
9			5/6	8			4896	4,080	1	300.0	283.3	255.0

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Table 26-66—HE-MCSs for mandatory 106-tone RU, N_{SS} = 7

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	102	4	714	178	1	13.1	12.4	11.1
0	0		1/2	1			714	357	1	26.3	24.8	22.3
1	1	QPSK	1/4	2			1428	357	1	26.3	24.8	22.3
1	0		1/2	2			1428	714	1	52.5	49.6	44.6
2	N/A		3/4	2			1428	1,071	1	78.8	74.4	66.9
3	1	16-QAM	1/4	4			2856	714	1	52.5	49.6	44.6
3	0		1/2	4			2856	1,428	1	105.0	99.2	89.3
4	1		3/8	4			2856	1,071	1	78.8	74.4	66.9
4	0		3/4	4			2856	2,142	1	157.5	148.8	133.9
5	N/A	64-QAM	2/3	6			4284	2,856	1	210.0	198.3	178.5
6			3/4	6			4284	3,213	1	236.3	223.1	200.8
7			5/6	6			4284	3,570	1	262.5	247.9	223.1
8		256-QAM	3/4	8			5712	4,284	1	315.0	297.5	267.8
9			5/6	8			5712	4,760	1	350.0	330.6	297.5

Table 26-67—HE-MCSs for mandatory 106-tone RU, N_{SS} = 8

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	102	4	816	204	1	15.0	14.2	12.8
0	0		1/2	1			816	408	1	30.0	28.3	25.5
1	1	QPSK	1/4	2			1632	408	1	30.0	28.3	25.5
1	0		1/2	2			1632	816	1	60.0	56.7	51.0
2	N/A		3/4	2			1632	1,224	1	90.0	85.0	76.5
3	1	16-QAM	1/4	4			3264	816	1	60.0	56.7	51.0
3	0		1/2	4			3264	1,632	1	120.0	113.3	102.0
4	1		3/8	4			3264	1,224	1	90.0	85.0	76.5
4	0		3/4	4			3264	2,448	1	180.0	170.0	153.0
5	N/A	64-QAM	2/3	6			4896	3,264	1	240.0	226.7	204.0
6			3/4	6			4896	3,672	1	270.0	255.0	229.5
7			5/6	6			4896	4,080	1	300.0	283.3	255.0
8		256-QAM	3/4	8			6528	4,896	1	360.0	340.0	306.0
9			5/6	8			6528	5,440	1	400.0	377.8	340.0

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Table 26-68—HE-MCSs for mandatory 242-tone RU and mandatory non-OFDMA 20 MHz, N_{SS} = 1

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	234	8	234	58	1	4.3	4.0	3.6
0	0		1/2	1			234	117	1	8.6	8.1	7.3
1	1	QPSK	1/4	2			468	117	1	8.6	8.1	7.3
1	0		1/2	2			468	234	1	17.2	16.3	14.6
2	N/A		3/4	2			468	351	1	25.8	24.4	21.9
3	1	16-QAM	1/4	4			936	234	1	17.2	16.3	14.6
3	0		1/2	4			936	468	1	34.4	32.5	29.3
4	1		3/8	4			936	351	1	25.8	24.4	21.9
4	0		3/4	4			936	702	1	51.6	48.8	43.9
5	N/A	64-QAM	2/3	6			1404	936	1	68.8	65.0	58.5
6			3/4	6			1404	1,053	1	77.4	73.1	65.8
7			5/6	6			1404	1,170	1	86.0	81.3	73.1
8		256-QAM	3/4	8			1872	1,404	1	103.2	97.5	87.8
9			5/6	8			1872	1,560	1	114.7	108.3	97.5
10		1024-QAM	3/4	10			2340	1,755	1	129.0	121.9	109.7
11			5/6	10			2340	1,950	1	143.4	135.4	121.9

Table 26-69—HE-MCSs for mandatory 242-tone RU and mandatory non-OFDMA 20 MHz, N_{SS} = 2

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	234	8	468	117	1	8.6	8.1	7.3
0	0		1/2	1			468	234	1	17.2	16.3	14.6
1	1	QPSK	1/4	2			936	234	1	17.2	16.3	14.6
1	0		1/2	2			936	468	1	34.4	32.5	29.3
2	N/A		3/4	2			936	702	1	51.6	48.8	43.9
3	1	16-QAM	1/4	4			1872	468	1	34.4	32.5	29.3
3	0		1/2	4			1872	936	1	68.8	65.0	58.5
4	1		3/8	4			1872	702	1	51.6	48.8	43.9
4	0		3/4	4			1872	1,404	1	103.2	97.5	87.8
5	N/A	64-QAM	2/3	6			2808	1,872	1	137.6	130.0	117.0
6			3/4	6			2808	2,106	1	154.9	146.3	131.6
7			5/6	6			2808	2,340	1	172.1	162.5	146.3
8		256-QAM	3/4	8			3744	2,808	1	206.5	195.0	175.5
9			5/6	8			3744	3,120	1	229.4	216.7	195.0
10		1024-QAM	3/4	10			4680	3,510	1	258.1	243.8	219.4
11			5/6	10			4680	3,900	1	286.8	270.8	243.8

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Table 26-70—HE-MCSs for mandatory 242-tone RU and mandatory non-OFDMA 20 MHz, N_{SS} = 3

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	234	8	702	175	1	12.9	12.2	10.9
0	0		1/2	1			702	351	1	25.8	24.4	21.9
1	1	QPSK	1/4	2			1404	351	1	25.8	24.4	21.9
1	0		1/2	2			1404	702	1	51.6	48.8	43.9
2	N/A		3/4	2			1404	1,053	1	77.4	73.1	65.8
3	1	16-QAM	1/4	4			2808	702	1	51.6	48.8	43.9
3	0		1/2	4			2808	1,404	1	103.2	97.5	87.8
4	1		3/8	4			2808	1,053	1	77.4	73.1	65.8
4	0		3/4	4			2808	2,106	1	154.9	146.3	131.6
5	N/A	64-QAM	2/3	6			4212	2,808	1	206.5	195.0	175.5
6			3/4	6			4212	3,159	1	232.3	219.4	197.4
7			5/6	6			4212	3,510	1	258.1	243.8	219.4
8		256-QAM	3/4	8			5616	4,212	1	309.7	292.5	263.3
9			5/6	8			5616	4,680	1	344.1	325.0	292.5
10		1024-QAM	3/4	10			7020	5,265	1	387.1	365.6	329.1
11			5/6	10			7020	5,850	1	430.1	406.3	365.6

Table 26-71—HE-MCSs for mandatory 242-tone RU and mandatory non-OFDMA 20 MHz, N_{SS} = 4

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	234	8	936	234	1	17.2	16.3	14.6
0	0		1/2	1			936	468	1	34.4	32.5	29.3
1	1	QPSK	1/4	2			1872	468	1	34.4	32.5	29.3
1	0		1/2	2			1872	936	1	68.8	65.0	58.5
2	N/A		3/4	2			1872	1,404	1	103.2	97.5	87.8
3	1	16-QAM	1/4	4			3744	936	1	68.8	65.0	58.5
3	0		1/2	4			3744	1,872	1	137.6	130.0	117.0
4	1		3/8	4			3744	1,404	1	103.2	97.5	87.8
4	0		3/4	4			3744	2,808	1	206.5	195.0	175.5
5	N/A	64-QAM	2/3	6			5616	3,744	1	275.3	260.0	234.0
6			3/4	6			5616	4,212	1	309.7	292.5	263.3
7			5/6	6			5616	4,680	1	344.1	325.0	292.5
8		256-QAM	3/4	8			7488	5,616	1	412.9	390.0	351.0
9			5/6	8			7488	6,240	1	458.8	433.3	390.0
10		1024-QAM	3/4	10			9360	7,020	1	516.2	487.5	438.8
11			5/6	10			9360	7,800	1	573.5	541.7	487.5

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Table 26-72—HE-MCSs for mandatory 242-tone RU and mandatory non-OFDMA 20 MHz, N_{SS} = 5

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	234	8	1170	292	1	21.5	20.3	18.3
0	0		1/2	1			1170	585	1	43.0	40.6	36.6
1	1	QPSK	1/4	2			2340	585	1	43.0	40.6	36.6
1	0		1/2	2			2340	1,170	1	86.0	81.3	73.1
2	N/A		3/4	2			2340	1,755	1	129.0	121.9	109.7
3	1	16-QAM	1/4	4			4680	1,170	1	86.0	81.3	73.1
3	0		1/2	4			4680	2,340	1	172.1	162.5	146.3
4	1		3/8	4			4680	1,755	1	129.0	121.9	109.7
4	0		3/4	4			4680	3,510	1	258.1	243.8	219.4
5	N/A	64-QAM	2/3	6			7020	4,680	1	344.1	325.0	292.5
6			3/4	6			7020	5,265	1	387.1	365.6	329.1
7			5/6	6			7020	5,850	1	430.1	406.3	365.6
8		256-QAM	3/4	8			9360	7,020	1	516.2	487.5	438.8
9			5/6	8			9360	7,800	1	573.5	541.7	487.5
10		1024-QAM	3/4	10			11700	8,775	1	645.2	609.4	548.4
11			5/6	10			11700	9,750	1	716.9	677.1	609.4

Table 26-73—HE-MCSs for mandatory 242-tone RU and mandatory non-OFDMA 20 MHz, N_{SS} = 6

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	234	8	1404	351	1	25.8	24.4	21.9
0	0		1/2	1			1404	702	1	51.6	48.8	43.9
1	1	QPSK	1/4	2			2808	702	1	51.6	48.8	43.9
1	0		1/2	2			2808	1,404	1	103.2	97.5	87.8
2	N/A		3/4	2			2808	2,106	1	154.9	146.3	131.6
3	1	16-QAM	1/4	4			5616	1,404	1	103.2	97.5	87.8
3	0		1/2	4			5616	2,808	1	206.5	195.0	175.5
4	1		3/8	4			5616	2,106	1	154.9	146.3	131.6
4	0		3/4	4			5616	4,212	1	309.7	292.5	263.3
5	N/A	64-QAM	2/3	6			8424	5,616	1	412.9	390.0	351.0
6			3/4	6			8424	6,318	1	464.6	438.8	394.9
7			5/6	6			8424	7,020	1	516.2	487.5	438.8
8		256-QAM	3/4	8			11232	8,424	1	619.4	585.0	526.5
9			5/6	8			11232	9,360	1	688.2	650.0	585.0
10		1024-QAM	3/4	10			14040	10,530	1	774.3	731.3	658.1
11			5/6	10			14040	11,700	1	860.3	812.5	731.3

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Table 26-74—HE-MCSs for mandatory 242-tone RU and mandatory non-OFDMA 20 MHz, N_{SS} = 7

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	234	8	1638	409	1	30.1	28.4	25.6
0	0		1/2	1			1638	819	1	60.2	56.9	51.2
1	1	QPSK	1/4	2			3276	819	1	60.2	56.9	51.2
1	0		1/2	2			3276	1,638	1	120.4	113.8	102.4
2	N/A		3/4	2			3276	2,457	1	180.7	170.6	153.6
3	1	16-QAM	1/4	4			6552	1,638	1	120.4	113.8	102.4
3	0		1/2	4			6552	3,276	1	240.9	227.5	204.8
4	1		3/8	4			6552	2,457	1	180.7	170.6	153.6
4	0		3/4	4			6552	4,914	1	361.3	341.3	307.1
5	N/A	64-QAM	2/3	6			9828	6,552	1	481.8	455.0	409.5
6			3/4	6			9828	7,371	1	542.0	511.9	460.7
7			5/6	6			9828	8,190	1	602.2	568.8	511.9
8		256-QAM	3/4	8			13104	9,828	1	722.6	682.5	614.3
9			5/6	8			13104	10,920	1	802.9	758.3	682.5
10		1024-QAM	3/4	10			16380	12,285	1	903.3	853.1	767.8
11			5/6	10			16380	13,650	1	1,003.7	947.9	853.1

Table 26-75—HE-MCSs for mandatory 242-tone RU and mandatory non-OFDMA 20 MHz, N_{SS} = 8

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	234	8	1872	468	1	34.4	32.5	29.3
0	0		1/2	1			1872	936	1	68.8	65.0	58.5
1	1	QPSK	1/4	2			3744	936	1	68.8	65.0	58.5
1	0		1/2	2			3744	1,872	1	137.6	130.0	117.0
2	N/A		3/4	2			3744	2,808	1	206.5	195.0	175.5
3	1	16-QAM	1/4	4			7488	1,872	1	137.6	130.0	117.0
3	0		1/2	4			7488	3,744	1	275.3	260.0	234.0
4	1		3/8	4			7488	2,808	1	206.5	195.0	175.5
4	0		3/4	4			7488	5,616	1	412.9	390.0	351.0
5	N/A	64-QAM	2/3	6			11232	7,488	1	550.6	520.0	468.0
6			3/4	6			11232	8,424	1	619.4	585.0	526.5
7			5/6	6			11232	9,360	1	688.2	650.0	585.0
8		256-QAM	3/4	8			14976	11,232	1	825.9	780.0	702.0
9			5/6	8			14976	12,480	1	917.6	866.7	780.0
10		1024-QAM	3/4	10			18720	14,040	1	1,032.4	975.0	877.5
11			5/6	10			18720	15,600	1	1,147.1	1,083.3	975.0

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Table 26-76—HE-MCSs for mandatory 484-tone RU and mandatory non-OFDMA 40 MHz, N_{SS} = 1

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	468	16	468	117	1	8.6	8.1	7.3
0	0		1/2	1			468	234	1	17.2	16.3	14.6
1	1	QPSK	1/4	2			936	234	1	17.2	16.3	14.6
1	0		1/2	2			936	468	1	34.4	32.5	29.3
2	N/A		3/4	2			936	702	1	51.6	48.8	43.9
3	1	16-QAM	1/4	4			1872	468	1	34.4	32.5	29.3
3	0		1/2	4			1872	936	1	68.8	65.0	58.5
4	1		3/8	4			1872	702	1	51.6	48.8	43.9
4	0		3/4	4			1872	1,404	1	103.2	97.5	87.8
5	N/A	64-QAM	2/3	6			2808	1,872	1	137.6	130.0	117.0
6			3/4	6			2808	2,106	1	154.9	146.3	131.6
7			5/6	6			2808	2,340	1	172.1	162.5	146.3
8		256-QAM	3/4	8			3744	2,808	1	206.5	195.0	175.5
9			5/6	8			3744	3,120	1	229.4	216.7	195.0
10		1024-QAM	3/4	10			4680	3,510	1	258.1	243.8	219.4
11			5/6	10			4680	3,900	1	286.8	270.8	243.8

Table 26-77—HE-MCSs for mandatory 484-tone RU and mandatory non-OFDMA 40 MHz, N_{SS} = 2

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	468	16	936	234	1	17.2	16.3	14.6
0	0		1/2	1			936	468	1	34.4	32.5	29.3
1	1	QPSK	1/4	2			1872	468	1	34.4	32.5	29.3
1	0		1/2	2			1872	936	1	68.8	65.0	58.5
2	N/A		3/4	2			1872	1,404	1	103.2	97.5	87.8
3	1	16-QAM	1/4	4			3744	936	1	68.8	65.0	58.5
3	0		1/2	4			3744	1,872	1	137.6	130.0	117.0
4	1		3/8	4			3744	1,404	1	103.2	97.5	87.8
4	0		3/4	4			3744	2,808	1	206.5	195.0	175.5
5	N/A	64-QAM	2/3	6			5616	3,744	1	275.3	260.0	234.0
6			3/4	6			5616	4,212	1	309.7	292.5	263.3
7			5/6	6			5616	4,680	1	344.1	325.0	292.5
8		256-QAM	3/4	8			7488	5,616	1	412.9	390.0	351.0
9			5/6	8			7488	6,240	1	458.8	433.3	390.0
10		1024-QAM	3/4	10			9360	7,020	1	516.2	487.5	438.8
11			5/6	10			9360	7,800	1	573.5	541.7	487.5

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Table 26-78—HE-MCSs for mandatory 484-tone RU and mandatory non-OFDMA 40 MHz, N_{SS} = 3

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	468	16	1404	351	1	25.8	24.4	21.9
0	0		1/2	1			1404	702	1	51.6	48.8	43.9
1	1	QPSK	1/4	2			2808	702	1	51.6	48.8	43.9
1	0		1/2	2			2808	1,404	1	103.2	97.5	87.8
2	N/A		3/4	2			2808	2,106	1	154.9	146.3	131.6
3	1	16-QAM	1/4	4			5616	1,404	1	103.2	97.5	87.8
3	0		1/2	4			5616	2,808	1	206.5	195.0	175.5
4	1		3/8	4			5616	2,106	1	154.9	146.3	131.6
4	0		3/4	4			5616	4,212	1	309.7	292.5	263.3
5	N/A	64-QAM	2/3	6			8424	5,616	1	412.9	390.0	351.0
6			3/4	6			8424	6,318	1	464.6	438.8	394.9
7			5/6	6			8424	7,020	1	516.2	487.5	438.8
8		256-QAM	3/4	8			11232	8,424	1	619.4	585.0	526.5
9			5/6	8			11232	9,360	1	688.2	650.0	585.0
10		1024-QAM	3/4	10			14040	10,530	1	774.3	731.3	658.1
11			5/6	10			14040	11,700	1	860.3	812.5	731.3

Table 26-79—HE-MCSs for mandatory 484-tone RU and mandatory non-OFDMA 40 MHz, N_{SS} = 4

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	468	16	1872	468	1	34.4	32.5	29.3
0	0		1/2	1			1872	936	1	68.8	65.0	58.5
1	1	QPSK	1/4	2			3744	936	1	68.8	65.0	58.5
1	0		1/2	2			3744	1,872	1	137.6	130.0	117.0
2	N/A		3/4	2			3744	2,808	1	206.5	195.0	175.5
3	1	16-QAM	1/4	4			7488	1,872	1	137.6	130.0	117.0
3	0		1/2	4			7488	3,744	1	275.3	260.0	234.0
4	1		3/8	4			7488	2,808	1	206.5	195.0	175.5
4	0		3/4	4			7488	5,616	1	412.9	390.0	351.0
5	N/A	64-QAM	2/3	6			11232	7,488	1	550.6	520.0	468.0
6			3/4	6			11232	8,424	1	619.4	585.0	526.5
7			5/6	6			11232	9,360	1	688.2	650.0	585.0
8		256-QAM	3/4	8			14976	11,232	1	825.9	780.0	702.0
9			5/6	8			14976	12,480	1	917.6	866.7	780.0
10		1024-QAM	3/4	10			18720	14,040	1	1,032.4	975.0	877.5
11			5/6	10			18720	15,600	1	1,147.1	1,083.3	975.0

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Table 26-80—HE-MCSs for mandatory 484-tone RU and mandatory non-OFDMA 40 MHz, N_{SS} = 5

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	468	16	2340	585	1	43.0	40.6	36.6
0	0		1/2	1			2340	1,170	1	86.0	81.3	73.1
1	1	QPSK	1/4	2			4680	1,170	1	86.0	81.3	73.1
1	0		1/2	2			4680	2,340	1	172.1	162.5	146.3
2	N/A		3/4	2			4680	3,510	1	258.1	243.8	219.4
3	1	16-QAM	1/4	4			9360	2,340	1	172.1	162.5	146.3
3	0		1/2	4			9360	4,680	1	344.1	325.0	292.5
4	1		3/8	4			9360	3,510	1	258.1	243.8	219.4
4	0		3/4	4			9360	7,020	1	516.2	487.5	438.8
5	N/A	64-QAM	2/3	6			14040	9,360	1	688.2	650.0	585.0
6			3/4	6			14040	10,530	1	774.3	731.3	658.1
7			5/6	6			14040	11,700	1	860.3	812.5	731.3
8		256-QAM	3/4	8			18720	14,040	1	1,032.4	975.0	877.5
9			5/6	8			18720	15,600	1	1,147.1	1,083.3	975.0
10		1024-QAM	3/4	10			23400	17,550	1	1,290.4	1,218.8	1,096.9
11			5/6	10			23400	19,500	1	1,433.8	1,354.2	1,218.8

Table 26-81—HE-MCSs for mandatory 484-tone RU and mandatory non-OFDMA 40 MHz, N_{SS} = 6

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	468	16	2808	702	1	51.6	48.8	43.9
0	0		1/2	1			2808	1,404	1	103.2	97.5	87.8
1	1	QPSK	1/4	2			5616	1,404	1	103.2	97.5	87.8
1	0		1/2	2			5616	2,808	1	206.5	195.0	175.5
2	N/A		3/4	2			5616	4,212	1	309.7	292.5	263.3
3	1	16-QAM	1/4	4			11232	2,808	1	206.5	195.0	175.5
3	0		1/2	4			11232	5,616	1	412.9	390.0	351.0
4	1		3/8	4			11232	4,212	1	309.7	292.5	263.3
4	0		3/4	4			11232	8,424	1	619.4	585.0	526.5
5	N/A	64-QAM	2/3	6			16848	11,232	1	825.9	780.0	702.0
6			3/4	6			16848	12,636	1	929.1	877.5	789.8
7			5/6	6			16848	14,040	1	1,032.4	975.0	877.5
8		256-QAM	3/4	8			22464	16,848	1	1,238.8	1,170.0	1,053.0
9			5/6	8			22464	18,720	1	1,376.5	1,300.0	1,170.0
10		1024-QAM	3/4	10			28080	21,060	1	1,548.5	1,462.5	1,316.3
11			5/6	10			28080	23,400	1	1,720.6	1,625.0	1,462.5

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Table 26-82—HE-MCSs for mandatory 484-tone RU and mandatory non-OFDMA 40 MHz, N_{SS} = 7

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	468	16	3276	819	1	60.2	56.9	51.2
0	0		1/2	1			3276	1,638	1	120.4	113.8	102.4
1	1	QPSK	1/4	2			6552	1,638	1	120.4	113.8	102.4
1	0		1/2	2			6552	3,276	1	240.9	227.5	204.8
2	N/A		3/4	2			6552	4,914	1	361.3	341.3	307.1
3	1	16-QAM	1/4	4			13104	3,276	1	240.9	227.5	204.8
3	0		1/2	4			13104	6,552	1	481.8	455.0	409.5
4	1		3/8	4			13104	4,914	1	361.3	341.3	307.1
4	0		3/4	4			13104	9,828	1	722.6	682.5	614.3
5	N/A	64-QAM	2/3	6			19656	13,104	1	963.5	910.0	819.0
6			3/4	6			19656	14,742	1	1,084.0	1,023.8	921.4
7			5/6	6			19656	16,380	1	1,204.4	1,137.5	1,023.8
8		256-QAM	3/4	8			26208	19,656	1	1,445.3	1,365.0	1,228.5
9			5/6	8			26208	21,840	1	1,605.9	1,516.7	1,365.0
10		1024-QAM	3/4	10			32760	24,570	1	1,806.6	1,706.3	1,535.6
11			5/6	10			32760	27,300	1	2,007.4	1,895.8	1,706.3

Table 26-83—HE-MCSs for mandatory 484-tone RU and mandatory non-OFDMA 40 MHz, N_{SS} = 8

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	468	16	3744	936	1	68.8	65.0	58.5
0	0		1/2	1			3744	1,872	1	137.6	130.0	117.0
1	1	QPSK	1/4	2			7488	1,872	1	137.6	130.0	117.0
1	0		1/2	2			7488	3,744	1	275.3	260.0	234.0
2	N/A		3/4	2			7488	5,616	1	412.9	390.0	351.0
3	1	16-QAM	1/4	4			14976	3,744	1	275.3	260.0	234.0
3	0		1/2	4			14976	7,488	1	550.6	520.0	468.0
4	1		3/8	4			14976	5,616	1	412.9	390.0	351.0
4	0		3/4	4			14976	11,232	1	825.9	780.0	702.0
5	N/A	64-QAM	2/3	6			22464	14,976	1	1,101.2	1,040.0	936.0
6			3/4	6			22464	16,848	1	1,238.8	1,170.0	1,053.0
7			5/6	6			22464	18,720	1	1,376.5	1,300.0	1,170.0
8		256-QAM	3/4	8			29952	22,464	1	1,651.8	1,560.0	1,404.0
9			5/6	8			29952	24,960	1	1,835.3	1,733.3	1,560.0
10		1024-QAM	3/4	10			37440	28,080	1	2,064.7	1,950.0	1,755.0
11			5/6	10			37440	31,200	1	2,294.1	2,166.7	1,950.0

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Table 26-84—HE-MCSs for mandatory 996-tone RU and mandatory non-OFDMA 80 MHz, N_{SS} = 1

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	980	16	980	245	1	18.0	17.0	15.3
0	0		1/2	1			980	490	1	36.0	34.0	30.6
1	1	QPSK	1/4	2			1960	490	1	36.0	34.0	30.6
1	0		1/2	2			1960	980	1	72.1	68.1	61.3
2	N/A		3/4	2			1960	1,470	1	108.1	102.1	91.9
3	1	16-QAM	1/4	4			3920	980	1	72.1	68.1	61.3
3	0		1/2	4			3920	1,960	1	144.1	136.1	122.5
4	1		3/8	4			3920	1,470	1	108.1	102.1	91.9
4	0		3/4	4			3920	2,940	1	216.2	204.2	183.8
5	N/A	64-QAM	2/3	6			5880	3,920	1	288.2	272.2	245.0
6			3/4	6			5880	4,410	1	324.3	306.3	275.6
7			5/6	6			5880	4,900	1	360.3	340.3	306.3
8		256-QAM	3/4	8			7840	5,880	1	432.4	408.3	367.5
9			5/6	8			7840	6,533	1	480.4	453.7	408.3
10		1024-QAM	3/4	10			9800	7,350	1	540.4	510.4	459.4
11			5/6	10			9800	8,166	1	600.4	567.1	510.4

Table 26-85—HE-MCSs for mandatory 996-tone RU and mandatory non-OFDMA 80 MHz, N_{SS} = 2

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	980	16	1960	490	1	36.0	34.0	30.6
0	0		1/2	1			1960	980	1	72.1	68.1	61.3
1	1	QPSK	1/4	2			3920	980	1	72.1	68.1	61.3
1	0		1/2	2			3920	1,960	1	144.1	136.1	122.5
2	N/A		3/4	2			3920	2,940	1	216.2	204.2	183.8
3	1	16-QAM	1/4	4			7840	1,960	1	144.1	136.1	122.5
3	0		1/2	4			7840	3,920	1	288.2	272.2	245.0
4	1		3/8	4			7840	2,940	1	216.2	204.2	183.8
4	0		3/4	4			7840	5,880	1	432.4	408.3	367.5
5	N/A	64-QAM	2/3	6			11760	7,840	1	576.5	544.4	490.0
6			3/4	6			11760	8,820	1	648.5	612.5	551.3
7			5/6	6			11760	9,800	1	720.6	680.6	612.5
8		256-QAM	3/4	8			15680	11,760	1	864.7	816.7	735.0
9			5/6	8			15680	13,066	1	960.7	907.4	816.6
10		1024-QAM	3/4	10			19600	14,700	1	1,080.9	1,020.8	918.8
11			5/6	10			19600	16,333	1	1,201.0	1,134.2	1,020.8

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Table 26-86—HE-MCSs for mandatory 996-tone RU and mandatory non-OFDMA 80 MHz, N_{SS} = 3

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	980	16	2940	735	1	54.0	51.0	45.9
0	0		1/2	1			2940	1,470	1	108.1	102.1	91.9
1	1	QPSK	1/4	2			5880	1,470	1	108.1	102.1	91.9
1	0		1/2	2			5880	2,940	1	216.2	204.2	183.8
2	N/A		3/4	2			5880	4,410	1	324.3	306.3	275.6
3	1	16-QAM	1/4	4			11760	2,940	1	216.2	204.2	183.8
3	0		1/2	4			11760	5,880	1	432.4	408.3	367.5
4	1		3/8	4			11760	4,410	1	324.3	306.3	275.6
4	0		3/4	4			11760	8,820	1	648.5	612.5	551.3
5	N/A	64-QAM	2/3	6			17640	11,760	1	864.7	816.7	735.0
6			3/4	6			17640	13,230	1	972.8	918.8	826.9
7			5/6	6			17640	14,700	1	1,080.9	1,020.8	918.8
8		256-QAM	3/4	8			23520	17,640	1	1,297.1	1,225.0	1,102.5
9			5/6	8			23520	19,600	1	1,441.2	1,361.1	1,225.0
10		1024-QAM	3/4	10			29400	22,050	1	1,621.3	1,531.3	1,378.1
11			5/6	10			29400	24,500	1	1,801.5	1,701.4	1,531.3

Table 26-87—HE-MCSs for mandatory 996-tone RU and mandatory non-OFDMA 80 MHz, N_{SS} = 4

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	980	16	3920	980	1	72.1	68.1	61.3
0	0		1/2	1			3920	1,960	1	144.1	136.1	122.5
1	1	QPSK	1/4	2			7840	1,960	1	144.1	136.1	122.5
1	0		1/2	2			7840	3,920	1	288.2	272.2	245.0
2	N/A		3/4	2			7840	5,880	1	432.4	408.3	367.5
3	1	16-QAM	1/4	4			15680	3,920	1	288.2	272.2	245.0
3	0		1/2	4			15680	7,840	1	576.5	544.4	490.0
4	1		3/8	4			15680	5,880	1	432.4	408.3	367.5
4	0		3/4	4			15680	11,760	1	864.7	816.7	735.0
5	N/A	64-QAM	2/3	6			23520	15,680	1	1,152.9	1,088.9	980.0
6			3/4	6			23520	17,640	1	1,297.1	1,225.0	1,102.5
7			5/6	6			23520	19,600	1	1,441.2	1,361.1	1,225.0
8		256-QAM	3/4	8			31360	23,520	1	1,729.4	1,633.3	1,470.0
9			5/6	8			31360	26,133	1	1,921.5	1,814.8	1,633.3
10		1024-QAM	3/4	10			39200	29,400	1	2,161.8	2,041.7	1,837.5
11			5/6	10			39200	32,666	1	2,401.9	2,268.5	2,041.6

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Table 26-88—HE-MCSs for mandatory 996-tone RU and mandatory non-OFDMA 80 MHz, N_{SS} = 5

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	980	16	4900	1,225	1	90.1	85.1	76.6
0	0		1/2	1			4900	2,450	1	180.1	170.1	153.1
1	1	QPSK	1/4	2			9800	2,450	1	180.1	170.1	153.1
1	0		1/2	2			9800	4,900	1	360.3	340.3	306.3
2	N/A		3/4	2			9800	7,350	1	540.4	510.4	459.4
3	1	16-QAM	1/4	4			19600	4,900	1	360.3	340.3	306.3
3	0		1/2	4			19600	9,800	1	720.6	680.6	612.5
4	1		3/8	4			19600	7,350	1	540.4	510.4	459.4
4	0		3/4	4			19600	14,700	1	1,080.9	1,020.8	918.8
5	N/A	64-QAM	2/3	6			29400	19,600	1	1,441.2	1,361.1	1,225.0
6			3/4	6			29400	22,050	1	1,621.3	1,531.3	1,378.1
7			5/6	6			29400	24,500	1	1,801.5	1,701.4	1,531.3
8		256-QAM	3/4	8			39200	29,400	1	2,161.8	2,041.7	1,837.5
9			5/6	8			39200	32,666	1	2,401.9	2,268.5	2,041.6
10		1024-QAM	3/4	10			49000	36,750	1	2,702.2	2,552.1	2,296.9
11			5/6	10			49000	40,833	1	3,002.4	2,835.6	2,552.1

Table 26-89—HE-MCSs for mandatory 996-tone RU and mandatory non-OFDMA 80 MHz, N_{SS} = 6

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	980	16	5880	1,470	1	108.1	102.1	91.9
0	0		1/2	1			5880	2,940	1	216.2	204.2	183.8
1	1	QPSK	1/4	2			11760	2,940	1	216.2	204.2	183.8
1	0		1/2	2			11760	5,880	1	432.4	408.3	367.5
2	N/A		3/4	2			11760	8,820	1	648.5	612.5	551.3
3	1	16-QAM	1/4	4			23520	5,880	1	432.4	408.3	367.5
3	0		1/2	4			23520	11,760	1	864.7	816.7	735.0
4	1		3/8	4			23520	8,820	1	648.5	612.5	551.3
4	0		3/4	4			23520	17,640	1	1,297.1	1,225.0	1,102.5
5	N/A	64-QAM	2/3	6			35280	23,520	1	1,729.4	1,633.3	1,470.0
6			3/4	6			35280	26,460	1	1,945.6	1,837.5	1,653.8
7			5/6	6			35280	29,400	1	2,161.8	2,041.7	1,837.5
8		256-QAM	3/4	8			47040	35,280	1	2,594.1	2,450.0	2,205.0
9			5/6	8			47040	39,200	1	2,882.4	2,722.2	2,450.0
10		1024-QAM	3/4	10			58800	44,100	1	3,242.6	3,062.5	2,756.3
11			5/6	10			58800	49,000	1	3,602.9	3,402.8	3,062.5

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Table 26-90—HE-MCSs for mandatory 996-tone RU and mandatory non-OFDMA 80 MHz, N_{SS} = 7

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	980	16	6860	1,715	1	126.1	119.1	107.2
0	0		1/2	1			6860	3,430	1	252.2	238.2	214.4
1	1	QPSK	1/4	2			13720	3,430	1	252.2	238.2	214.4
1	0		1/2	2			13720	6,860	1	504.4	476.4	428.8
2	N/A		3/4	2			13720	10,290	1	756.6	714.6	643.1
3	1	16-QAM	1/4	4			27440	6,860	1	504.4	476.4	428.8
3	0		1/2	4			27440	13,720	1	1,008.8	952.8	857.5
4	1		3/8	4			27440	10,290	1	756.6	714.6	643.1
4	0		3/4	4			27440	20,580	1	1,513.2	1,429.2	1,286.3
5	N/A	64-QAM	2/3	6			41160	27,440	1	2,017.6	1,905.6	1,715.0
6			3/4	6			41160	30,870	1	2,269.9	2,143.8	1,929.4
7			5/6	6			41160	34,300	1	2,522.1	2,381.9	2,143.8
8		256-QAM	3/4	8			54880	41,160	1	3,026.5	2,858.3	2,572.5
9			5/6	8			54880	45,733	1	3,362.7	3,175.9	2,858.3
10		1024-QAM	3/4	10			68600	51,450	1	3,783.1	3,572.9	3,215.6
11			5/6	10			68600	57,166	1	4,203.4	3,969.9	3,572.9

Table 26-91—HE-MCSs for mandatory 996-tone RU and mandatory non-OFDMA 80 MHz, N_{SS} = 8

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	980	16	7840	1,960	1	144.1	136.1	122.5
0	0		1/2	1			7840	3,920	1	288.2	272.2	245.0
1	1	QPSK	1/4	2			15680	3,920	1	288.2	272.2	245.0
1	0		1/2	2			15680	7,840	1	576.5	544.4	490.0
2	N/A		3/4	2			15680	11,760	1	864.7	816.7	735.0
3	1	16-QAM	1/4	4			31360	7,840	1	576.5	544.4	490.0
3	0		1/2	4			31360	15,680	1	1,152.9	1,088.9	980.0
4	1		3/8	4			31360	11,760	1	864.7	816.7	735.0
4	0		3/4	4			31360	23,520	1	1,729.4	1,633.3	1,470.0
5	N/A	64-QAM	2/3	6			47040	31,360	1	2,305.9	2,177.8	1,960.0
6			3/4	6			47040	35,280	1	2,594.1	2,450.0	2,205.0
7			5/6	6			47040	39,200	1	2,882.4	2,722.2	2,450.0
8		256-QAM	3/4	8			62720	47,040	1	3,458.8	3,266.7	2,940.0
9			5/6	8			62720	52,266	1	3,843.1	3,629.6	3,266.6
10		1024-QAM	3/4	10			78400	58,800	1	4,323.5	4,083.3	3,675.0
11			5/6	10			78400	65,333	1	4,803.9	4,537.0	4,083.3

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Table 26-92—HE-MCSs for optional non-OFDMA 160 MHz and 80+80 MHz, N_{SS} = 1

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	1960	32	1960	490	1	36.0	34.0	30.6
0	0		1/2	1			1960	980	1	72.1	68.1	61.3
1	1	QPSK	1/4	2			3920	980	1	72.1	68.1	61.3
1	0		1/2	2			3920	1,960	1	144.1	136.1	122.5
2	N/A		3/4	2			3920	2,940	1	216.2	204.2	183.8
3	1	16-QAM	1/4	4			7840	1,960	1	144.1	136.1	122.5
3	0		1/2	4			7840	3,920	1	288.2	272.2	245.0
4	1		3/8	4			7840	2,940	1	216.2	204.2	183.8
4	0		3/4	4			7840	5,880	1	432.4	408.3	367.5
5	N/A	64-QAM	2/3	6			11760	7,840	1	576.5	544.4	490.0
6			3/4	6			11760	8,820	1	648.5	612.5	551.3
7			5/6	6			11760	9,800	1	720.6	680.6	612.5
8		256-QAM	3/4	8			15680	11,760	1	864.7	816.7	735.0
9			5/6	8			15680	13,066	1	960.7	907.4	816.6
10		1024-QAM	3/4	10			19600	14,700	1	1,080.9	1,020.8	918.8
11			5/6	10			19600	16,333	1	1,201.0	1,134.2	1,020.8

Table 26-93—HE-MCSs for optional non-OFDMA 160 MHz and 80+80 MHz, N_{SS} = 2

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	1960	32	3920	980	1	72.1	68.1	61.3
0	0		1/2	1			3920	1,960	1	144.1	136.1	122.5
1	1	QPSK	1/4	2			7840	1,960	1	144.1	136.1	122.5
1	0		1/2	2			7840	3,920	1	288.2	272.2	245.0
2	N/A		3/4	2			7840	5,880	1	432.4	408.3	367.5
3	1	16-QAM	1/4	4			15680	3,920	1	288.2	272.2	245.0
3	0		1/2	4			15680	7,840	1	576.5	544.4	490.0
4	1		3/8	4			15680	5,880	1	432.4	408.3	367.5
4	0		3/4	4			15680	11,760	1	864.7	816.7	735.0
5	N/A	64-QAM	2/3	6			23520	15,680	1	1,152.9	1,088.9	980.0
6			3/4	6			23520	17,640	1	1,297.1	1,225.0	1,102.5
7			5/6	6			23520	19,600	1	1,441.2	1,361.1	1,225.0
8		256-QAM	3/4	8			31360	23,520	1	1,729.4	1,633.3	1,470.0
9			5/6	8			31360	26,133	1	1,921.5	1,814.8	1,633.3
10		1024-QAM	3/4	10			39200	29,400	1	2,161.8	2,041.7	1,837.5
11			5/6	10			39200	32,666	1	2,401.9	2,268.5	2,041.6

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Table 26-94—HE-MCSs for optional non-OFDMA 160 MHz and 80+80 MHz, N_{SS} = 3

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	1960	32	5880	1,470	1	108.1	102.1	91.9
0	0		1/2	1			5880	2,940	1	216.2	204.2	183.8
1	1	QPSK	1/4	2			11760	2,940	1	216.2	204.2	183.8
1	0		1/2	2			11760	5,880	1	432.4	408.3	367.5
2	N/A		3/4	2			11760	8,820	1	648.5	612.5	551.3
3	1	16-QAM	1/4	4			23520	5,880	1	432.4	408.3	367.5
3	0		1/2	4			23520	11,760	1	864.7	816.7	735.0
4	1		3/8	4			23520	8,820	1	648.5	612.5	551.3
4	0		3/4	4			23520	17,640	1	1,297.1	1,225.0	1,102.5
5	N/A	64-QAM	2/3	6			35280	23,520	1	1,729.4	1,633.3	1,470.0
6			3/4	6			35280	26,460	1	1,945.6	1,837.5	1,653.8
7			5/6	6			35280	29,400	1	2,161.8	2,041.7	1,837.5
8		256-QAM	3/4	8			47040	35,280	1	2,594.1	2,450.0	2,205.0
9			5/6	8			47040	39,200	1	2,882.4	2,722.2	2,450.0
10		1024-QAM	3/4	10			58800	44,100	1	3,242.6	3,062.5	2,756.3
11			5/6	10			58800	49,000	1	3,602.9	3,402.8	3,062.5

Table 26-95—HE-MCSs for optional non-OFDMA 160 MHz and 80+80 MHz, N_{SS} = 4

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	1960	32	7840	1,960	1	144.1	136.1	122.5
0	0		1/2	1			7840	3,920	1	288.2	272.2	245.0
1	1	QPSK	1/4	2			15680	3,920	1	288.2	272.2	245.0
1	0		1/2	2			15680	7,840	1	576.5	544.4	490.0
2	N/A		3/4	2			15680	11,760	1	864.7	816.7	735.0
3	1	16-QAM	1/4	4			31360	7,840	1	576.5	544.4	490.0
3	0		1/2	4			31360	15,680	1	1,152.9	1,088.9	980.0
4	1		3/8	4			31360	11,760	1	864.7	816.7	735.0
4	0		3/4	4			31360	23,520	1	1,729.4	1,633.3	1,470.0
5	N/A	64-QAM	2/3	6			47040	31,360	1	2,305.9	2,177.8	1,960.0
6			3/4	6			47040	35,280	1	2,594.1	2,450.0	2,205.0
7			5/6	6			47040	39,200	1	2,882.4	2,722.2	2,450.0
8		256-QAM	3/4	8			62720	47,040	1	3,458.8	3,266.7	2,940.0
9			5/6	8			62720	52,266	1	3,843.1	3,629.6	3,266.6
10		1024-QAM	3/4	10			78400	58,800	1	4,323.5	4,083.3	3,675.0
11			5/6	10			78400	65,333	1	4,803.9	4,537.0	4,083.3

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Table 26-96—HE-MCSs for optional non-OFDMA 160 MHz and 80+80 MHz, N_{SS} = 5

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	1960	32	9800	2,450	1	180.1	170.1	153.1
0	0		1/2	1			9800	4,900	1	360.3	340.3	306.3
1	1	QPSK	1/4	2			19600	4,900	1	360.3	340.3	306.3
1	0		1/2	2			19600	9,800	1	720.6	680.6	612.5
2	N/A		3/4	2			19600	14,700	1	1,080.9	1,020.8	918.8
3	1	16-QAM	1/4	4			39200	9,800	1	720.6	680.6	612.5
3	0		1/2	4			39200	19,600	1	1,441.2	1,361.1	1,225.0
4	1		3/8	4			39200	14,700	1	1,080.9	1,020.8	918.8
4	0		3/4	4			39200	29,400	1	2,161.8	2,041.7	1,837.5
5	N/A	64-QAM	2/3	6			58800	39,200	1	2,882.4	2,722.2	2,450.0
6			3/4	6			58800	44,100	1	3,242.6	3,062.5	2,756.3
7			5/6	6			58800	49,000	1	3,602.9	3,402.8	3,062.5
8		256-QAM	3/4	8			78400	58,800	1	4,323.5	4,083.3	3,675.0
9			5/6	8			78400	65,333	1	4,803.9	4,537.0	4,083.3
10		1024-QAM	3/4	10			98000	73,500	1	5,404.4	5,104.2	4,593.8
11			5/6	10			98000	81,666	1	6,004.9	5,671.3	5,104.1

Table 26-97—HE-MCSs for optional non-OFDMA 160 MHz and 80+80 MHz, N_{SS} = 6

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	1960	32	11760	2,940	1	216.2	204.2	183.8
0	0		1/2	1			11760	5,880	1	432.4	408.3	367.5
1	1	QPSK	1/4	2			23520	5,880	1	432.4	408.3	367.5
1	0		1/2	2			23520	11,760	1	864.7	816.7	735.0
2	N/A		3/4	2			23520	17,640	1	1,297.1	1,225.0	1,102.5
3	1	16-QAM	1/4	4			47040	11,760	1	864.7	816.7	735.0
3	0		1/2	4			47040	23,520	1	1,729.4	1,633.3	1,470.0
4	1		3/8	4			47040	17,640	1	1,297.1	1,225.0	1,102.5
4	0		3/4	4			47040	35,280	1	2,594.1	2,450.0	2,205.0
5	N/A	64-QAM	2/3	6			70560	47,040	1	3,458.8	3,266.7	2,940.0
6			3/4	6			70560	52,920	1	3,891.2	3,675.0	3,307.5
7			5/6	6			70560	58,800	1	4,323.5	4,083.3	3,675.0
8		256-QAM	3/4	8			94080	70,560	1	5,188.2	4,900.0	4,410.0
9			5/6	8			94080	78,400	1	5,764.7	5,444.4	4,900.0
10		1024-QAM	3/4	10			117600	88,200	1	6,485.3	6,125.0	5,512.5
11			5/6	10			117600	98,000	1	7,205.9	6,805.6	6,125.0

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Table 26-98—HE-MCSs for optional non-OFDMA 160 MHz and 80+80 MHz, N_{SS} = 7

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	1960	32	13720	3,430	1	252.2	238.2	214.4
0	0		1/2	1			13720	6,860	1	504.4	476.4	428.8
1	1	QPSK	1/4	2			27440	6,860	1	504.4	476.4	428.8
1	0		1/2	2			27440	13,720	1	1,008.8	952.8	857.5
2	N/A		3/4	2			27440	20,580	1	1,513.2	1,429.2	1,286.3
3	1	16-QAM	1/4	4			54880	13,720	1	1,008.8	952.8	857.5
3	0		1/2	4			54880	27,440	1	2,017.6	1,905.6	1,715.0
4	1		3/8	4			54880	20,580	1	1,513.2	1,429.2	1,286.3
4	0		3/4	4			54880	41,160	1	3,026.5	2,858.3	2,572.5
5	N/A	64-QAM	2/3	6			82320	54,880	1	4,035.3	3,811.1	3,430.0
6			3/4	6			82320	61,740	1	4,539.7	4,287.5	3,858.8
7			5/6	6			82320	68,600	1	5,044.1	4,763.9	4,287.5
8		256-QAM	3/4	8			109760	82,320	1	6,052.9	5,716.7	5,145.0
9			5/6	8			109760	91,466	1	6,725.4	6,351.8	5,716.6
10		1024-QAM	3/4	10			137200	102,900	1	7,566.2	7,145.8	6,431.3
11			5/6	10			137200	114,333	1	8,406.8	7,939.8	7,145.8

Table 26-99—HE-MCSs for optional non-OFDMA 160 MHz and 80+80 MHz, N_{SS} = 8

HE-MCS Index	DCM	Modulation	R	N_{BPSCS}	N_{SD}	N_{SP}	N_{CBPS}	N_{DBPS}	N_{ES}	Data rate (Mb/s)		
										0.8 usec GI	1.6 usec GI	3.2 usec GI
0	1	BPSK	1/4	1	1960	32	15680	3,920	1	288.2	272.2	245.0
0	0		1/2	1			15680	7,840	1	576.5	544.4	490.0
1	1	QPSK	1/4	2			31360	7,840	1	576.5	544.4	490.0
1	0		1/2	2			31360	15,680	1	1,152.9	1,088.9	980.0
2	N/A		3/4	2			31360	23,520	1	1,729.4	1,633.3	1,470.0
3	1	16-QAM	1/4	4			62720	15,680	1	1,152.9	1,088.9	980.0
3	0		1/2	4			62720	31,360	1	2,305.9	2,177.8	1,960.0
4	1		3/8	4			62720	23,520	1	1,729.4	1,633.3	1,470.0
4	0		3/4	4			62720	47,040	1	3,458.8	3,266.7	2,940.0
5	N/A	64-QAM	2/3	6			94080	62,720	1	4,611.8	4,355.6	3,920.0
6			3/4	6			94080	70,560	1	5,188.2	4,900.0	4,410.0
7			5/6	6			94080	78,400	1	5,764.7	5,444.4	4,900.0
8		256-QAM	3/4	8			125440	94,080	1	6,917.6	6,533.3	5,880.0
9			5/6	8			125440	104,533	1	7,686.3	7,259.2	6,533.3
10		1024-QAM	3/4	10			156800	117,600	1	8,647.1	8,166.7	7,350.0
11			5/6	10			156800	130,666	1	9,607.8	9,074.0	8,166.6

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Annex C

(normative)

ASN.1 encoding of the MAC and PHY MIB

C.3 MIB Detail

Change the dot11smt object as follows:

```
(#1123)dot11smt OBJECT IDENTIFIER ::= { ieee802dot11 1 }
…
-- dot11STACivicLocationConfigTable::= { dot11smt 37 }
-- dot11HEStationConfigTable::= { dot11smt <ANA> }
…
```

Change Dot11StationConfigEntry as follows:

```
Dot11StationConfigEntry ::= SEQUENCE
    {
        …,
        dot11FutureChannelGuidanceActivated                    TruthValue,
        dot11HEOptionImplemented                               TruthValule
    }
…

dot11HEOptionImplemented OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
    "This is a capability variable.
    Its value is determined by device capabilities.

    This attribute indicates whether the entity is HE Capable."
::= { dot11StationConfigEntry <ANA>}

…
```

Insert the following (after getting some sucker to validate MIB compilation, etc.):

```
Dot11HEStationConfigEntry ::= SEQUENCE
    {
        dot11HEDynamicFragmentationImplemented,                TruthValue
    }

dot11HEDynamicFragmentationImplemented OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
        "This is a capability variable.
         Its value is determined by device capabilities.

         This attribute, when true, indicates that the STA implementation is
         capable of receiving dynamic fragments. The capability is disabled,
         otherwise"
    DEFVAL { false }
::= { dot11HEStationConfigEntry <XX>}
```

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```
dot11PPEThresholdsRequired OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-only
    STATUS current
    DESCRIPTION
    "This is a capability variable.
     Its value is determined by device capabilities.
    This attribute, when true, indicates that Post-FEC Padding and Packet Exten-
       sion Thresholds exist and are provided in dot11PPEThresholdsTable(#1313)."
    DEFVAL { false }
    ::= { dot11StationConfigEntry <ANA>}(#1481)

-- ************************************************************************
-- * dot11PPEThresholdsMappings TABLE
-- ************************************************************************
dot11PPEThresholdsMappingsTable OBJECT-TYPE
    SYNTAX SEQUENCE OF Dot11PPEThresholdsMappingsEntry
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION
        "Conceptual table for PPE Thresholds Mappings. The MIB supports the
         ability to share separate PPE Thresholds for each NSS/RU pair. The
         Thresholds Mappings Table contains one entry for each NSS/RU pair
         and contains two fields for each entry: PPET8 and PPET16. The PPE
         Thresholds mappings are logically WRITE-ONLY. Attempts to read the
         entries in this table return unsuccessful status and values of null or 0.
         The default value for all PPET8 fields is NONE."
    REFERENCE "IEEE Std 802.11-<year>, 25.13 (HE PPDU post FEC padding and packet
       extension)(#1632)"
::= { dot11smt 4 }

dot11PPEThresholdsMappingsEntry OBJECT-TYPE
    SYNTAX Dot11PPEThresholdsMappingsEntry
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION
        "An Entry (conceptual row) in the PPE Thresholds Mappings Table.
         ifIndex - Each IEEE Std 802.11 interface is represented by an ifEntry.
         Interface tables in this MIB module are indexed by ifIndex."
    INDEX { ifIndex, dot11PPEThresholdsMappingIndex }
::= { dot11PPEThresholdsMappingsTable 1 }

Dot11PPEThresholdsMappingsEntry ::= SEQUENCE {
    dot11PPEThresholdsMappingIndex                    Unsigned32,
    dot11PPEThresholdsMappingNSS                      Integer,
    dot11PPEThresholdsMappingRUIndex                  Integer,
    dot11PPEThresholdsMappingPPET8                    Integer,
    dot11PPEThresholdsMappingPPET16                   Integer,
    dot11PPEThresholdsMappingStatus                   RowStatus}

dot11PPEThresholdsMappingIndex OBJECT-TYPE
    SYNTAX Unsigned32
    MAX-ACCESS not-accessible
    STATUS current
    DESCRIPTION
    "The auxiliary variable used to identify instances of the columnar objects
     in the PPE Thresholds Mappings Table."
::= { dot11PPEThresholdsMappingsEntry 1 }

dot11PPEThresholdsMappingNSS OBJECT-TYPE
    SYNTAX Integer
    MAX-ACCESS read-create
```


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```
    STATUS current
    DESCRIPTION
        "The NSS value portion of the NSS/RU pair for which the values from this
         Thresholds mapping entry are to be used."
::= { dot11PPEThresholdsMappingsEntry 2 }

dot11PPEThresholdsMappingRUIndex OBJECT-TYPE
    SYNTAX Integer
    MAX-ACCESS read-create
    STATUS current
    DESCRIPTION
        "The index of the RU value portion of the NSS/RU pair for which the values
         from this Thresholds mapping entry are to be used. The index values
         map to an RU as follows: RU Index of 0 is 996 tones, 1 is 448 tones,
         2 is TBD tones, 3 is reserved."
::= { dot11PPEThresholdsMappingsEntry 3 }

dot11PPEThresholdsMappingPPET8 OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-create
    STATUS current
    DESCRIPTION
        "An index that determines a constellation value at or above which a
         Post FEC Padding and Packet Extension value of at least 8 us is
         required for the given NSS/RU pair corresponding to the row of the
         entry. The index values are mapped as follows: 0 is BPSK, 1 is QPSK,
         2 is 16-QAM, 3 is 64-QAM, 4 is 256-QAM, 5 is 1024-QAM(#1633),
         6 is reserved, 7 is the special value of NONE."
::= { dot11PPEThresholdsMappingsEntry 4 }

dot11PPEThresholdsMappingPPET16 OBJECT-TYPE
    SYNTAX TruthValue
    MAX-ACCESS read-create
    STATUS current
    DESCRIPTION
        "An index that determines a constellation value at or above which a
         Post FEC Padding and Packet Extension value of 16 us is required for
         the given NSS/RU pair corresponding to the row of the entry. The index
         values are mapped as follows: 0 is BPSK, 1 is QPSK, 2 is 16-QAM,
         3 is 64-QAM, 4 is 256-QAM, 5 is 1024-QAM#1633), 6 is reserved,
         7 is the special value of NONE."
::= { dot11PPEThresholdsMappingsEntry 5 }

dot11PPEThresholdsMappingStatus OBJECT-TYPE
    SYNTAX RowStatus
    MAX-ACCESS read-create
    STATUS current
    DESCRIPTION
        "The status column used for creating, modifying, and deleting instances
         of the columnar objects in the PPE Thresholds mapping Table."
    DEFVAL { active }
::= { dot11PPEThresholdsMappingsEntry 6 }

-- ************************************************************************
-- * End of dot11PPEThresholdsMappings TABLE
-- ************************************************************************

dot11HEComplianceGroup OBJECT-GROUP
    OBJECTS {
        dot11HEDynamicFragmentationImplemented}
    STATUS current
    DESCRIPTION
        "Attributes that configure the HE Group for IEEE 802.11."
::= { dot11Groups <XX> }(#1481)
```

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(#576)Insert the following:

```
dot11DurationRTSThreshold OBJECT-TYPE
   SYNTAX Unsigned16 (0..1023)
   UNITS "32 microseconds"
   MAX-ACCESS read-write
   STATUS current
   DESCRIPTION
      "This is a control variable.
      It is written by an external management entity or by the MAC upon receiv-
      ing duration-based RTS threshold notification frame.
      Changes take effect as soon as practical in the implementation.

      This attribute indicates the duration of the transmission or TXOP above
      which an RTS/CTS handshake is performed. Value zero means the RTS should
      be always used for TxOP transmission. Value 1023 means this feature is
      disabled"
   DEFVAL { 1023 }
::= { Dot11OperationEntry <ANA> }
```


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Appendix J

The Wayback Machine - https://web.archive.org/web/20161121130718/http://www.ieee802.org/11/abt80211.h…

ABOUT IEEE P802.11 AND HOW TO PARTICIPATE

The following are general statements of how to participate in the IEEE802.11 Working Group. For the official rules, please see the Policies and Procedures of the IEEE Project 802, LAN MAN Standards Committee (LMSC) and the IEEE 802.11 Working Group Operations Manual.

Introduction

IEEE P802.11 is a standards working group on wireless local area networks. The working group is a part of IEEE LMSC (LAN MAN Standards Committee) formerly called IEEE Project 802. IEEE LMSC reports to the Standards Activity Board (SAB) of the IEEE Computer Society.

Open Forum

All meetings of the standards activities of IEEE are open meetings. Everybody is allowed to attend as long as he/she pays their dues to the organization to offset the costs of the meeting. It is not required to be a member of IEEE to participate in, or to become a voting member of the working group. We recommend, however, that you become a member of either the IEEE or of the Computer Society.

Voting

At all meetings of the working group and its sub and ad-hoc groups, participation in the discussions and voting is limited to the voting members (see section Membership for the rules to become a member), although the chair has the discretion to allow non-members to participate in the discussions. At study-group meetings, however, all attendees can participate in discussions and in voting. The voting rules are defined in LMSC WG P&P, and described in the 802.11 Operations Manual.

Organizational matters

A handy guide for how to develop standards is provided in the IEEE Standards Association Develop Standards site. More formal rules regarding the organization of our work are provided in the IEEE Standards Board Bylaws and the IEEE Standards Operations Manual. A short summary made specifically for 802.11 follows below.

Before a standard can be developed, a Project Authorization Request (PAR) has to be approved by the IEEE Standards Board. The PARs approved for the work of 802.11 are available here.

Once the working group has agreed on a draft standard (i.e., the draft was approved by a working group letter ballot), the draft is balloted in a sponsor balloting group. Membership of sponsor balloting groups is limited to members of the IEEE or the Computer Society. After approval by the balloting group, the result is reviewed by the Standards Board before publication. The IEEE Standards Board Review Committee (RevCom) are responsible for deciding whether the procedure for the development of the standard was followed correctly.

Meeting schedule

Currently the 802.11 standards working group meets 3 times a year during the plenary sessions of IEEE LMSC. LMSC meets in plenary sessions in March, July and November. And 802.11 holds interim meetings an additional 3 times a year in January, May and September. Refer to the meeting plan.

Additional 802.11 interim meetings are held to host TGaj (China Milli-Metre Wave) meetings in China.

Membership of standards development working group

The membership rules are defined in LMSC WG P&P, and described in the 802.11 Operations Manual.

In summary, membership belongs to an individual, not to an organization, and may not be transferred. You have to gain voting membership rights by participating in at least 2 plenary meetings out of 4 consecutive plenary meetings and then recording attendance at a subsequent plenary (at which you may vote). Participation means that you attend at least 75% of the time of the whole session of meetings. You may substitute one interim meeting for a plenary meeting.

Member categories and gaining voting rights

IEEE 802.11 recognises the following categories of membership:

1. Aspirant members. Those members have participated in one plenary or interim session of meetings within the last 4 plenary sessions.
2. Potential voter members. Those have participated in two sessions of meetings, at least one of which being a plenary session within the last 4 plenary sessions.
3. Voter members. Those members qualify for voting membership status.

Potential voter members become voter members in the beginning of the first session they attend and and at which they record attendance.

"Participation" means recording electronic attendance for 75% of the "in hours" 802.11 meeting slots during a meeting and paying the meeting fee.

Note that recording attendance in some other (i.e., non-802.11) working-group's meeting during an 802.11 session does not count towards this 75% target.

Sponsor Ballot Group

Before LMSC sends a proposed standard to the IEEE Standards Board for approval, they must have a positive response from a letter ballot among the members of the related sponsor ballot group (the "pool") within its organization. The sponsor ballot pool for an 802.11 standard is established by invitation to interested members of IEEE-SA before the first sponsor ballot of that standard. The pool is not changed once it has been established - i.e., the voters on the first sponsor ballot are also the voters for all subsequent recirculation ballots of the same standard.

The rules and procedures for sponsor ballot groups are provided in section 5.4 of the IEEE Standards Operations Manual. In summary they are as follows. For each main PAR, LMSC establishes a ballot pool. If you want to be invited to participate in sponsor ballots of IEEE P802.11 and you are a member of the IEEE Standards

Association (IEEE-SA), you can register interest in a standards project. A short time before a sponsor ballot for the project is issued, the IEEE sends the people in the pool an invitation to ballot. If you agree to commit to review and vote on the acceptability, you can apply for membership of that ballot pool. LMSC is responsible for balancing the membership of the ballot pool among various classifications, typically: producer, user and general-interest.

Document distribution

All documents submitted to and produced by the P802.11 working Group (excluding draft standards), such as liaison statements, minutes of meetings, meeting announcements, etc., are provided to the members of the working group by way of the IEEE802.11 document server (see https://mentor.ieee.org/802.11/documents).

Draft standards are available to active participants of 802.11 in its members area. (Access is available by username/password supplied to active participants by 802.11 officers).

During 802.11 plenary and interim sessions, documents and drafts are available to all attendees using a local fileserver.

Procedures

The Policies and Procedures of IEEE Project 802, LAN MAN Standards Committee require that Robert's Rules of Order are used in combination with the LMSC Policies and Procedures and the Working Group Policies and Procedures with the LMSC Policies and Procedure taking precedence.

Submissions to the working group

The 802.11 Working Group Policies and Procedures requires that every document must be formatted to a common standard before being submitted to the document server. Special tools and instructions are available to make the task for submitters easy.

All submissions made to 802.11 WG and its sub-groups must be submitted to the document server before any presentation is made. The ensures that all members have equal access to the material at the time is is being presented.

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Appendix K

The Wayback Machine - https://web.archive.org/web/20160205145836/http://www.ieee802.org/11/

IEEE 802.11™ WIRELESS LOCAL AREA NETWORKS

The Working Group for WLAN Standards

Agenda for WG11 meetings in the January 2016 session

Please refer to the latest revision of 11-15/1485

IEEE 802.11 Presentation

The publicity standing committee (PUB SC) have produced a presentation called "What 802.11 is doing" intended to be used to explain 802.11's current activities to those outside 802.11. This is now available on this website.

IEEE 802 STANDARDS AVAILABLE FOR FREE DOWNLOAD !

The IEEE has made available IEEE 802 standards for free download. Under this program, a standard may be downloaded for free six months after the initial publication of the standard.

All relevant IEEE 802.11 Standard, Amendments, and Recommended Practices are listed here.

ACCESS TO 802 DRAFT STANDARDS

Draft standards are available from a number of sources:

- If you are a voting 802.11 member, go to the members' area and log in using the 802.11 members ID and password supplied to you by the 802.11 officers. Contact Adrian Stephens if you have lost this. During an 802.11 session, attendees may access 802.11 draft standards from a local fileserver, regardless of their membership status.
- If you are an active member of one of the other 802 groups, you may be able to access the 802.11 members' area using the same credentials used to access your own group. If this doesn't work, ask your group's Chair to request access from the 802.11 Chair (Adrian Stephens).
- Draft IEEE standards are, from time to time, made available for purchase using the IEEE store or Techstreet.

IEEE STANDARDS DEVELOPMENT GUIDE

The IEEE-SA has created an easy to use Online Standards Development web site that has a wealth of information that details the whole standards process flow, from creation of the initial PAR, to balloting to final draft, and beyond. It even includes, tutorials, and online forms of the various processes evolved. This site is recommended for all Members and Chairs involved.

Many of the IEEE 802.11 teleconferences use "Join Me". We share a single IEEE-SA supplied account amongst these meetings. The meeting credentials and local dial-in numbers are shown here.

802 11

Today **Thursday, January 21** Pr

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Calendar

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IEEE Std 802.11, 802.11a, 802.11b, 802.11b-Cor1, 802.11d, 802.11e, 802.11F, 802.11g, 802.11h, 802.11i, 802.11j, 802.11k, 802.11m, 802.11ma, 802.11-REVma, 802.11mb, 802.11REVmb, 802.11n, 802.11p, 802.11r, 802.11s, 802.11T, 802.11v, 802.11u, 802.11w, 802.11y, 802.11z, 802.11aa, 802.11ac, 802.11ad, 802.11ae, 802.11af, 802.11ah, 802.11ai, 802.11aj, 802.11ak, 802.11aq, 802.11ax, 802.11REVmc, 802.11.1 and 802.11.2 are trademarks of the IEEE.
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Appendix L

IEEE P802.11 Wireless LANs

Submission

Designator: **doc.: IEEE 802.11-15/1485r5**

Venue Date: **January 2016**

First Author: Adrian Stephens, Chair, IEEE 802.11 WLANs Working Group

Subject: **WG Agenda January 2016**

Full Date: 2016-01-22

Author(s):

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Abstract: This document is the combined session agenda for the stated IEEE 802.11 Working Group session, including (dire by reference) agendas for all sub-groups (Standing Committees, Task Groups and Study Groups).

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155th IEEE 802.11 WIRELESS LOCAL AREA NETWORKS SESSION

Hyatt Regency, Atlanta, GA, USA

January 17-22, 2016

IEEE 802.11™

" Setting the Standards for Wireless LANs ... "

www.ieee802.org/11

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Links

Task Group (TG), Standing Committee (SC) and Study Group (SG) Agenda Links				
Group **	**Description**	**Chair**	**Agenda Document**	
ARC SC	Architecture Standing Committee	Mark Hamilton	https://mentor.ieee.org/802.11/dcn/11-15-1519	
PAR SC	Project Authorization Review (PAR) Review Standing Committee	Jon Rosdahl		Not meeting
REG SC	Regulatory Standing Committee	Rich Kennedy	https://mentor.ieee.org/802.11/dcn/11-15-1523	
WNG SC	Wireless Next Generation Standing Committee	Jim Lansford	https://mentor.ieee.org/802.11/dcn/11-15-1518	
TGah	< 1 GHz	Yongho Seok	https://mentor.ieee.org/802.11/dcn/11-15-1511	
TGai	Fast Initial Link Setup	Hiroshi Mano	https://mentor.ieee.org/802.11/dcn/11-15-1536	
TGaj	China Millimeter Wave (CMMW)	Xiaoming Peng	https://mentor.ieee.org/802.11/dcn/11-15-1521	Note the TGaj meeting takes place the week following the Atlanta interim in Harbin, CN.
TGak	General Link	Donald Eastlake 3rd	https://mentor.ieee.org/802.11/dcn/11-15-1473	
TGaq	Pre-association Discovery	Stephen McCann	https://mentor.ieee.org/802.11/dcn/11-15-1515	
MC	Revision MC	Dorothy Stanley	https://mentor.ieee.org/802.11/dcn/11-15-1522	
TGax	High efficiency wireless LAN (HEW)	Osama Aboul-Magd	https://mentor.ieee.org/802.11/dcn/11-15-1516	
TGay	Next Generation 60 GHz	Edward Au	https://mentor.ieee.org/802.11/dcn/11-15-1472	
TGaz	Next Generation Positioning	Jonathan Segev	https://mentor.ieee.org/802.11/dcn/11-15-1466	
LRLP TIG	Long range low power Topic Interest Group	Tim Godfrey	https://mentor.ieee.org/802.11/dcn/11-15-1520	

Policy Links	
Refer to the 802.11 WG Agenda for links to policy documents under which the session operates.	

WG Information	
802.11 Website	http://www.ieee802.org/11/
802.11 Document Server	https://mentor.ieee.org/802.11/documents
802.11 Reflector Request	http://grouper.ieee.org/groups/802/11/Reflector.html
802.11 Meeting Plan	http://www.ieee802.org/11/Meetings/Meeting_Plan.htm
802.11 Members' Area	http://www.ieee802.org/11/private/index.shtml
802.11 Operations Manaul	TBD
802.11 Officers	http://www.ieee802.org/11/Photographs/officers.htm

WG Session Reports	
WG Agenda	https://mentor.ieee.org/802.11/dcn/11-15-1485
Opening report	https://mentor.ieee.org/802.11/dcn/11-15-1486
Snapshots	https://mentor.ieee.org/802.11/dcn/11-15-1526
1st vice chair	https://mentor.ieee.org/802.11/dcn/11-15-1524
2nd vice chair	https://mentor.ieee.org/802.11/dcn/11-15-1527
Treasurer	https://mentor.ieee.org/802.11/dcn/11-15-1525
Supplementary Material	https://mentor.ieee.org/802.11/dcn/11-15-1487
Motions	https://mentor.ieee.org/802.11/dcn/11-15-1528
Closing report	https://mentor.ieee.org/802.11/dcn/11-15-1529

Session Information	http://802world.org/attendee

*Embedded Agendas ***	
WG11	IEEE 802.11 Working Group
CAC	IEEE 802.11 Chair's Advisory Committee
JTC1	JTC1 EC SC

Other Meetings	
NM	New Members Orientation

*** The colours used for these entries matches the colour used in the Agenda Graphic*

802.11 Agenda R5

Hyatt Regency, Atlanta, GA, USA

January 17-22, 2016

The graphic below describes this session of the IEEE P802.11 Working Group

TIME	Sunday	Monday 2016-01-18	Tuesday 2016-01-19	Wednesday 2016-01-20	Thursday 2016-01-21	Friday 2016-01-22
07:00-08:00			Editors' Meeting			
08:00-08:30		Wireless Opening Plenary	WNG AY LRLP TIG AH	ARC AX AY AQ AI	AI AH AK AY	802.11 Working Group Closing Plenary
08:30-09:00						
09:00-09:30		802.11 Opening Plenary				
09:30-10:00						
10:00-10:30		*Break*	*Break*	*Break*	*Break*	
10:30-11:00		AK AX AY NM AI	ARC AX AX REG fixed slot AI	802.11 Working Group Mid-Week Plenary	AX AY AQ AK	
11:00-11:30						
11:30-12:00						
12:00-12:30						
12:30-13:00		*Lunch Break*	*Lunch Break*	*Lunch Break*	*Lunch Break*	
13:00-13:30						
13:30-14:00		AK AH AI LRLP TIG NG MN	ARC AX AX AQ JTC1	AK AX AQ AZ	MC AH LRLP TIG AQ AI	
14:00-14:30						
14:30-15:00						
15:00-15:30						
15:30-16:00		*Break*	*Break*	*Break*	*Break*	
16:00-16:30	Wireless Chairs Meeting	MC AX AX AQ AI	MC AH AZ AK AI	MC AX AH AI	AX AZ AQ AK	
16:30-17:00						
17:00-17:30						
17:30-18:00						
18:00-18:30	CAC	*Dinner Break*	*Dinner Break*		*Dinner Break*	
18:30-19:00						
19:00-19:30						
19:30-20:00		AK AH	AK AX AX AY AI	*Social*	CAC	
20:00-20:30						
20:30-21:00						
21:00-21:30						
21:30-22:00						
22:00-22:30						

Joint Meeting with ARC

Joint Meeting with ARC

Regular Session Hours

Extra Attendance Credit is given for:
Sunday CAC
Monday morning (if meeting as an ad-hoc)
Monday evening *
Tuesday Editors'
Tuesday evening *
Thursday CAC

** Any meetings marked thus are subject to confirmation based on room

155th IEEE 802.11 WIRELESS LOCAL AREA NETWORKS SESSION
Hyatt Regency, Atlanta, GA, USA
January 17-22, 2016

WG Chair - Adrian Stephens (Intel Corporation)
WG Vice Chair - Jon Rosdahl (CSR - Qualcomm)
WG Vice Chair - Dorothy Stanley (HPE - Aruba)
WG Secretary - Stephen McCann (Blackberry)

Agenda R5

WG11 Agenda - Mon 2016-01-18 - 09:00 to 10:00

Item	Type	Description	Document	Presenter	Start Time	Duration	End Time	Changes
1		**Opening formalities**						
1.1	II	Meeting called to order & assertion of quorum		Stephens	9:00	1	9:01	
1.2	II	Front table introductions. Introduce IEEE-SA staff representative, if present.		All	9:01	1	9:02	
1.3	II	Meeting Decorum (i.e., how to behave in meetings)	Opening Report	Stephens	9:02	1	9:03	
1.4	MI	Review and approve 802.11 session agenda	WG Agenda	Stephens	9:03	2	9:05	
1.5	MI	Review and approve WG minutes	WG minutes	McCann	9:05	1	9:06	
1.6	II	Straw poll of new attendees		Stephens	9:06	0	9:06	
2		**Announcements**						
2.1	**II**	**Policies and procedures (P&Ps)**						
2.1.1	II	Review Patent Policy slides (including call for essential patents)	PatCom materials	Stanley	9:06	6	9:12	
2.1.2	**II**	**Inform participants of the following P&Ps**						
2.1.2.1	II	IEEE Code of Ethics	Code of ethics	Stanley	9:12	1	9:13	
2.1.2.2	II	IEEE Standards Association (IEEE-SA) Affiliation FAQ	Affiliation FAQ	Stanley	9:13	0	9:13	
2.1.2.3	II	IEEE-SA Antitrust and Competition Policy		Stanley	9:13	0	9:13	
2.1.2.4	II	IEEE-SA Letter of Assurance (LoA) form	LoA form	Stanley	9:13	0	9:13	
2.1.2.5	II	IEEE-SA Patent Committee (PatCom) information	PatCom website	Stanley	9:13	0	9:13	
2.1.2.6	II	IEEE 802 LAN/MAN Standards Committee (LMSC) P&Ps, Chairs Guidelines, Operations Manual	LMSC P&P	Stanley	9:13	0	9:13	
2.1.2.7	II	IEEE 802 LMSC WG P&P	LMSC WG P&P	Stanley	9:13	0	9:13	
2.1.2.8	II	IEEE 802 LMSC rules changes		Stanley	9:13	1	9:14	
2.1.2.9	II	IEEE 802.11 Operations Manual changes		Stanley	9:14	1	9:15	
2.2	II	Reflectors		Stanley	9:15	1	9:16	
2.3	II	Attendance action from November 2015		Stanley	9:16	1	9:17	
2.4		**Incoming Liaisons**						
2.4.1	II	Summary of new and pending liaisons and processing this week	Opening Report	Stephens	9:17	2	9:19	
2.5	II	Other Anouncements		All	9:19	0	9:19	
2.6					9:19	0	9:19	
3		**Logistics and Key events/activities**						
3.1	II	Working group session documents	Opening Report	Stephens	9:19	1	9:20	
3.2	II	Joint meetings & Reciprocal Credit	Opening Report	Stephens	9:20	1	9:21	
3.3	II	Other WG meeting plans	1st VC Report	Rosdahl	9:21	1	9:22	
3.4	II	Meeting room locations	1st VC Report	Rosdahl	9:22	1	9:23	
3.5	II	Next meeting reminder	1st VC Report	Rosdahl	9:23	1	9:24	
3.6	II	Meeting registration	1st VC Report	Rosdahl	9:24	1	9:25	
3.7	II	Recording attendance	1st VC Report	Rosdahl	9:25	1	9:26	
3.8	II	File server	1st VC Report	Rosdahl	9:26	1	9:27	
3.9	II	Breakfast, breaks, Social logistics	1st VC Report	Rosdahl	9:27	1	9:28	
3.10	II	Wednesday Topics	Opening Report	Stephens	9:28	1	9:29	
3.11	II	Report on 802 EC or IEEE-SA Standards Board decisions	Opening Report	Stephens	9:29	3	9:32	
3.12					9:32	0	9:32	
4		**Opening reports, objectives & plans**						
4.1		**WG reports**						
4.1.1	II	802.11 groups	Opening Report	Stephens	9:32	1	9:33	
4.1.2	II	802.11 PARS	Opening Report	Stephens	9:33	1	9:34	
4.1.3	II	Officers	Opening Report	Stephens	9:34	1	9:35	
4.1.4	II	Standards pipeline and 802.11 revisions	Opening Report	Stephens	9:35	1	9:36	
4.1.5	II	Summary of Ballots / Comment collections	Opening Report	Stephens	9:36	2	9:38	
4.1.6	II	WG membership summary	Opening Report	Stephens	9:38	1	9:39	
4.1.7	II	WG ANA report	Opening Report	Stephens	9:39	1	9:40	
4.1.8	II	WG timeline report / planning		McCann	9:40	1	9:41	
4.1.9	II	WG technical editor	Snapshots Report	Ecclesine	9:41	1	9:42	
4.1.10					9:42	0	9:42	
4.2		**Standing committee reports**						

4.2.1	II	Architecture (ARC) (including 802 Architecture status)	Snapshots Report	Levy	9:42	2	9:44
4.2.2	II	PAR Review (PAR)	Snapshots Report	Rosdahl	9:44	1	9:45
4.2.3	II	Regulatory (REG)	Snapshots Report	Kennedy	9:45	1	9:46
4.2.4	II	Wireless Next Generation (WNG)	Snapshots Report	Lansford	9:46	1	9:47
4.2.5	II	JTC1 802 SC	Snapshots Report	Myles	9:47	1	9:48
4.3		**Task Group reports**					
4.3.1	II	TGmc - Revision mc (REVmc)	Snapshots Report	Stanley	9:48	1	9:49
4.3.2	II	TGah - Sub 1 GHz (S1G)	Snapshots Report	Seok	9:49	1	9:50
4.3.3	II	TGai - Fast Initial Link Setup (FILS)	Snapshots Report	Mano	9:50	1	9:51
4.3.4	II	TGaj - China Millimeter-Wave (CMMW)	Snapshots Report	Stanley	9:51	1	9:52
4.3.5	II	TGak - General Link (GLK)	Snapshots Report	Eastlake	9:52	1	9:53
4.3.6	II	TGaq - Pre-Association Discovery (PAD)	Snapshots Report	McCann	9:53	1	9:54
4.3.7	II	TGax - High Efficiency Wireless LAN (HEW)	Snapshots Report	Aboul-Magd	9:54	1	9:55
4.3.8	II	TGay - Next generation 60 GHz	Snapshots Report	Au	9:55	1	9:56
4.3.9	II	TGaz - Next generation positioning (NGP)	Snapshots Report	Segev	9:56	1	9:57
4.4		**Study Group / TIG reports**					
4.4.1	II	LRLP - Long Range Low Power TIG	Snapshots Report	Godfrey	9:57	1	9:58

5		**New Business**					
5.1					9:58	0	9:58
5.2					9:58	0	9:58

6		**Recess**		**Stephens**	**9:58**	**0**	**9:58**
		Slack Time				**2**	**10:00**

WG11 Agenda - Wed 2016-01-20 - 10:30 to 12:30

Item	Type	Description	Document	Presenter	Start Time	Duration	End Time	Changes
1		**Opening formalities**						
1.1	II	Meeting called to order		Stephens	10:30	1	10:31	
1.2	II	Front Table introductions		All	10:31	1	10:32	
1.3	MI	Modify and approve modifications to agenda	WG Agenda	Stephens	10:32	1	10:33	
2		**Announcements**						
2.1	II	Policies and Procedures (P&P) reminder	Supplementary	Stephens	10:33	1	10:34	
2.2	II	Call for essential patents	Supplementary	Stephens	10:34	1	10:35	
2.3	II	Reminder of Thursday night CAC meeting	Supplementary	Stephens	10:35	1	10:36	
2.4	II	Any other announcements		All	10:36	0	10:36	
2.5					10:36	0	10:36	
3		**Old business**						
3.1	II	Treasurer's Report	11-15/1525	Rosdahl	10:36	0	10:36	
3.2	II	Any WG reports carried forward			10:36	5	10:41	
3.3					10:41	0	10:41	
4		**Liaisons**						
4.1		**External (non-802) liaisons**						
4.1.1	II	Wi Fi Alliance		Sherlock	10:41	5	10:46	
4.1.2	II	Internet Engineering Task Force (IETF)		Stanley	10:46	10	10:56	
4.2		**Internal (802) liaisons**						
4.2.1					10:56	0	10:56	
4.2.2					10:56	0	10:56	
5		**New business**						
5.1	MI	Room change requests & Graphic update	WG Agenda	Stephens	10:56	6	11:02	
5.2	II	Status & Future of Regulatory		Stephens	11:02	2	11:04	
5.3	DT	State of Regulatory in 802 / 802.11	11-15/1537	Kennedy	11:04	15	11:19	
5.4	II	Reminder about process		Stephens	11:19	5	11:24	
5.5	II	EC workshop description		Stephens	11:24	5	11:29	
5.6	II	Report on leadership summit with WFA		Stephens	11:29	10	11:39	
5.7	II	Report on Attendance Rules	11-16/0025	Stanley	11:39	15	11:54	
5.8	DT	Making progress on IMT-2020		Levy	11:54	30	12:24	
5.9	II	Macau Logistics		Slykhouse	12:24	10	12:34	
6		**Recess**		**Stephens**	**12:34**	**0**	**12:34**	
		Slack Time				**-4**	**12:30**	

WG11 Agenda - Fri 2016-01-22 - 08:00 to 12:00

Item	Type	Description	Document	Presenter	Start Time	Duration	End Time	Changes
1		**Opening formalities**						
1.1	II	Meeting called to order		Stephens	8:00	1	8:01	
1.2	II	Front Table introductions		All	8:01	1	8:02	
1.3	MI	Modify and approve modifications to agenda	WG Agenda	Stephens	8:02	1	8:03	
2		**Announcements**						
2.1	II	Policies and Procedures (P&P) reminder	Supplementary	Stephens	8:03	1	8:04	
2.2	II	Call for essential patents	Supplementary	Stephens	8:04	1	8:05	

2.3	II	Reminder to get minutes to WG secretary		McCann	8:05	1	8:06
2.4	II	Reminder to get objectives & agendas for next session to WG Chair by 1st CAC telecon	Supplementary	Stephens	8:06	1	8:07
2.5	II	Letters of Assurance (LoAs) received	Supplementary	Stephens	8:07	1	8:08
2.6	II	Drafts for Sale in IEEE Shop	Supplementary	Stephens	8:08	1	8:09
2.7	II	Drafts to liaise with ISO/JTC1/SC6	Supplementary	Stephens	8:09	1	8:10
2.8	II	Status of ballots	Supplementary	Stephens	8:10	1	8:11
2.9	II	3GPP presentation on LWA (LTE WiFi Access)		Stephens	8:11	1	8:12
3		**Closing reports**					
3.1		**Working Group**					
3.1.1	II	Straw Poll of membership regarding this meeting location		Rosdahl	8:12	2	8:14
3.1.2	DT	Future venues insight	1st VC Report	Rosdahl	8:14	10	8:24
3.1.3	II	Treasurer's report		Rosdahl	8:24	10	8:34
3.1.4	II	Timeline		McCann	8:34	5	8:39
3.1.5	II	Attendance report	Closing Report	Stephens	8:39	2	8:41
3.1.6	II	WG Editor	Closing Report	Ecclesine	8:41	3	8:44
3.1.7					8:44	0	8:44
3.2		**Standing committee reports**					
3.2.1	II	Architecture (ARC)	Closing Report	Levy	8:44	3	8:47
3.2.2	II	PAR Review (PAR)	Closing Report	Rosdahl	8:47	0	8:47
3.2.3	II	Regulatory (REG)	Closing Report	Kennedy	8:47	3	8:50
3.2.4	II	Wireless Next Generation (WNG)	Closing Report	Lansford	8:50	3	8:53
3.2.5	II	JTC1 802 SC	Closing Report	Myles	8:53	3	8:56
3.3		**Task Group reports**					
3.3.1	II	TGmc - Revision mc (REVmc)	Closing Report	Stanley	8:56	3	8:59
3.3.2	II	TGah - Sub 1 GHz (S1G)	Closing Report	Seok	8:59	3	9:02
3.3.3	II	TGai - Fast Initial Link Setup (FILS)	Closing Report	Mano	9:02	3	9:05
3.3.4	II	TGaj - China Millimeter-Wave (CMMW)	Closing Report	Peng	9:05	0	9:05
3.3.5	II	TGak - General Link (GLK)	Closing Report	Eastlake	9:05	3	9:08
3.3.6	II	TGaq - Pre-Association Discovery (PAD)	Closing Report	McCann	9:08	3	9:11
3.3.7	II	TGax - High Efficiency Wireless LAN (HEW)	Closing Report	Aboul-Magd	9:11	3	9:14
3.3.8	II	TGay - Next Generation 60 GHz	Closing Report	Au	9:14	3	9:17
3.3.9	II	TGaz - Next Generation Positioning (NGP)	Closing Report	Segev	9:17	3	9:20
3.4		**Study Group / Topic Interest Group**					
3.4.1	II	LRLP - Long Range Low Power TIG	Closing Report	Godfrey	9:20	3	9:23
3.5		**Ad-hoc reports**					
3.5.1		NGMN ad-hoc	Closing Report	Stanley	9:23	3	9:26
3.6		**Liaison**					
3.6.1	II	802.15 liaison report	Closing Report	Chaplin	9:26	5	9:31
3.6.2	II	802.18 RR TAG liaison report	Closing Report	Kennedy	9:31	3	9:34
3.6.3	II	802.24 liaison report	Closing Report	Godfrey	9:34	5	9:39
3.6.4	II	802.1CF (OmniRAN) Status Update	Closing Report	Riegel	9:39	5	9:44
4		**Discussion topics**					
4.1					9:44	0	9:44
5		**Motions (old business)**					
5.1		**Working Group motions**					
5.1.1	MI	Telecon schedule	Motions	Stanley	9:44	3	9:47
5.1.2	MI	OM Updates		Stanley	9:47	0	9:47
5.1.3					9:47	0	9:47
5.2		**Standing committee motions**					
5.2.1	ME	Architecture (ARC)		Hamilton	9:47	0	9:47
5.2.2	ME	PAR Review (PAR)		Rosdahl	9:47	0	9:47
5.2.3	ME	Publicity (PUB)		McCann	9:47	0	9:47
5.2.4	ME	Regulatory (REG)		Kennedy	9:47	0	9:47
5.2.5	MI	Wireless Next Generation (WNG)		Lansford	9:47	0	9:47
5.2.6	ME	JTC1 802 SC		Myles	9:47	0	9:47
5.3		**Task Group motions**					
5.3.1	ME	TGmc - Revision mc (REVmc)		Stanley	9:47	0	9:47
5.3.2	MI	TGah - Sub 1 GHz (S1G		Seok	9:47	0	9:47
5.3.4	MI	TGai - Fast Initial Link Setup (FILS)		Mano	9:47	0	9:47
5.3.5	MI	TGaj - China Millimeter-Wave (CMMW)		Peng	9:47	0	9:47
5.3.6	MI	TGak - General Link (GLK)	Motions	Eastlake	9:47	5	9:52
5.3.7	MI	TGaq - Pre-Association Discovery (PAD)		McCann	9:52	0	9:52
5.3.8	MI	TGax - High Efficiency Wireless LAN (HEW)		Aboul-Magd	9:52	0	9:52
5.3.9	MI	TGay - Next Generation 60 GHz (NG60)		Au	9:52	0	9:52
5.3.10	MI	TGaz - Next Generation Positioning (NGP)		Segev	9:52	0	9:52
5.4		**Study Group / Topic Interest Group motions**					
5.4.1	ME	LRLP - Long Range Low Power TIG		Godfrey	9:52	0	9:52
6		**New Business**					
6.1	ME	802 liaison to ITU-R WP5D	Motions	Myles	9:52	10	10:02
6.2	DT	Making progress with IMT-2020 - Straw polls	Motions	Levy	10:02	30	10:32
6.3	DT	Leadership summit - does the WG need to approve?		Stephens	10:32	15	10:47
6.4	DT	Future of 802.18	11-16/196r0	Kennedy	10:47	15	11:02
6.5					11:02	0	11:02

7		**Closing formalities**					
7.1	II	Reminder about wireless chairs meeting	Supplementary	Stephens	11:02	1	11:03
7.2	II	Next meeting reminder	Supplementary	Stephens	11:03	1	11:04
7.3	MI	Adjourn		Stephens	11:04	0	11:04
		Slack Time				**56**	**12:00**

JTC1 SC AGENDA & OBJECTIVES FOR THIS SESSION

CHAIR - ANDREW MYLES (Cisco)

- **Forum to discuss any IEEE 802 issues related to ISO/IEC JTC1/SC6**

IEEE 802 JTC1 Standing Committee Ad Hoc AGENDA - 18 Jan 2016 - AM1

1	*	IEEE 802 JTC1 SC Meeting Call To Order	-	Chair	1
2	*	Select secretary for session	-	Chair	1
3	II	Review IEEE 802 Policies and Rules	-	Chair	2
4	MI	Approve Agenda	-	All	5
5	DT	Review meeting dates and agenda for SC6 meeting in February 2016	-	All	?
6	DT	Consider any submissions made for SC6 meeting in February 2016		All	?
7	DT	Recess			

IEEE 802 JTC1 Standing Committee AGENDA - 18 Jan 2016 - PM1

1	*	IEEE 802 JTC1 SC Meeting Call To Order	-	Chair	1
2	*	Select secretary for session	-	Chair	1
3	II	Review IEEE 802 Policies and Rules	-	Chair	2
4	II	Chair's Update	-	Chair	2
5	MI	Approve Agenda	-	All	5
6	MI	Approve previous minutes	-	All	2
7	DT	Review goals of IEEE 802 JTC1 SC	-	All	2
8	DT	Review status of IEEE 802 liaisons previously sent to SC6	-	All	5
9	DT	Review status of FDIS ballots in SC6	-	All	5
10	DT	Review agenda of next SC6 meeting	-	All	?
11	DT	Consider other matters	-	All	?
12	DT	Consider any motions	-	All	?
13	DT	Adjourn	-	All	?

ME - Motion, External MI - Motion, Internal
DT- Discussion Topic II - Information Item

^ - All time durations are estimates.
Recess and adjournment times are fixed.

155th IEEE 802.11 WIRELESS LOCAL AREA NETWORKS SESSION
Hyatt Regency, Atlanta, GA, USA
January 17-22, 2016

WG Chair - Adrian Stephens (Intel Corporation)
WG Vice Chair - Jon Rosdahl (CSR - Qualcomm)
WG Vice Chair - Dorothy Stanley (HPE - Aruba)
WG Secretary - Stephen McCann (Blackberry)

Agenda R5

CAC Agenda - Thu 2016-01-21 - 19:30 to 21:30

Item	Type	Description	Document	Presenter	Start Time	Duration	End Time	Changes
1		Meeting called to order		Stephens	19:00	0	19:00	
2		Review closing reports for closing plenary		Stanley	19:00	15	19:15	
3		Review closing motions for closing plenary		Stanley	19:15	15	19:30	
4		Review room requests and prepare room request schedule		Rosdahl	19:30	30	20:00	
5		Review agenda for closing plenary		Stephens	20:00	15	20:15	
6		Review material for closing 802 EC (Plenary sessions only)			20:15	15	20:30	
7		Adjourn			20:30	0	20:30	
		Slack Time				60	21:30	

Session Description:	155th IEEE 802.11 WIRELESS LOCAL AREA NETWORKS SESSION
Session Location:	Hyatt Regency, Atlanta, GA, USA
Readable Session Date Range:	January 17-22, 2016
Start Date:	Sunday 2016-01-17
General Session Start Date	Monday 2016-01-18
Duration (days):	6
End Date:	Friday 2016-01-22
Revision:	5

Appendix M

Wi-Fi 6

Protocol and Network

For a complete listing of titles in the
Artech House Mobile Communications Library,
turn to the back of this book.

Wi-Fi 6

Protocol and Network

Susinder R. Gulasekaran

Sundar G. Sankaran

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10 9 8 7 6 5 4 3 2 1

Dedicated to all those who have contributed to Wi-Fi and love Wi-Fi

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Chapter 1

Introduction

Wi-Fi has become a necessity in today's world. It has evolved into a fundamental utility, like electricity and water, that everyone—without any thought—expects to be available everywhere irrespective of whether it is a school, a hotel, a restaurant, a stadium, an office building, or even public transportation.

Wi-Fi is a wireless local area network (WLAN) technology, essentially an Ethernet replacement that allows devices to connect to the internet without being tethered by any wires or cables. It is based on Institute of Electrical and Electronic Engineers (IEEE) 802.11 standards. The absence of wires and cables extends access to places where the wires and cables cannot reach. This also brings down the network deployment cost since it avoids any trenching and drilling needed to create physical connections.

Wi-Fi is one of the greatest success stories of the modern technology era. Wi-Fi enabled devices can connect to the internet via a wireless access point (AP). APs have a range between 10 and 30 meters indoors, and the range can be much longer outdoors. Hundreds of millions of Wi-Fi access points connect billions of computers, smartphones, smart TVs, game consoles, cameras, printers, Internet of Things (IoT) devices, and other consumer devices to the internet to enable millions of applications to reach everyone, everywhere. According to a study commissioned by Wi-Fi Alliance (WFA), this generates a global economic value estimated at $3.3 trillion USD. This is expected to grow to $4.9 trillion by 2025.

The total global mobile traffic is estimated to increase from around 51 exabytes (51 billion gigabytes) per month by the end of 2020 to 226 exabytes per month in 2026. Operators have long been leveraging Wi-Fi networks to scale capacity to meet these ever-increasing bandwidth needs of their subscribers.

One of the main catalysts for the widespread adoption of Wi-Fi is the decision by regulatory bodies around the world to make significant blocks of spectrum available on a license-exempt basis. Unlike licensed bands, where the wireless communication protocol to be used is mandated as part of the licensing process, no protocols were specified for these unlicensed bands. This unregulated environment created opportunities for the industry to develop novel wireless communication protocols for various applications, including computer-to-computer communication. However, this resulted in several companies developing WLAN products that were incompatible with each other. The IEEE 802.11 standard was later developed in order to guarantee compatibility and interoperability.

1.1 IEEE STANDARDIZATION PROCESS

IEEE standardization starts with an idea for a standard. A group of individuals or companies form a study group under the IEEE Standards Association's umbrella for up to six months before their work gets approved as an IEEE standards project. The most famous among IEEE standards projects is the IEEE 802 project that focuses on local area network (LAN) standards. Working groups are formed within a project to develop standards to address a particular aspect of the problem. The working groups are assigned a number, which is written after the decimal point for the corresponding projects. WLAN happens to be the eleventh working group formed under IEEE 802, and hence got the number 802.11. The working group opens a PAR – a Project Authorization Request – that includes items such as the purpose and scope of the standard, who will chair the working group, and the expected duration of the project. After the PAR is approved by the IEEE SA's standards board, the working group begins the work to develop the standard. The standard that the working group develops is called a draft standard. At least 75 percent of the sponsor ballot group comprising interested entities or individuals needs to approve the draft standard by a letter ballot before it gets sent to the IEEE-SA Standards Board for approval. Once approved, it becomes an officially ratified standard. Then the publishing process begins, and the standard is made available to everyone.

As the standard gets used and as technology advances, an inevitable need to update the standard arises. This restarts the standardization process all over again. Task groups are formed within working groups to amend or add to the standard and are assigned alphabet(s) beneath the working group. The task group then submits a PAR. Once the PAR is approved, the draft to revise the standard is developed; the draft is then balloted and sent to the IEEE-SA Standards Board for approval.

The document produced by the task group is identified by the project number and working group number, followed by the alphabet(s) assigned to the task group. Task Group a (TGa) is the first WLAN task group formed and the standard developed by this task group is called IEEE 802.11a specification. Table 1.1 lists all the specifications, also known as amendments, developed by the IEEE 802.11 task groups.

Periodically, once every four years or so in the case of IEEE 802.11, a task group is formed to roll up the amendments into the parent specification. The first such task group TGma was formed in 2003 to create a single document that merged 8 amendments (802.11a, b, d, e, g, h, i, j) with the original IEEE 802.11 standard. The resultant document, approved in 2007, became the new base standard named IEEE 802.11-2007. The most recent rolled out standard is IEEE 802.11-2020, which was produced by the fourth maintenance task group referred to as TGmd. Maintenance/revision for IEEE 802.11-2020 is being handled by TGme.

1.2 WI-FI ALLIANCE

IEEE 802.11 is a long and complex standard. Despite the best efforts, some sections of the standard are bound to be ambiguous or not fully defined. Furthermore, the standard includes several optional features and different manufacturers might make different choices in their designs. To avoid interoperability problems, a non profit organization called Wireless Ethernet Compatibility Alliance (WECA) was formed by a group of major manufacturers two years after the original standard was ratified. The main objectives of WECA were to promote the use and implementation of the new standard and to certify products that conform to subsets of the 802.11 standard for interoperability. In 2000, WECA changed the name of its technology from Wireless Ethernet to Wi-Fi, a name coined by the brand consulting firm Interbrand as a pun on hi-fi and the organization was renamed WFA.

Since its founding in 1999, WFA has developed several interoperability certification programs to ensure that the Wi-Fi devices from different vendors interoperate seamlessly. These certification programs test various aspects of the 802.11 specifications on devices under test primarily for interoperability. The devices that pass these tests are certified to be "Wi-Fi Certified TM" for the specific 802.11 technology. Wi-Fi Certified TM is an internationally recognized certificate of approval for products indicating that these products have met industry standards of interoperability and security. Currently, WFA has more than 750 companies from around the

Table 1.1
IEEE 802.11 Amendments

Amendment	*Year Ratified*	*Description*
802.11b	1999	OFDM PHY in 5 GHz (Wi-Fi 2)
802.11a	1999	2.4 GHz CCK 5.5 and 11 Mbps (Wi-Fi 1)
802.11d	2001	Tx power and frequency compliance for regulatory domains
802.11g	2003	OFDM PHY in 2.4 GHz (Wi-Fi 3)
802.11h	2003	DFS and TPC to protect radar
802.11i	2004	Wi-Fi security enhancements (AES CCMP)
802.11j	2004	Japan regulatory domain rules in 4.9-5 GHz band
802.11e	2005	QoS enhancements EDCA, UAPSD, blockacks, direct link setup
802.11k	2008	Radio resource management
802.11r	2008	Fast roaming for WPA2
802.11y	2008	High power operation in 3650 to 3700 MHz
802.11n	2009	Wi-Fi 4
802.11w	2009	Protected management frames
802.11p	2010	Wireless access for vehicular applications using OFDM in upper 5-GHz band
802.11z	2010	Tunneled Direct link setup
802.11v	2011	Wireless network management and BSS transition management
802.11u	2011	Seamless roaming between participating Wi-Fi networks (Hotspot 2.0)
802.11s	2011	Wireless mesh networking
802.11ae	2012	Medium access prioritization of management frames
802.11ad	2012	60 GHz Wi-Fi
802.11ac	2013	Wi-Fi 5
802.11af	2014	Wi-Fi operation in TV White spaces frequency band (59-790 MHz)
802.11mc	2015	Maintenance standard which also added Wi-Fi positioning
802.11ah	2016	Standard for Wi-Fi operation below 1 GHz (755-928 MHz) intended for long range and IoT applications
802.11ai	2016	Fast Initial Link Setup
802.11aj	2018	Amendments to 802.11ad for operation in China
802.11ak	2018	Defines how clients with both 802.11 Wi-Fi and 802.3 wired capability can bridge the two mediums and also provides services like VLAN, audio-visual stream, and time synchronization for audio-visual streams
802.11aq	2018	Defines how APs can advertise network service information to clients prior to connecting to a network
802.11ax	2021	Wi-Fi 6
TGay	To be ratified	Next generation standard upgrade to 802.11ad for 60 GHz
TGaz	To be ratified	Next generation Wi-Fi positioning
TGbe	To be ratified	Wi-Fi 7

world as members and has certified more than 50,000 products for various Wi-Fi technologies.

The Wi-Fi standards, as described earlier, are identified as IEEE 802.11n, IEEE 802.11ac, IEEE 802.11ax, and so on. These are not very user-friendly, so, the WFA introduced a new naming convention in 2018 to easily recognize the Wi-Fi capability of devices. The new Wi-Fi naming scheme easily identifies the different generations by using a numerical sequence, each one of which corresponds to a major advancement in Wi-Fi technology. This numbering scheme makes it easier to see the progression of different generations of Wi-Fi. It is not obvious to most people that IEEE 802.11ac was the next generation from IEEE 802.11n, but it is much easier to see that Wi-Fi 6 is the next development on from Wi-Fi 5. This approach is very similar to the concept of technology generations, like 2G, 3G, 4G, and 5G, used in the cellular industry.

1.3 SPECTRUM

Since Wi-Fi operates in unlicensed spectrum, Wi-Fi networks can be deployed by anyone without any license or permission from the government. In the early days, Wi-Fi used the unlicensed 2.4 GHz ISM band. However, the 2.4-GHz band is crowded as it is used by more than just Wi-Fi. Old cordless phones, baby monitors, microwave ovens, and Bluetooth devices tend to use the 2.4-GHz band. To overcome the connectivity issues such as slow and dropped connections, Wi-Fi devices started using the 5-GHz unlicensed band also known as Unlicensed National Information Infrastructure (U-NII) band. Initially, Wi-Fi was allowed to operate only in a small fraction of the U-NII band. But as the demand for Wi-Fi increased, to mitigate congestion, regulatory bodies opened up more parts of the U-NII band. Table 1.2 lists various sub bands of the U-NII band. The availability as well as the regulations for using the allowed sub bands varies depending on the country.

1.4 OUTLINE OF CHAPTERS

Wi-Fi has gone through six generations over the last 25 years. Each new generation is built on the previous one to achieve improvements in speed and spectral efficiency. Over these six generations, Wi-Fi speed and efficiency have improved by three orders of magnitude.

This book is about the latest sixth-generation Wi-Fi, based on 802.11ax standard. Wi-Fi 6 supports a maximum data rate of nearly 10 Gbps with spectral

Appendix N

Wi-Fi® 2015: The top-10 list

by Craig Mathias

With 2015 now here (what, already?), it's time for the annual Top-10 lists to hit the airwaves. And what could be more interesting or important than a look at what's really going to matter in Wi-Fi® over the next year? Sure, many already take Wi-Fi for granted as a mature fixture in networking, and that's actually a good thing. Wi-Fi has indeed become ubiquitous to the point that it's achieved the networking nirvana of (however inelegant this may sound) *plumbing*. That's right, Wi-Fi *just works*. It's right up there with Ethernet and LTE as an *essential* networking and communications technology that few – *very, very few*, and, regardless, no one I know – could live without.

But that doesn't mean that the folks at the Patent Office can relax – the rate of innovation in Wi-Fi remains at a significant pace, and new developments continue to enable advanced applications that will yield far-reaching benefits. So what follows is a look at what I think will be the most important advances in Wi-Fi technologies, and more, for 2015 – and, as we'll allude below, about which there will be plenty of talk about in the outyears. I've listed my Top-10 in no particular order, with no prioritization or relative importance implied. With Wi-Fi, again, now so important across so many applications, it would be tough to say which of the following is truly Number One.

802.11ac takes off

But let's start with what's usually top-of-mind today, *802.11ac*. As we forecast about two years ago, 2015 will be *the* year in which sales of 802.11ac-based products exceed those of 802.11n. This is not to say that 802.11n is obsolete; indeed, sales of .11n-based products will continue and we still don't see any large-scale de-commissioning of 802.11n installations occurring before 2018 (and even then, 802.11ac will still provide backwards compatibility for the many still-in-service 802.11n clients). But the rate-vs.-range performance of .11ac, thanks primarily to beamforming and clever vendor implementations, and the improvement in overall capacity inherent in 802.11ac, thanks to increased channel bandwidths, will bring even the most skeptical IT managers and residential buyers into the 802.11ac fold in 2015. Sure, vendors are leading with the amazing throughput numbers enabled by 802.11ac, with four-stream products offering in excess of 3 Gbps aggregate throughput now available, but most deployments will really be all about improved *range, reliability, management*, and the *capacity* to support multiple, simultaneous, and demanding users, devices, and applications ranging from streaming video to the Internet of Things.

WiGig® on the move

802.11ad, or WiGig, will also gain a good deal of steam in 2015. Many have not yet even heard of 802.11ad, perhaps because it's getting lost in the alphabet soup (see the final item, below) of WLAN standards, and the fact is that few products are available today. But 802.11ad is no afterthought, and it won't be to .11ac like 802.11a was to 802.11g, a powerful but underutilized also-ran. 802.11ad is best thought of as a *complement* to 802.11ac, designed for *very* (very!) high throughput over more limited range. 802.11ad operates in the 60 GHz bands, where's there's a *vast* amount of available spectrum, and can reach close to 7 Gbps. OK, you say; so can 802.11ac - but that's possible only in an 8x8 MIMO configuration, and such won't be common in 2015, if ever. But, again you say, the 5 GHz. of 802.11ac propagates more efficiently, and 60 GHz really doesn't go through walls. True – but in open offices, for in-room full-speed HD video links, high-performance virtual reality and medical applications, and many more, however – let's just say that *a lot* more people will appreciate what 802.11ad can really do by the end of 2015. And with Wi-Fi Alliance® hard at work on a certification program here, many of these folks will soon have direct experience with just how amazing 802.11ad really is. Stay tuned – *this is going to be big*.

Passpoint™: Cellular-like connectivity comes to Wi-Fi

Passpoint is one of the most important innovations ever to come out of Wi-Fi Alliance, ranking right up with WPA™, the brilliant solution that addressed the fundamental flaws in WEP that at the time threatened to derail the momentum that was just beginning to build behind wireless LANs. Just like WPA, Passpoint is simple and elegant, and designed to make authenticating with Wi-Fi hotspots as easy and as transparent as handsets connecting to a cellular network. In other words, the same seamless authentication experience that is essential to cellular will become *common* in Wi-Fi based hotspots and beyond in 2015 – momentum is building, and the flexibility inherent in Passpoint leaves few opportunities for either objections or alternatives – a done deal, in other words.

Wi-Fi and the cloud – In more ways than one

Which leads us to the future of information systems and IT overall as the continuous connectivity enabled by Wi-Fi becomes commonplace. I'm of the opinion that the Cloud, not apps, wins in the long run. Why? Because modern organizational computing centers on large (make that *vast*) amounts of data, sufficient server processing power to deal with all that data, and real-time, anytime/anywhere communication and collaboration. The argument about needing to be productive when offline is now moot: *no one can really be productive without access to the network*. Wi-Fi – *real mobile broadband networking* – is going to be available almost everywhere (it'll be rare to be on a flight that doesn't offer Wi-Fi, for example), and often the *first* choice for this essential connectivity (see the next item). Look for HTML5-based applications, desktop virtualization, all manner of network and other operational management services, and, really, all cloud services available at the end of a Wi-Fi connection to *define* IT from 2015 onwards. And remember - *only* Wi-Fi offers the combination of throughput, capacity, and cost-effectiveness that truly makes the cloud mobile.

Wi-Fi is critical to the success of - *Cellular*

Going hand-in-hand with (and also augmented by) Passpoint is the emerging momentum towards *cellular offload*. I've argued for some time that Wi-Fi is *fundamental – essential,* really – to the future of wide-area wireless communications because cellular networks are so limited in terms of available spectrum. Sure, the trend towards small cells and LTE-Advanced will help here, but more spectrum is always king in wireless. With vast amounts of spectrum available on an unlicensed basis, and rapid reuse of this spectrum due to both efficient sharing mechanisms and limited transmit power, Wi-Fi is an *ideal* complement to cellular, especially indoors and in high-population-density, high-demand areas. In fact, all that abundant spectrum and 802.11ac-equipped clients will likely drive the nascent *"Wi-Fi First"* movement that's just coming onto radar screens. And such exciting developments as the increasing availability of Wi-Fi in cars as both mobile hotspots and as a core element in intelligent vehicles and highways, the increasing application of voice over Wi-Fi, and even mobile unified communications (landlines? remember those?), and more – exciting just doesn't begin to describe it!

Wi-Fi and the enterprise: Two key developments

Just as is the case in the residence, enterprises are now provisioning Wi-Fi as not just their primary or preferred networks, but rather as their *only* access for essentially *everyone*, from staff to contractors to guests. As a consequence, wired networks in organizations are now taking on a supporting role, providing connectivity, power (over Ethernet), and backhaul for the ever-increasingly dense population of APs. This means that *unified wired/wireless management* is gaining steam, as IT staffs always pressed to improve productivity seek to optimize Wi-Fi performance end-to-end and minimize operational expense, and the rise of big-data *analytics* to help spot performance and potential security and integrity issues before these can have an impact.

Wi-Fi maintains its leading role in location-based services

One of the most interesting applications (again, almost everywhere) going forward will be *location-based services* and, at least in some cases, Wi-Fi-based *tracking* in the interests of enhancing these services and a number of dimensions of security. Many in the press are ga-ga about beacons based on Bluetooth Low Energy (BLE), but let's face it: these have limited range and are broadcast-only – meaning another wireless technology is required to close the loop. And that technology is – well, I think you know… And Wi-Fi can also be used for the location and tracking of unmodified clients, with excellent range, accuracy, and convenience. We'll see the launch of new location-based services and applications across a broad range of market opportunities. Even the obvious privacy concerns can be addressed – such represent, after all, a *political*, and not technical, challenge.

Wi-Fi dominates in IoT applications

2015, as I **recently wrote**, will see the dramatically increased application of Wi-Fi in M2M/IoT/IoE. The real beauty of Wi-Fi in the Internet of Things world is that Wi-Fi already speaks IP natively, and new applications can in many cases leverage a robust, broadband infrastructure that's already in place. Everything required is in fact here today – security, authentication, and even low-cost, low-power (I recently reviewed, for example, a Wi-Fi *camera* that can run for up to 90 days on a single USB charge!) implementations suitable for anything that needs to be done in the residence, or the enterprise. Wi-Fi is a very serious alternative to other M2M/IoT/IoE radio technologies, and I expect Wi-Fi will even *dominate* many IoT applications going forward. And let's not forget the many potential beneifts of Wi-Fi Direct® here as well.

Service discovery: Convenience and value

Just announced by Wi-Fi Alliance, Wi-Fi Aware™ is an exciting advance in the vital service-discovery space. The idea here is for devices and users to learn about potential services, applications, information, and beyond *before* connecting to a given Wi-Fi network. The implications here are huge: looking for a printer? How about being notified about an item on your shopping list being not just available nearby, but also on sale? Think of service discovery as social networking that runs in the background on mobile devices. The real power of service discovery will be unlocked when application developers discover all that's here – but it's going to be exciting (there's that word again!) nonetheless, and, yes, in 2015.

And the innovation continues: We're not done yet

OK, most of these extend well beyond 2015, but you'll see many new products based on the continuing innovation coming out of IEEE 802.11 Working Groups in 2015 and beyond. A few notable examples here include work on 802.11ax, which could reach (around 2018, I think) the magical 10 Gbps level of throughput; 802.11ah, for additional M2M/IoT opportunities in the sub-1 GHz. bands; 802.11ai, for improved connect times (this is a/k/a Fast Link Setup); and 802.11aq, or Pre-Association Discovery – which should fit nicely with the Wi-Fi Aware effort noted above (and, once again, Wi-Fi Alliance is well ahead of the formal standards process). While Wi-Fi Alliance has yet to announce

plans in many of these areas, the ongoing high levels of activity and innovation in wireless LANs point to a future that will yield numerous additional benefits for us all.

So you see what I mean: Wi-Fi is indeed *everywhere* and has achieved the status of an *essential* technology - it's right up there with electricity, the Internet, and, yes, indoor plumbing as a universal requisite for effective business, education, government, health and healthcare, entertainment - and much, much more.

Happy New Year – *and an innovative 2015* – to all!

Add new comment

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Submitted by Anonymous on Fri, 03/13/2015 - 14:46

Permalink

this is one of the world best

this is one of the world best application

Reply

Submitted by Vinod Vyas on Sun, 10/25/2015 - 06:55

Permalink

Whats the latest update, we are in Q4 2015

Good article Craig. Whats the update. We are in Q4 2015. How do you see WiFi now after lots of changes in technology and recent acquisition of Aruba by HP and Meru by Fortinet.

Reply

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Your name

Subject

Comment

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SAVE PREVIEW

Craig Mathias

Farpoint Group

Craig J. Mathias is a Principal with Farpoint Group, an advisory firm specializing in wireless networking and mobile computing. Founded in 1991, Farpoint Group works with technology developers, manufacturers, carriers and operators, enterprises, and the financial community. Craig is an internationally-recognized industry and technology analyst, consultant, conference speaker, author, columnist, and blogger. He regularly writes for *Network World, CIO.com,* and *TechTarget*. Craig holds an Sc.B. degree in Computer Science from Brown University, and is a member of the Society of Sigma Xi and the IEEE.

Follow Craig Mathias at:

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Appendix O

IEEE Spectrum

NEWS TELECOMMUNICATIONS

What's Next After 25 Years of Wi-Fi? › The 25th anniversary of the IEEE 802.11 wireless standard provides a chance to glimpse next-gen Wi-Fi

BY JEREMY HSU

10 SEP 2015

PHOTO: ISTOCKPHOTO

IN 1997, THE FIRST VERSION OF WI-FI APPEARED. (The same year saw a bout half of U.S. homes using AOL as their Internet Service Provider, Netscape with the most web browser users, and Microsoft rescuing Apple from the verge of bankruptcy.) Today, the the Wi-Fi standard known as IEEE 802.11 celebrates its 25th anniversary in a world where many people take Wi-Fi access for granted while streaming high-definition video and checking in on social media through their smartphones and laptops.

The IEEE 802.11 wireless technology standard has come a long way since it first originated from a working group meeting in September 1990. Early Wi-Fi supported data rates of just 2 megabits per second. By comparison, the latest Wi-Fi standard supports 3,500 times faster data rates, ranging up to 7 gigabits per second. IEEE Spectrum spoke with Dorothy Stanley, a vice chair of the IEEE 802.11 Working Group and senior standards architect at Aruba Networks, about what to expect from the next generation of Wi-Fi.

This interview has been edited and condensed for clarity.

IEEE Spectrum: How have the goals of the 802.11 Working Group evolved since it first met 25 years ago?

Dorothy Stanley: At a high level, the goal of the group that first met is very similar to the goal of the group we have today, which is to incorporate technology into the 802.11 standard that improves throughput and capacity and capability. And the technology we have to work with today is obviously much more advanced. Standards have gone from rates of 1 to 2 megabits per second—which at the time was very respectable —to 11 Mb/s, then 54 Mb/s, then hundreds of Mb/s and now into the gigabit range. The impact of the technology has exceeded anyone's crystal ball predictions.

IEEE Spectrum: What do you see as the biggest impacts of Wi-Fi on society?

Dorothy Stanley: Today, 802.11 technology is global and it's almost an expected infrastructure utility in many places. I think the generation growing up now and anyone who is 30 years or younger expects Wi-Fi to be there. Since their cell phone data plans are limited, they look for Wi-Fi and they value Wi-Fi.

I think the 802.11 standard is a prime example of how

technology has made it possible for people to access data and information in a very cost-effective way. 802.11 was the first case of making wireless technology effectively available to the masses. Any person could set up a wireless network. They didn't have to get a license, go through an operator, or get someone else to get it done. You empower individuals and corporations to use the technology and experiment with it and improve productivity in a very cost-effective way.

IEEE Spectrum: What can we expect next-generation Wi-Fi standards to deliver?

Dorothy Stanley: The 802.11ad amendment deals with 60 gigahertz wireless operations. The technical challenges of building radios in 60 GHz are much more difficult than in the 2-4 GHz or 5 GHz ranges. Those products are going to be later to market; I expect they'll be more prevalent in 2016, 2017 and beyond. 60 GHz will be another spectrum band that will be available for very low range applications such as those within a room; primarily docking applications and video applications. The current 60 GHz standard provides data rates of up to 7 Gb/s. The next-gen 60 GHz standard, 802.11ay, will go up to 20 Gb/s. You'll get very high throughput.

Another amendment is the 802.11ax amendment for high-

efficiency wireless local area networks. That looks for efficiency in dense deployments such as stadiums, shopping malls, and subways where you have a lot of people accessing the Wi-Fi system.

There is also work going on with the next-generation 802.11az amendment, which is designed for new positioning applications designed to run on wireless networks. It's about more efficient positioning and location finding that can augment GPS for indoor locations.

IEEE Spectrum: Have there been big challenges in the next-generation 802.11ah standard being developed for the Internet of Things (IoT)?

Dorothy Stanley: The Internet of Things is a little different from Internet access applications, because you're not interested so much in high Internet throughput, but you're interested in longer range and higher power efficiency. 802.11ah provides protocols and definitions for operating in the sub-one-gigahertz band (900 megahertz). In the sub-one-gigahertz spectrum, there is much less spectrum available. The spectrum that is available is different in different countries; it's not like the 2.4 gigahertz band where you had virtually all channels available globally. Work is underway with regulators,

particularly in Europe, to get additional spectrum allocated.

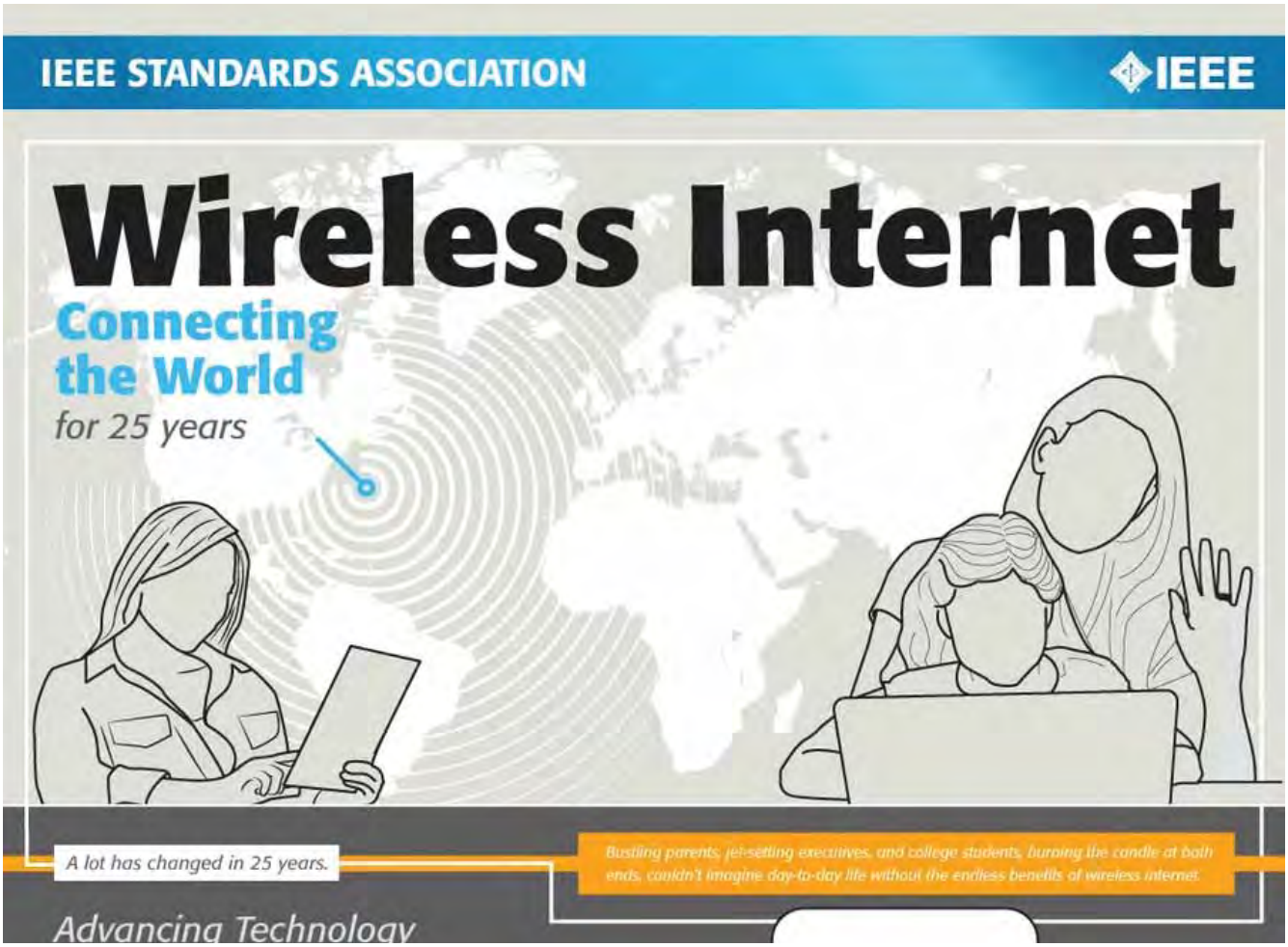
Here, the data rates are in the hundreds of kilobits range rather than in the hundreds of megabits range. But because you're operating at sub-one-gigahertz, the range is longer. The transmission range is up to a kilometer. For most smart grid or Internet of Things applications, a kilometer is more than adequate. A lot of the consumer applications that have been identified as use cases would be 802.11ah-enabled appliances, such as water softeners down in the basement, the furnace, or the lighting around the house.

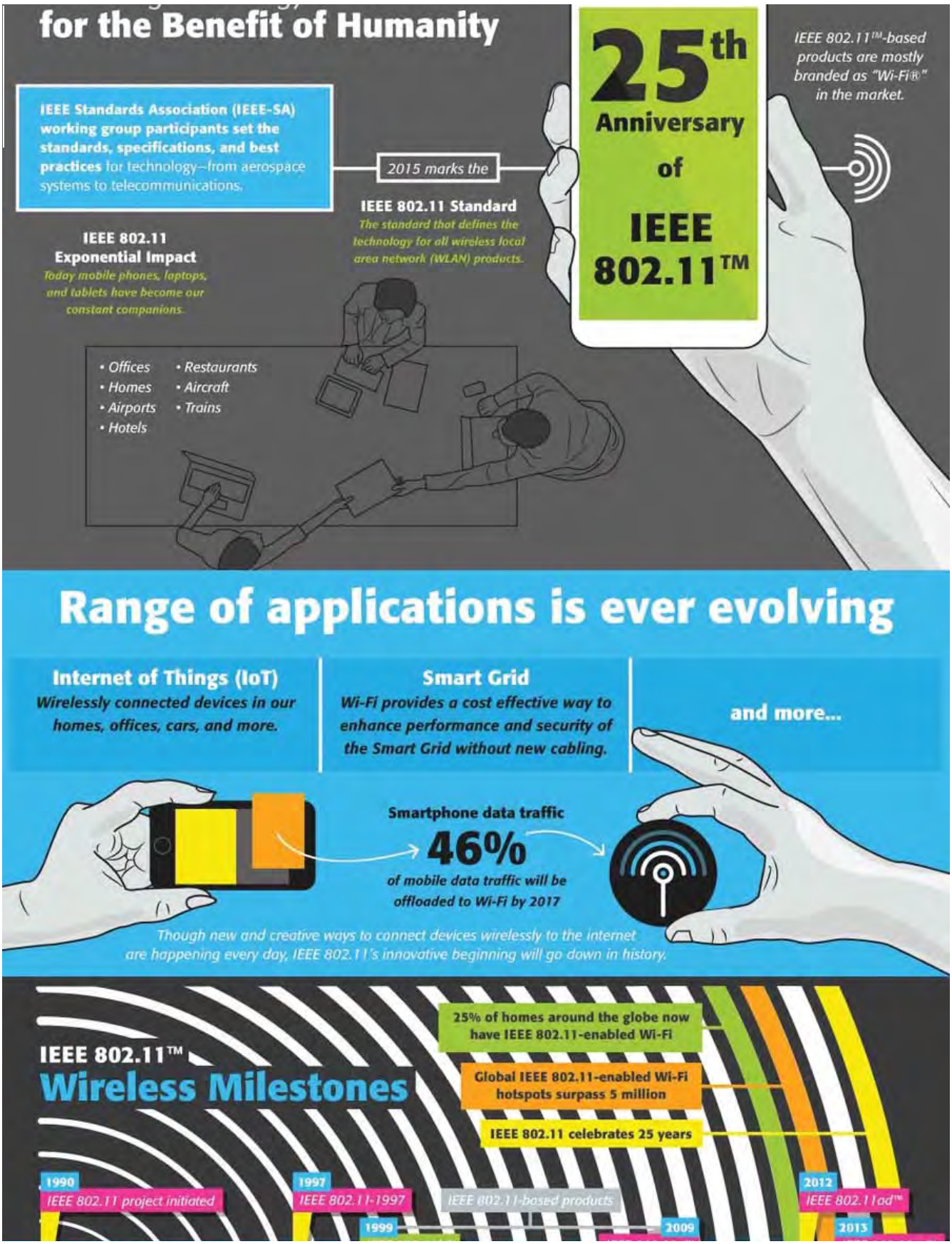
IEEE Spectrum: Why do you think the IEEE 802.11 Working Group process has been successful over the past 25 years? And do you expect the process to continue working well in the future?

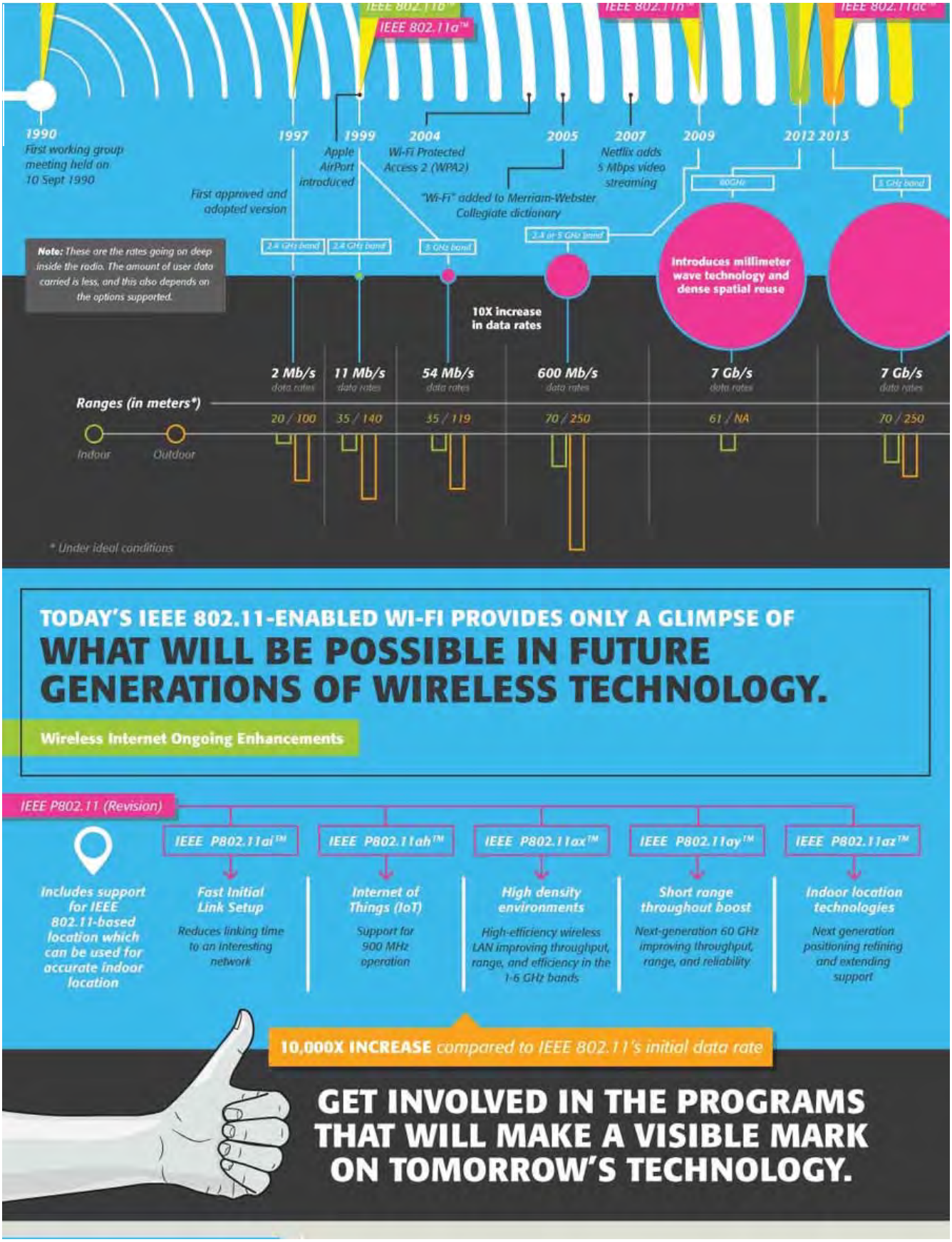
Dorothy Stanley: There is a very open, global and collaborative consensus process in place. The benefit is that you can have any people come who have technology or information to contribute. You don't have to be associated with a government; people come from new companies, established companies and academia to provide contributions. The success of the 802.11 standard is really due to not just the folks who developed the standard, but also due to the engineers in all the companies who built products based on the standard, and to

companies who built products based on the standard, and to the customers who bought those products.

It's not just companies supporting us in going to the Wi-Fi standard, but also end consumers and the world in general accessing the Internet. My kids and the college generation expect Wi-Fi to be there. Our goal is to make sure the 802.11 standards are there in the future to provide an efficient technology that people can use and improve their lives with.




for the Benefit of Humanity
IEEE Standards Association (IEEE-SA) working group participants set the standards, specifications, and best practices for technology—from aerospace systems to telecommunications.
2015 marks the
25th Anniversary of IEEE 802.11™
IEEE 802.11™-based products are mostly branded as "Wi-Fi®" in the market.
IEEE 802.11 Standard
The standard that defines the technology for all wireless local area network (WLAN) products.
IEEE 802.11 Exponential Impact
Today mobile phones, laptops, and tablets have become our constant companions.
• Offices
• Homes
• Airports
• Hotels
• Restaurants
• Aircraft
• Trains
Range of applications is ever evolving
Internet of Things (IoT)
Wirelessly connected devices in our homes, offices, cars, and more.
Smart Grid
Wi-Fi provides a cost effective way to enhance performance and security of the Smart Grid without new cabling.
and more...
Smartphone data traffic
46%
of mobile data traffic will be offloaded to Wi-Fi by 2017
Though new and creative ways to connect devices wirelessly to the internet are happening every day, IEEE 802.11's innovative beginning will go down in history.
IEEE 802.11™
Wireless Milestones
25% of homes around the globe now have IEEE 802.11-enabled Wi-Fi
Global IEEE 802.11-enabled Wi-Fi hotspots surpass 5 million
IEEE 802.11 celebrates 25 years
1990
IEEE 802.11 project initiated
1997
IEEE 802.11-1997
1999
IEEE 802.11-based products
2009
2012
IEEE 802.11ad™
2013


IEEE 802.11a™
1990
First working group meeting held on 10 Sept 1990
1997
First approved and adopted version
1999
Apple AirPort introduced
2004
Wi-Fi Protected Access 2 (WPA2)
2005
"Wi-Fi" added to Merriam-Webster Collegiate dictionary
2007
Netflix adds 5 Mbps video streaming
2009
2012
2013
Note: These are the rates going on deep inside the radio. The amount of user data carried is less, and this also depends on the options supported.
2.4 GHz band
2.4 GHz band
5 GHz band
2.4 or 5 GHz band
60GHz
5 GHz band
10X increase in data rates
Introduces millimeter wave technology and dense spatial reuse
2 Mb/s data rates
11 Mb/s data rates
54 Mb/s data rates
600 Mb/s data rates
7 Gb/s data rates
7 Gb/s data rates
Ranges (in meters*)
20 / 100
35 / 140
35 / 119
70 / 250
61 / NA
70 / 250
Indoor
Outdoor
* Under ideal conditions
TODAY'S IEEE 802.11-ENABLED WI-FI PROVIDES ONLY A GLIMPSE OF
WHAT WILL BE POSSIBLE IN FUTURE GENERATIONS OF WIRELESS TECHNOLOGY.
Wireless Internet Ongoing Enhancements
IEEE P802.11 (Revision)
Includes support for IEEE 802.11-based location which can be used for accurate indoor location
IEEE P802.11ai™
Fast Initial Link Setup
Reduces linking time to an interesting network
IEEE P802.11ah™
Internet of Things (IoT)
Support for 900 MHz operation
IEEE P802.11ax™
High density environments
High-efficiency wireless LAN improving throughput, range, and efficiency in the 1-6 GHz bands
IEEE P802.11ay™
Short range throughout boost
Next-generation 60 GHz improving throughput, range, and reliability
IEEE P802.11az™
Indoor location technologies
Next generation positioning refining and extending support
10,000X INCREASE compared to IEEE 802.11's initial data rate
GET INVOLVED IN THE PROGRAMS THAT WILL MAKE A VISIBLE MARK ON TOMORROW'S TECHNOLOGY.

Sources:

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open-stand.org | searchnetworking.techtarget.com | standards.ieee.org | wi-fi.org

Appendix P

ACCEPTED FROM OPEN CALL

IEEE 802.11AX: HIGH-EFFICIENCY WLANS

BORIS BELLALTA

ABSTRACT

IEEE 802.11ax-2019 will replace both IEEE 802.11n-2009 and IEEE 802.11ac-2013 as the next high-throughput WLAN amendment. In this article, we review the expected future WLAN scenarios and use cases that justify the push for a new PHY/MAC IEEE 802.11 amendment. After that, we overview a set of new technical features that may be included in the IEEE 802.11ax-2019 amendment, and describe both their advantages and drawbacks. Finally, we discuss some of the network-level functionalities that are required to fully improve the user experience in next-generation WLANs and note their relation with other ongoing IEEE 802.11 amendments.

INTRODUCTION

IEEE 802.11 wireless local area networks (WLANs) [1] are a cost-efficient solution for wireless Internet access that can satisfy most current communication requirements in domestic, public, and business scenarios.

Similar to other wireless technologies, WLANs have evolved by integrating the latest technological advances in the field as soon as they have become sufficiently mature, aiming to continuously improve spectrum utilization and raw WLAN performance. IEEE 802.11n-2009 adopted single-user multiple-input multiple-output (SU-MIMO), channel bonding, and packet aggregation. Those mechanisms were further extended in IEEE 802.11ac-2013, which also introduced downlink multi-user (MU) MIMO transmissions. In addition, new amendments such as IEEE 802.11af-2013 and IEEE 802.11ah-2016 are further expanding the application scenarios of WLANs, which include cognitive radio, long-range communication, advanced power saving mechanisms, and support for machine-to-machine (M2M) devices.

Partly because of their own success, next-generation WLANs face two main challenges. First, they must address dense scenarios, which is motivated by the continuous deployment of new access points (APs) to cover new areas and provide higher transmission rates. Second, the current evolution of Internet usage toward real-time high-definition audio and video content will also significantly increase users' throughput needs in the coming years.

To address those challenges, the High-Efficiency WLAN (HEW) Task Group [2] is currently working on a new high-throughput amendment named IEEE 802.11ax-2019. This new amendment will develop new physical (PHY) and medium access control (MAC) layer enhancements to further improve the WLAN performance, with a focus on the throughput and battery duration. This article overviews some of those new enhancements, and describes the potential benefits and drawbacks of each one. We have grouped these enhancements into four main categories: spatial reuse, temporal efficiency, spectrum sharing, and multiple-antenna technologies. Moreover, we also discuss several key system-level improvements for next-generation WLANs, as in addition to the IEEE 802.11ax-2019 amendment, they will likely implement other in-progress amendments such as IEEE 802.11aq-2016 (pre-association discovery of services), IEEE 802.11ak-2017 (bridged networks), and IEEE 802.11ai-2016 (fast initial link setup time) to satisfy the created expectations.

SCENARIOS, USE CASES, AND REQUIREMENTS

The forecast number of devices and networks, and traffic characteristics and user demands for the 2020–2030 decade motivate the development of a new PHY/MAC IEEE 802.11 amendment to cope with the new challenges and usages WLANs will face [2].

One of the most representative characteristics of WLANs is the use of carrier sense multiple access with collision avoidance (CSMA/CA) as the MAC protocol. It offers a reasonable trade-off between performance, robustness, and implementation costs. Using CSMA/CA, when a node has a packet ready for transmission, it listens to the channel. Once the channel has been detected as free (i.e., the energy level on the channel is lower than the clear channel assessment, CCA, threshold), the node starts the backoff procedure by selecting a random initial value for the backoff counter. The node then starts decreasing the backoff counter while sensing the channel. Whenever a transmission, either from other nodes within the same WLAN or belonging to other WLANs, is detected on the channel, the backoff counter is paused until the channel is detected to be free again, at which point the countdown is resumed. When the backoff counter reaches zero, the node starts transmitting. Figure 1a shows an example of CSMA/CA operation.

DENSE WLAN SCENARIOS

Providing high data rates in scenarios where the density of WLAN users is very high (e.g., 1 user/m^2) requires the deployment of many APs

The author is with Universitat Pompeu Fabra, Barcelona

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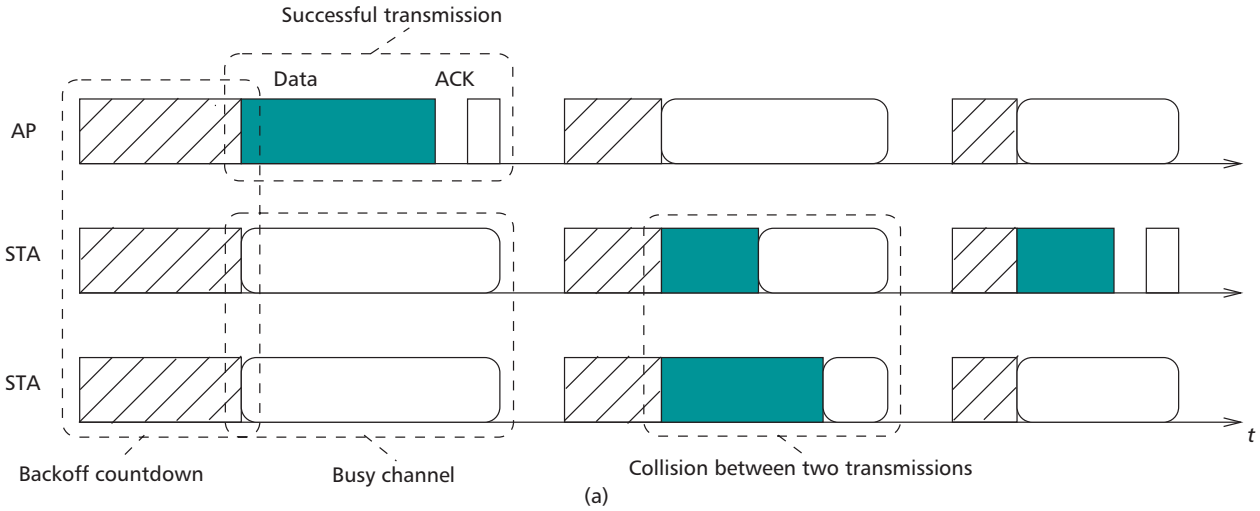

Scenario (area, m²)	APs	STAs	Description
Stadium (~12,500 m²)	> 1000	> 50,000	Large events that require many APs to provide a satisfactory connectivity service able to support video uploading/downloading.
Train (~600 m²)	< 10	> 1000	Full coverage inside a train to provide both work and entertainment services.
Apartment building — 4 floors, 6 apartments/ floor (~2400 m²)	> 120	< 480	Several short-range APs deployed in each apartment, offering full coverage and high data rates for bandwidth hungry entertainment applications, as well as connectivity for house appliances. Community APs may also be deployed in the corridors and shared spaces.

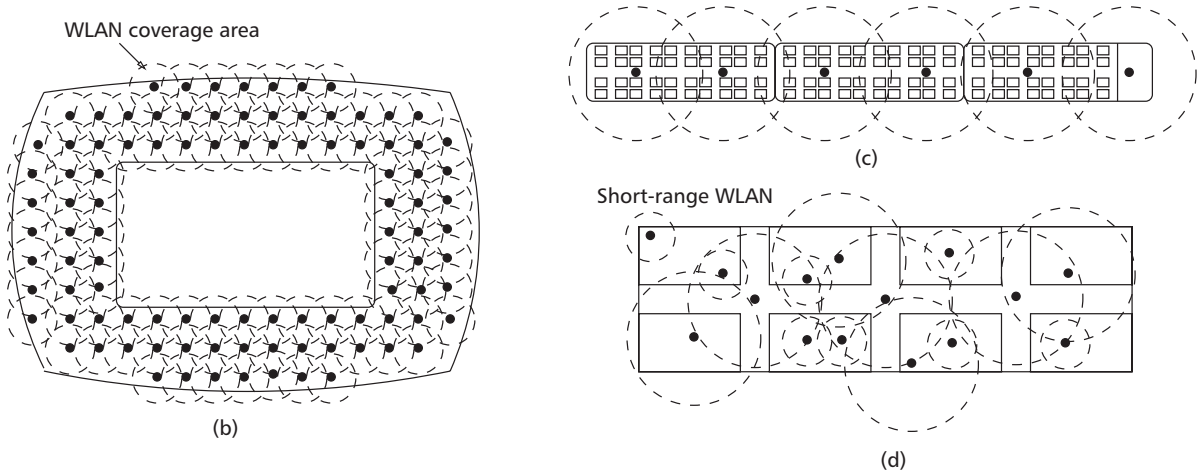

Figure 1. Key scenarios in next-generation WLANs: a) example of CSMA/CA temporal evolution with one AP and two STAs; b) stadium; c) train; d) floor of a building with several apartments.

placed close to each other (e.g., within 5–10 m of one another). Figure 1 depicts and describes three of those scenarios: a stadium, a train, and an apartment building. In these dense scenarios, most relevant challenges are related to interference issues, which increase the packet error rate and reduce the number of concurrent transmissions in a given area by preventing neighboring WLANs from accessing the channel. Additionally, the presence of many stations (STAs) in the same area increases the chances that the backoff counters of two or more STAs reach zero simultaneously, which results in a collision.

In the stadium scenario, many people are concentrated in small areas because of a fair, a conference, or a sporting event. The presence of many people results in a high density of STAs and the necessity of deploying many APs to offer satisfactory service. A fundamental challenge in these scenarios is to deploy, optimize, and coordinate such a large number of APs and STAs.

Public transport is also a key scenario for next-generation WLANs because trains, buses, and planes will offer broadband Internet access. In these scenarios, the user density may be notably high, with several people per square meter. Then smart AP coordination can help improve spatial reuse, and the use of an efficient medium

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Interactive and high-definition video applications are predicted to dominate future Internet usage. Two examples of applications that require throughputs of several gigabits per second are high-definition multi-party video conferences in business environments, and virtual reality entertainment applications at home, which include culture, films, and games.

access protocol may help support many simultaneous contenders.

Finally, in an apartment building, we can find multiple autonomous and heterogeneous WLANs overlapping, including short-range WLANs that offer high transmission rates in small spaces [3]. In this scenario, each WLAN is primarily configured independent of the others, where the channel selection, channel width, and transmission power are randomly set or are simply the preset values. Therefore, autonomous WLANs must be able to implement smart decentralized self-configuration and self-adaptation mechanisms to minimize the interference among them.

WLANs must also coexist with other wireless networks that operate in the industrial, scientific, and medical (ISM) band, such as wireless sensor networks and personal area networks. In addition, Long Term Evolution (LTE) operators are currently considering deploying LTE networks in the ISM band [4], which is known as LTE-Unlicensed, thus opening further coexistence challenges for WLANs.

Future WLAN Usages

Interactive and high-definition video applications are predicted to dominate future Internet usage. Two examples of applications that require throughputs of several gigabits per second are high-definition multi-party video conferences in business environments, which can help avoid unnecessary travel and meetings, and virtual reality entertainment applications at home, which include culture, films, and games. Additionally, web surfing is moving further toward a multimedia experience, where rich text, images, audio, and video content interact. Furthermore, file storage, management, and synchronization in the cloud are becoming the standard in terms of content management and generation. Those applications are bandwidth-demanding, and require both reliability and limited delay.

Requirements

Based on the aforementioned scenarios and expected use cases, there are four key requirements for the IEEE 802.11ax-2019 amendment.

Coexistence: WLANs operate as unlicensed devices in the ISM bands. Therefore, the IEEE 802.11ax-2019 amendment has to include the required mechanisms to coexist with both the other wireless networks that operate there and the licensed devices.

Higher Throughput: Improving both the system and user throughput requires the improved use of channel resources. IEEE 802.11ax-2019 aims for a four-fold throughput increase compared to IEEE 802.11ac-2013. To achieve this goal, some new wireless technologies such as dynamic CCA, OFDMA (orthogonal frequency-division multiple access), and advanced multiple-antenna techniques may be used.

Energy Efficiency: The target in IEEE 802.11ax-2019 is, at least, to not consume more energy than the previous amendments, considering the aforementioned four-fold throughput increase, which requires both new low-power hardware architectures [5] and new low-power PHY/MAC functionalities.

Backward Compatibility: Because WLANs implementing IEEE 802.11ax-2019 must also support devices using any previous IEEE 802.11 PHY/MAC amendments, mechanisms must also be implemented to make it backward compatible (i.e., common frame headers and transmission rates), although it is a clear source of inefficiency.

New Features and Concepts

The IEEE 802.11ax-2019 amendment may include some new technical features compared to the IEEE 802.11ac-2013 amendment. We introduce them in this section, providing insight into their potential performance gains and limitations. All numerical results presented in this section are obtained using the analytical model and parameters from [6], unless otherwise stated.

Spatial Reuse

In dense scenarios, the combined use of CSMA/CA, a conservative CCA, and a high transmit power level may result in scenarios with limited spatial reuse. A conservative configuration of both the CCA and transmit power levels minimizes the interference among the WLANs, which supports higher transmission rates. However, the number of concurrent transmissions is reduced, which may decrease the achievable area throughput. The alternatives that can be used to reach an optimal trade-off between individual transmission rates and the number of concurrent transmissions that maximize the area throughput include dynamically adapting the transmit power level, the CCA level, and the use of directional transmissions based on the observed network performance.

Figure 2a shows three neighboring WLANs. The channels that each WLAN uses are shown in Fig. 2b. Because WLANs A and C, and B and C partially share their channels, they overlap. The three APs are inside the carrier sense range of the others, as shown in Fig. 2a, which pauses their backoff if either of the other two transmits. Although WLAN C uses the widest channel, it achieves the lowest throughput because it overlaps with WLANs A and B, which are independent of each other (Fig. 2c).

Dynamic Adaptation of the Transmit Power and CCA Levels: Reducing the used transmission power in a WLAN reduces its influence area, which benefits the spatial reuse. However, it may result in a larger number of packet errors and lower transmission rates, as well as an increased number of hidden nodes.

Alternatively, to reduce the area of influence of neighboring WLANs and increase each WLAN's chances to transmit, the nodes in a WLAN may increase their CCA level, hence requiring a higher energy level in the channel to consider it as occupied and pause the backoff countdown. In [7], significant throughput gains are achieved by tuning the CCA level in a multicell WLAN scenario. The downside of increasing the CCA level is again the higher interference that a node may suffer, which could be detrimental in some cases.

Beamforming: Omnidirectional transmissions homogeneously spread the transmitted energy in all directions, which fills the channel with energy

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in areas where it is not required. Concentrating the energy toward the desired destination improves the spatial reuse because the devices that are placed in other directions will observe the channel as being empty and, therefore start their own transmissions concurrently. However, similar to the previous case, those nodes outside the energy beam may also become hidden nodes.

Temporal Efficiency

The backoff countdown, packet headers, inter-frame spaces, collisions, and retransmissions are an intrinsic part of the CSMA/CA channel access scheme, but they significantly decrease the effective time that a node spends transmitting data every time it accesses the channel. IEEE 802.11ax-2019 may include several solutions to mitigate such overheads.

Control Packets: The time consumed by the exchange of control packets may result in large overheads, particularly because they are usually transmitted at a low rate. Common control packet exchanges between the AP and STAs include the request to send/clear to send (RTS/CTS) exchange to avoid hidden nodes and ACKs to acknowledge the reception of data packets.

Additionally, some of the new technical features described in the next sections that enable multi-user transmissions may require frequent exchange of control packets to synchronize all involved STAs, hence also increasing the control packets' overheads.

Packet Headers, Aggregation, and Piggy-Backing: Packet aggregation was introduced in IEEE 802.11n-2009 to reduce temporal overheads by combining short packets into a longer one. Using packet aggregation, multiple packets can be transmitted with a single backoff, distributed inter-frame space (DIFS), short inter-frame space (SIFS), PHY header, and ACK.

The packet header overheads can be reduced by supporting variable size headers and using only the minimum required fields for every packet. Additionally, the use of shorter identifiers instead of the full MAC address is considered.

Moreover, the piggybacking of ACKs with DATA will improve the efficiency, although some changes in the current setting of the network allocation vector (NAV) are required because the full transmission duration is unknown to the transmission initiator.

Efficient Retransmissions: Packet errors are also a source of overhead because they currently require full retransmission of the data packet. Further work about the use of incremental redundancy-based automatic repeat requests (ARQs) can reduce the time spent in retransmissions, although it implies some extra complexity in both transmitter and receiver firmware.

Simultaneous Transmit and Receive: By allowing the AP and a STA to simultaneously transmit and receive (STR), which is commonly known as full-duplex communication, the channel capacity can be theoretically doubled [8]. Using CSMA/CA, the only way they can have full-duplex communication is if they finish their backoff countdown simultaneously. Otherwise, one will start transmitting before the other, causing the latter to pause its backoff until the former finishes its transmission. Only when the number of active STAs is low do they have bidirectional and saturated traffic flows, and use a small backoff contention window; here, the use of STR can result in significant gains. Therefore, specific channel access mechanisms should be considered in the IEEE 802.11ax-2019 amendment in case the STR capability is finally considered. Alternatively, the STR capability can allow WLANs to replace the CA feature of CSMA/CA with collision detection (CD), because collisions can be promptly detected and resolved.

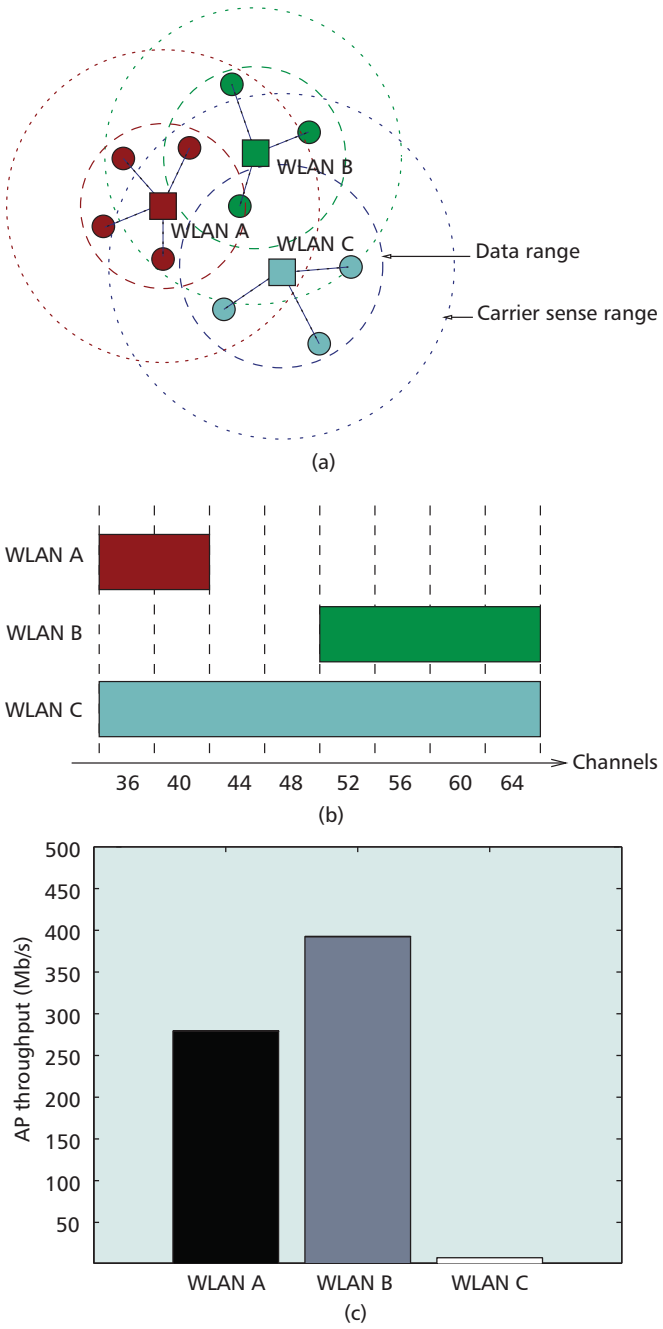

Figure 2. Throughput unfairness between overlapping WLANs: a) three overlapping WLANs; b) channel used by each WLAN; c) throughput achieved by each WLAN.

Collision-Free MAC Protocols: Collisions represent an important waste of channel resources

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An unplanned deployment of WLANs results in chaotic and fragmented spectrum occupancy, which causes many inefficiencies and undesirable interactions among neighboring WLANs. To improve the spectrum usage efficiency, two main approaches can be considered in IEEE 802.11ax-2019: dynamic channel bonding and OFDMA.

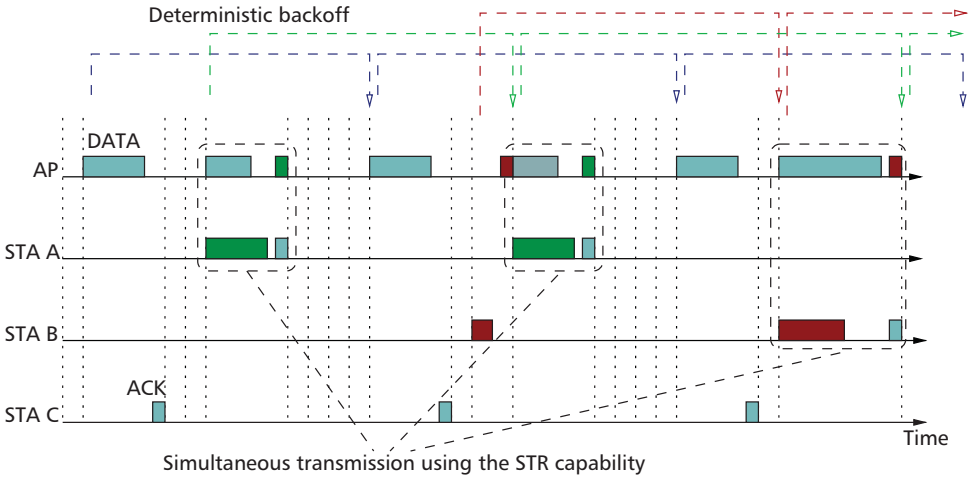

Figure 3. CSMA/ECA operation. It can be observed how the use of a deterministic backoff allows prediction of when a node will transmit again after successful transmission.

in WLANs. IEEE 802.11ax-2019 may consider enhancing or changing the underlying CSMA/CA protocol to minimize collisions. There are two possibilities: moving to a centralized solution or enhancing the current CSMA/CA protocol. Because centralized options such as hybrid coordination function controlled channel access (HCCA) were never adopted in WLANs, a focus on enhancing CSMA/CA appears more plausible. CSMA with enhanced CA (CSMA/ECA) is a particularly good candidate to replace CSMA/CA because it is backward compatible, is easily implemented, and outperforms CSMA/CA in all cases [9].

Figure 3 shows the basic operation of CSMA/ECA with STR. Compared to CSMA/CA, the main difference observed for CSMA/ECA is its use of a deterministic backoff after successful transmissions. This deterministic backoff guarantees that after some time, a collision-free schedule can be achieved. In addition, because the AP can learn when the STAs will transmit, the use of STR can provide huge performance gains.

Spectrum Sharing

An unplanned deployment of WLANs results in a chaotic and fragmented spectrum occupancy, which causes many inefficiencies and undesirable interactions among neighboring WLANs [6]. To improve the spectrum usage efficiency, two main approaches can be considered in IEEE 802.11ax-2019: dynamic channel bonding and OFDMA.

Dynamic Channel Bonding: To adapt to the instantaneous channel occupancy, IEEE 802.11ax-2019 may consider extending the dynamic bandwidth channel access (DBCA) scheme introduced in the IEEE 802.11ac-2013 amendment [10]. Using DBCA, only the available channel width is used at each transmission, which allows WLANs to adapt to the instantaneous spectrum occupancy. This mechanism helps fill most spectrum gaps and share them fairly among neighboring WLANs.

OFDMA: The use of orthogonal frequency-division multiple access (OFDMA) adds a new degree of flexibility to the use of spectrum resources by dividing the channel width into multiple narrow channels. Then these narrow channels can be used to transmit to multiple users in parallel [11]. A basic implementation of OFDMA in WLANs may simply consider the use of multiple independent 20 MHz channels. This approach is shown in Fig. 4: when channel bonding is used, each 20 MHz subchannel can be independently allocated to a different user. The RTS packet has been extended to announce the subchannels allocation to the STAs. Additionally, OFDMA may enable the use of non-contiguous channel bonding and remove the requirement to use only 20 MHz consecutive channels.

Figure 4a shows an example where dynamic channel bonding and OFDMA operate together. The upper part of Fig. 4a shows a snapshot of the spectrum occupancy for a group of neighboring WLANs. The lower part of Fig. 4a shows two transmissions: a node in the target WLAN transmits to a single user via a bonded channel of 40 MHz (left), and a node uses a bonded channel of 80 MHz and OFDMA to transmit to three different users (right). Figure 4b shows the AP throughput when OFDMA is used to split a 160 MHz channel into multiple subchannels. The parallelization of temporal overheads clearly improves the throughput.

Multiple Antennas

Spatial multiplexing using multiple antennas at both APs and STAs remains one of the key technologies to achieve high throughput in WLANs. IEEE 802.11ax-2019 will continue implementing both SU-MIMO and downlink MU-MIMO, as in IEEE 802.11ac-2013. However, it may also include or provide support for uplink MU-MIMO, massive MIMO, and network MIMO, as well as distributed antenna solutions.

Multi-User MIMO: Multi-user MIMO enables multiple simultaneous transmissions to different STAs from the AP in the downlink, and from multiple STAs to the AP in the uplink. A survey of MU-MIMO MAC protocols for WLANs is presented in [12], where the challenges and requirements to design an MU-MIMO MAC

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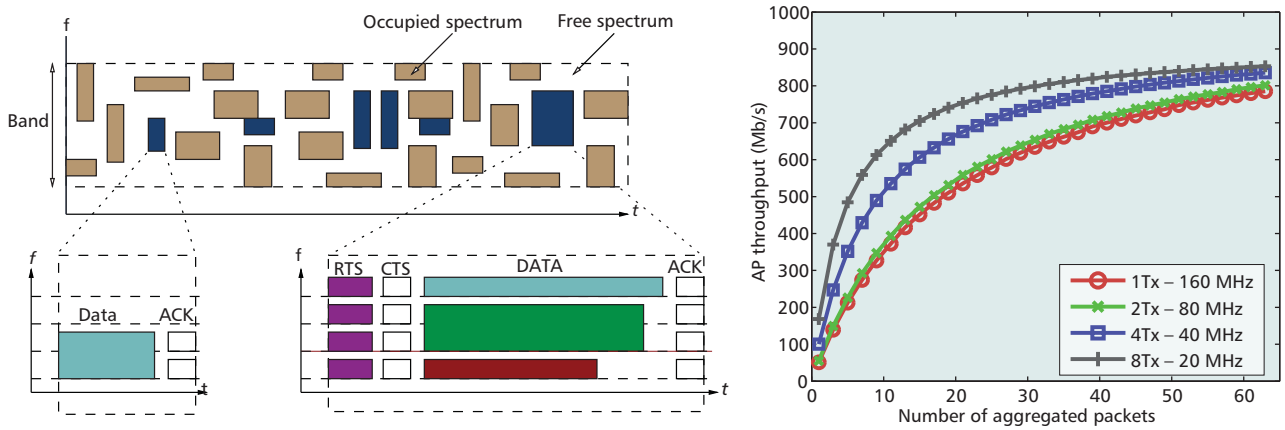

Figure 4. Dynamic spectrum access with and without OFDMA: a) dynamic channel bonding and OFDMA; b) achievable downlink throughput using a channel width of 160 MHz and OFDMA. The RTS size is $120 + 56 \cdot N_{tx}$ bits, with N_{tx} the number of OFDMA subchannels.

protocol are introduced, and several uplink and downlink MAC proposals are reviewed.

In the downlink, a challenge for IEEE 802.11ax-2019 is to reduce the channel sounding overheads given the same explicit approach as in IEEE 802.11ac-2013 is considered. The overhead caused by the explicit channel sounding protocol implemented depends on the channel sounding rate and number of sounded STAs, which can result in an unacceptable overhead in scenarios with many STAs. Solutions to reduce such a large overhead, apart from replacing the current channel sounding protocol with a more efficient solution, will require the use of smart schedulers that consider the current traffic patterns and the quality of service (QoS) demands of users to decide when the channel state information (CSI) has to be requested, and from which STAs.

To support MU-MIMO transmissions in the uplink, IEEE 802.11ax-2019 must also detail how the uplink CSI from each STA is obtained by the AP, introduce a mechanism to signal a group of STAs to simultaneously start a transmission, and include techniques to overcome channel calibration and timing issues in order to efficiently decode all the simultaneously received packets at the AP.

In both cases, using the collected CSI, the AP has to select the specific STAs that will take part in the next MU-MIMO transmission. Therefore, the design of an efficient mechanism to create groups of STAs with low spatial channel correlation and similar channel quality is still an open challenge. Failing to properly create those groups may prevent next-generation WLANs from fully benefiting from MU-MIMO technology.

Figure 5a shows an AP with three STAs. On the left, we have three downlink MU-MIMO transmissions. The ones directed to STAs A, B, and C contain four, two, and one SU-MIMO spatial streams, respectively. To start a downlink transmission, the AP omnidirectionally sends the PHY header with information about the group of selected STAs and the number of spatial streams that are transmitted to each STA in SU-MIMO mode. On the right, we show an uplink MU-MIMO transmission. In IEEE 802.11ax-2019, because several STAs are unlikely to finish their backoff countdowns at the same time, uplink MU-MIMO transmissions may be started by the AP using a special RTS″ packet containing information about the STAs that can transmit in parallel. Then the selected STAs will simply start transmitting at the same time and wait to receive the corresponding ACKs. This approach allows all selected STAs to be synchronized, but requires knowledge of the STAs's buffer occupancy by the AP, which can be provided by the same STAs as in previous transmissions. Figure 5b shows the throughput achieved by the AP in two downlink MU-MIMO configurations (cases 16:4:4 and 16:16:1). The obtained throughput values are compared with the case where a single spatial stream is transmitted to only one destination (case 1:1:1).

Massive MIMO: Massive MIMO refers to the case where the AP has many more antennas than STAs and uses them to create a nearly identical number of point-to-point links as the number of active STAs [13]. In addition to the cost of APs, the extra processing complexity, and higher energy consumption, other open challenges for massive MIMO include obtaining the CSI information; WLANs may require switching to an implicit channel feedback approach.

Network MIMO: In coordinated WLAN deployments, network MIMO can be used to minimize the interference among simultaneous transmissions from different APs. The idea behind network MIMO is that different APs can coordinate the transmissions as if they were a large array of antennas, which reduces the inter-transmission interference and increases the spatial reuse [14]. However, effectively solving the tight synchronization requirements among the APs remains an open challenge.

WLAN-Level Improvements

The user experience in next-generation WLANs will not be simply enhanced by increasing the achievable network and user throughput as previous technical features do. To achieve that goal, apart from the IEEE 802.11ax-2019 amendment, there are other IEEE 802.11 amendments in progress. Figure 6 shows the most significant ones, including the new features they are targeting.

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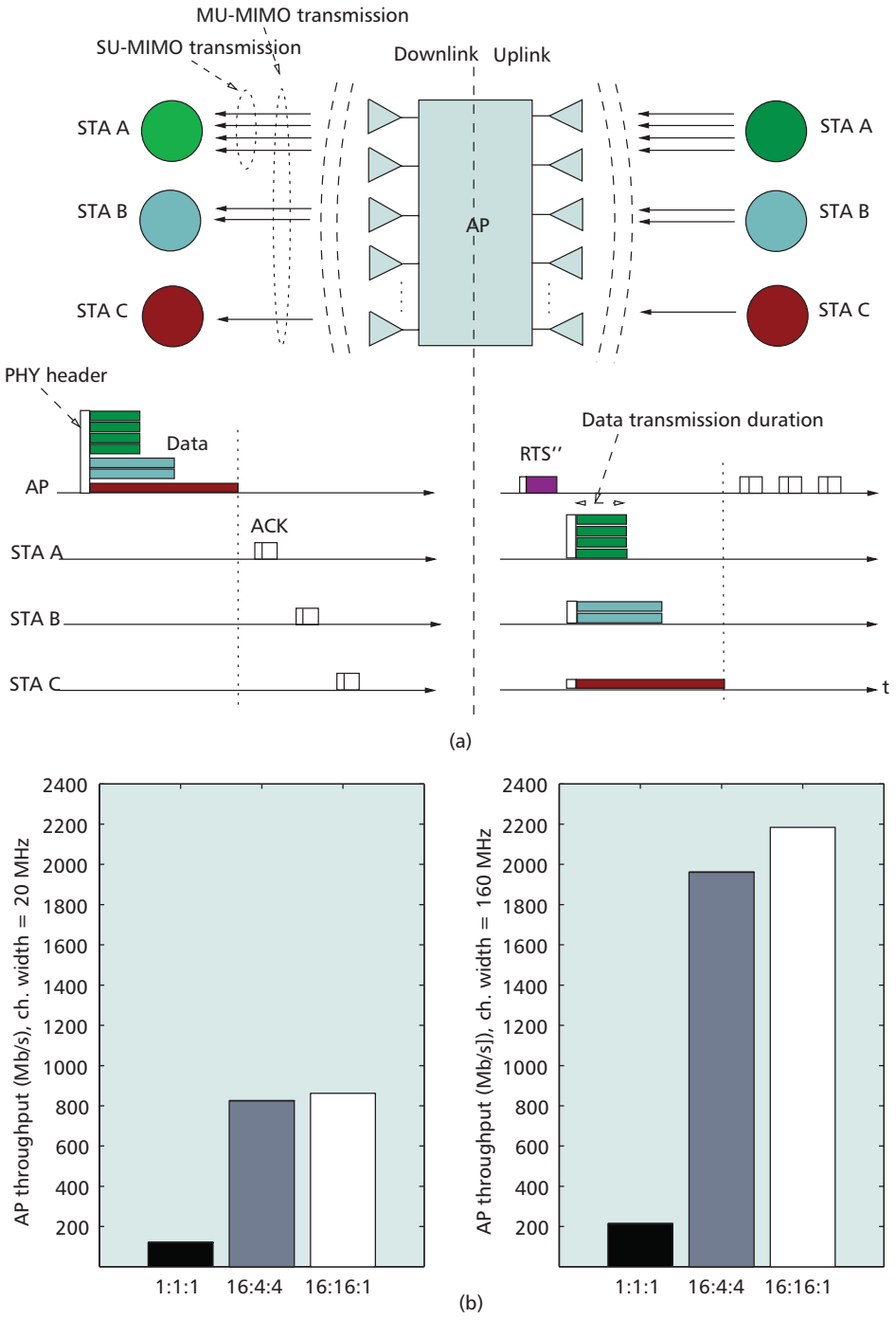

Figure 5. Multi-user spatial multiplexing: a) downlink and uplink MU-MIMO transmissions in WLANs; b) downlink throughput. The AP is equipped with 16 antennas. Each configuration is identified by the code x:y:z, where x refers to the total number of transmitted spatial streams, y the number of destinations, and z the number of streams transmitted to each destination.

In scenarios where multiple APs are used to offer a large coverage area and higher data rates by deploying multiple WLANs nearby, a mechanism that enables fast handoff among the APs is required because the current large delays when a STA switches to a new AP are unacceptable. The IEEE 802.11ai-2016 amendment targets this challenge. It aims to provide a handoff duration below 100 ms by implementing preemptive channel sensing and user authentication. Alternatives based on network virtualization and software defined networks are also an interesting option as they are able to centralize all decisions, including the handoff between overlapping APs. Future IEEE amendments will probably consider such an approach.

Device-to-device (D2D) communications, which are also known as WiFi Direct in the IEEE WLAN context, will also be a key element in next-generation WLANs [15]. Examples of D2D communications are file synchronization

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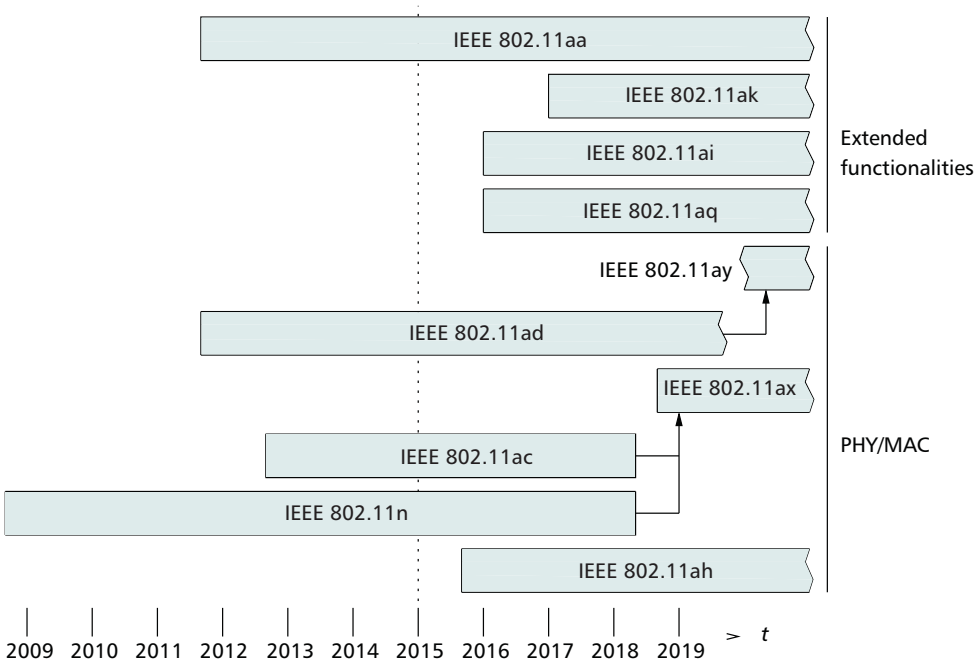

Feature	Amendment	Objective
Fast handoff between APs	IEEE 802.11ai-2016	Handoff duration below 100 ms by implementing preemptive channel sensing and user authentication.
D2D/WiFi Direct	WiFi Alliance feature	STAs with D2D capability can decide to create their own WLAN to communicate directly.
Multi-technology APs and bridging capabilities	IEEE 802.11ak-2017	Interconnection of multiple WLANs.
Video traffic differentiation	IEEE 8v02.11aa-2012	Stream prioritization and groupcast mechanisms.
AP/service selection	IEEE 802.11aq-2018	APs provide pre-association information about the services offered to help STAs to choose between multiple APs

Figure 6. Upcoming IEEE 802.11 amendments.

with an external hard disk and instantaneous file exchange between a mobile phone and a projector/smart television. The use of D2D communications will reduce the amount of airtime required for each transmission by allowing higher data rates and avoiding the use of the AP as a relay. Beamforming is an interesting feature for D2D communication because it may allow concurrent transmissions inside the same WLAN by different groups of nodes.

IEEE 802.11ax-2019 aims to operate in the 2.4 and 5 GHz bands by superseding and integrating the IEEE 802.11n-2009 and IEEE 802.11ac-2013 amendments. In a few years, every single AP will most likely implement two IEEE 802.11ax-2019 instances that independently operate at 2.4 and 5 GHz, with a IEEE 802.11ah-2016 instance at 1 GHz for M2M and long-range communications, and one IEEE 802.11ad-2012 (or the future IEEE 802.11ay-202x) at 60 GHz for very fast millimeter-wave communications. In this situation, the STAs of any of those networks should be able to communicate with the STAs in any of the other WLANs. This is the aim of the IEEE 802.11ak-2017 amendment, which focuses on adding bridging capabilities to WLANs.

Finally, next-generation WLANs will use traffic differentiation, flow admission control, and groupcast mechanisms from the IEEE 802.11e-2007, IEEE 802.11ae-2012 and IEEE 802.11aa-2012 amendments to support multimedia traffic with the required QoS. Also, further advances in power saving mechanisms are expected to keep WLAN energy consumption as low as possible.

Conclusion

We have reviewed some technological options that could be included in the IEEE 802.11ax-2019 amendment for next-generation WLANs. Individually, all those solutions offer some per-

The use of D2D communications will reduce the amount of airtime required for each transmission by allowing higher data rates and avoiding the use of the AP as a relay. Beamforming is an interesting feature for D2D communication because it may allow concurrent transmissions inside the same WLAN by different groups of nodes.

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In addition to the higher achievable throughput provided by IEEE 802.11ax-2019 PHY/MAC features, we believe that the most disruptive performance and user experience improvements in next-generation WLANs will also be related to the development and implementation of the other recently approved or ongoing amendments.

formance gains by improving the spatial reuse and spectrum utilization. However, the analysis of the actual performance gains when several of those solutions are combined and used simultaneously is still an open challenge requiring significant research efforts in the next years. For instance, for a given transmission power, multiplexing different users in a single transmission using channel bonding and spatial multiplexing reduces the received power per Hertz and user, which may require the selection of lower-order modulation schemes and coding rates, and the theoretical gain in throughput obtained by the combined use of spatial multiplexing and channel bonding may be lost by the larger transmission delay.

Finally, in addition to the higher achievable throughput provided by IEEE 802.11ax-2019 PHY/MAC features, we believe that the most disruptive performance and user experience improvements in next-generation WLANs will also be related to the development and implementation of the other recently approved or ongoing amendments, and by developing efficient and smart mechanisms to improve the coexistence and cooperation among WLANs.

Acknowledgments

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Biography

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Appendix Q

Edward Au

Exciting Projects for PHY and MAC Layers of IEEE 802.11

The first few widely accepted amendments to IEEE 802.11 [1] wireless networking specifications, namely IEEE 802.11a, IEEE 802.11b, and IEEE 802.11g, featured relatively low spectral efficiencies and data rates. Driven by technological advances in signal processing and communications theory, sustained improvement in spectral efficiency, coverage, and quality of service has been achieved in IEEE 802.11n and IEEE 802.11ac [2]. Particularly, progressive system improvement is achieved by the successive introduction of novel techniques, including orthogonal frequency division multiplexing (OFDM) and multiple-input, multiple-output (MIMO) antenna techniques. Some advanced transmission techniques, especially multiuser (MU)-MIMO and transmit beamforming, have also helped to boost the performance of Wi-Fi to gigabit-per-second speed, and they have led to the current state of the art, namely IEEE 802.11ac in 2.4- and 5-GHz bands, and IEEE 802.11ad in the 60-GHz frequency band [3].

In this column, I would like to share with you a few interesting and exciting projects related to both the physical (PHY) layer and the media access (MAC) layer of wireless local area networks (WLANs), which are developed in IEEE 802.11 Working Group under the management of the IEEE 802 LAN/MAN Standards Committee.

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IEEE 802.11ah

Existing IEEE 802.11 technologies are now being used by Internet of Things (IoT) applications that may require lower power consumption and/or extended transmission range with limited throughput, such as backhaul sensor and meter data, home automation, and wearable devices. IEEE 802.11ah is a new amendment in IEEE 802.11 [4] that has dedicated MAC and PHY features for these kinds of IoT applications. Specifically, IEEE 802.11ah targets a sub-1-GHz frequency band that enables extended transmission range with respect to the existing IEEE 802.11 technologies operating in 2.4- and 5-GHz frequency bands. As per the task group's project authorization request [5], it aims to define a standardized modification to OFDM MAC and PHY operating in the license-exempt bands below 1 GHz with a transmission range of up to 1 km and data rates of 100 kb/s and beyond.

With respect to the existing IEEE 802.11 amendments, IEEE 802.11ah can be considered as an evolution of IEEE 802.11 MAC and PHY but with dedicated enhancement for a sub-1-GHz frequency band, which includes optimization for highly robust links and low-power consumption required for battery-operated devices and the support of a larger number of devices per access point. In particular, IEEE 802.11ah OFDM PHY features not only the fast Fourier transform size of 64, but also a smaller one of 32. To accommodate outdoor operation and to work with a larger delay spread, a new reliable modulation and coding scheme (MCS), namely MSC10, is also proposed. As for the channel bandwidth, there are a few options other than the minimum channel bandwidth of 20 MHz used in IEEE 802.11n and IEEE 802.11ac. Specifically, 1- and 2-MHz channel bandwidths are mandatory and globally interoperable modes optimized for sensor networking, while 4-, 8-, and 16-MHz channel bandwidths are optional higher data-rate modes for extended range. For IEEE 802.11ah MAC, it would support up to 8,191 devices per access point by introducing a restricted access window operation and hierarchical traffic indication map structure. Furthermore, it considers efficient frame transmission

DRIVEN BY TECHNOLOGICAL ADVANCES IN SIGNAL PROCESSING AND COMMUNICATIONS THEORY, SUSTAINED IMPROVEMENT IN SPECTRAL EFFICIENCY, COVERAGE, AND QUALITY OF SERVICE HAS BEEN ACHIEVED IN IEEE 802.11N AND IEEE 802.11AC.

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In particular, both single user MIMO and downlink MU-MIMO are proposed for maximizing throughput and allowing the distribution of capacity to multiple nonaccess point/nonpriority code point stations, respectively.

by incorporating short control and management frames together with asymmetric and bidirectional transmission. A target wake-time mechanism and an extended sleeping and listen internal are also introduced for the purpose of reducing power consumption. To further extend the transmission range, relay operation is also introduced.

As for the progress of amendment development, IEEE 802.11ah is currently working toward a completion of resolution of comments received from the initial sponsor ballot on version 7.0 of the draft amendment. The target completion date is August 2016.

IEEE 802.11ax

IEEE 802.11ax represents the next major generation of Wi-Fi technology evolution after IEEE 802.11a, IEEE 802.11g, IEEE 802.11n, and IEEE 802.11ac. While the former amendments focus mainly on improvement in maximum throughput of a station measured at an MAC data service access point, IEEE 802.11ax started its activity [6] to consider improving the spectrum efficiency and system throughput per area in high-density scenarios of access points and stations in both indoor and outdoor deployments, such as crowded public spaces, public transportation, and dense apartment buildings. As per the task group's project authorization request [7], it aims to achieve improvement at least four times the average throughput per station measured at the MAC data service access point in a dense deployment scenario, while maintaining or improving power efficiency per station between 1- and 6-GHz frequency bands that will improve performance in dense deployment scenarios. Furthermore, backward compatibility and coexistence with legacy IEEE 802.11 devices operating in the same frequency band are also required.

With respect to the current state-of-the-art IEEE 802.11ac, the task group is currently discussing a large variety of technical proposals on different features with the aim to fulfill the aforementioned requirements. For example, while downlink MU-MIMO and 256 quadrature amplitude modulation (QAM) are adopted in IEEE 802.11ac, uplink MU-MIMO and 1024 QAM are now considered in IEEE 802.11ax for the purpose of improving throughput upstream and boosting the maximum throughput further, respectively. Furthermore, OFDM access is proposed for both the uplink and the downlink for extending transmission range and reducing system overhead, respectively. In a realistic deployment of a Wi-Fi network, there are always a lot of interfering sources, and the access points are always heavily loaded. To tackle these problems, MCS0 with twice repetition is introduced to increase robustness to interference, and spatial reuse is proposed to increase multiple basic service set support system capacity so as to enhance medium reuse. Lastly, there are also a number of proposals for the improvement of MAC control signaling with the aim to improve the efficiency of operation while reducing power consumption.

As for the progress of amendment development, IEEE 802.11ax is now working on version 1.0 of the draft amendment, which is expected to be ready for letter ballot in July 2016. The target completion date of this program is March 2019.

IEEE 802.11ay

IEEE 802.11ay [8] is considered an extension of IEEE 802.11ad with the aim to further improve the maximum throughput per station measured at the MAC data service access point. While the maximum throughput achieved by IEEE 802.11ad is about 4.7 and 6.9 Gb/s when single-carrier and OFDM modes are respectively implemented, IEEE 802.11ay aims to define modifications for both the IEEE 802.11 PHY and MAC layers that enable at least one mode of operation that is capable of supporting a maximum throughput of at least 20 Gb/s measured at the MAC data service access point while maintaining or improving the power efficiency per station. One of the main reasons this new project is needed is the increasing demand for capacity for not only existing applications of IEEE 802.11ad (e.g., docking) but also new usage scenarios and applications, including crowded public spaces, data centers, and fronthaul and backhaul communication. As per the task group's project authorization request [9], this amendment also defines operations for license-exempt bands above 45 GHz while ensuring backward compatibility and coexistence with legacy directional multigigabit stations (defined by the IEEE 802.11ad 2012 amendment) operating in the same band.

With respect to IEEE 802.11ad, IEEE 802.11ay just starts to discuss many technical proposals on different features with the aim to fulfill all the aforementioned requirements. In particular, both single user MIMO and downlink MU-MIMO are proposed for maximizing throughput and allowing the distribution of capacity to multiple nonaccess point/nonpersonal basic service set control point stations, respectively. Channel bonding of at least two 2.16-GHz channels as well as contiguous and noncontiguous channel aggregation of at least two 2.16-GHz channels are also proposed as two key technologies to meet the throughput requirement for a majority of the usage scenarios considered by the task

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MCS0 WITH TWICE REPETITION IS INTRODUCED TO INCREASE ROBUSTNESS TO INTERFERENCE, AND SPATIAL REUSE IS PROPOSED TO INCREASE MULTIPLE BASIC SERVICE SET SUPPORT SYSTEM CAPACITY SO AS TO ENHANCE MEDIUM REUSE.

group. Furthermore, IEEE 802.11ay is also discussing a few proposals on MIMO channel access and beamforming protocols that would potentially utilize antenna pattern reciprocity to allow for multiple devices to perform beamforming training simultaneously. As for the time line of amendment development, IEEE 802.11ay is currently working on a few task group documents, including functional requirements, channel model, and evaluation methodology. Furthermore, the task group is now working on an initial version of the draft amendment, which is expected to go for a letter ballot in May 2017. The target completion date is December 2019.

References

[1] *Telecommunications and Information Exchange Between Systems Local and Metropolitan Area Networks—Specific Requirements Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications*, IEEE Standard 802.11-2012.

[2] *Telecommunications and Information Exchange Between Systems Local and Metropolitan Area Networks—Specific Requirements Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications—Amendment 4: Enhancements for Very High Throughput for Operation in Bands below 6 GHz*, IEEE Standard 802.11ac-2013.

[3] *Telecommunications and Information Exchange Between Systems Local and Metropolitan Area Networks—Specific Requirements Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications—Amendment 3: Enhancements for Very High Throughput in the 60 GHz Band*, IEEE Standard 802.11ad-2012.

[4] Status of Project IEEE 802.11ah. (2010). [Online]. Available: http://www.ieee802.org/11/Reports/tgah_update.htm

[5] P802.11ah. (2010). [Online]. Available: http://www.ieee802.org/11/PARs/P802.11ah.pdf

[6] Status of Project IEEE 802.11ax. (2013). [Online]. Available: http://www.ieee802.org/11/Reports/tgax_update.htm

[7] https://mentor.ieee.org/802.11/dcn/14/11-14-0165-01-0hew-802-11-hew-sg-proposed-par

[8] Status of Project IEEE 802.11ay. (2015). [Online]. Available: http://www.ieee802.org/11/Reports/tgay_update.htm

[9] https://mentor.ieee.org/802.11/dcn/14/11-14-1151-08-ng60-ng60-proposed-par

VT

PRESIDENT'S MESSAGE

(continued from page 4)

need more volunteers to maintain and expand our level of activities. Volunteers can participate in our technical committees, publications, conferences, etc. VTS has a dedicated section on our web portal to disseminate volunteer positions. Please have a look and get in touch with us if you would like to participate in VTS whether your interests are reflected or not in the current list of open volunteer positions. We need volunteers from all our fields of interest: automotive electronics and motor vehicles, land transportation and railways, and mobile radio.

Chapters provide a good opportunity to volunteer and engage with the Society at the local level. You can find the list of VTS Chapters on our web portal together with the contact details of our Chapters' chair, Pawel Dmochowski. If you do not have a Chapter in your country or region but would like to form one, get in touch with Pawel. One of the many advantages of belonging to a VTS Chapter is that it gives you access to our Distinguished Lecturers program, one of the largest within the IEEE.

Our Distinguished Lecturers are internationally recognized technical experts and leaders. It is important that we all recognize the efforts, impact, and leadership of our members and volunteers, and VTS has several awards to do so. The information on the VTS awards can, again, be found in our portal. Please, do not hesitate to contact our awards chair, David Haccoun, if you would like to nominate a colleague. You might also want to recognize a colleague by nominating him or her for the possibility to be elevated to IEEE Fellow. If this is the case, please contact Gordon Stüber, the chair of the Fellows committee, to get more information on the timing and process to submit your nomination through VTS.

2016 is certainly going to be an exciting year for VTS and for me, and I hope we will provide the level and quality of service that you expect from your Society. It is important that you let us know, electronically or personally at one of our VTS meetings, how we are doing and how we can improve further our value and level of service. I would like to finish this message thanking all our members and the VTS board of governors for giving me the honor to serve the VTS members as 2016 president.

VT

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Appendix R

OFFICIAL IEEE 802.11 WORKING GROUP PROJECT TIMELINES - 2025-04-23

IN PROCESS - Standards, Amendments, and Recommended Practices

IEEE Project and Final Document	Final Doc Type	Project Authorization Request (PAR)	Task Group and Activity	Documentation: Session End Snapshot Format & Version	Documentation: Session End Snapshot Incorporated Baselines	Current Status	PAR Approved, Modified, or Extended [Expires]	WG Letter Ballots: Draft Predicted Initial	WG Letter Ballots: Date Predicted Recirc	WG Letter Ballots: Result	Form Standards Association (SA) Ballot Pool / Reform	MEC / MDR Done	IEEE SA Ballots: Draft Predicted Initial	IEEE SA Ballots: Date Predicted Recirc	IEEE SA Ballots: Result	Final 802.11 WG Approval	Final or Conditional 802 LMSC Approval	RevCom & Standards Board Final or Continuous Process Approval	ANSI Approved	Sup Wit Sta B
IEEE Std P802.11bq	A	Integrated Millimeter Wave	TGbq		802.11-2020 802.11ax-2021 802.11ay-2021 802.11ba-2021 802.11-2020/Cor1-2022 802.11az-2022 802.11bd-2022 802.11bb-2023 802.11bc-2023 802.11-2020/Cor2-2024 802.11me 802.11bh 802.11be 802.11bk 802.11bf 802.11bi 802.11mf 802.11bn 802.11bp	Actual	2024-12-11												
						Predicted	C												N/A	
IEEE Std P802.11mf	A	802.11 Accumulated Maintenance Changes	TGmf		802.11-2020 802.11ax-2021 802.11ay-2021 802.11ba-2021 802.11-2020/Cor1-2022 802.11az-2022 802.11bd-2022 802.11bb-2023 802.11bc-2023 802.11-2020/Cor2-2024 802.11me 802.11bh 802.11be 802.11bk 802.11bf 802.11bi	Actual	2024-11-12												
						Predicted	C	May 2025	Jan 2026		Oct 2026	Oct 2026	Jan 2027	Jul 2027		Nov 2027	Nov 2027	Feb 2028	N/A	
IEEE Std P802.11bp	A	Ambient Power Communication	TGbp		802.11-2020 802.11ax-2021 802.11ay-2021 802.11ba-2021 802.11-2020/Cor1-2022 802.11az-2022 802.11bd-2022 802.11bb-2023 802.11bc-2023 802.11-2020/Cor2-2024 802.11me 802.11bh 802.11be 802.11bk 802.11bf 802.11bi 802.11mf 802.11bn	Actual	2024-03-19 [2028-12-31]												
						Predicted	C	Feb 2026	Nov 2026		Mar 2027	Oct 2027	Aug 2027	Oct 2027		Jan 2028	Mar 2028	May 2028	N/A	
IEEE Std P802.11bn	A	Ultra High Reliability	TGbn	D0.20	802.11-2020 802.11ax-2021 802.11ay-2021 802.11ba-2021 802.11-2020/Cor1-2022 802.11az-2022 802.11bd-2022 802.11bb-2023 802.11bc-2023 802.11-2020/Cor2-2024 802.11me 802.11bh 802.11be 802.11bk 802.11bf 802.11bi 802.11mf	Actual	2023-09-21 [2027-12-31]												
						Predicted	C	May 2025	May 2026		Mar 2027	May 2027	May 2027	Jul 2027		Mar 2028	Mar 2028	May 2028	N/A	
IEEE Std P802.11bk	A	320 MHz Positioning	TGbk	PDF D5.00	802.11-2020 802.11ax-2021 802.11ay-2021 802.11ba-2021 802.11-2020/Cor1-2022 802.11az-2022 802.11bd-	Actual	2022-12-03	D1.0 D2.0 D3.0	2023-12-28 2024-04-26 2024-08-15	95% 97% 98%	2024-05-01	2024-06-01	D3.0 D4.0 D5.0	2024-11-10 2025-02-07 2025-03-30	94% 97% 98%	2025-03-12	2025-03-14			

IEEE Project and Final Document	Final Doc Type	Project Authorization Request (PAR)	Task Group and Activity	Documentation Session End Snapshot Format & Version	Documentation Session End Snapshot Incorporated Baselines	Current Status	PAR Approved, Modified, or Extended [Expires]	WG Letter Ballots Draft Predicted Initial	WG Letter Ballots Date Predicted Recirc	WG Letter Ballots Result	Form Standards Association (SA) Ballot Pool / Reform	MEC / MDR Done	IEEE SA Ballots Draft Predicted Initial	IEEE SA Ballots Date Predicted Recirc	IEEE SA Ballots Result	Final 802.11 WG Approval	Final or Conditional 802 LMSC Approval	RevCom & Standards Board Final or Continuous Process Approval	ANSI Approved	Sup Wit Sta E
					2022 802.11bb-2023 802.11bc-2023 802.11-2020/Cor2-2024 802.11me 802.11bh 802.11be	Predicted	C	C	C		C	C	C	C		C	C	Sep 2025	N/A	
IEEE Std P802.11bi	A	Enhanced Data Privacy	TGbi	PDF D1.10	802.11-2020 802.11ax-2021 802.11ay-2021 802.11ba-2021 802.11-2020/Cor1-2022 802.11az-2022 802.11bd-2022 802.11bb-2023 802.11bc-2023 802.11-2020/Cor2-2024 802.11me 802.11bh 802.11be 802.11bk 802.11bf	Actual	2021-02-10 [2025-12-31]	D1.0	2025-02-27	89%										
						Predicted	C	C	Jul 2025		Sep 2025	Jul 2025	Jan 2026	Mar 2026		May 2026	May 2026	Jul 2026	N/A	
IEEE Std P802.11me	A	802.11 Accumulated Maintenance Changes	TGme	PDF D7.00	802.11-2020 802.11ax-2021 802.11ay-2021 802.11ba-2021 802.11-2020/Cor1-2022 802.11az-2022 802.11bd-2022 802.11bb-2023 802.11bc-2023 802.11-2020/Cor2-2024	Actual	2021-02-10 [2025-12-31]	D1.0 D2.0 D3.0 D4.0	2022-01-10 2022-11-11 2023-05-07 2023-08-30	84% 87% 93% 96%	2023-05-01	2023-07-01	D4.0 D5.0 D6.0 D7.0	2023-10-10 2024-03-05 2024-07-02 2024-08-08	85% 84% 93% 98%	2024-07-01	2024-07-01			
						Predicted	C	C	C		C	C	C	C		C	C	Sep 2024	N/A	
IEEE Std P802.11bh	A	Randomized and Changing MAC Addresses	TGbh	PDF D6.00	802.11-2020 802.11ax-2021 802.11ay-2021 802.11ba-2021 802.11-2020/Cor1-2022 802.11az-2022 802.11bd-2022 802.11bb-2023 802.11bc-2023 802.11-2020/Cor2-2024 802.11me	Actual	2021-02-10 [2025-12-31]	D1.0 D2.0 D3.0 D4.0	2023-07-01 2024-01-05 2024-02-24 2024-04-06	92% 94% 98% 99%	2024-02-01	2024-03-01	D4.0 D5.0 D6.0	2024-05-09 2024-07-13 2024-08-15	91% 92% 98%	2024-07-01	2024-07-01			
						Predicted	C	C	C		C	C	C	C		C	C	Sep 2024	N/A	
IEEE Std P802.11bf	A	WLAN Sensing	TGbf	PDF D8.00	802.11-2020 802.11ax-2021 802.11ay-2021 802.11ba-2021 802.11-2020/Cor1-2022 802.11az-2022 802.11bd-2022 802.11bb-2023 802.11bc-2023 802.11-2020/Cor2-2024 802.11me 802.11bh 802.11be 802.11bk	Actual	2020-09-25 [2026-12-31]	D1.0 D2.0 D3.0 D4.0	2023-03-02 2023-08-20 2024-01-04 2024-04-26	78% 86% 93% 96%	2024-04-01	2024-03-01	D4.0 D5.0 D6.0 D7.0 D8.0	2024-06-12 2024-10-23 2024-12-11 2025-01-16 2025-04-04	90% 96% 97% 98% 98%	2025-03-12	2025-03-14			
						Predicted	C	C	C		C	C	C	C		C	C	Jun 2025	N/A	
IEEE Std P802.11be	A	Extremely High Throughput	TGbe	PDF D7.00	802.11-2020 802.11ax-2021 802.11ay-2021 802.11ba-2021 802.11-2020/Cor1-2022 802.11az-2022 802.11bd-2022 802.11bb-2023 802.11bc-2023 802.11-2020/Cor2-2024 802.11me 802.11bh	Actual	2019-03-21 [2025-12-31]	D2.0 D3.0 D4.0 D5.0	2022-07-04 2023-03-02 2023-08-13 2023-12-16	64% 80% 90% 95%	2023-10-01	2023-09-01	D5.0 D6.0 D7.0	2024-02-02 2024-05-31 2024-08-10	82% 93% 97%	2024-07-01	2024-07-01			
						Predicted	C	C	C		C	C	C	C		C	C	Sep 2024	N/A	

IEEE Project and Final Document	Final Doc Type	Project Authorization Request (PAR)	Task Group and Activity	Documentation: Session End Snapshot: Format & Version	Documentation: Session End Snapshot: Incorporated Baselines	Current Status	PAR Approved, Modified, or Extended [Expires]	WG Letter Ballots: Draft: Predicted Initial	WG Letter Ballots: Date: Predicted Recirc	WG Letter Ballots: Result: Predicted Recirc	WG Letter Ballots: Form SA Ballot Pool / Reform	WG Letter Ballots: MEC / MDR Done	IEEE SA Ballots: Draft: Predicted Initial	IEEE SA Ballots: Date: Predicted Recirc	IEEE SA Ballots: Result: Predicted Recirc	Final 802.11 WG Approval	Final or Conditional 802 LMSC Approval	RevCom & Standards Board Final or Continuous Process Approval	ANSI Approved	P
IEEE Std P802.11-2020/Cor2-2024	COR	Correct 802.11bc identifer of EBCS ANQP element	WG Tech Ed	PDF D1.00	802.11-2020 802.11ax-2021 802.11ay-2021 802.11ba-2021 802.11-2020/Cor1-2022 802.11az-2022 802.11bd-2022 802.11bb-2023 802.11bc-2023	Actual	2023-07-20 [2024-07-20]	D1.0	2023-10-25	100%	2023-10-01	2023-11-01	D1.0	2023-12-28	100%	2023-11-17	2024-01-09	2024-01-01		20
IEEE Std P802.11bc-2023	A	Enhanced Broadcast Service	TGbc	PDF D7.00	802.11-2020 802.11ax-2021 802.11ay-2021 802.11ba-2021 802.11-2020/Cor1-2022 802.11az-2022 802.11bd-2022 802.11bb-2023	Actual	2018-12-05 [2022-12-31]	D1.0 D2.0 D3.0 D4.0	2020-12-20 2021-10-28 2022-04-28 2022-08-25	83% 90% 92% 95%	2022-09-01	2022-07-01	D4.0 D5.0 D6.0 D7.0	2022-11-04 2023-01-13 2023-02-21 2023-03-13	92% 97% 100% 100%	2023-03-01	2023-03-01	2023-06-01		20
IEEE Std P802.11bb-2023	A	Light Communications	TGbb	PDF D7.00	802.11-2020 802.11ax-2021 802.11ay-2021 802.11ba-2021 802.11-2020/Cor1-2022 802.11az-2022 802.11bd-2022	Actual	2018-03-09 [2022-12-31]	D1.0 D2.0 D3.0 D4.0	2022-01-12 2022-04-22 2022-08-31 2022-10-01	87% 94% 95% 99%	2022-03-01	2022-03-01	D4.1 D5.0 D6.0 D7.0	2022-11-07 2023-01-14 2023-02-21 2023-03-14	91% 92% 96% 100%	2023-03-01	2023-03-01	2023-06-01		20
IEEE Std P802.11bd-2022	A	Enhancements for Next Generation V2X	TGbd	PDF D8.00	802.11-2020 802.11ax-2021 802.11ay-2021 802.11ba-2021 802.11-2020/Cor1-2022 802.11az-2022	Actual	2018-12-05 [2022-12-31]	D1.0 D2.0 D3.0 D4.0	2020-11-18 2021-08-01 2021-12-16 2022-03-30	82% 88% 94% 99%	2021-12-02	2022-03-01	D4.0 D5.0 D6.0 D7.0 D8.0	2022-05-09 2022-07-05 2022-08-30 2022-09-30 2022-10-14	92% 93% 95% 97% 97%	2022-09-16	2022-10-04	2022-12-01		20
IEEE Std P802.11az-2022	A	Next Generation Positioning	TGaz	PDF D7.00	802.11-2020 802.11ax-2021 802.11ay-2021 802.11ba-2021 802.11-2020/Cor1-2022	Actual	2015-09-03 [2023-12-31]	D1.0 D2.0 D3.0 D4.0 D4.0	2019-03-09 2020-01-03 2021-02-10 2021-09-07 2021-10-01	79% 87% 88% 95% 98%	2021-08-01	2021-07-01	D4.0 D5.0 D6.0 D7.0	2021-11-05 2022-06-09 2022-09-07 2022-09-29	93% 94% 99% 100%	2022-09-16	2022-10-04	2022-12-01		20
IEEE Std P802.11-2020/Cor1-2022	COR	Correct 802.11ay Assignment of Protected Announce Support Bit	WG Tech Ed	PDF D2.10	802.11-2020 802.11ax-2021 802.11ay-2021 802.11ba-2021	Actual	2022-02-23 [2026-12-31]	D1.0 D2.1	2022-04-14 2022-06-01	99% 100%	2022-05-01	2022-06-01	D2.1	2022-07-08	100%	2022-07-01	2022-07-01	2022-09-21		20
IEEE Std P802.11ba-2021	A	Wake Up Radio	TGba	PDF D8.00	802.11-2020 802.11ax-2021 802.11ay-2021	Actual	2016-12-07 [2020-12-31]	D1.0 D2.0 D3.0 D4.0 D5.0 D6.0	2018-10-24 2019-03-03 2019-06-18 2019-10-15 2019-12-17 2020-02-01	72% 82% 84% 90% 96% 99%	2019-08-01	2019-11-01	D6.0 D7.0 D8.0	2020-03-18 2020-10-01 2020-12-21	91% 95% 98%	2020-11-01	2020-11-01	2021-03-01		20
IEEE Std P802.11ay-2021	A	Next Generation 60GHz	TGay	PDF D7.00	802.11-2020 802.11ax-2021	Actual	2015-03-26 [2021-12-31]	D1.0 D2.0 D3.0 D4.0 D5.0	2018-01-07 2018-08-31 2019-02-28 2019-07-08 2019-11-08	74% 93% 93% 98% 99%	2019-06-01	2019-07-16	D5.0 D6.0 D7.0	2020-01-09 2020-09-29 2020-12-20	89% 92% 98%	2020-11-01	2020-11-01	2021-03-01		20
IEEE Std P802.11ax-2021	A	High Efficiency WLAN	TGax	PDF D8.00	802.11-2020	Actual	2014-03-27 [2020-12-31]	D1.0 D2.0 D3.0 D4.0 D5.0 D6.0	2017-01-08 2017-11-04 2018-07-01 2019-02-25 2019-10-24 2019-12-11	58% 63% 87% 92% 94% 97%	2019-09-01	2019-05-01	D6.0 D7.0 D8.0	2020-01-24 2020-09-17 2020-11-27	82% 88% 95%	2020-09-01	2020-11-01	2021-02-01		20
IEEE Std P802.11-2020	STD	802.11 Accumulated Maintenance Changes	TGmd	PDF D5.00	802.11-2016	Actual	2017-03-23 [2021-12-31]	D1.0 D2.0 D3.0	2018-03-17 2019-01-10 2019-10-30	85% 93% 96%	2019-09-01	2019-05-01	D3.0 D4.0 D5.0 D7.0	2019-12-15 2020-09-04 2020-10-04 2024-08-08	83% 91% 97% 98%	2020-09-01	2020-10-01	2020-12-01		20

SUPERSEDED OR WITHDRAWN - Standards, Amendments, and Recommended Practices

IEEE Project and Final Document	Final Doc Type	Project Authorization Request (PAR)	Task Group and Activity	Documentation: Session End Snapshot: Format & Version	Documentation: Session End Snapshot: Incorporated Baselines	Current Status	PAR Approved, Modified, or Extended [Expires]	WG Letter Ballots: Draft: Predicted Initial	WG Letter Ballots: Date: Predicted Recirc	WG Letter Ballots: Result: Predicted Recirc	WG Letter Ballots: Form SA Ballot Pool / Reform	WG Letter Ballots: MEC / MDR Done	IEEE SA Ballots: Draft: Predicted Initial	IEEE SA Ballots: Date: Predicted Recirc	IEEE SA Ballots: Result: Predicted Recirc	Final 802.11 WG Approval	Final or Conditional 802 LMSC Approval	RevCom & Standards Board Final or Continuous Process Approval	ANSI Approved	Su W S
IEEE Std P802.11aq-2018	A	Pre-Association Discovery	TGaq	PDF D14.00	802.11-2016 802.11ai-2016 802.11-2020 802.11ah-2016 802.11aj-2018 802.11ak-2018	Actual	2012-12-05 [2018-12-31]	D1.0 D3.0 D4.0 D5.0 D6.0 D7.0	2015-03-04 2015-11-07 2016-04-21 2016-07-19 2016-08-19 2016-09-25	73% 93% 93% 93% 96% 97%	2016-08-01	2016-06-01	D7.0 D8.0 D9.0 D10.0 D12.0 D13.0 D14.0 D14.0	2016-11-04 2017-03-18 2017-06-23 2017-07-29 2017-10-01 2017-10-30 2018-01-04 2018-01-31	88% 91% 94% 98% 97% 97% 98% 99%	2018-03-07	2018-03-09	2018-06-14		2
IEEE Std P802.11ak-2018	A	General Link	TGak	PDF D6.00	802.11-2016 802.11ai-2016 802.11-2020 802.11ah-2016 802.11aj-2018	Actual	2012-12-05 [2018-12-31]	D1.0 D2.0 D3.0 D4.0	2015-05-06 2016-03-10 2017-01-10 2017-03-30	85% 91% 94% 95%	2016-11-01	2016-11-01	D4.0 D5.0 D6.0	2017-05-11 2017-11-09 2018-01-01	90% 93% 97%	2018-01-19	2018-01-31	2018-03-08		2
IEEE Std P802.11aj-2018	A	China Millimeter Wave	TGaj	PDF D9.00	802.11-2016 802.11ai-2016 802.11-2020 802.11ah-2016	Actual	2012-08-01 [2018-12-31]	D1.0 D2.0 D3.0 D4.0 D5.0	2016-01-20 2016-06-30 2016-08-30 2016-12-21 2017-03-04	88% 89% 89% 92% 95%	2017-01-01	2016-11-01	D6.0 D7.0 D8.0 D9.0 D14.0	2017-06-25 2017-08-04 2017-08-24 2017-12-17 2018-01-04	98% 100% 100% 100% 98%	2017-11-10	2017-11-10	2018-01-24		2
IEEE Std P802.11-2016	STD	802.11 Accumulated Maintenance Changes	TGmc	PDF D8.00	802.11-2012 802.11ae-2012 802.11aa-2012 802.11ad-	Actual	2012-08-30 [2016-12-31]	D1.0 D2.0 D3.0 D4.0 D4.0	2013-03-02 2013-10-23 2014-06-23 2015-02-17 2015-03-26	88% 90% 90% 94% 96%	2014-09-01	2014-07-01	D4.0 D5.0 D6.0 D7.0 D8.0	2015-04-26 2016-01-26 2016-06-30 2016-08-20 2016-09-08	88% 90% 93% 97% 99%	2016-09-01	2016-10-01	2016-12-07		2

IEEE Project and Final Document	Final Doc Type	Project Authorization Request (PAR)	Task Group and Activity	Documentation: Session End Snapshot Format & Version	Documentation: Session End Snapshot Incorporated Baselines	Current Status	PAR Approved, Modified, or Extended [Expires]	WG Letter Ballots: Draft Predicted Initial	WG Letter Ballots: Date Predicted Recirc	WG Letter Ballots: Result	Form SA Ballot Pool / Reform	MEC / MDR Done	IEEE SA Ballots: Draft Predicted Initial	IEEE SA Ballots: Date Predicted Recirc	IEEE SA Ballots: Result	Final 802.11 WG Approval	Final or Conditional 802 LMSC Approval	RevCom & Standards Board Final or Continuous Process Approval	ANSI Approved	St W S
					2012 802.11ac-2013 802.11af-2013															
IEEE Std P802.11ah-2016	A	Sub 1 GHz	TGah	PDF D10.00	802.11-2016 802.11ai-2016 802.11-2020	Actual	2010-10-04 [2016-12-31]	D1.0 D2.0 D3.0 D4.0 D5.0 D5.0	2013-11-04 2014-07-05 2014-10-25 2015-02-14 2015-04-16 2015-10-03	73% 83% 90% 93% 93% 98%	2015-04-01	2016-02-01	D5.0 D6.0 D7.0 D8.0 D9.0 D10.0	2015-11-05 2016-03-02 2016-04-14 2016-05-17 2016-09-09 2016-09-30	91% 91% 92% 95% 95% 96%	2016-09-01	2016-10-01	2016-12-07		2
IEEE Std P802.11ai-2016	A	Fast Initial Link Setup	TGai	PDF D11.00	802.11-2016	Actual	2010-12-08 [2016-12-31]	D1.0 D2.0 D3.0 D4.0 D5.0 D6.0	2013-09-12 2014-05-07 2014-10-14 2015-02-24 2015-06-26 2015-07-31	74% 85% 88% 90% 92% 97%	2015-03-01	2014-11-01	D6.0 D7.0 D8.0 D9.0 D9.0 D11.0	2015-09-15 2016-03-30 2016-07-13 2016-08-06 2016-09-09 2016-09-30	90% 89% 93% 95% 97% 95%	2016-09-01	2016-10-01	2016-12-07		2
IEEE Std P802.11af-2013	A	TV White Spaces	TGaf	PDF D6.00	802.11-2012 802.11ae-2012 802.11aa-2012 802.11ad-2012 802.11ac-2013	Actual	2009-12-09 [2013-12-31]	D1.0 D2.0 D3.0 D4.0 D5.0 D5.0	2011-02-24 2012-08-19 2013-02-08 2013-04-17 2013-06-14 2013-08-01	62% 79% 87% 92% 94% 99%	2013-06-01	2013-11-01	D5.0 D6.0 D6.0	2013-09-11 2013-10-19 2013-10-30	97% 99% 99%	2013-11-01	2013-11-01	2013-12-11		2
IEEE Std P802.11ac-2013	A	Very High Throughput 6GHz	TGac	PDF D7.00	802.11-2012 802.11ae-2012 802.11aa-2012 802.11ad-2012	Actual	2008-09-26 [2012-12-31]	D1.0 D2.0 D3.0 D4.0 D5.0 D5.0	2011-06-25 2012-02-18 2012-06-25 2012-11-01 2013-02-01 2013-04-04	74% 89% 91% 94% 95% 96%	2013-01-01	2013-01-01	D5.0 D6.0 D7.0	2013-05-05 2013-08-03 2013-10-23	93% 97% 99%	2013-11-01	2013-11-01	2013-12-09		2
IEEE Std P802.11ad-2012	A	Very High Throughput 60GHz	TGad	PDF D9.00	802.11-2012 802.11ae-2012 802.11aa-2012	Actual	2008-12-10 [2012-12-31]	D1.0 D2.0 D3.0 D4.0 D5.0 D5.0	2010-10-24 2011-04-05 2011-06-01 2011-08-09 2011-10-06 2011-11-24	87% 88% 92% 95% 94% 95%	2011-09-01	2011-07-01	D5.0 D6.0 D7.0 D8.0 D9.0 D9.0	2012-01-05 2012-03-30 2012-05-11 2012-06-16 2012-07-28 2012-08-12	86% 90% 95% 97% 98% 98%	2012-07-01	2012-07-01	2012-10-23		2
IEEE Std P802.11aa-2012	A	Video Transport Streams	TGaa	Word / PDF D9.00	802.11-2012 802.11ae-2012	Actual	2008-03-27 [2012-12-31]	D1.0 D2.0 D3.0 D4.0 D5.0 D6.0 D6.0	2010-07-10 2010-12-08 2011-02-24 2011-04-09 2011-06-17 2011-08-09 2011-08-31	78% 79% 81% 85% 90% 94% 95%	2011-06-30	2011-06-16	D6.0 D7.0 D8.0 D9.0	2011-10-12 2011-11-26 2012-01-02 2012-01-27	93% 96% 99% 100%	2012-01-28	2012-02-17	2012-06-01		2
IEEE Std P802.11ae-2012	A	Prioritization of Management Frames	TGae	PDF D8.00	802.11-2012	Actual	2009-12-09 [2010-10-15]	D1.0 D2.0 D3.0 D4.0 D5.0	2010-10-27 2011-02-18 2011-04-26 2011-06-18 2011-08-04	81% 86% 89% 96% 96%	2011-07-01	2011-05-01	D5.0 D6.0 D7.0 D8.0	2011-09-09 2011-10-29 2011-12-13 2012-01-04	95% 96% 100% 100%	2012-01-20	2012-02-17	2012-03-01		2
IEEE Std P802.11-2012	STD	802.11 Accumulated Maintenance Changes	TGmb	Frame / PDF D9.01	802.11-2007 802.11k-2008 802.11r-2008 802.11y-2008 802.11w-2009 802.11n-2009 802.11p-2010 802.11z-2010 802.11v-2011 802.11u-2011 802.11s-2011	Actual	2007-03-22 [2011-12-31]	D1.0 D2.0 D3.0 D4.0 D5.0	2009-06-27 2010-01-08 2010-04-25 2010-06-25 2010-08-19	87% 89% 89% 89% 92%	2010-09-14	2010-09-01	D6.0 D7.0 D8.0 D9.0 D10.0 D11.0 D12.0	2010-11-05 2011-02-18 2011-04-14 2011-06-22 2011-09-07 2011-10-22 2011-11-13	87% 90% 92% 93% 92% 94% 97%	2011-11-11	2011-11-11	2012-03-01		2
IEEE Std P802.11s-2011	A	Mesh Networking	TGs	PDF	802.11-2007 802.11k-2008 802.11r-2008 802.11y-2008 802.11w-2009 802.11n-2009 802.11p-2010 802.11z-2010 802.11v-2011 802.11u-2011	Actual	2004-05-13 [2010-12-31]	D1.0 D2.0 D3.0 D4.0 D5.0 D6.0 D7.0	2007-01-06 2008-05-03 2009-05-04 2010-01-08 2010-04-15 2010-06-28 2010-08-13	48% 61% 79% 85% 89% 89% 95%	2010-09-12	2010-09-29	D7.0 D8.0 D9.0 D10.0 D11.0	2010-11-01 2011-01-10 2011-03-05 2011-04-09 2011-05-07	95% 96% 95% 97% 97%	2011-07-01	2011-07-01	2011-08-01		2
IEEE Std P802.11u-2011	A	InterWorking with External Networks	TGu	Frame / PDF D13.00	802.11-2007 802.11k-2008 802.11r-2008 802.11y-2008 802.11w-2009 802.11n-2009 802.11p-2010 802.11z-2010 802.11v-2011	Actual	2004-12-08 (02/05/2008) [2010-12-31]	D1.0 D2.0 D3.0 D4.0 D5.0 D6.0 D7.0 D8.0	2007-07-08 2008-03-15 2008-07-12 2008-10-08 2009-02-20 2009-04-24 2009-06-19 2009-08-18	64% 70% 77% 78% 82% 90% 88% 93%	2009-06-01	2009-07-12	D8.0 D9.0 D10.0 D11.0 D12.0 D13.0	2009-11-07 2010-04-23 2010-07-08 2010-08-13 2010-09-12 2010-11-21	90% 92% 94% 96% 98% 99%	2010-11-01	2010-11-01	2011-02-25		2
IEEE Std P802.11v-2011	A	Wireless Network Management	TGv	Frame / PDF D16.00	802.11-2007 802.11k-2008 802.11r-2008 802.11y-2008 802.11w-2009 802.11n-2009 802.11p-2010 802.11z-2010	Actual	2004-12-08 [2010-12-31]	D1.0 D2.0 D3.0 D4.0 D5.0 D6.0 D7.0	2007-08-30 2008-03-15 2008-07-13 2008-12-19 2009-04-04 2009-06-12 2009-08-07	63% 67% 69% 81% 83% 90% 92%	2009-06-01	2009-07-12	D7.0 D9.0 D10.0 D11.0 D12.0 D13.0 D14.0 D15.0 D15.0 D16.0	2009-11-07 2010-02-17 2010-04-13 2010-06-10 2010-07-07 2010-07-28 2010-08-25 2010-10-18 2010-09-30 2010-11-15	81% 84% 87% 92% 94% 98% 98% 98% 98% 98%	2010-11-01	2010-11-01	2011-02-09		2
IEEE Std P802.11z-2010	A	Extensions to Direct Link Setup	TGz	Word / PDF D13.00	802.11-2007 802.11k-2008 802.11r-2008 802.11y-2008 802.11w-2009 802.11n-2009 802.11p-2010	Actual	2007-08-22	D1.0 D2.0 D3.0 D4.0 D5.0 D6.0	2008-05-03 2008-08-20 2008-12-18 2009-03-05 2009-06-23 2009-08-26	64% 66% 84% 88% 92% 96%	2009-06-01	2009-06-18	D6.0 D7.0 D8.0 D9.0 D11.0 D13.0	2009-11-07 2010-02-27 2010-05-04 2010-06-10 2010-08-04 2010-08-29	87% 87% 94% 95% 95% 98%	C	C	2010-10-01		2
IEEE Std P802.11p-2010	A	Wireless Access for the Vehicular Environment	TGp	N/A	802.11-2007 802.11k-2008 802.11r-2008 802.11y-2008 802.11w-2009 802.11n-2009	Actual	2004-09-23	D1.0 D2.0 D3.0 D4.0 D5.0 D6.0 D7.0 D8.0 D9.0	2006-04-11 2007-01-05 2007-09-12 2008-05-03 2008-12-05 2009-03-31 2009-06-13 2009-08-05 2009-10-10	59% 67% 74% 79% 85% 89% 85% 89% 93%	2009-06-01	2008-06-19	D9.0 D10.0 D11.0	2009-11-22 2010-02-16 2010-04-07	93% 96% 99%	C	C	2010-07-15		2
IEEE Std P802.11w-2009	A	Protected Management Frames	TGw	N/A	802.11-2007 802.11k-2008 802.11r-2008 802.11y-2008	Actual	2005-03-20	D1.0 D2.0 D3.0 D4.0 D5.0 D6.0	2006-11-19 2007-05-02 2007-10-19 2008-01-05 2008-02-20 2008-04-18	86% 89% 92% 92% 95% 97%	2007-11-13		D6.0 D7.0 D9.0 D10.0 D11.0	2008-09-24 2009-01-18 2009-05-23 2009-06-14 2009-06-28	86% 88% 92% 93% 95%	C	C	2009-09-11		2
IEEE Std P802.11n-2009	A	High Throughput	TGn		802.11-2007 802.11k-2008 802.11r-2008 802.11y-2008 802.11w-2009	Actual	2003-09-11 [2007-09-27]	D1.0 D2.0 D3.0 D4.0 D5.0 D6.0 D7.0 D7.0	2006-04-29 2007-03-09 2007-10-27 2008-04-12 2008-06-12 2008-08-05 2008-09-30 2008-12-02	47% 83% 85% 88% 90% 91% 94% 95%	2008-12-11	2008-12-11	D7.0 D8.0 D9.0 D10.0 D11.0 D11.0	2009-01-10 2009-03-06 2009-04-04 2009-05-30 2009-07-03 2009-06-20	78% 80% 81% 88% 91% 90%	C	C	2009-09-11		2
IEEE Std P802.11y-2008	A	3650-3700 MHz Operation in USA	TGy	N/A	802.11-2007 802.11k-2008 802.11r-2008	Actual	2006-03-16	D1.0 D2.0 D3.0 D4.0 D5.0 D6.0	2007-01-07 2007-05-05 2007-06-20 2007-08-21 2007-10-13 2007-12-08	76% 84% 91% 94% 96% 99%	2007-06-20	2007-07-28	D7.0 D8.0 D9.0 D10.0 D11.0	2008-01-30 2008-03-08 2008-03-27 2008-03-18 2008-06-20	93% 93% 96% 97% 97%	C	C	2008-11-06		2
IEEE Std P802.11r-2008	A	Fast Roaming	TGr	N/A	802.11-2007 802.11k-2008	Actual	2006-05-25	D1.0 D2.0 D3.0 D4.0 D5.0 D6.0	2006-01-04 2006-04-04 2006-10-14 2006-12-04 2007-04-04 2007-06-13	81% 88% 86% 92% 95% 97%		2007-04-11	D7.0 D8.0 D9.0 D9.0	2007-08-30 2007-10-07 2008-02-01 2008-01-17	86% 90% 97% 96%	C	C	2008-05-09		2
IEEE Std P802.11k-	A	Radio Resource	TGk	N/A	802.11-2007	Actual	2002-12-11		2007-09-11 2008-01-05	90% 100%		2007-04-10	D8.0 D9.0	2007-08-13 2007-10-04	90% 89%	C	C	2008-05-09		2

IEEE Project and Final Document	Final Doc Type	Project Authorization Request (PAR)	Task Group and Activity	Documentation: Session End Snapshot Format & Version	Documentation: Session End Snapshot Incorporated Baselines	Current Status	PAR Approved, Modified, or Extended [Expires]	WG Letter Ballots: Draft Predicted Initial	WG Letter Ballots: Date Predicted Recirc	WG Letter Ballots: Result Recirc	Form SA Ballot Pool / Reform	MEC / MDR Done	IEEE SA Ballots: Draft Predicted Initial	IEEE SA Ballots: Date Predicted Recirc	IEEE SA Ballots: Result Recirc	Final 802.11 WG Approval	Final or Conditional 802 LMSC Approval	RevCom & Standards Board Final or Continuous Process Approval	ANSI Approved	Su W S
2008		Measurement						D1.0 D2.0 D3.0 D4.0 D5.0 D6.0 D7.0 D7.0	2004-09-11 2005-03-15 2005-11-12 2006-03-31 2006-09-16 2006-11-16 2007-02-13 2007-05-05	95% 86% 80% 81% 85% 91% 92% 93%			D10.0 D11.0 D12.0 D12.0 D13.0	2007-12-08 2008-01-17 2008-02-14 2008-02-01 2008-03-18	91% 95% 95% 95% 97%					
IEEE Std P802.11-2007	STD	802.11 Standard Maintenance Revision	TGma	N/A	802.11-1999 802.11c 802.11a-1999 802.11b-1999 802.11b Cor1-2001 802.11d-2001 802.11g-2003 802.11h-2003 802.11i-2004 802.11j-2004 802.11e-2005	Actual	2003-03-20 [2003-03-20]	D1.0 D2.0 D3.0 D4.0	2005-05-08 2005-07-17 2005-08-19 2005-09-19	91% 94% 95% 96%	2005-08-21	2005-08-21	D5.0 D6.0 D7.0 D8.0 D9.0	2005-11-20 2006-05-10 2006-07-11 2006-09-09 2006-11-07	86% 90% 91% 96% 96%	2006-11-08	2006-11-08	2007-03-08		2
IEEE Std P802.11.2	RP	Wireless Performance	TGt			Actual	2008-12-31	D1.0	2007-05-16	76%										2
IEEE Std P802.11e-2005	A	MAC Enhancements QoS	TGe	N/A	802.11-1999 802.11c 802.11a-1999 802.11b-1999 802.11b Cor1-2001 802.11d-2001 802.11g-2003 802.11h-2003 802.11i-2004 802.11j-2004	Actual	2000-03-30	D4.0 D5.0 D6.0 D7.0 D8.0	2001-05-15 2002-01-16 2002-07-02 2003-01-08 2003-08-22 2003-12-20 2004-02-15 2004-03-10	0% 55% 49% 83% 97% 89% 93% 94%			D8.0 D9.0 D10.0 D11.0 D12.0 D13.0 D13.0	2004-05-30 2004-08-31 2004-10-08 2004-11-11 2004-12-23 2005-04-16 2005-02-18	85% 87% 92% 95% 96% 99% 96%	2005-07-22	2005-07-22	2005-09-22		2
IEEE Std P802.11j-2004	A	4.9 GHz-5 GHz Operation in Japan	TGj	N/A	802.11-1999 802.11c 802.11a-1999 802.11b-1999 802.11b Cor1-2001 802.11d-2001 802.11g-2003 802.11h-2003 802.11i-2004	Actual	2002-12-11	D1.0 D1.2 D1.3 D1.4	2003-05-12 2004-01-14 2004-03-11 2004-04-20	68% 89% 94% 95%	2004-05-13		D1.5 D1.6	2004-07-02 2004-08-14	88% 96%	C	C	2004-09-23	2005-02-02	2
IEEE Std P802.11i-2004	A	MAC Security Enhancements	TGi	N/A	802.11-1999 802.11c 802.11a-1999 802.11b-1999 802.11b Cor1-2001 802.11d-2001 802.11g-2003 802.11h-2003	Actual	2001-05-30	D3.0 D4.0 D5.0 D6.0 D7.0	2002-05-04 2003-01-12 2003-06-06 2003-08-19 2003-10-09 2003-11-04	77% 76% 78% 87% 92% 95%	2003-08-10		D7.0 D8.0 D9.0 D10.0	2003-12-20 2004-03-12 2004-04-10 2004-05-08	89% 92% 98% 98%	C	C	2004-06-24	2005-02-14	2
IEEE Std P802.11h-2003	A	Spectrum and Transmit Power Management Extensions in the 5 GHz Band in Europe	TGh	N/A	802.11-1999 802.11c 802.11a-1999 802.11b-1999 802.11b Cor1-2001 802.11d-2001 802.11g-2003	Actual	2000-12-07	D2.2	2001-09-03 2002-05-05 2002-09-01 2002-11-01	0% 76% 90% 97%	2002-07-25		D3.0 D3.11 D3.6	2003-02-06 2003-06-26 2003-04-30	92% 98% 96%	C	C	2003-09-11	2003-12-29	2
IEEE Std P802.11g-2003	A	Further Higher Data Rate Extension in the 2.4 GHz Band	TGg	N/A	802.11-1999 802.11c 802.11a-1999 802.11b-1999 802.11b Cor1-2001 802.11d-2001	Actual	2000-09-21	D5.0 D4.0 D6.1	2002-03-11 2002-09-01 2003-01-08 2002-11-01 2003-02-04	45% 83% 88% 87% 89%	2002-07-25		D6.2 D7.1 D8.2	2003-03-09 2003-04-08 2003-05-14	84% 85% 96%	C	C	2003-06-12	2003-10-20	2
IEEE Std P802.11b Cor1-2001	COR	Corrigenda to IEEE 802.11b-1999	TGb-Cor1		802.11-1999 802.11c 802.11a-1999	Actual	1999-11-27						D1.5	2001-04-13	98%	C	C	2001-10-10	2002-01-30	2
IEEE Std P802.11d-2001	A	Operation in Additional Regulatory Domains	TGd	N/A	802.11-1999 802.11c 802.11a-1999 802.11b-1999 802.11b Cor1-2001	Actual	1999-06-26		2000-04-04 2000-06-26	0% 0%	2001-11-29		D2.0 D3.0	2001-03-01 2001-04-13	93% 100%	C	C	2001-06-14	2001-10-25	2
IEEE Std P802.11b-1999	A	Higher Speed PHY Extension in the 2.4 GHz Band	TGb	N/A	802.11-1999 802.11c 802.11a-1999	Actual	1997-12-09		1998-11-09	0%						C	C	1999-09-16		2
IEEE Std P802.11a-1999	A	Higher Speed PHY Extension in the 5GHz Band	TGa	N/A	802.11-1999	Actual	1997-09-16									C	C	1999-09-16	2000-02-04	2
IEEE Std P802.11f-2003	RP	Inter-Access Point Protocol Across Distribution Systems Supporting IEEE 802.11 Operation	TGf	N/A		Actual	2000-03-30		2001-05-15 2001-09-03 2002-03-10 2002-06-16	0% 0% 82% 96%	2002-07-27		D4.0 D4.1 D5.0 D6.0	2002-10-28 2002-12-19 2003-02-17 2003-04-08	88% 95% 97% 98%	C	C	2003-06-12		2
IEEE Std P802.11-1999	STD	Part II Wireless LAN Medium Access Control MAC and Physical Layer PHY Specifications	MAC/PHY	N/A		Actual	1997-12-09							2003-01-07 2003-04-09 2003-02-02	99% 99% 99%	C	C	1999-03-18	1999-07-15	2
IEEE Std P802.11-1997	STD	IEEE Standard for Wireless LAN Medium Access Control MAC and Physical Layer PHY Specifications	MAC/PHY	N/A		Actual	1991-03-21									C	C	1997-06-26		1
IEEE Std P802.11c	A	Media Access Control MAC Bridges - Supplement for Support by IEEE 802.11 [Rolled into IEEE 802.1D]	TGc	N/A	802.11-1999	Actual	1997-12-09													

Timeline Chart Notes:

C = Stage Completed or Currently In-Process
A / COR = Amendment / Corrigendum
Predicted = Current Date Estimate
Date = Actual or Start Date
LB = Letter Ballot
N/A = Not Applicable
RP = Recommended Practice
SB = SA Ballot
STD = Standard and/or Revision
TG = Task Group
MEC = IEEE-SA Mandatory Editorial Coordination
Final 802.11 WG = Approval by 802.11 WG - Current WG Calendar
Final or Conditional 802 LMSC = Approval by 802 LMSC at Plenary Session - Current 802 LMSC Plenary Calendar
RevCom/Standards Board = Approval of RevCom / IEEE-SA Standards Board in Normal Session - Current IEEE-SA Calendar
ANSI = American National Standards Institute
MDR = 802.11 WG Mandatory Draft Review

This page is maintained by Stephen McCann . Comments are welcome.

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Appendix S

The Wayback Machine - https://web.archive.org/web/20140702154806/http://www.ieee802.org/11/Reports/802.11_Timelines.htm

OFFICIAL IEEE 802.11 WORKING GROUP PROJECT TIMELINES - 2014-06-02

IN PROCESS - Standards, Amendments, and Recommended Practices

IEEE Project and Final Document	Final Doc Type	Project Authorization Request (PAR)	Task Group and Activity	Documentation: Session End Snapshot Format & Version	Documentation: Session End Snapshot Incorporated Baselines	Current Status	PAR Approved, Modified, or Extended [Expires]	WG Letter Ballots: Draft Predicted Initial	WG Letter Ballots: Date Predicted Recirc	WG Letter Ballots: Result	Form Sponsor Ballot Pool / Reform	MEC / MDR Done	IEEE-SA Sponsor Ballots: Draft Predicted Initial	IEEE-SA Sponsor Ballots: Date Predicted Recirc	IEEE-SA Sponsor Ballots: Result	Final 802.11 WG Approval	Final or Conditional 802 EC Approval	RevCom & Standards Board Final or Continuous Process Approval	ANSI Approved
IEEE Std P802.11ax	A	High Efficiency WLAN	TGax	None	802.11REVmc 802.11ai 802.11ah 802.11ak 802.11aq 802.11aj	Actual	2014-03-25												
						Predicted	C	Jul 2016			Jan 2018	Jan 2018	May 2018			Jan 2019	Mar 2019	Mar 2019	N/A
IEEE Std P802.11ak	A	General Link	TGak	None	802.11REVmc 802.11ai 802.11ah	Actual	2012-12-05 [2016-12-31]												
						Predicted	C	Jul 2014	Nov 2014		May 2015	Sep 2015	Nov 2015	Jan 2016		May 2016	May 2016	May 2016	N/A
IEEE Std P802.11aq	A	Pre-association Discovery	TGaq	None	802.11REVmc 802.11ai 802.11ah 802.11ak	Actual	2012-12-05 [2016-12-31]												
						Predicted	C	Nov 2014	Mar 2015		Jul 2015	Jul 2015	Nov 2015	Mar 2016		Jul 2016	Jul 2016	Jul 2016	N/A
IEEE Std P802.11aj	A	China Millimeter Wave	TGaj	PDF D0.01	802.11REVmc 802.11ai 802.11ah 802.11ak 802.11aq	Actual	2012-08-01												
						Predicted	C	Mar 2015	Jul 2015		Jul 2015	Sep 2015	Sep 2015	Jan 2016		May 2016	May 2016	Jun 2016	N/A
IEEE Std P802.11REVmc	STD	Maintenance	TGmc	PDF D2.70	802.11-2012 802.11ae-2012 802.11aa-2012 802.11ad-2012 802.11ac-2013 802.11af-2013	Actual	2012-07-20	D1.0 D2.0	2013-03-02 2013-10-23	88% 90%									
						Predicted	C	C	C		Aug 2014	Jul 2014	Nov 2014	Mar 2015		Jul 2015	Jul 2015	Dec 2015	Dec 2015
IEEE Std P802.11ai	A	Fast Initial Link Setup	TGai	PDF D1.30	802.11REVmc	Actual	2010-12-08 [2014-12-31]	D1.0 D2.0	2013-09-12 2014-05-07	74% 85%									
						Predicted	C	C	Sep 2014		Mar 2015	Nov 2014	Jul 2015	Sep 2015		Nov 2015	Nov 2015	Mar 2016	N/A
IEEE Std P802.11ah	A	Sub 1 GHz	TGah	PDF D1.20	802.11REVmc 802.11ai	Actual	2010-10-04 [2013-12-31]	D1.0	2013-11-04	73%									
						Predicted	C	C	Sep 2014		Nov 2014	Nov 2014	Feb 2015	Nov 2015		Jan 2016	Jan 2016	Mar 2016	N/A

PUBLISHED - Standards, Amendments, and Recommended Practices

IEEE Project and Final Document	Final Doc Type	Project Authorization Request (PAR)	Task Group and Activity	Documentation: Session End Snapshot Format & Version	Documentation: Session End Snapshot Incorporated Baselines	Current Status	PAR Approved, Modified, or Extended [Expires]	WG Letter Ballots: Draft Predicted Initial	WG Letter Ballots: Date Predicted Recirc	WG Letter Ballots: Result	Form Sponsor Ballot Pool / Reform	MEC / MDR Done	IEEE-SA Sponsor Ballots: Draft Predicted Initial	IEEE-SA Sponsor Ballots: Date Predicted Recirc	IEEE-SA Sponsor Ballots: Result	Final 802.11 WG Approval	Final or Conditional 802 EC Approval	RevCom & Standards Board Final or Continuous Process Approval	ANSI Approved
IEEE Std P802.11af-2013	A	TV White Spaces	TGaf	PDF D6.00	802.11-2012 802.11ae-2012 802.11aa-2012 802.11ad-2012 802.11ac-2013	Actual	2009-12-09 [2013-12-31]	D1.0 D2.0 D3.0 D4.0 D5.0 D5.0	2011-02-24 2012-08-19 2013-02-08 2013-04-17 2013-06-14 2013-08-01	62% 79% 87% 92% 94% 99%	2013-06-01	2013-11-01	D5.0 D6.0 D6.0	2013-09-11 2013-10-19 2013-10-30	97% 99% 99%	2013-11-01	2013-11-01	2013-12-11	2013-12-11
IEEE Std P802.11ac-2013	A	Very High Throughput 6GHz	TGac	PDF D7.00	802.11-2012 802.11ae-2012 802.11aa-2012 802.11ad-2012	Actual	2008-09-26 [2012-12-31]	D1.0 D2.0 D3.0 D4.0 D5.0 D5.0	2011-06-25 2012-02-18 2012-06-25 2012-11-01 2013-02-01 2013-04-04	74% 89% 91% 94% 95% 96%	2013-01-01	2013-01-01	D5.0 D6.0 D7.0	2013-05-05 2013-08-03 2013-10-23	93% 97% 99%	2013-11-01	2013-11-01	2013-12-09	2013-12-11
IEEE Std P802.11ad-2012	A	Very High Throughput 60GHz	TGad	PDF D9.00	802.11-2012 802.11ae-2012 802.11aa-2012	Actual	2008-12-10 [2012-12-31]	D1.0 D2.0 D3.0 D4.0 D5.0 D5.0	2010-10-24 2011-04-05 2011-06-01 2011-08-09 2011-10-06 2011-11-24	87% 88% 92% 95% 94% 95%	2011-09-01	2011-07-01	D5.0 D6.0 D7.0 D8.0 D9.0 D9.0	2012-01-05 2012-03-30 2012-05-11 2012-06-16 2012-07-28 2012-08-12	86% 90% 95% 97% 98% 98%	2012-07-01	2012-07-01	2012-10-23	2012-12-28
IEEE Std P802.11aa-2012	A	Video Transport Streams	TGaa	Word / PDF D9.00	802.11-2012 802.11ae-2012	Actual	2008-03-27 [2012-12-31]	D1.0 D2.0 D3.0 D4.0 D5.0 D6.0 D6.0	2010-07-10 2010-12-08 2011-02-24 2011-04-09 2011-06-17 2011-08-09 2011-08-31	78% 79% 81% 85% 90% 94% 95%	2011-06-30	2011-06-16	D6.0 D7.0 D8.0 D9.0	2011-10-12 2011-11-26 2012-01-02 2012-01-27	93% 96% 99% 100%	2012-01-28	2012-02-17	2012-06-01	2012-05-29
IEEE Std P802.11ae-2012	A	Prioritization of Management Frames	TGae	PDF D8.00	802.11-2012	Actual	2009-12-09 [2010-10-15]	D1.0 D2.0 D3.0 D4.0 D5.0	2010-10-27 2011-02-18 2011-04-26 2011-06-18 2011-08-04	81% 86% 89% 96% 96%	2011-07-01	2011-05-01	D5.0 D6.0 D7.0 D8.0	2011-09-09 2011-10-29 2011-12-13 2012-01-04	95% 96% 100% 100%	2012-01-20	2012-02-17	2012-03-01	2012-03-31
IEEE Std P802.11-2012	STD	802.11 Accumulated Maintenance Changes	TGmb	Frame / PDF D9.01	802.11-2007 802.11k-2008 802.11r-2008 802.11y-2008 802.11w-2009 802.11n-2009 802.11p-2010 802.11z-2010 802.11v-2011 802.11u-2011 802.11s-2011	Actual	2007-03-22 [2011-12-31]	D1.0 D2.0 D3.0 D4.0 D5.0	2009-06-27 2010-01-08 2010-04-25 2010-06-25 2010-08-19	87% 89% 89% 89% 92%	2010-09-14	2010-09-01	D6.0 D7.0 D8.0 D9.0 D10.0 D11.0 D12.0	2010-11-05 2011-02-18 2011-04-14 2011-06-22 2011-09-07 2011-10-22 2011-11-13	87% 90% 92% 93% 92% 94% 97%	2011-11-11	2011-11-11	2012-03-01	2012-05-13

SUPERSEDED OR WITHDRAWN - Standards, Amendments, and Recommended Practices

IEEE Project and Final Document	Final Doc Type	Project Authorization Request (PAR)	Task Group and Activity	Documentation: Session End Snapshot Format & Version	Documentation: Session End Snapshot Incorporated Baselines	Current Status	PAR Approved, Modified, or Extended [Expires]	WG Letter Ballots: Draft Predicted Initial	WG Letter Ballots: Date Predicted Recirc	WG Letter Ballots: Result	Form Sponsor Ballot Pool / Reform	MEC / MDR Done	IEEE-SA Sponsor Ballots: Draft Predicted Initial	IEEE-SA Sponsor Ballots: Date Predicted Recirc	IEEE-SA Sponsor Ballots: Result	Final 802.11 WG Approval	Final or Conditional 802 EC Approval	RevCom & Standards Board Final or Continuous Process Approval	ANSI Approved
IEEE Std P802.11s-2011	A	Mesh Networking	TGs	PDF	802.11-2007 802.11k-2008 802.11r-2008 802.11y-2008	Actual	2004-05-13 [2010-12-31]	D1.0 D2.0 D3.0 D4.0	2007-01-06 2008-05-03 2009-05-04 2010-01-08	48% 61% 79% 85%	2010-09-12	2010-09-29	D7.0 D8.0 D9.0	2010-11-01 2011-01-10 2011-03-05	95% 96% 95%	2011-07-01	2011-07-01	2011-08-01	

IEEE Project and Final Document	Final Doc Type	Project Authorization Request (PAR)	Task Group and Activity	Documentation: Session End Snapshot: Format & Version	Documentation: Session End Snapshot: Incorporated Baselines	Current Status	PAR Approved, Modified, or Extended [Expires]	WG Letter Ballots: Draft: Predicted Initial	WG Letter Ballots: Date: Predicted Recirc	WG Letter Ballots: Result: Predicted Recirc	Form Sponsor Ballot Pool / Reform	MEC / MDR Done	IEEE-SA Sponsor Ballots: Draft: Predicted Initial	IEEE-SA Sponsor Ballots: Date: Predicted Recirc	IEEE-SA Sponsor Ballots: Result: Predicted Recirc	Final 802.11 WG Approval	Final or Conditional 802 EC Approval	RevCom & Standards Board Final or Continuous Process Approval	ANSI Approved	Su W S
					802.11w-2009 802.11n-2009 802.11p-2010 802.11z-2010 802.11v-2011 802.11u-2011			D5.0 D6.0 D7.0	2010-04-15 2010-06-28 2010-08-13	89% 89% 95%			D10.0 D11.0	2011-04-09 2011-05-07	97% 97%					
IEEE Std P802.11u-2011	A	InterWorking with External Networks	TGu	Frame / PDF D13.00	802.11-2007 802.11k-2008 802.11r-2008 802.11y-2008 802.11w-2009 802.11n-2009 802.11p-2010 802.11z-2010 802.11v-2011	Actual	2004-12-08 (02/05/2008) [2010-12-31]	D1.0 D2.0 D3.0 D4.0 D5.0 D6.0 D7.0 D8.0	2007-07-08 2008-03-15 2008-07-12 2008-10-08 2009-02-20 2009-04-24 2009-06-19 2009-08-18	64% 70% 77% 78% 82% 90% 88% 93%	2009-06-01	2009-07-12	D8.0 D9.0 D10.0 D11.0 D12.0 D13.0	2009-11-07 2010-04-23 2010-07-08 2010-08-13 2010-09-12 2010-11-21	90% 92% 94% 96% 98% 99%	2010-11-01	2010-11-01	2011-02-25		2
IEEE Std P802.11v-2011	A	Wireless Network Management	TGv	Frame / PDF D16.00	802.11-2007 802.11k-2008 802.11r-2008 802.11y-2008 802.11w-2009 802.11n-2009 802.11p-2010 802.11z-2010	Actual	2004-12-08 [2010-12-31]	D1.0 D2.0 D3.0 D4.0 D5.0 D6.0 D7.0	2007-08-30 2008-03-15 2008-07-13 2008-12-19 2009-04-04 2009-06-12 2009-08-07	63% 67% 69% 81% 83% 90% 92%	2009-06-01	2009-07-12	D7.0 D9.0 D10.0 D11.0 D12.0 D13.0 D14.0 D15.0 D15.0 D16.0	2009-11-07 2010-02-17 2010-04-13 2010-06-10 2010-07-07 2010-07-28 2010-08-25 2010-10-18 2010-09-30 2010-11-15	81% 84% 87% 92% 94% 98% 98% 98% 98% 98%	2010-11-01	2010-11-01	2011-02-09		2
IEEE Std P802.11z-2010	A	Extensions to Direct Link Setup	TGz	Word / PDF D13.00	802.11-2007 802.11k-2008 802.11r-2008 802.11y-2008 802.11w-2009 802.11n-2009 802.11p-2010	Actual	2007-08-22	D1.0 D2.0 D3.0 D4.0 D5.0 D6.0	2008-05-03 2008-08-20 2008-12-18 2009-03-05 2009-06-23 2009-08-26	64% 66% 84% 88% 92% 96%	2009-06-01	2009-06-18	D6.0 D7.0 D8.0 D9.0 D11.0 D13.0	2009-11-07 2010-02-27 2010-05-04 2010-06-10 2010-08-04 2010-08-29	87% 87% 94% 95% 95% 98%	C	C	2010-10-01		2
IEEE Std P802.11p-2010	A	Wireless Access for the Vehicular Environment	TGp	N/A	802.11-2007 802.11k-2008 802.11r-2008 802.11y-2008 802.11w-2009 802.11n-2009	Actual	2004-09-23	D1.0 D2.0 D3.0 D4.0 D5.0 D6.0 D7.0 D8.0 D9.0	2006-04-11 2007-01-05 2007-09-12 2008-05-03 2008-12-05 2009-03-31 2009-06-13 2009-08-05 2009-10-10	59% 67% 74% 79% 85% 89% 85% 89% 93%	2009-06-01	2008-06-19	D9.0 D10.0 D11.0	2009-11-22 2010-02-16 2010-04-07	93% 96% 99%	C	C	2010-07-15		2
IEEE Std P802.11w-2009	A	Protected Management Frames	TGw	N/A	802.11-2007 802.11k-2008 802.11r-2008 802.11y-2008	Actual	2005-03-20	D1.0 D2.0 D3.0 D4.0 D5.0 D6.0	2006-11-19 2007-05-02 2007-10-19 2008-01-05 2008-02-20 2008-04-18	86% 89% 92% 92% 95% 97%	2007-11-13		D6.0 D7.0 D9.0 D10.0 D11.0	2008-09-24 2009-01-18 2009-05-23 2009-06-14 2009-06-28	86% 88% 92% 93% 95%	C	C	2009-09-11		2
IEEE Std P802.11n-2009	A	High Throughput	TGn		802.11-2007 802.11k-2008 802.11r-2008 802.11y-2008 802.11w-2009	Actual	2003-09-11 [2007-09-27]	D1.0 D2.0 D3.0 D4.0 D5.0 D6.0 D7.0 D7.0	2006-04-29 2007-03-09 2007-10-27 2008-04-12 2008-06-12 2008-08-05 2008-09-30 2008-12-02	47% 83% 85% 88% 90% 91% 94% 95%	2008-12-11	2008-12-11	D7.0 D8.0 D9.0 D10.0 D11.0 D11.0	2009-01-10 2009-03-06 2009-04-04 2009-05-30 2009-07-03 2009-06-20	78% 80% 81% 88% 91% 90%	C	C	2009-09-11		2
IEEE Std P802.11y-2008	A	3650-3700 MHz Operation in USA	TGy	N/A	802.11-2007 802.11k-2008 802.11r-2008	Actual	2008-12-31	D1.0 D2.0 D3.0 D4.0 D5.0 D6.0	2007-01-07 2007-05-05 2007-06-20 2007-08-21 2007-10-13 2007-12-08	76% 84% 91% 94% 96% 99%	2007-06-20	2007-07-28	D7.0 D8.0 D9.0 D10.0 D11.0	2008-01-30 2008-03-08 2008-03-27 2008-03-18 2008-06-20	93% 93% 96% 97% 97%	C	C	2008-11-06		2
IEEE Std P802.11r-2008	A	Fast Roaming	TGr	N/A	802.11-2007 802.11k-2008	Actual	2008-12-31	D1.0 D2.0 D3.0 D4.0 D5.0 D6.0	2006-01-04 2006-04-04 2006-10-14 2006-12-04 2007-04-04 2007-06-13	81% 88% 86% 92% 95% 97%		2007-04-11	D7.0 D8.0 D9.0 D9.0	2007-08-30 2007-10-07 2008-02-01 2008-01-17	86% 90% 97% 96%	C	C	2008-05-09		2
IEEE Std P802.11k-2008	A	Radio Resource Measurement	TGk	N/A	802.11-2007	Actual	2002-12-11	D1.0 D2.0 D3.0 D4.0 D5.0 D6.0 D7.0 D7.0	2007-09-11 2008-01-05 2004-09-11 2005-03-15 2005-11-12 2006-03-31 2006-09-16 2006-11-16 2007-02-13 2007-05-05	90% 100% 95% 86% 80% 81% 85% 91% 92% 93%		2007-04-10	D8.0 D9.0 D10.0 D11.0 D12.0 D12.0 D13.0	2007-08-13 2007-10-04 2007-12-08 2008-01-17 2008-02-14 2008-02-01 2008-03-18	90% 89% 91% 95% 95% 95% 97%	C	C	2008-05-09		2
IEEE Std P802.11-2007	STD	802.11 Standard Maintenance Revision	TGma	N/A	802.11-1999 802.11c 802.11a-1999 802.11b-1999 802.11b Cor1-2001 802.11d-2001 802.11g-2003 802.11h-2003 802.11i-2004 802.11j-2004 802.11e-2005	Actual	2003-03-20 [2003-03-20]	D1.0 D2.0 D3.0 D4.0	2005-05-08 2005-07-17 2005-08-19 2005-09-19	91% 94% 95% 96%	2005-08-21	2005-08-21	D5.0 D6.0 D7.0 D8.0 D9.0	2005-11-20 2006-05-10 2006-07-11 2006-09-09 2006-11-07	86% 90% 91% 96% 96%	2006-11-08	2006-11-08	2007-03-08		2
IEEE Std P802.11.2	RP	Wireless Performance	TGt			Actual	2008-12-31	D1.0	2007-05-16	76%										2
IEEE Std P802.11e-2005	A	MAC Enhancements QoS	TGe	N/A	802.11-1999 802.11c 802.11a-1999 802.11b-1999 802.11b Cor1-2001 802.11d-2001 802.11g-2003 802.11h-2003 802.11i-2004 802.11j-2004	Actual	2000-03-30	D4.0 D5.0 D6.0 D7.0 D8.0	2001-05-15 2002-01-16 2002-07-02 2003-01-08 2003-08-22 2003-12-20 2004-02-15 2004-03-10	0% 55% 49% 83% 97% 89% 93% 94%			D8.0 D9.0 D10.0 D11.0 D12.0 D13.0 D13.0	2004-05-30 2004-08-31 2004-10-08 2004-11-11 2004-12-23 2005-04-16 2005-02-18	85% 87% 92% 95% 96% 99% 96%	2005-07-22	2005-07-22	2005-09-22		2
IEEE Std P802.11j-2004	A	4.9 GHz-5 GHz Operation in Japan	TGj	N/A	802.11-1999 802.11c 802.11a-1999 802.11b-1999 802.11b Cor1-2001 802.11d-2001 802.11g-2003 802.11h-2003 802.11i-2004	Actual	2002-12-11	D1.0 D1.2 D1.3 D1.4	2003-05-12 2004-01-14 2004-03-11 2004-04-20	68% 89% 94% 95%	2004-05-13		D1.5 D1.6	2004-07-02 2004-08-14	88% 96%	C	C	2004-09-23	2005-02-02	2
IEEE Std P802.11i-2004	A	MAC Security Enhancements	TGi	N/A	802.11-1999 802.11c 802.11a-1999 802.11b-1999 802.11b Cor1-2001 802.11d-2001 802.11g-2003 802.11h-2003	Actual	2001-05-30	D3.0 D4.0 D5.0 D6.0 D7.0	2002-05-04 2003-01-12 2003-06-06 2003-08-19 2003-10-09 2003-11-04	77% 76% 78% 87% 92% 95%	2003-08-10		D7.0 D8.0 D9.0 D10.0	2003-12-20 2004-03-12 2004-04-10 2004-05-08	89% 92% 98% 98%	C	C	2004-06-24	2005-02-14	2
IEEE Std P802.11h-2003	A	Spectrum and Transmit Power Management Extensions in the 5 GHz Band in Europe	TGh	N/A	802.11-1999 802.11c 802.11a-1999 802.11b-1999 802.11b Cor1-2001 802.11d-2001 802.11g-2003	Actual	2000-12-07	D2.2	2001-09-03 2002-05-05 2002-09-01 2002-11-01	0% 76% 90% 97%	2002-07-25		D3.0 D3.11 D3.6	2003-02-06 2003-06-26 2003-04-30	92% 98% 96%	C	C	2003-09-11	2003-12-29	2
IEEE Std P802.11g-2003	A	Further Higher Data Rate Extension in	TGg	N/A	802.11-1999 802.11c 802.11a-1999 802.11b-1999	Actual	2000-09-21	D5.0	2002-03-11 2002-09-01 2003-01-08	45% 83% 88%	2002-07-25		D6.2 D7.1 D8.2	2003-03-09 2003-04-08 2003-05-14	84% 85% 96%	C	C	2003-06-12	2003-10-20	2

IEEE Project and Final Document	Final Doc Type	Project Authorization Request (PAR)	Task Group and Activity	Documentation: Session End Snapshot Format & Version	Documentation: Session End Snapshot Incorporated Baselines	Current Status	PAR Approved, Modified, or Extended [Expires]	WG Letter Ballots: Draft Predicted Initial	WG Letter Ballots: Date Predicted Initial	WG Letter Ballots: Date Predicted Recirc	WG Letter Ballots: Result Predicted Recirc	Form Sponsor Ballot Pool / Reform	MEC / MDR Done	IEEE-SA Sponsor Ballots: Draft Predicted Initial	IEEE-SA Sponsor Ballots: Date Predicted Initial	IEEE-SA Sponsor Ballots: Date Predicted Recirc	IEEE-SA Sponsor Ballots: Result Predicted Recirc	Final 802.11 WG Approval	Final or Conditional 802 EC Approval	RevCom & Standards Board Final or Continuous Process Approval	ANSI Approved	Su W S
		the 2.4 GHz Band			802.11b Cor1-2001 802.11d-2001			D4.0 D6.1		2002-11-01 2003-02-04	87% 89%											
IEEE Std P802.11b Cor1-2001	COR	Corrigenda to IEEE 802.11b-1999	TGb-Cor1		802.11-1999 802.11c 802.11a-1999	Actual	1999-11-27							D1.5		2001-04-13	98%	C	C	2001-10-10	2002-01-30	2
IEEE Std P802.11d-2001	A	Operation in Additional Regulatory Domains	TGd	N/A	802.11-1999 802.11c 802.11a-1999 802.11b-1999 802.11b Cor1-2001	Actual	1999-06-26			2000-04-04 2000-06-26	0% 0%	2001-11-29		D2.0 D3.0		2001-03-01 2001-04-13	93% 100%	C	C	2001-06-14	2001-10-25	2
IEEE Std P802.11b-1999	A	Higher Speed PHY Extension in the 2.4 GHz Band	TGb	N/A	802.11-1999 802.11c 802.11a-1999	Actual	1997-12-09			1998-11-09	0%							C	C	1999-09-16		2
IEEE Std P802.11a-1999	A	Higher Speed PHY Extension in the 5GHz Band	TGa	N/A	802.11-1999	Actual	1997-09-16											C	C	1999-09-16	2000-02-04	2
IEEE Std P802.11f-2003	RP	Inter-Access Point Protocol Across Distribution Systems Supporting IEEE 802.11 Operation	TGf	N/A		Actual	2000-03-30			2001-05-15 2001-09-03 2002-03-10 2002-06-16	0% 0% 82% 96%	2002-07-27		D4.0 D4.1 D5.0 D6.0		2002-10-28 2002-12-19 2003-02-17 2003-04-08	88% 95% 97% 98%	C	C	2003-06-12		2
IEEE Std P802.11-1999	STD	Part II Wireless LAN Medium Access Control MAC and Physical Layer PHY Specifications	MAC/PHY	N/A		Actual	1997-12-09									2003-01-07 2003-04-09 2003-02-02	99% 99% 99%	C	C	1999-03-18	1999-07-15	2
IEEE Std P802.11c	A	Media Access Control MAC Bridges - Supplement for Support by IEEE 802.11	TGc	N/A	802.11-1999	Actual	1997-12-09															2
IEEE Std P802.11-1997	STD	IEEE Standard for Wireless LAN Medium Access Control MAC and Physical Layer PHY Specifications	MAC/PHY	N/A		Actual	1991-03-21											C	C	1997-06-26		1

Timeline Chart Notes:

C = Stage Completed or Currently In-Process
A / COR = Amendment / Corrigendum
Predicted = Current Date Estimate
Date = Actual or Start Date
LB = Letter Ballot

N/A = Not Applicable
RP = Recommended Practice
SB = Sponsor Ballot
STD = Standard and/or Revision
TG = Task Group

MEC = IEEE-SA Mandatory Editorial Coordination
MDR = 802.11 WG Mandatory Draft Review
Final 802.11 WG = Approval by 802.11 WG - Current WG Calendar
Final or Conditional 802 EC = Approval by 802 EC at Plenary Session - Current 802 EC Plenary Calendar
RevCom/Standards Board = Approval of RevCom / IEEE-SA Standards Board in Normal Session - Current IEEE-SA Calendar
ANSI = American National Standards Institute

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Appendix T

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    - Storage Systems (SS)
  - Computational Intelligence (CI) Groups
    - Fuzzy Markup Language
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  - SCC21 Groups
  - SCC31 Groups
  - SCC40 Groups
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Appendix U

IEEE 802.11 technical submissions

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IEEE 802.11 technical submissions, also known as draft standards, are **documents proposed and reviewed by the IEEE 802.11 working group to enhance the Wi-Fi technology**. Submissions are made by members and must follow specific formatting rules. These submissions are available on the "mentor" document server, which is accessible to the public. Draft standards and other members-only information are available in a password-protected area for members.

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IEEE 802.11, The Working Group Setting the Standards for ...

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2025, 519, 5, TGbn, Minutes for **802.11** bn PHY ad-hoc Teleconference in March to May, Dongguk Lim (LG Electronics). 29-Apr-2025 22:30:41 ET.

Wiki 12 11 14

IEEE802.org
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About 802.11 and How To Participate

The draft standard is ready for final approval once it has achieved at least a 75% approval rate and met various other critria (e.g., no new Disapprove votes on ...

IEEE Standards Association
https://standards.ieee.org › ieee › 802.11

IEEE SA - IEEE 802.11-2024

Technical corrections and clarifications to **IEEE** Std **802.11** for wireless local area networks (WLANs) as well as enhancements to the existing medium access ...

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https://en.wikipedia.org › wiki › IEEE_802

IEEE 802.11

IEEE 802.11 is used in most home and office networks to allow laptops, printers, smartphones, and other devices to communicate with each other and access the ...

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Scholarly articles for **IEEE 802.11 technical submissions**

IEEE 802.11 n development: history, process, and ... - Perahia - Cited by 239

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802.11 Operation Manual

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Complex **technical** changes to a draft shall be in a **submission** that has been accepted by document control according to document formats specified in section 3.7 ...

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by P Brenner · 1997 · Cited by 322 — This version of the document is actualized to Draft 4.0 of the Standard. Page 3. A **Technical** Tutorial on the **IEEE 802.11** Standard. 18 July, 1996.

TechTarget
https://www.techtarget.com › searchmobilecomputing

What is 802.11? Definition from TechTarget

802.11 is a family of evolving specifications for wireless local area networks (WLANs) developed and maintained by a working group of **IEEE**.

What Is 802.11? | What Does 802.11 Mean? | How Does 802.11 Work?

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- IEEE 802.16 Working Group on Broadband Wireless Access
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- IEEE 802.24 Smart Grid Technical Advisory Group
- IEEE 802 EC Privacy Recommendation SG and subsequently on the 802.1 Security TG Web Page

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Appendix W

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Created (ET) ▼	Year	DCN	Rev	Group	Title	Author (Affiliation)	Uploaded (ET)	Actions
28-Apr-2025 ET	2025	255	3	TGm	P2P TWT Harmonization	Brian Hart (Cisco Systems)	28-Apr-2025 13:34:11 ET	Download
28-Apr-2025 ET	2024	1925	6	TGm	REVmf Motions	Michael Montemurro (Huawei)	28-Apr-2025 12:17:19 ET	Download
28-Apr-2025 ET	2025	662	3	TGm	April 28 Teleconference Agenda	Michael Montemurro (Huawei)	28-Apr-2025 12:14:48 ET	Download
28-Apr-2025 ET	2025	371	1	TGm	NR-IE_6GHz_Bits	Abhishek Patil (Qualcomm)	28-Apr-2025 11:33:33 ET	Download
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28-Apr-2025 ET	2025	676	1	TGbn	CC50 CR for CID3866	Bo Cao (ZTE)	28-Apr-2025 09:37:41 ET	Download
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28-Apr-2025 ET	2024	2080	1	TGbn	High-Capability Protection in DPS Follow Up	Maolin Zhang (Huawei)	28-Apr-2025 06:32:10 ET	Download
28-Apr-2025 ET	2025	3	2	TGbn	NPCA follow up	Yan Li(ZTE)	28-Apr-2025 04:45:27 ET	Download
28-Apr-2025 ET	2025	5	3	TGbn	MAP discovery follow up	Jay Yang(ZTE)	28-Apr-2025 03:46:33 ET	Download
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28-Apr-2025 ET	2025	673	3	TGbn	CR for CC50 on subclause 37.x.x.x.x Allowed settings	Hong Won Lee(LG Electronics Inc.)	28-Apr-2025 01:26:53 ET	Download
28-Apr-2025 ET	2025	727	1	TGbk	Minutes for telecons in March-APril2025	Dibakar Das (Intel)	28-Apr-2025 01:04:27 ET	Download
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27-Apr-2025 ET	2025	723	1	TGm	802.11REVmf Editor's Report	Po-Kai Huang (Intel)	27-Apr-2025 21:29:07 ET	Download
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27-Apr-2025 ET	2025	726	0	TGbn	Transmit and Receive Specifications for New MCS Follow-Up	Alice Chen (Qualcomm)	27-Apr-2025 02:02:47 ET	Download
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26-Apr-2025 ET	2025	345	4	TGm	PASN ID for MLO	Yan Li(ZTE)	26-Apr-2025 22:58:57 ET	Download
26-Apr-2025 ET	2025	260	7	TGm	Trigger, BA, BAR Protection	Po-Kai Huang (Intel)	26-Apr-2025 01:07:52 ET	Download
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25-Apr-2025 ET	2025	600	6	TGbn	PDT MAC Co-RTWT Signaling and Protocol Aspects	Giovanni Chisci, Qualcomm Technologies Inc.	25-Apr-2025 21:01:02 ET	Download
25-Apr-2025 ET	2025	599	6	TGbn	PDT MAC MAPC Signaling and Protocol Aspects	Giovanni Chisci, Qualcomm Technologies Inc.	25-Apr-2025 21:00:26 ET	Download
25-Apr-2025 ET	2025	721	0	TGbn	UHR Transmit and Receiver Specification for New MCSs-Follow Up	Juan Fang (Intel)	27-Apr-2025 01:16:00 ET	Download
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25-Apr-2025 ET	2025	715	0	TGbn	Discussion on Time Synchronization in MAP Framework	Qingwei Fu (TP-Link Systems Inc.)	28-Apr-2025 06:45:08 ET	Download
24-Apr-2025 ET	2024	209	14	TGbn	Specification Framework for TGbn	Ross Jian Yu (Huawei)	24-Apr-2025 23:19:58 ET	Download
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24-Apr-2025 ET	2025	301	2	TGbn	TGbn Editor's Report	Ross Jian Yu (Huawei)	24-Apr-2025 10:22:06 ET	Download
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23-Apr-2025 ET	2011	270	78	802.11 WG	ANA Database	Carol Ansley (Cox)	23-Apr-2025 17:03:53 ET	Download
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22-Apr-2025 ET	2025	554	4	TGbi	12.16.6 comments	Po-Kai Huang (Intel)	22-Apr-2025 23:27:19 ET	Download
22-Apr-2025 ET	2025	554	3	TGbi	12.16.6 comments	Po-Kai Huang (Intel)	22-Apr-2025 23:08:17 ET	Download
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21-Apr-2025 ET	2025	694	0	TGbn	UHR OFDMA Sounding Limitations	Avner Epstein	21-Apr-2025 10:08:04 ET	Download
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21-Apr-2025 ET	2025	692	0	TGbi	CIDs 9.6.42.5 9.6.42.6	Antonio de la Oliva, Interdigital	21-Apr-2025 05:15:43 ET	Download
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    - Software & Systems Engineering Groups (S2ESC)
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  - Power Electronics (PEL) Groups
  - SCC21 Groups
  - SCC31 Groups
  - SCC40 Groups
  - Smart Grid Groups
  - Vehicular Technology Groups (VT)
  - Computational Intelligence (CI) Groups
    - Fuzzy Markup Language
- **Industry Connections Activities**
  - Industry Connections Security Group (ICSG)
    - ICSG Executive Committee
    - ICSG Malware (Software Taggant System) Working Group
    - ICSG Malware Metadata Exchange Format (MMDEF) Working
    - ICSG eCrime Management & Response (Stop-eCrime) Working
    - ICSG Privilege Management Protocols (PMP) Working Group
  - Future Directions For Nanonetworking (FDFN)

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- IEEE 802 Whitespace SG (not active group - archive)
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08-Jun-2015 ET	2015	532	5	TGm	REVmc Sponsor Ballot Comments	Adrian Stephens (Intel Corporation)	08-Jun-2015 09:39:35 ET	Download
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07-Jun-2015 ET	2015	751	0	TGai	TGa-Agenda-Waikoloa-Jun-2015	Hiroshi Mano (KDTI)	07-Jun-2015 02:52:37 ET	Download
06-Jun-2015 ET	2015	739	1	TGm	REVmc BRC Telecon Minutes May-June	Jon Rosdahl (CSR)	06-Jun-2015 22:51:12 ET	Download
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05-Jun-2015 ET	2015	750	0	TGak	11ak Telecon Minutes 20150601	Donald Eastlake (Huawei Technologies)	05-Jun-2015 20:44:06 ET	Download
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05-Jun-2015 ET	2015	744	0	TGm	TGmc BRC meeting agenda 2015-06-17-18-19	Dorothy Stanley (HP-Aruba Networks)	05-Jun-2015 13:28:58 ET	Download
05-Jun-2015 ET	2015	12	4	TGm	Location Capability Indication	Ganesh Venkatesan (intel Corporation)	05-Jun-2015 11:04:13 ET	Download

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03-Jun-2015 ET	2015	733	0	TGah	July 2015 Agenda	Yongho Seok (NEWRACOM)	03-Jun-2015 17:19:14 ET	Download
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